Paths of increase of efficiency Maglev-transport with the purpose acceleration of implantation

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Key words:

Electrodynamics suspension, high-speed surface transport, Maglev-transport, Maglev-transport systems, main and regional communication.

Abstract

In the present moment development of Maglev-transport are leads up to operational use. In this connection most important problem is the definition area of effective application Maglev-transport systems. One of perspective directions of application Maglev-transport is the combined main and regional communication. The increase of large cities and agglomeration, volume of pendulous transportations, air contamination, and also overload of an exis-ting transport system, requires considerable of changes, where Maglev-transport can become the important link in implementation of regio-nal transportations. The definition of the favorable operation conditions and optimum engineering solution Maglev-transport systems, at which their application will be effective, is a main problem of this work.

1 Introduction

Now, when the application of a Maglev-transport (? ?) is actual, are especially important the researches permitting to expand an orbs of it effective application.

The researches, executed by the authors, have shown profitability of application ? ? on electrodynamics suspension (EDS) with superconducting-coil electromagnets (SCE) as a high-speed surface transport (HSST) in territory of Ukraine under condition of construction of a ring line passing through the main regional centers of the country, and permitting to concentrate the stream of passenger a on a line HSST, [1] artificially.

The mathematical model for definition of economic parameters of transportations of the passengers and freights transportation has been designed. Thus the fares were determined from a condition of provision of normative term the pay back of a capital investment.

The program allowed conducting calculations for a particular kind ? ? (HSST or suburban communication (SM)) by means of appropriate initial data input. As a result of calculation the following outcomes were given:

1. Type of a line (single-line, with two-line inserts or two-line);
2. Passenger traffic fare;
3. Freight traffic fare;
4. Annual investment costs;
5. Annual operating cost;
6. Reduced capital investment;
7. Reduced building-operational costs;
8. Income;
9. Profit.

And the data of item 4-9 were presented on 10, 15 and 20 years of maintenance of a line.

2 Paths of increase of efficiency Maglev-transport

As indicated, the research executed by the authors earlier has shown, that at fulfillment of a series of conditions in Ukraine it is profitable to use a Maglev-transport on EDS with SCE as a high-speed surface transport.

However in the indicated researches not all capabilities of increase of efficiency of Maglev-transport systems were taken into account, basic of which are following:

- implantation of the modular approach in organization of production of Maglev-transport systems, that will allow to reduce their cost; essentially

- unification of all components ?? with implantation of an international labour division of transactions;
- optimization of ? ? systems depending on the particular operating conditions with usage of standard modules;
- overlapping freight and passenger traffic in one train;
- implementation of the new no conventional approaches to tracing of ? ? (for example, creation of ring lines instead of radial);
- overlapping of main and suburban communications in one line;
- organization of through-trips on a main transport with optimization of trains formation;
- organization of non–stop motion of suburban trains with a capability of boarding and disembarkation of the passengers in an automatic mode.

3 Updating of algorithm

In the present work, the profitability of overlapping of main and suburban transportations in one line ? ? is evaluated.

Two versions of overlapping of suburban and main transportations were surveyed. In the first of them the suburban trains have stops through 10 km of a line that does not allow implementing the greatest possible running speeds and requires removal of a part of trains HSST. In the second version for suburban trains non–stop motion is implemented (with stops on main stations through 100 km) with automatic boarding and disembarkation of the passengers on suburban stations.

However, it has appeared, that in this case site of path about 14 km in length is necessary for boost of a suburban train up to V_{max} = 600 km/h with acceleration of 1 m/?^{2} and the same site is necessary for braking action of a train. In result it is necessary to lay additional line, which length will be more than length of the main line, i.e. practically it is necessary for the program SM to lay separate line. Therefore indicated version was not considered further.

For the solution of a problem on the first version the adjustment to mathematical model permitting to take into account a feature of such organization of motion were brought in. The algorithm of calculation was processed in view necessity removal of a part of trains HSST for the passing of trains of the program SM, calculation reduced the passenger stream HSST, and on this basis of definition of bandwidth of a line and it type.

Agrees [5], the factor of pick up displays how many trains of one category it is necessary to remove from a site for the admission of one train of other category and represents relation of times of running on line of trains different categories. By comparison of trains HSST and SM it will look like:

$$e = \frac{t_{SM}}{t_{HSST}}, \qquad (1)$$

Where t_{SM} - time of a train running on stage or pair of trains suburban communication

t_{HSST} - time of a train running on stage of a passenger train or pair of trains.

Thus expression (1) displays how many train HSST are necessary to remove from a site for the admission of one train of the program SM.

The running at boost of trains is accepted uniformly accelerated. Then the acceleration time for a passenger train HSST will be determined under the formula:

$$t_? = \frac{V_?}{3{,}6 \times ?_?} \text{ (s)}, \qquad (2)$$

Where V_c - computed running speed of a passenger train HSST, km/h;

$3{,}6$ - conversion factor of km/h in m/s;

a_a - admitted acceleration at boost under of the passengers comfort, m/s^2.

We shall determine acceleration site lehgth
under the formula:

$$S_a = \frac{a_a \times t_a^2}{2000} \text{ (km)}, \qquad (3)$$

The time a passenger train running on a site depends, besides, from the time of running with computed speed, length of a site, quantity of sites, on which there will be a boost and braking action of a train.

Quantity of site will be determined as:

$$n_s = \frac{S}{S_s}, \quad (4)$$

Where S_s - length of site, km;

S - length of a site for which factor of pick up is determined , km.

Thus, taking into account, that the acceleration site length is equal to a braking site length, we shall receive the formula for definition of a running time with computed speed:

$$t_t = (S - 2S_a \cdot n_s)\cdot 3600/V_{max}, \quad (5)$$

For the suburban communication it is accepted, that distance between stations is such, that the train has no time to gain full speed and therefore $t_t = 0$.

Let's determine length of an acceleration site length for the MS under the formula:

$$S_{a1} = \frac{S_{s1}}{2} \text{ (km)}, \quad (6)$$

Where S_{s1} - length of distance between stations (stage) for trains of the suburban communication, km.

The acceleration time for trains of the SM will make:

$$t_{a1} = \sqrt{\frac{2S_{?1_1} \times 1000}{?_1}} \text{ (s)}, \quad (7)$$

Where a_1 - permissible acceleration for trains of the SM, m/s^2.

We define mean running for passenger trains HSST speeds: (km/h)

$$V_m = \frac{S}{t_1 + 2t_a \times n_s} \times 3600, \quad (8)$$

For suburban trains (km/h)

$$V_{m1} = \frac{S}{2t_{a1}\cdot n_s + T_{pv1}(n_{s1}-1)}\cdot 3600, \quad (9)$$

Where n_{s1} - an amount of stages for the suburban communication, defined under the formula:

$$n_{s1} = \frac{S}{S_{?1}}, \quad (10)$$

Where T_{pv1} - the time of boarding and disembarkation of suburban train passengers.

Thus we define time of running:

a) for a two-line and single-line site with insertions for unceasing intersections of trains:

- for passenger trains HSST

$$t_{tt} = t_t + 2\,t_a, \quad (11)$$

- for suburban trains

$$t_{tt1} = 2t_a \cdot n_{s1} + ?_{?v1} \cdot (n_{s1} - 1), \quad (12)$$

b) for a single-line site:

- for passenger trains HSST

$$t_{ts} = (t_{tt} + t)\cdot 2, \quad (13)$$

- for suburban trains

$$t_{ts1} = (t_{tt1} + t)\cdot 2, \quad (14)$$

Where t - station interval of trains intersections

The factor of pick up of passenger trains HSST will make:

- on a two-line site and single-line site with insertions for uncasing of trains intersections

$$e_t = \frac{t_{tt1}}{t_{tt}}, \quad (15)$$

- on a single-line site

$$e_s = \frac{t_{ts1}}{t_{ts}}, \quad (16)$$

The evaluation of a capital investment on a site, where the combined driving of trains HSST and MS is implemented, was executed that the cost of coaches MS was adopted approximately twice less the cost of coaches HSST.

At an evaluation of the on transportations fares it was accepted, that in the program MS they are three times less, than in HSST (outgoing from an existing ratio of the fares on the suburban communication and passenger traffic).

4 Results of accounts

The multivariate calculations were executed with changement over a wide range the value of the passengers stream and length of a line.

The input data sets for calculations are shown in Table 1. The outcomes of a part of calculations are shown in Figures 1 and 2.

The boundaries of an orb of effective application ? ? in considered conditions similarly [2] were determined by comparison of the ? ? fares with the fares of existing types of transport, which are listed in Table 2.

5 Conclusions

It has appeared, that the designed measures allow to expand orbs of effective application ? ? in conditions of Ukraine considerably.

The results of account have shown, that on sites, where the streams of the passengers are within the limits of 7,5 - 15 millions passengers per one year, ? ? becomes equivalent with traditional types of transport. At a stream of the passengers, greater 15 millions passengers per one year, it is favourable to apply the mixed movement ? ?, i.e. joint movement of trains HSST and MS.

In Ukraine now at existing of the passengers stream at architecture combined freight and passenger of transportations by trains HSST and combin driving of trains HSST and MS on one line ? ? become competitive with conventional types of transport.

Table 1. Magnitude of input data for calculation

Parameters	Input dates	
	Version 1	Version 2
Time of boarding (disembarkation) HSST, min.	5	5
Time of boarding (disembarkation) MS, min.	1	1
Factor of increase stream of the passengers HSST	0,1	0,1
Admissible magnitude of acceleration HSST, m/?^{2}	2	2
Admissible magnitude of acceleration MS, m/?^{2}	1	1
Initial length of a line, km	250	250
Final length of a line, km	4500	4500
Initial magnitude stream of the passengers HSST, mill. pass./year	1	25
Final magnitude stream of the passengers HSST, mill. pass./year	25	250
Step of change stream of the passengers HSST, mill. pass./year	4	25
Magnitude stream of the passengers MS, mill. pass./year	1	1(2)
Length of stage HSST, km	100	100
Length of stage MS, km	10	10
Part of transfer and elevation decks on paths at h=10 m	0.2	0.2
Part of transfer and elevation decks on paths at h=15 m	0,6	0,6
Part of transfer and elevation decks on paths at h=25 m	0.13	0.13
Part of a path on land	0.07	0.07
Mean slope of a line, ‰	10	10
Maximum slope of a line, ‰	100	100
Station interval intersections of trains, min.	2	2

Table 2. Magnitude of the mean fare for conventional types of transport

Type of transport	Magnitude of the mean fare, U.S. Cent / pass. km*)
Bus	1.4
Carriage coach in a passenger train	1.2
Compartment coach in a passenger train	2.0
Carriage coach in a speed train	1.3
Compartment coach in a speed train	2.2

The offered way of researches can be used also in conditions of other developed countries of world community [3-4].

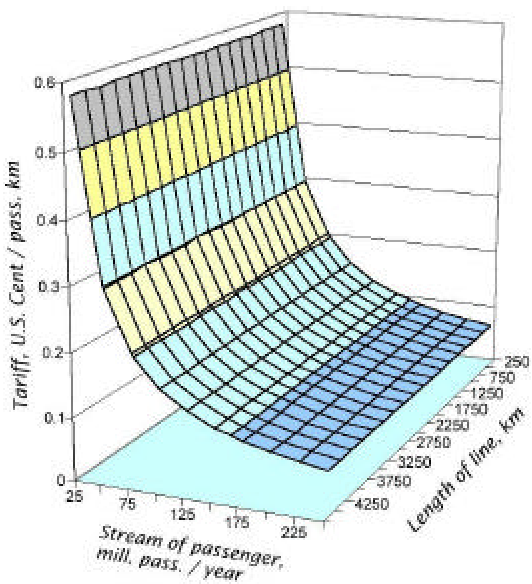

Figure 1. The fare for transportations of the passengers at change of a stream of the passengers from 1 up to 25 million annually

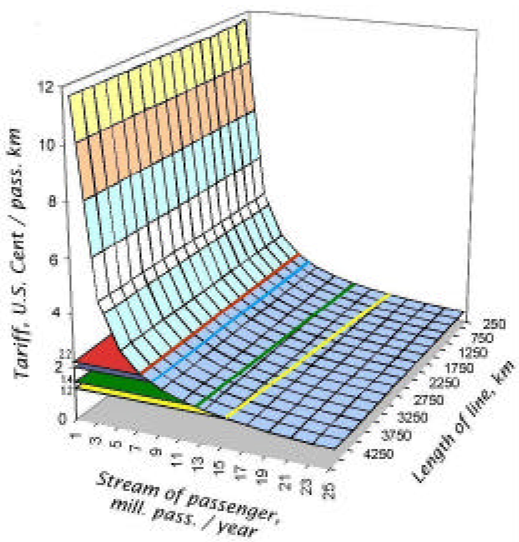

Figure 2. The fare for transportations of the passengers at change of a stream of the passengers from 25 up to 250 million annually

6 Literature:

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*) Calculations were executed for the prices working on ukrainian internal market in 2002