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Discussion

Comments on "Analyses of dynamic response of vehicle and track coupling system with random irregularity of track vertical profile"

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Lei and Noda [1] have developed a vertical dynamic computational model for the vehicle and track coupling system by means of finite element method, and investigated the dynamic responses of this system with random irregularity of track profile. In Ref. [1], the authors used generalized beam element [2] for track structure. While the development is interesting, some statements are inconsistent and questionable.

According to assumption (7) in p. 148 of Ref. [1], only half of the coupling system is used, since the vehicle and railway track are symmetrical about the centerline of the track. As a result, in Eqs. (2), (4)–(6), M_c and J_c should be half mass and rolling moment of inertia for the car body of the vehicle, M_t and J_t should be half mass and rolling moment of inertia for bogies, K_{s2} and C_{s2} should be half stiffness coefficient and damping coefficient of secondary suspension system for vehicle, and K_{s1} and C_{s1} should be half stiffness coefficient and damping coefficient of primary suspension system for vehicle.

In model for analysis of vehicle and track coupling system, as shown in Fig. 1 of Ref. [1], the equivalent stiffness coefficients K_{y1}, K_{y2} and damping coefficients C_{y1}, C_{y2} stand for stiffness coefficients and damping coefficients of one support, which are resulted from ballast and roadbed. Therefore, Fig. 2 of Ref. [1], the symbol K_{x1}, K_{y1}, K_{y2}, C_{x1}, C_{y1} and C_{y2} should be replaced by

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$\frac{1}{2}K_{x1}, \frac{1}{2}K_{y1}, \frac{1}{2}K_{y2}, \frac{1}{2}C_{x1}, \frac{1}{2}C_{y1}$ and $\frac{1}{2}C_{y2}$, respectively.Furthermore, the generalized beam element stiffness matrix $[K]_e^e$ resulting from elastic supports in Eq. (9), p. 151 of Ref. [1] should read:

$$[K]_e^e = \begin{bmatrix} \frac{1}{2}K_{x1} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ & \frac{1}{2}K_{y1} & 0 & -\frac{1}{2}K_{y1} & 0 & 0 & 0 & 0 \\ & & 0 & 0 & 0 & 0 & 0 & 0 \\ & & & \frac{1}{2}K_{y1} + \frac{1}{2}K_{y2} & 0 & 0 & 0 & 0 \\ & & & & \frac{1}{2}K_{x1} & 0 & 0 & 0 \\ & & & & & \frac{1}{2}K_{y1} & 0 & -\frac{1}{2}K_{y1} \\ & & & \text{symm} & & & 0 & 0 \\ & & & & & & & \frac{1}{2}K_{y1} + \frac{1}{2}K_{y2} \end{bmatrix}.$$

Otherwise, the beam stiffness resulting from elastic supports in the global stiffness matrix $[K]_l$ for track structure obtained by using $[K]_l = \sum_e [K]_l^e$ in Eq. (14) of Ref. [1] would have doubled.

Similarly, Eq. (12) of Ref. [1] should read:

$$[C]_e^e = \begin{bmatrix} \frac{1}{2}C_{x1} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ & \frac{1}{2}C_{y1} & 0 & -\frac{1}{2}C_{y1} & 0 & 0 & 0 & 0 \\ & & 0 & 0 & 0 & 0 & 0 & 0 \\ & & & \frac{1}{2}C_{y1} + \frac{1}{2}C_{y2} & 0 & 0 & 0 & 0 \\ & & & & \frac{1}{2}C_{x1} & 0 & 0 & 0 \\ & & & & & \frac{1}{2}C_{y1} & 0 & -\frac{1}{2}C_{y1} \\ & & & \text{symm} & & & 0 & 0 \\ & & & & & & & \frac{1}{2}C_{y1} + \frac{1}{2}C_{y2} \end{bmatrix}.$$

It is claimed, in the middle of p. 152 of Ref. [1], that m_p and m_b are half masses of the tie and the ballast between two ties, respectively. Therefore, the generalized beam element mass matrix $[M]_e^e$ resulting from sleeper and ballast in Eq. (10) of Ref. [1] should read:

$$[M]_e^e = \begin{bmatrix} \frac{1}{2}m_p & & & & & & & 0 \\ & \frac{1}{2}m_p & & & & & & \\ & & 0 & & & & & \\ & & & \frac{1}{2}m_b & & & & \\ & & & & \frac{1}{2}m_p & & & \\ & & & & & \frac{1}{2}m_p & & \\ & & & & & & 0 & \\ 0 & & & & & & & \frac{1}{2}m_b \end{bmatrix}.$$

References

[1] X. Lei, N.-A. Noda, Analyses of dynamic response of vehicle and track coupling system with random irregularity of track vertical profile, *Journal of Sound and Vibration* 258 (1) (2002) 147–165.
[2] X.Y. Lei, *Numerical Analysis Method for Track Structure*, Chinese Railway Publication House, Beijing, 1998.