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The soil effect to efforts in rails of continuous welded rail track on bridges

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Abstract

The present work contains the results of studies devoted to determining the effect of the stiffness of bridge piers in the plane of the bridge structures on the longitudinal forces in the rails welded rails on the bridge. The calculations used the finite element method. As a design scheme of the receiving system “bridge-jointlesstrack”, and spans were assumed to be riding on the ballast, so that the connection between the rail and the rail base were made of elastic-plastic. As a result of the analysis revealed the dependence of the longitudinal forces in the rails welded rails on the bridge of stiffness parameters bridge supports. In particular, we studied the influence of the stiffness of soil at the base of the supports efforts in the rails of the deck with welded through.

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*Keywords:*rails, jointless track, bridge, stiffness, piers, soil

1. Introduction

In rails of jointless track on bridges additional efforts, due to the mobility of rail base, which bridge structure is, occur under temperature and power influences [1, 2]. In research focused on the problem of interaction between jointless track and bridge structure [3-6, 9-15] it is emphasized that the values of longitudinal forces in rails largely determined by bridge piers stiffness in the direction along the axis of the bridge: with an increase of piers stiffness the efforts of longitudinal loads in rails are reduced. This requires not only the accounting impact of the bending stiffness of the piers, but the stiffness of the foundation too.

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2. Results of the study

To evaluate specified factor the interaction between track and overpass (12×23,66=284) is calculated. In terms of rails temperature reduction at 56℃ the break load τ = 10,5kN/m acts on the overpass. At a constant abutment stiffness equal to 78000 kN/m changes in piers stiffness are expected from 10000 kN/m to 37000 kN/m. The calculation results are shown in Fig. 1.

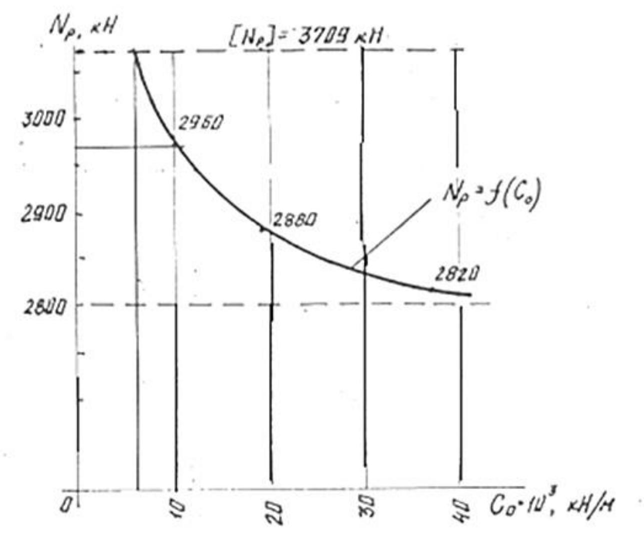

Fig. 1. Piers stiffness Co influence on longitudinal forces Np in rails on jointless track of overpass

It can be seen that increasing of piers stiffness Co reduces efforts inrails Np. However when piers stiffness is high enough, the decline is not so big and is only ((2960-2820)/2960)100=5% (Fig. 1) by increasing of piers stiffness almost 4 times. Thence we can conclude that from the point of view of longitudinal forces reducing excessive increase in piers stiffness (and therefore materials consumption) is inexpedient. Apparently there is a limit of piers stiffness the excess of which does not reduce efforts in rails (and, in addition, as it follows from the static indetermination of the system “bridge – jointless track”, leads to horizontal support reaction under longitudinal forces, for example, breaking or temperature forces.

On the other hand, there is a minimum stiffness below which the efforts in rails go beyond allowable.

For example, for the overpass 12×23,66 m optimal piers stiffness is about (10…30)×103 kN/m. Less than 10×103 kN/m piers stiffness leads to increasing of forces in rails over permissible; more than 30×103 kN/m is not required, from the point of view of rails strength (Fig. 1).

To give an idea about real pier stiffness will consider Lengiprotrans proposals about possible piers types for overpasses on high speed railway (HSR) St. Petersburg – Moscow. They are shown in Fig. 2.