Zeitschrift: IABSE reports = Rapports AIPC = IVBH Berichte
Band: 64 (1991)

Artikel: Vibration amplitudes of steel railway bridges
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DOI: https://doi.org/10.5169/seals-49362

Vibration Amplitudes of Steel Railway Bridges

Amplitude des vibrations de ponts ferroviaires métalliques

Schwingungsamplituden in Eisenbahn-Stahlbrücken

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A method of calculation of element vibration amplitudes of high-speed railway metal bridges is given in the paper. Sometimes high-frequency stresses, caused by vibrations, can significantly reduce the durability of metal bridge elements [1]. The operation of such bridge structures proves that vibrations of separate elements of lattice span structures increase with the growth of the trains' speeds. The main cause of the above-mentioned phenomenon seems to be the high-frequency dynamic forces, resulting from the "carriage wheel-bridge railway track" interaction.

Structural models selected for the problem in question are given in Fig.1 and 2.

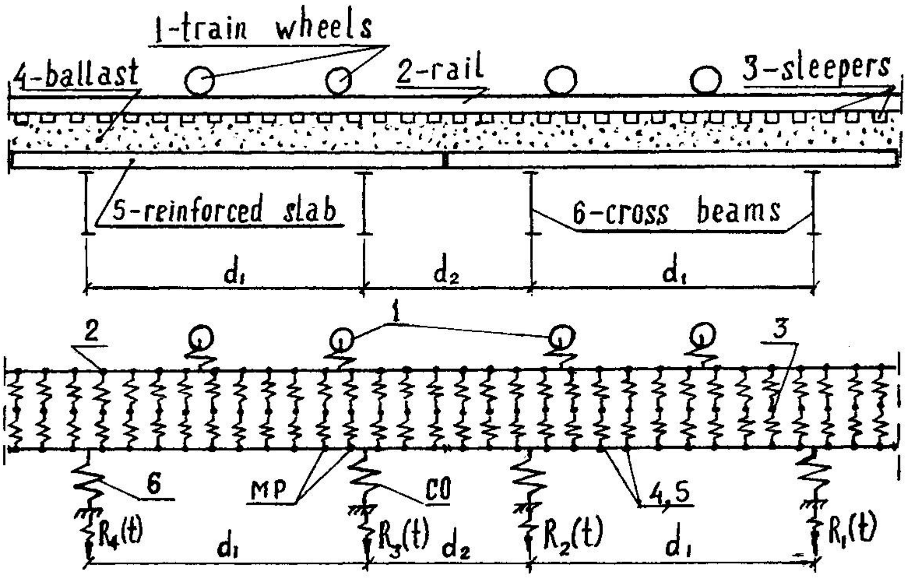

Fig.1

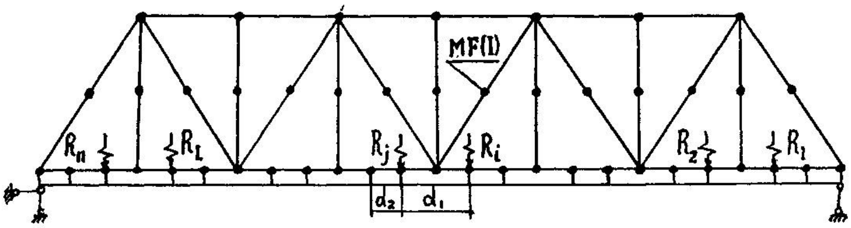

Fig.2

Metal span structures for the high-speed railway bridges are supposed to have rigid bottom chord and the continuous welded track placed on the ballast. The problem is solved in two stages. At the first stage on the basis of both the adopted structural model (see Fig.1), and mathematical model of "carriage wheels - bridge floor - bridge roadway" system variable reactions $R_i(t)$ at the elastic supports with CO stiffness are estimated. These elastic supports model the cross-beams of the span structure. At the second stage accelerations $\ddot{YF}(I)$ and displacements YF (I) of masses which model the elements of the main trusses are determined (see Fig.2). Oscillations of these masses are caused by dynamic forces $R_i(t)$ and are described by the equations as

$$MF(I) \cdot \ddot{YF}(I) = R(I,t) - \Sigma K(I, J) \cdot YF(J) - \Sigma \dot{YF}(J) \cdot B(I,J), \qquad (1)$$

where MF(I), YF(I) are mass and displacement of the first unit of the truss; K(I,J), B(I,J) are coefficients of rigidity and resistance of the system.

$R_i(t)$ - force, transferred to the first mass of the bottom chord of a truss from the bridge roadway, is determined by the following expression

$$R(I,t) = MP(YP(J) + YP(J+1))/2, \qquad (2)$$

where YP(J) and YP(J+1) are accelerations of the roadway slab masses MP, between which the elastic support CO is placed (see Fig.1).

The estimation of YP(J) and YF(J) values is based on the numerical integration of the movement of masses, shown in Fig.1 and 2, by Predicator-Corrector Method [2]. The problem statement allows to take into account one-sided ties at the "wheel-rail" contact and during the "sleeper-ballast" interaction. Integration step T depends on dynamic parameters of the system in question. Generally T is adopted by an order of magnitude less than the minimum period of natural oscillations of the system ($T = 10^{-3} - 10^{-5}$ s.)

REFERENCE

1) KONDRATOV V. The Vibration of Lattice's Elements of Metal Span Structure Main Trusses of the Railway Bridges. Diss. for the Degree of Cand. of Sci., Leningrad, 1984.

2) VASSILYEV B. Numerical Simulation by the Particles Method in the Problems of Mechanics of the Media Deformed. Moscow, Transport, 1990, pp 188-197.

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