MATHEMATICAL DEPENDENCIES OF CHARACTERISTICS OF THERMAL LEVELLING ON ELEMENTS OF RAIL TRANSPORT MEANS

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At the present state of development the railway transport of Ukraine pays great attention to maintaining not only wagon and locomotive serviceability but also developing and producing new rolling stock units. Besides, residual deformations in the elements of railway transport means can be eliminated during production and maintenance. Among all known levelling methods for metal structures of rolling stock units one of the most effective methods for stabilization of their frame components is the local thermal levelling [1-5]. It justifies the reasonability of research aimed at mathematical description of the task of the optimization research into the thermal levelling in order to obtain the appropriate mathematical models.

The general view of the optimization research into the thermal levelling of any element of a rail transport mean is as follows:

$$f(\overline{X}) \to min,$$
$$\overline{X} \in Д_x \in Д;$$

$$Д = \left\{ \overline{X} \left| \begin{array}{l} x_{Ba\,min} \le x_{Ba} \le x_{Ba\,max},\; x_{Дd\,min} \le x_{Дd} \le x_{Дd\,max},\; x_{Шe\,min} \le x_{Шe} \le x_{Шe\,max}, \\ x_{Пj\,min} \le x_{Пj} \le x_{Пj\,max},\; x_{Tk\,min} \le x_{Tk} \le x_{Tk\,max};\; a \in [1:n], d \in [1:c], e \in [1:s], \\ j \in [1:h], k \in [1:m]. \end{array} \right. \right\}, \quad (1)$$

$$Д_x = \left\{ \overline{X} \left| \begin{array}{l} \sigma_{max} \le [\sigma],\, c_{max} \le [c],\, \sigma_{cm\,max} \le [\sigma_{cm\,max}],\, E = E_{cm},\, \eta \ge \eta_{min},\, \eta \le \eta_{max} \\ x_{Ba\,min} \le x_{Ba} \le x_{Ba\,max},\; x_{Дd\,min} \le x_{Дd} \le x_{Дd\,max},\; x_{Шe\,min} \le x_{Шe} \le x_{Шe\,max}, \\ x_{Пj\,min} \le x_{Пj} \le x_{Пj\,max},\; x_{Tk\,min} \le x_{Tk} \le x_{Tk\,max};\; a \in [1:n], d \in [1:c], e \in [1:s], \\ j \in [1:h], k \in [1:m] \end{array} \right. \right\}. \quad (2)$$

The three-factor generalized mathematical models, obtained by applying the method of mathematical research planning, describe the change of the primary variable (profile deflection of the top rail Δy) depending on change in variables (geometrical parameters of the "wedge" – the width b, the height h and the heating temperature t)

$$\Delta y = -3092{,}45833 + 25{,}76542 \cdot b + 25{,}48611 \cdot h + 5{,}16319 \cdot t - 0{,}08472 \cdot b^2 + $$
$$+ 0{,}01403 \cdot h^2 - 0{,}00213 \cdot b \cdot t - 0{,}00244 \cdot t^2 - 0{,}17688 \cdot b \cdot h - 0{,}02538 \cdot h \cdot t, \quad (3)$$

$$\Delta y = 2239{,}51667 - 5{,}23146 \cdot b - 8{,}93556 \cdot h - 4{,}60260 \cdot t - 0{,}00889 \cdot b^2 + $$
$$+ 0{,}06986 \cdot h^2 + 0{,}00299 \cdot t^2 + 0{,}03656 \cdot b \cdot h + 0{,}00731 \cdot b \cdot t - 0{,}00256 \cdot h \cdot t. \quad (4)$$

The adequacy check of the above-mentioned mathematical models proved their operating capacity and possibility for further application. Thus, for model (1) the mean-square deviation value is $\sigma = \pm 0.2867$, and for model (2) it is $\sigma = \pm 0.2014$.

Figures 1, 2, 3 demonstrate additional diagrams for defining geometrical parameters of the "wedge" (at the heating temperatures $650\ ^{\circ}C$, $700\ ^{\circ}C$ and $750\ ^{\circ}C$) with isolines (lines of equal values) of deflection of the top rail.

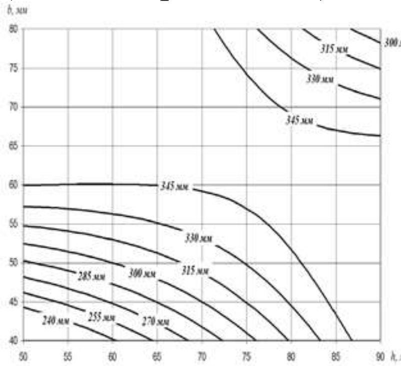

Fig. 1. Additional diagram for size selection of the "wedge" ($t = 650\ ^{\circ}C$)

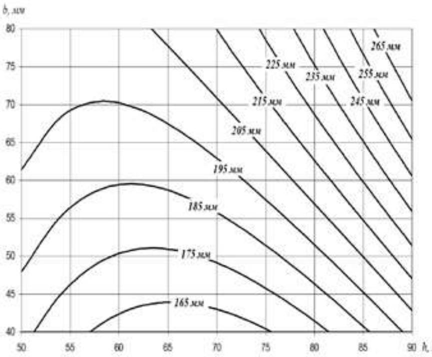

Fig. 2. Additional diagram for size selection of the "wedge" ($t = 700\ ^{\circ}C$)

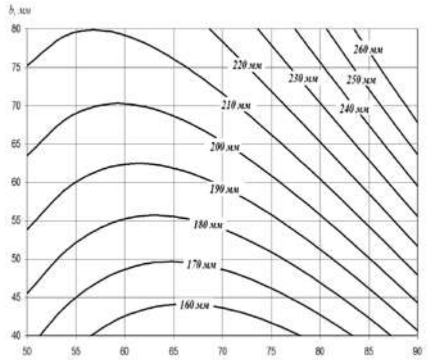

Fig. 3. Additional diagram for size selection of the "wedge" ($t = 750\ ^{\circ}C$)

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EFFICIENCY JUSTIFICATION OF THE DOUBLE-TREAD PROFILE WHEELSET PASSAGE ALONG SPECIFIC TRACK SECTION

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Rolling stock operated in the urban railways environment is a significant, efficient and environmentally friendly mass transit system that forms an indispensable part of modern cities. In this system, the problem of tramcars passing small radius arches appears to be topical. In many European cities, on tracks with a gauge of 1000 mm, where curves with a radius of 50 m are common, under arduous conditions, arches of the track with a radius of 18 m and more are built, with a requirement for the vehicle design to be able to pass a track with a curve of 17 m [1, 2, 3].

The outcome of such operation of vehicles is an increase in vehicle's effects on the track in the rail-wheel contact resulting in increased ride resistance, creep in the