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EXPERIMENTAL INVESTIGATION OF TENSION CLAMPS

EXPERIMENTÁLNE SKÚŠKY PRUŽNÝCH ZVIEROK

Abstract

The places of rail contact with rail supports (cross sleepers or slabs) in which the fastening the rails is realized can be considered as certain kind of tuning joints because of by the change of mechanical properties of fastening components the rail (rubber pads and tension clamps) it is possible to modify the mechanical properties of the whole system. The submitted paper is dedicated to the static and dynamic analysis of tension clamps SKL12 currently used as a part of elastic fastening the rails in the construction of high-speed railway lines.

Abstrakt

Miesta kontaktu koľajnice s koľajnicovými podperami (priečne podvaly alebo doskové podklady), kde sa realizuje upevnenie koľajníc, môžu byť považované za určitý druh ladiacich uzlov, pretože zmenou mechanických vlastností komponentov upevnenia (gumové podložky a pružné zvierky), je možné modifikovať mechanické vlastnosti celého systému. Predkladaný príspevok je venovaný statickej a dynamickej analýze pružných zvierok SKL12 bežne používaných ako súčasť pružného upevnenia koľajníc pre trate s vyššími rýchlosťami.

1 INTRODUCTION

The object of the static and dynamic analysis is the tension clamp SKL12 shoved in Fig. 1. The tension clamp is installed in the rail construction by the following way. The clamp bolt is inserted in to the slot in sole plate rib. The tension clamp and trust pad are sleeved on the bolt. The pad nut is screwed on the clamp bolt in the end. The detail of the assembled clamp is showed in Fig. 2. The magnitude of pressing force in required value is reached by tightening the pad nut by the tightening moment of specified value. The maker states the magnitude of tightening moment in the value of 180 – 200 N.m for new as yet unused set (sole plate, tension clamp, clamp bolt, trust pad, pad nut).

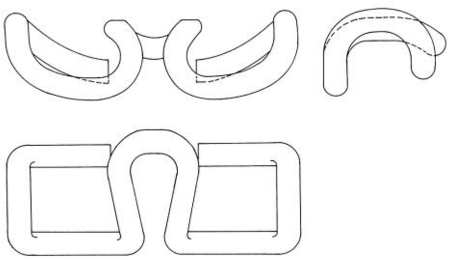

Fig. 1 Tension clamp SKL12

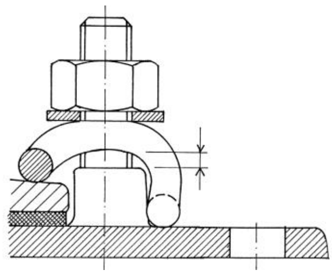

Fig. 2 The detail of the assembled clamp

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2 STATIC TESTS OF TENSION CLAMPS SKL12

The goal of static test was to obtain stiffness characteristics of clamp pairs. Before the test the clamps were numbered from 1 to 16 and the clamp pairs 1-2, 2-3, 3-4, 5-6, 7-8, 9-10, 11-12, 13-14, 15-16 were created. The stiffness characteristics of clamp pairs were determined by the following way. On the support from the steel profile I_{500} the steel beam with adapted sole plate was situated. The adaptation of sole plate was realized by the following way. The central part of sole plate between the ribs was cut out to originate adequate space for plugging the rail without pressing the tension clamps, Fig. 3. The set of tested tension clamps and short rail were installed into sole plate. The rib sole plate and the rail of the type S49 were used within the tests. 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. The indicating gauge Frich was used as a control gauge. The view on arrangement of all equipments is in the Fig. 4

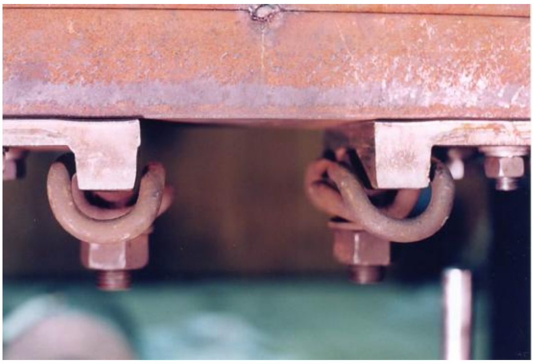

Fig. 3 The adapted sole plate

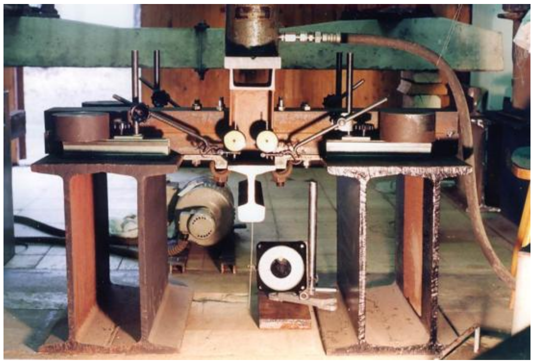

Fig. 4 Overall view on experimental equipments

In the first stage two pairs of clamps ***5 – 6*** and ***15 – 16*** was selected for testing. The clamps were loading to the force level of 30 kN to reach their overloading. Typical shape of stiffness characteristics is in the Fig. 5. It was not achieved such stage during the test to come to the occurrence of permanent irreversible deformations because of by the picking up of pressing arm of tension clamp circa 15,0 mm the rail forces down the pressing arms of the clamp to the level of that part of clamp which encircle the clamp bolt. From this moment not only the pressing arms of the clamp but also the part of clamp encircling the clamp bolt resist against the rail shifting, Fig. 3 and Fig. 4. This encircling part of the clamp is considerably stiffer than pressing arms of the clamp. This fact is registered as expressive dislocation in the running of stiffness characteristics and by essentially steeper course of the graph. Probability of occurrence of permanent irreversible deformations of the clamp is minimal practically unrealised in rail construction. Repeated tests (No. 2) showed that the clamp works after such loading as well as before loading (No. 1). The risk of clamp defect within rail installation and within manipulation with track panels is eliminated. The recapitulation of obtained results is in the Fig. 6. The stiffness characteristics of all tested clamp pairs are situated in the interval bounded by stiffness characteristics of clamp pairs ***13 – 14*** and ***1 – 2***. The stiffness characteristic of the clamp pair ***15 – 16*** can be approximately considered as a mean value of the tested set. When the pressing force for clamp pair ***15 – 16*** at the value of picking up equal 10,0 mm will be considered as 100 % than the value of pressing force at the same picking up for the clamp pair ***13 – 14*** is about 4,2 % higher and for the clamp pair ***1 – 2*** is about 4,8 % lower. The tension clamps SKL12 in comparison with the others clamps (Pandrol, EWEM, SKL1, SKL14) showed the smallest dispersion of tested magnitudes [2].

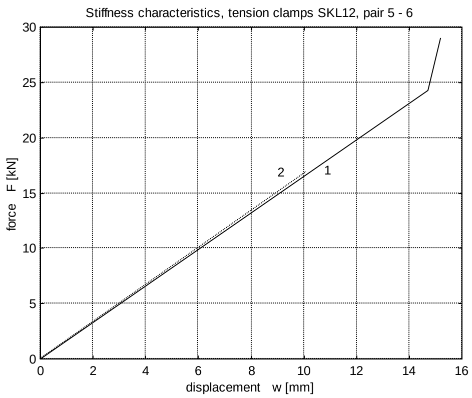

Fig. 5 Stiffness characteristics, pair 5-6

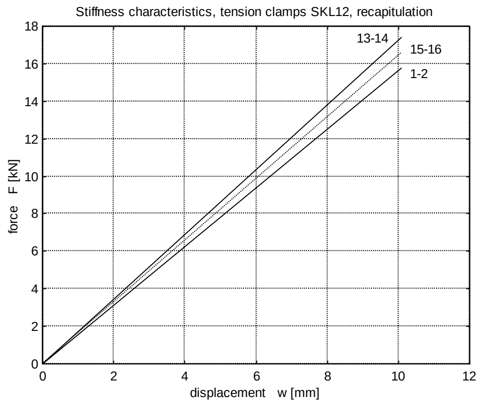

Fig.6 Stiffness characteristics, recapitulation

3 DYNAMIC TESTS OF TENSION CLAMPS SKL12

Dynamic test of tension clamp 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, pair ***7-8***, Fig. 6 and 7.

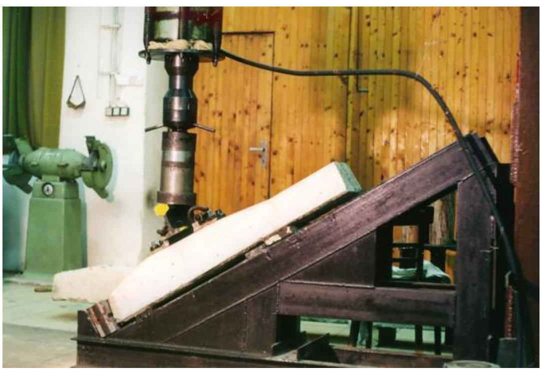

Fig. 6 Dynamic loading test

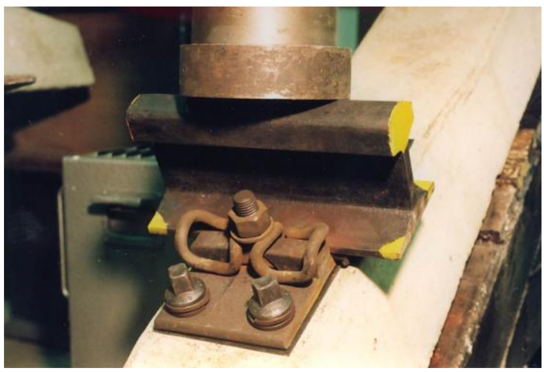

Fig. 7 Detail of rail fastening

The dynamic cyclic load was periodically variable by the equation F(t) = F. sin(2.π.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. 4 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 1 560 000. After the dynamic test the static test was carried out. The comparison of results obtained before and after dynamic test is in the Fig. 8.

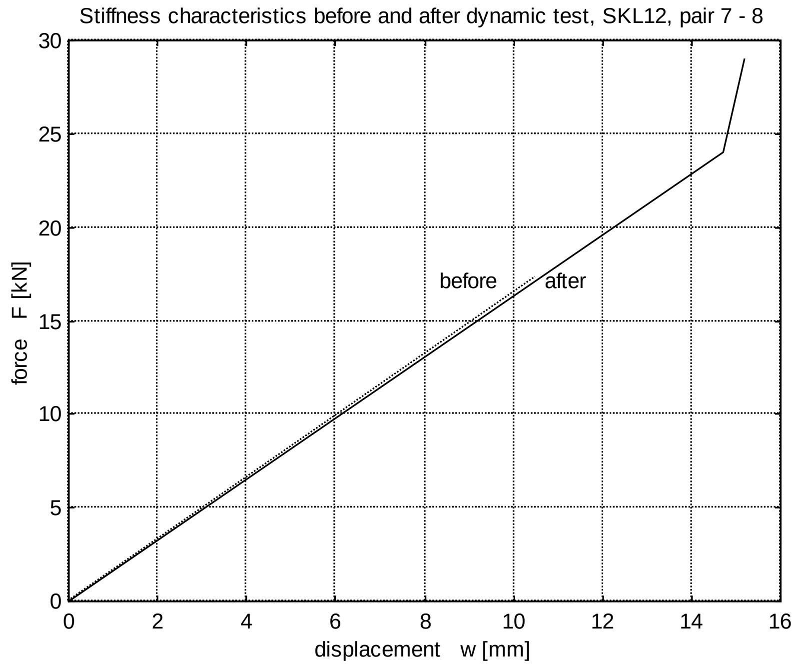

Fig. 9 Stiffness characteristics before and after dynamic loading test

4 CONCLUSIONS

The places of connection of rails on cross sleepers or slab supports in which the elastic fastening the rails is realised represent so-called tuning joints, because through mechanical properties of their elements we can influence the mutual interaction of rail vehicles with railway track and in the final phase to influence the straining of the structure and the riding comfort of passengers. The tension clamps SKL12 are currently used as a part of elastic fastening the rails in the construction of high-speed railway lines. The clamps have linear stiffness characteristics and the risk of clamp defect within rail installation and within manipulation with track panels is practically eliminated. The tension clamps SKL12 showed the smallest dispersion of mechanical properties. The dynamical tests confirm that the simulation in laboratory condition of three-year truck working load on the railway of the 4^{th} order has not practically any noticeable influence on the change of clamp stiffness characteristics. The high stability of mechanical properties guarantees the right function of clamp in rail construction all along the time of its operation.

REFERENCES

[1] MELCER, J. Tuning joints of slender transport structures. *Building Research Journal*. 2004, Vol. 52, Nr. 2, pp. 81-88.

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