TEKA. COMMISSION OF MOTORIZATION AND ENERGETICS IN AGRICULTURE – 2012, Vol. 12, No.4, 36-40

Results of researches by the numeral methods of vertical influences on the way of carriages of industrial transport at the railroad ties SB 3-0

Alexandr Darenskiy, Vladimir Vitolberg

Ukrainian State Academy of Railway Transport, Kharkov, Ukraine

Summary. Determined the impact of special power and special cars on the road transport industry with concrete sleepers type SB 3-0. The dependences of the dynamics of changes in the coefficients depending on the type of rolling stock and the life path

Key words: special and specialized rolling stock, rail track in curves, interaction of rolling stock and track.

INTRODUCTION

One of the main problems in determining the possibility of inserting the road industrial transport perspective constructions, such as concrete sleepers type SB 3-0, is to find ways and means to accurately determine the impact of the special force and special wagons industrial transport this design rail base.

These methods and tools must provide not only qualitative but also quantitative information about the processes that are adequate to the real processes in the way. Requires that information was the form of graphs depicting during dynamic processes in time. Amount of input in research and technical information that describes almost all details of the design track and rolling stock must be large enough for studies of the effect on the dynamic processes of interaction of rolling stock and track a large number of parameters and their combinations and traffic conditions.

This method is, in my opinion, the method of mathematical modeling of spatial dynamical system "crew-path" [1-4] and its implementation with the use of modern software systems. Algorithm and program mathematical models actually adequate natural physical processes taking place in the way of actual structures and rolling stock, which is confirmed by a series of experimental studies [5, 6, 7].

Study of the effects of special and specialized wagons on the road by numerical methods using a software implementation of the mathematical model allows to obtain accurate results with the original data set. Meanwhile, in the experiments on the way to establish accurate baseline data for each experience is almost impossible. Execution time studies numerical methods, fast initial data, costs, material and financial resources, mathematical modeling method is much superior to natural experiments.

To identify the characteristics of special effects on the path of rolling stock and industrial transport with sleepers SB 3-0 multiple calculations were performed using the computer program of the mathematical model of the spatial dynamical system "crew- rail track " [1-4].

As calculated crews were taken some of the most common types of special and specialized wagons of metals and mining companies in Ukraine.

Also adopted the most massive main transport wagon - a tetraaxial wagons on trolleys type CRI-HZ-0, which was considered as the reference load for comparative qualitative analysis of the results. The calculations use the model 12-1000, as the most commonly used for external and internal transportation of metallurgical and mining enterprises.

Technical specifications of the above wagons, which were taken into account, and based on the analysis of information contained in [8-10]. For each crew accounted 25 parameters.

Velocity of the crew asked for special wagons from 2.5 to 7.5 km / h, in some cases - up to 10 km / h, for specialized wagons and gondola car model 12-1000 - from 5 to 40, rarely - up to 80 km / h , corresponding speed limit for such rolling on industrial transport.

The direct part of the way with rails type P65. Features rails - moments of inertia, section modulus, cross-sectional area are consistent rail wear in service. [11]

Spatial stiffness and damping coefficient given equivalent rail supports are taken depending on the age of the way the results of research presented in [12].

Because of the vertical impact forces on the path y different types of special and specialized wagons can differ by more than two times, and the force constant change moving crews, for comparative analysis is more convenient to use and informative than their absolute values, and the coefficients of the dynamics and amplitude coefficients. Performance ratio is the ratio of the maximum vertical dynamic forces generated by the movement of the static wheel (or axial) loads:

$$K_y = \frac{P_{\max din}}{P_{st}}$$

Since moving crew vertical forces vary not only large, but also in the smaller side of the static values, the magnitude of these changes can be assessed values of the amplitude ratio:

$$K_a = \frac{P_{\max din}}{P_{\min din}}$$

It should be noted that the use of the design scheme of rail as a beam on a continuous elastic foundation in dynamic computations of the crew and the path in the vertical plane, the motion of the crew on the direct level ground with the established rate of rate of change and amplitude coefficient equal to one. Meanwhile, in the real vertical forces are continually changing and these coefficients differ from unity is essential.

In fig. 1 shows the resulting calculations graphic changes of the vertical forces acting on the wheels on the rails when driving different cars on the road at a speed of 10 km / h. As the x-axis covered wagon used by the distance y-axis - the impact force (N). In these calculations, the value of spatial rigidities rail supports were assumed constant.

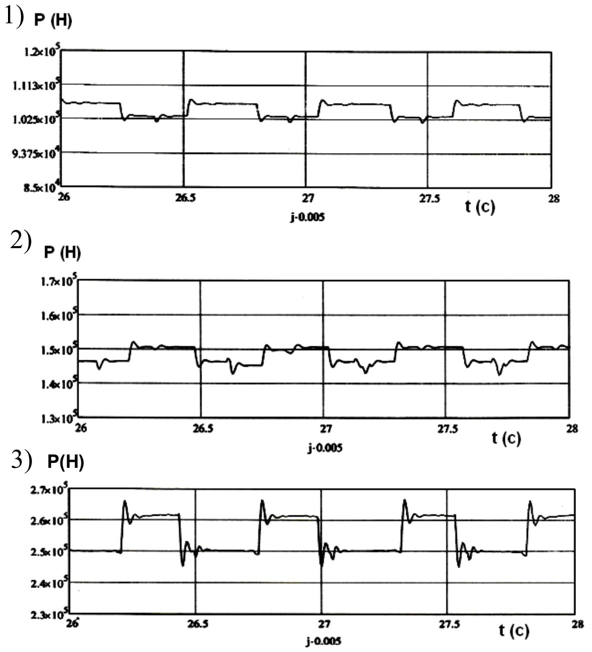

Fig. 1. Graphs of dynamic vertical forces during the motion of cars: 1 - open-top car model 12-1000, speed - 10 km / h;
2 - Boxcar BC-85; 7 - hot metal transfer car capacity of 140 tons, the speed - 5 km/h

The graphs show that the dynamic vertical forces affect both performance moving crews, their speed and stiffness rail supports. And the nature of the changes of the force varies considerably at different variants of calculations.

In fig. 6 – 2 are obtained from the analysis of the results of calculations plots of the rate of change and amplitude ratios of speeds of the wagons that are the most typical types of rolling stock for an industrial railway. The velocities of motion adopted in the aisles actually implemented. The figure shows plots of the both the new construction, and after ten years of operation. Diagram of sleepers in the calculations is assumed to be 1840 pcs. / Km.

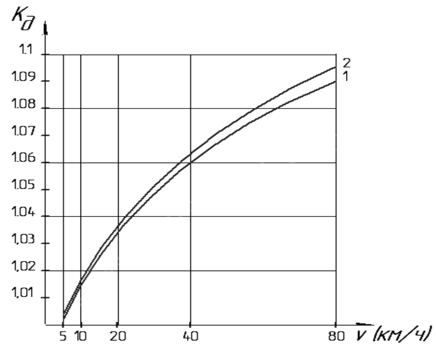

Fig. 2. Graph of rate of change of velocity of the gondola car model 12-1000
1 - time of service t_{ts} = 0; 2 - time of service t_{ts} = 10 years

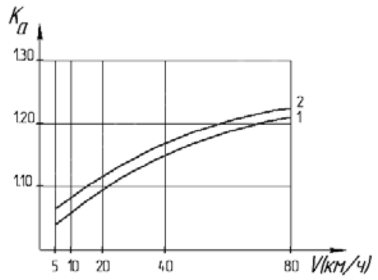

Fig. 3. Graph of amplitude coefficients of speed gondola car model 12-1000: 1 - time of service $t_{ts} = 0$; 2 - time of service $t_{ts} = 10$ years

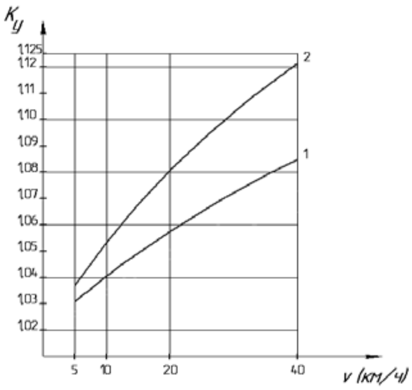

Fig. 4. Graph of rate of change of velocity of the dumpcar VS-85: 1 - time of service $t_{ts} = 0$; 2 - time of service $t_{ts} = 10$ years

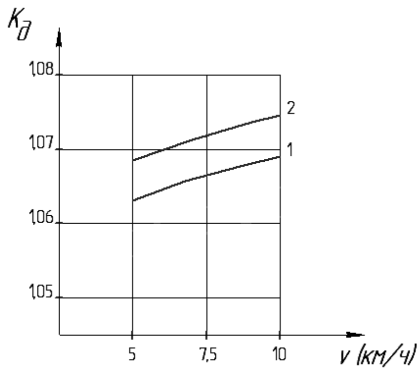

Fig. 5. Graph of rate of change of velocity of hot metal transfer car capacity of 140 tons: 1 - time of service $t_{ts} = 0$; 2 - time of service $t_{ts} = 10$ years

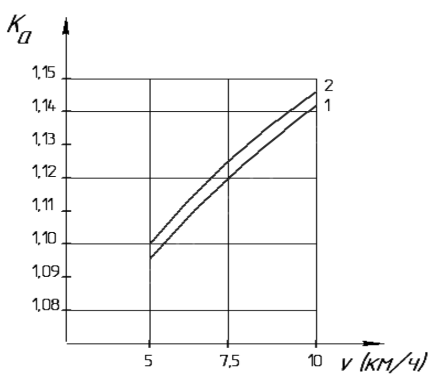

Fig. 6. Graph of amplitude coefficients of speed of hot metal transfer car capacity of 140 tons: 1 - time of service $t_{ts} = 0$; 2 - time of service $t_{ts} = 10$ years

For all the types of wagons depending on rate of change and amplitude ratios of velocities are exponential functions, and the exponent of the argument is less than one, though, focusing on the general terms of the dynamics of the process, one would expect different values. Apparently this affects not only the speed of the cars, but also the ratio of spring stiffness kit cars and the way the parameters of dissipation in these subsystems, and other factors.

At the same speeds, such as 5 km / h, for gondola performance ratio is in the range 1,006 ÷ 1,009; dumpcar VS-85- 1,032 ÷ 1,057; hot metal transfer car capacity of 140 tons - 1,059 ÷ 1,075. At the same time, at a speed of 10 km / h value of the amplitude ratio was 1.06 - 1.15 for gondolas 1.01 - 1.02 for dumpcar VS-85, 1.128 - 1.147 hot metal transfer car capacity of 140 tons

Thus, the effect of axial load and stiffness of spring group on a straight stretch of track that does not have the irregularities on the analyzed parameters is clearly seen.

Introduction to calculations unequal elasticity rail supports the use of the Monte Carlo has a very significant impact on the rate of change. So, at a speed of 10 km / h, changing the unequal elasticity supports from 0 to 0.2 (Fig. 7) causes an increase in rate of change from 1.02 to 1.055 when moving gondola cars, dumpcars for the BC-85, these changes amount to 1,065 ÷ 1,125, hot metal transfer car capacity of 140 tons - 1,085 ÷ 1,173.

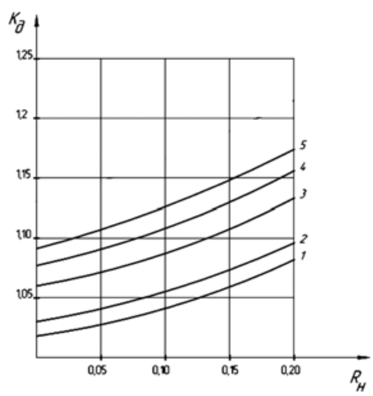

Fig. 7. Graph of the coefficients of the dynamics of the crew ratio unequal elasticity rail supports, the speed of 10 km/h: 1 - open-top car model 12-1000; 2 - dumpcar 6 BC-60; 3 - dumpcar BC-85; 4 - 70 tons of pig iron platform; 5 - 140 t hot metal transfer car

When implemented on the paths of industrial rail train speed main influence on the vertical dynamic forces have short isolated surface roughness of up to 6 m in Fig. 8 and 9 are graphs of changes and rate of change of the amplitude coefficients of the movement of certain types of cars, taken to the calculations, the vertical isolated irregularities length of 2 and 4. In these calculations, as supports taken concrete sleepers, the life of the way - 10 years. To establish the effect is uneven impact on the dynamics of the rolling stock on the road, the rigidity of supports are the same.

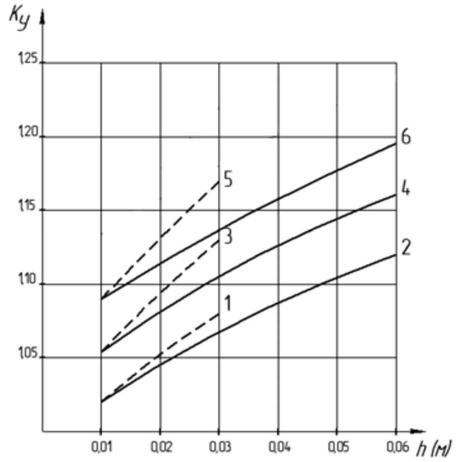

Fig. 8. Graph of rate of change of the vertical depth of the rough on concrete sleepers, the speed of 10 km/h: 1, 3 and 5, 7 - 2 m length of irregularities; 2, 4, 6, 8 - roughness length of 4 m; 1, 2 - open-top car model 12-1000; 3, 4 - dumpcar BC-85; 5, 6 - hot metal transfer car 140 t

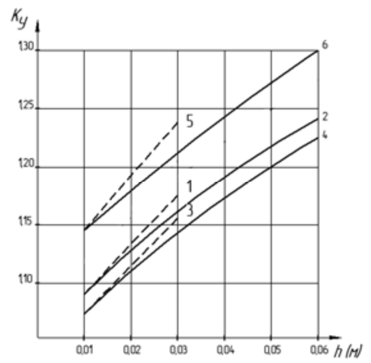

Fig. 9. Graph of amplitude coefficients of the dynamics of the depth of the vertical road bumps on concrete sleepers, the speed of 10 km / h: 1, 3, 5, 7 - 2 m length of irregularities; 2, 4, 6, 8 - roughness length of 4 m; 1, 2 - open-top car model 12-1000; 3, 4 - dumpcar BC-85; 5, 6 - hot metal transfer car 140 t

At a speed of 10 km / h on a straight section of road with a vertical isolated roughness length of 2 or 4 m gondola performance ratio, depending on the depth of roughness reaches 1.075 - 1.123, the amplitude coefficient - to 1.230, for dumpca, BC-85, these values are 1.16 and 1.22, for hot metal transfer car 1.195 and 1.30. In this case, if the calculation is introduced unequal elasticity rail supports, the coefficients of the dynamics when driving on the road with vertical irregularities increased by 12-20%, the amplitude coefficients - by 8-17%.

CONCLUSIONS

Thus, the use of a design scheme way as beams on elastic supports in the mathematical model of a dynamic system "crew- rail track" allowed to establish estimates that on a straight section of road with a maximum value of unequal elasticity supports dynamic vertical forces acting on the wheel on the rail for the gondola car 12-1000 can be up to 118 kN (40 km / h), for dumpcar BC-85 - 174 kN (40 km / h), hot metal transfer car lifting capacity of 140 tonnes - 296 kN (a speed of 10 km / h). Over time of driving these wagons with the same speed on the road with a vertical, isolated roughness values of the vertical force increased to 126 kN for the gondola, 187 kN for dumpcar, BC-85, 319 kN for hot metal transfer car capacity of 140 tons.

REFERENCES

1. **Darenskiy A.N., 2010.:** Calculation of rail as a beam on elastic supports under moving load / A.N. Darenskiy, N.V. Buhayets, V.G. Vitolberg // GIET, abstracts. - 2010. № 14. – P.171.
2. **Darenskiy A.N., 2010.:** Methodological bases of choice design scheme of dynamic systems "crew- rail track" for an industrial transport / A.N. Darenskiy // IMSRT, 2010. - № 2.-P. 32-36.
3. **Darenskiy A.N., 2010.:** Design model dynamic systems "crew- rail track" for an industrial railway. Terms and assumptions of the mathematical model of the system / A. Darenskiy, V.G. Vitolberg // DonNUERT. Scientific Papers - 2010. - № 21.-P. 219-230.
4. **Darenskiy A.N., 2010.:** Terms contacting wheels and rails in the horizontal plane. Strength and kinematic relationships crew and track [Text] / A. Darenskiy / / Coll. Science. works UkrSART - - № 113.-P. 171-177.
5. **Golubenko A., Malohatko A., Klyuev S., Klyuev A., 2011.:** The application review on the rolling stock of devices for turn of wheel pairs in the horizontal plane // TEKA - № XI A – P. 5 – 11.
6. **Golubenko A., Kostyukevich A., Tsyganovskiy I., Nozhenko V.** The influence of a rail lateral bending on the stress – strain state of a wheel – rail contact // TEKA - № XI A – P. 78 – 84.
7. **Darenskiy A.N., 2009.:** Results of experimental work on the determination of resistance forces concrete sleepers movements / A.N. Darenskiy, V.G. Vitolberg, N.V. Bugaets // DonNUERT. collection of scientific papers. - 2009. - № 17.-P. 157-171.

8. Wagons. Design theory and calculation: Textbook / Ed. L.A. Shadura - Moscow: Transport, 1943 - 439 p.
9. The wagons of the USSR [Directory 7/16/68].-M.: RIIinformheavyindustry, 1969. - 176.
10. The wagons of the USSR [Directory 8/18/74].-M.: RIIinformheavyindustry, 1975. - 198 p.
11. Terms of payment railroad for strength and stability / E.I. Danilenko, V.V. Rybkin. - K.: Transport of Ukraine - 2006.-168 p.
12. **Darenskiy A.N., 2010.:** The results of determination of the spatial elastic resistance railroad to deformation conditions for industrial transport // IMSRT. - № 6. - P. 24-31.

РЕЗУЛЬТАТЫ ИССЛЕДОВАНИЙ ЧИСЛЕННЫМИ МЕТОДАМИ ВЕРТИКАЛЬНЫХ ВОЗДЕЙСТВИЙ НА ПУТЬ ВАГОНОВ ПРОМЫШЛЕННОГО ТРАНСПОРТА ПРИ ШПАЛАХ СБ 3-0

Александр Даренский, Владимир Витольберг

Аннотация. Определены силовые воздействия специальных и специализированных вагонов промышленного транспорта на пути с железобетонными шпалами типа СБ 3-0. Получены зависимости изменения коэффициентов динамики в зависимости от типа подвижного состава и срока службы пути.
Ключевые слова: специальный и специализированный подвижной состав, рельсовый путь в кривых, взаимодействие подвижного состава и пути.