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EXPERIMENTAL INVESTIGATION OF EWEM TENSION CLAMPS
EXPERIMENTÁLNE VYŠETROVANIE PRUŽNÝCH ZVIEROK EWEM

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Using the rails with higher bending stiffness brings 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. Within the installation 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. During a transport of tract panels 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 track panels. 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. It was the reason for modelling in laboratory the operating conditions to which the tension clamps and the track panels are subjected during the operation. In such a way it is possible to determine the limit value of the picking up and to estimate the conditions of overloading the tension clamp.

Keywords

rail construction, tension clamps, experimental investigation, static analysis, dynamic analysis, stiffness characteristics, inertial forces, natural frequencies.

Introduction

EWEM tension clamps are the topic of the analysis, Fig. 1. 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.

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Fig. 1 EWEM tension clamp

Static test of tension clamps

The subject of the laboratory tests has been the set of 16 randomly selected tension clamps, which were used in the rail construction. Every clamp was denoted by a type (*a, b, c, d, e, f, g, h, I, j, k, l, m, n, o, p*) before the test. The subject of static tests have been the stiffness characteristics described the dependence of acting pressed force versus deformation of a clamp. The stiffness characteristics were determined by the following way. On the support from the steel profile I_{500} the steel beam with sole plate was situated. The set of tested tension clamps and short rail were installed into sole plate. The press force was initialized by the hydraulic cylinder TOS CHZM 25-15-2. The pressure in the cylinder was regulated by the mechanical pump TOS CHZM 100-15. The force magnitude was indicated by the dynamometer of German production KMB M 10187 with the working scale to 100 kN. The equipment was braced towards the frame of pulsating device.

The deformations of clamps were measured by the indicating gauge SONET with the accuracy of 0,01 mm. Four symmetrically situated indicating gauges were applied. The average values were used for the graphic presentation of the results. Recapitulation of obtained results is in the Fig. 2. All results lie in the interval limited by the stiffness characteristics corresponding to measuring couple *j-d* and *o-p*. The result for couple *m-n* can be approximately considered as mean value of the tested set. The temperature during the tests was in the interval 20 – 23 ^{0} C and the humidity in the interval 36 – 39 %.

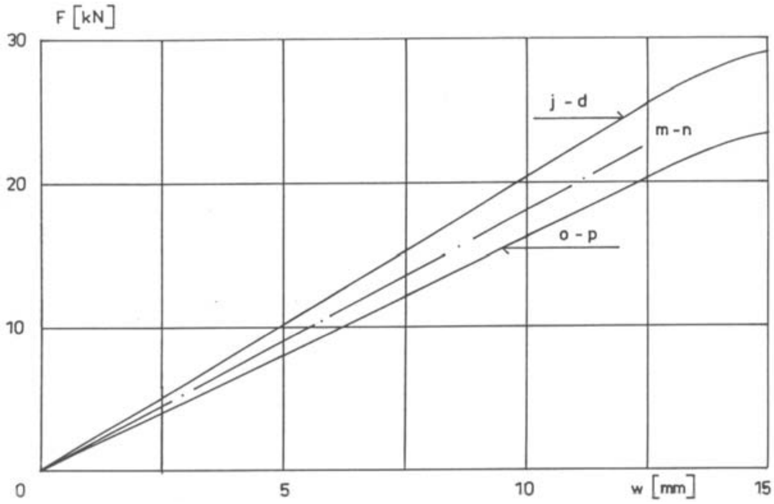

Fig. 2 Stiffness characteristics

Contact forces acting between a sleeper and a rail

Bending stiffness of rail caused that the contact forces acting between a wheel and rail are not transferred on a sleeper in the full scale. Every interaction force is distributed on a few sleepers due to bending stiffness of a rail. Let us analyse contact forces acting between sleepers and rail for a track of length 24,375 m containing 42 sleepers under static load of four-wheel engine (4 x 100 kN) and under one bogie of railway wagon (2 x 65 kN), by the computing model from the Fig. 3. The contact forces in characteristic points 1, 6, 11, 19, 24, 32, 36, 42 are in the Table 1, [1].

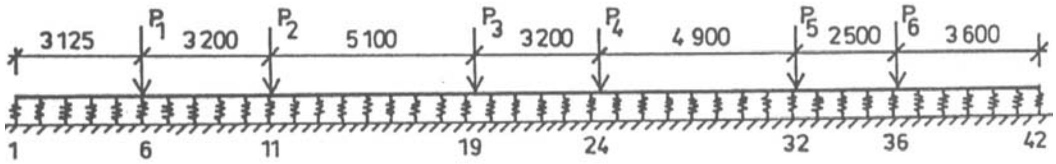

Fig. 3 Computing model of a rail

Sleeper No.	*Contact force in [kN]*
1	0,160
6	45,166
11	45,235
19	45,235
24	45,196
32	28,772
36	28,888
42	0,112

Tab. 1 Contact forces between sleepers and rail in characteristic point

In the Table 1 the static values of contact forces are given. These values are higher in reality due to dynamic behaviour. The value of dynamic coefficient δ is about 1,2 for the well maintenance truck. On the places of truck with local discrete unevenness or on the places with sudden change of subgrade stiffness the dynamic coefficient can achieve the value 1,7. So the high level of contact forces can be 46 kN x 1,7 = 78,2 kN. The horizontal forces between sleeper and rail acting in the longitudinal direction of a sleeper can achieve the value till 50 % of vertical forces. It is approximately 39 kN.

The above given values were the basis for the simulation of real dynamic load in laboratory conditions. When the rail is loaded by the force F, changeable in the interval 40 – 90 kN, then its components F_V and F_H at the angle $\alpha = 30^0$ are changeable in the interval $F_V = F . \cos\alpha = 34{,}6 – 77{,}9$ kN, $F_H = F . \sin\alpha = 20 – 45$ kN. It is in agreement with the reality.

Dynamic tests of tension clamps

Dynamic test of tension clamps was realized in laboratory conditions by the use of Pulse Equipment HAPZ/6 No.298.14/3 made by WEB WPM Leipzig, working in the scale 0 – 300 kN. Into the steel support frame with the slope of $\alpha = 30^0$ the one half of RC sleeper of SB8 was attached. On the sleeper the polyethylene pad, sole plate and rubber pad was installed. The part of rail S49 was attached on sole plate by two elastic clamps (couple *l-f*). The dynamic cyclic load was periodically variable by the equation $F(t) = F. \sin(2.\pi.f.t)$ with the amplitude F = 50 kN and the frequency f = 250 cyc/min. The lower level of dynamic force was F_l = 40 kN and the upper level of dynamic force was F_u = 90 kN. Than the components F_V and F_H in the sense of Fig. 8 are F_{Vl} = 34,6 kN, F_{Vu} = 77,9 kN, F_{Hl} = 20,0 kN, F_{Hu} = 45,0 kN. The number of cycles was 1 590 000. It represents the simulation of three years operation in real conditions. After the dynamic test the static test was carried out. The comparison of results obtained before and after dynamic test is in the Fig. 4.

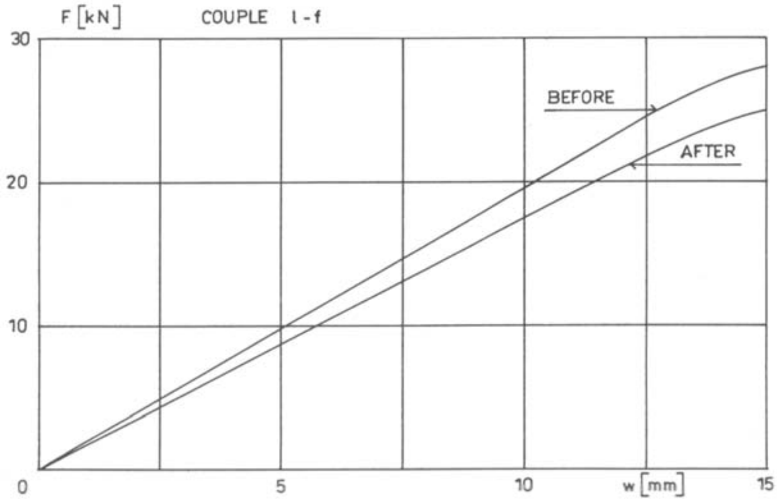

Fig. 4 Comparison of results obtained before and after dynamic test

Conclusions

The EWEM tension clamp represents very simple constructing element of elastic fastening the rails. The clamps show working imperfections. These imperfections influence the shape of stiffness characteristics and ability to generate the pressing force in needed value. Additional forces occurring during transport of track panels and during manipulation give rise to additional stresses. They could cause partial overloading the certain clamps and to decrease the ability of clams to activate the pressing force of certain value. From this reason the inertial forces acting on the sleepers during transport of track panels should be maximally reduced. The value of picking up of the clamp pressing arm equal 15 mm may be considered as limited value from the point of view of overloading the tension clamp without serious influence on the decreasing of pressing force. The comparison of new tension clamp with overloading tension clamp after occurring permanent irreversible deformations you can find in the Fig. 5.

Fig. 5 Overloaded tension clam

References

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