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ALGORITHM FOR NUMERICAL STUDIES ON THE SPEED MODES OF THE HIGH-SPEED ELECTRIC TRAIN "AFROSIYOB"

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ABSTRACT

The article presents an algorithm for numerical studies on the speed modes of the high-speed electric train "Afrosiyob".

Foreign and domestic experience shows that it is still difficult to drive a high-speed engine in the current era, and it is necessary to take into account all the positive and negative results of competition, not only in transport, but also in other aspects. national economy and social considerations, environmental, foreign economic sphere and highways of the entire "life" cycle, including the introduction of R&D, construction of roads and energy [1,2].

Taking into account the above features, the evaluation of the effectiveness of measures to organize high-speed passenger train traffic requires an integrated, systematic approach.

The world experience testifies to significant social and economic effect of high-speed traffic introduction [3]:

- high-speed traffic makes it possible to provide a much higher level of passenger service due to the reduction of passenger travel time, competing with air transport in terms of travel speed;
- safety of movement increases and the level of traumatism on the railroad transport decreases.
- The railway has a significant environmental effect, and modern construction technologies help to minimize damage when laying new railway lines.

To perform numerical studies on high-speed modes of movement of high-speed electric train "Afrosiyob" and analysis of their energy efficiency, taking into account dynamic effects and increased speeds (with speeds over 140 km / h to 250 km / h inclusive), an algorithm and program for the programming environment MATHCAD 15 was compiled.

The algorithm for numerical studies of high-speed traffic modes of the high-speed electric train "Afrosiyob" is built according to the modular principle and consists of 5 blocks-modules. Block diagram for numerical studies of high-speed modes of movement of the high-speed electric train "Afrosiyob" and the analysis of their energy efficiency is presented in Figure 1.

1 этап. *Ввод исходных данных для расчета.*

Stage 1. Input of initial data for the calculation.

1.1 Input data for the rational design are: the total mass of the electric train $M_Э$, parameters of the layout scheme, running gear, the number and diameter of wheels, the total modulus of rigidity of spring suspension in the static position, selected on the basis of evaluation of the smooth running. The basic initial data are taken from the Operating and Maintenance Instructions for the electric train T-250-AFROSIYOB/ The Talgo Company (2009) [4].

Stage 2. Calculation of the basic specific resistance to movement of the high-speed electric train "Afrosiyob".

Calculation of the basic specific resistance to movement of the high-speed electric train "Afrosiyob" is performed in accordance with the Rules [5] in the traction mode w'0 and at idle speed w'_x..

Stage 3. Additional specific resistance to movement of the high-speed electric train "Afrosiyob".

Calculation of additional specific resistance to movement of the high-speed electric train "Afrosiyob" is performed in accordance with the Rules [5].

3.1.Resistance from track gradient.

Additional specific resistance to movement (*N/kN*) from the slope (uphill or downhill) for all types of rolling stock numerically take equal to the value of the ppm (‰) of uphill (plus sign) or downhill (minus sign) actual or straightened track section, i.e. w_i *[Н/кН]=±i[‰]*.

3.2 Resistance from track curvature.

Additional specific resistance to movement from curves on operating railroads for all types of rolling stock determined by the formulas:

(a) at a train length not less than or equal to the length of the curve

$$\omega_r = \frac{700}{R} \quad \text{or} \quad \omega_r = 12{,}2\frac{\alpha^\circ}{S_{кр}},$$

where α° - central angle of the curve, deg;

b) if the length of the train $l_П$ more than the length of the curve $S_{кр}$

$$\omega_r = \frac{700}{R}\frac{S_{кр}}{l_П} \quad \text{or} \quad \omega_r = 1{,}2\frac{\alpha^\circ}{l_П}.$$

3.3 Additional specific resistance to movement from the reduced slope.

Additional resistance to movement from the reduced slope should be taken according to the formula $i_K = i + w_r$.

Stage 4. Calculation of aerodynamic resistance from the air flow arising during the movement of a high-speed electric train "Afrosiyob".

Additional specific resistance to movement caused by the action of the oncoming or side wind, take into account the coefficient K_v, depending on the speed of the train. Rules for traction calculations [5] establish the procedure according to which for the schedule of trains this additional resistance should be taken into account for wind speeds v_v to 12 m/s.

The main parameter in the calculation of high-speed electric rolling stock is the aerodynamics criterion.

Stage 5. Consideration of braking calculations in the analysis of the high-speed electric train AFROSIAB.

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The braking force of the train and the coefficient of friction during braking are determined according to the data [5].

Stage 6. Consideration of the wheel-rail grip coefficient when analyzing the speed mode of the high-speed electric train AFROSIAB.

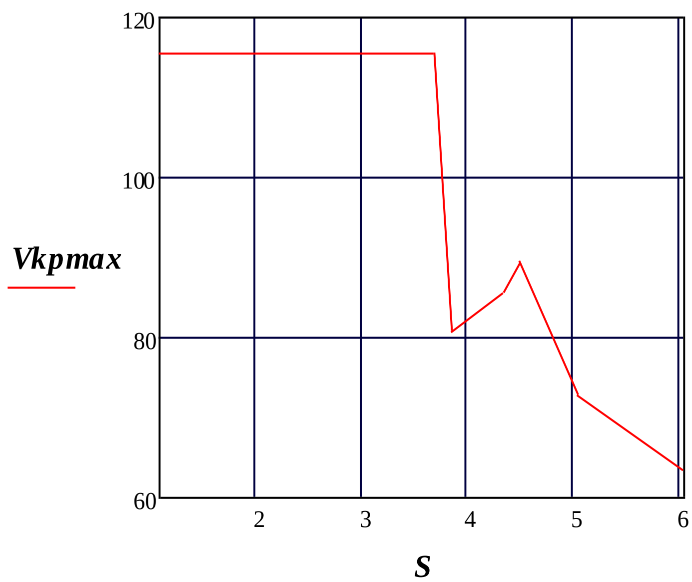
The adopted design values of wheel-rail grip coefficients determine the maximum efficiency of the braking system.

So, for example, at $V \leq 100$ km/hour the coupling coefficient is taken equal to $f = 0.3 \div 0.25$, according to [6,7].

When $V = 100 \div 140$ km/hour the coupling factor is taken to be $f = 0.25 \div 0.22$, When $V = 140 \div 250$ km/hour the coupling factor is taken to be $f = 0.22 \div 0.15$ (according to the website: "Brake systems of high-speed electric trains").

Stage 7. Determination of permissible speeds of movement on the elements of the profile of the railway.

For dynamic calculations adopted railway line "Tashkent-Samarkand". The total distance from Tashkent to Samarkand - 344 km. The width of railway gauge is 1520 mm. For the calculated section of the railroad with a specific profile, a graph for the change in the speed of the high-speed electric train Afrosiab was constructed. At the same time, the travel speed $V_{\_kpmax}$ varied from 63.246 km/hour to 115.382 km/hour. The smaller the radius of curvature and the greater the gradient of the railway track, the lower the speed.



S_j =	$Vkpmax_j$ =
1.1	115.382
3.7	115.382
3.85	80.641
4.35	85.641
4.5	89.443
5.05	72.673
6.05	63.246

Figure 1. Diagram for the speed change of the high-speed electric train Afrosiab $V_{\_kpmax}$ on a particular section of the railway

Based on numerical studies conducted using the Program for programming environment MATHCAD 15 [6], the following generalizing conclusions can be made: 1. With the increase in speed of the high-speed electric train AFROSIAB the dynamic loads acting on its components and parts increase, as well as the dynamic impact on the railway track increases.

2. As the radius of curvature decreases and the gradient of the track increases, the

maximum critical speed of the electric train decreases.

4. Accepted design values of coefficients of traction of the wheel with the rail determine the maximum efficiency of the braking system.

5.The main parameter in the calculation of high-speed electric rolling stock is the criterion of aerodynamics.

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