STUDY OF THE DYNAMIC OF INTERREGIONAL DUAL-SYSTEM ELECTRIC TRAIN OF JSC "KRYUKOV CAR-BUILDING COMPANY"

Sergey MYAMLIN, Vladimir PRIKHOD'KO, Victoriya ZHIZHKO and Vadim DUZIK

Dnepropetrovsk National University
of Railway Transport named after
Academician V.Lazaryan
49010, Dnepropetrovsk, Ukraine

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ABSTRACT

The purpose of this study is a theoretical evaluation of dynamic parameters of the head and the intermediate dual-system electric interregional train of JSC "Kryukov car-building company" throughout the range of operating speeds. The simulation uses a computer program «DYNRAIL», developed in Dnepropetrovsk National University of Railway Transport (DNURT). A results of the theoretical studies of dynamic loading of the head and intermediate cars of dual- system interregional electric train it's received a confirmation of design speed, which is 200 km/h.

Keywords: dynamic parameters, dual-system electric interregional train, design speed, simulation

1. INTRODUCTION

Creating of new contractions of railway rolling stock usually accompanied by the implementation of a number of both normative and research calculations and subsequent tests. Computation of structures characteristics created during design and development, prototypes complements the theoretical studies on the choice of rational parameters of basic mechanical systems [1-6]. The purpose of this study is a theoretical evaluation of dynamic parameters of the head and the intermediate dual-system electric interregional train of JSC "Kryukov car-building company" throughout the range of operating speeds [7].

2. MAIN PART

Dynamic performance evaluation is done by modeling the motion of the head and intermediate cars along the straight section of way, as well as on of the medium-range (600m) and short-range (300m) curve. The simulation uses a computer program «DYNRAIL» [8-10], developed in Dnepropetrovsk National University of Railway Transport (DNURT). Since head coach car by design is close to the locomotive, it's very important to perform calculations of its dynamic performance taking into account the allowed values adopted for electric locomotive. Intermediate car of the train is passenger one, so during calculations to assess its dynamic performance it is necessary to use the permissible values of dynamic performance passenger cars.

As perturbation it's used geometrical irregularities rail yarn obtained according to the recommendations set in the document "Calculation of railway track irregularities for use in research and design of passenger and freight cars." Obviously, for intermediate car use, irregularities for passenger cars, and for the head car- the data for freight car are applied. Comparing with the "usual" state of the track, this track has a rate "excellent" and "good." Fig. 1-4 presents graphics of irregularities.

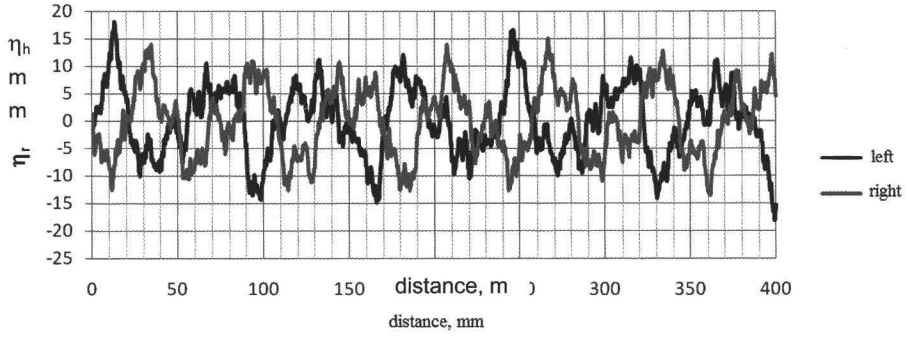

Fig.1 Horizontal irregularities (intermediate car)

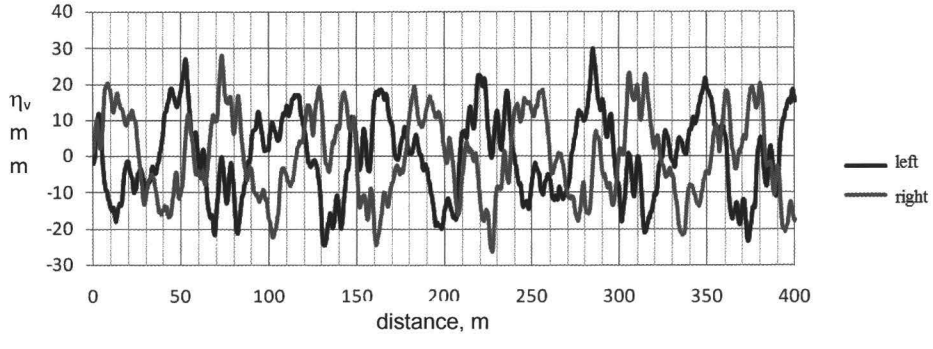

Fig.2 Vertical irregularities (intermediate car)

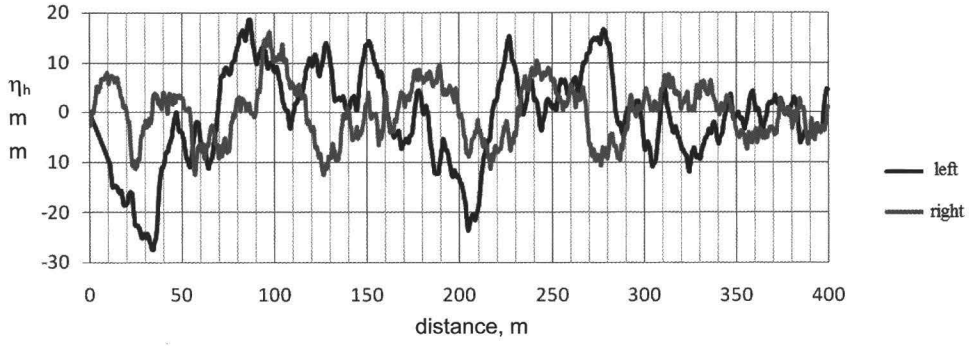

Fig.3 Horizontal irregularities (head car)

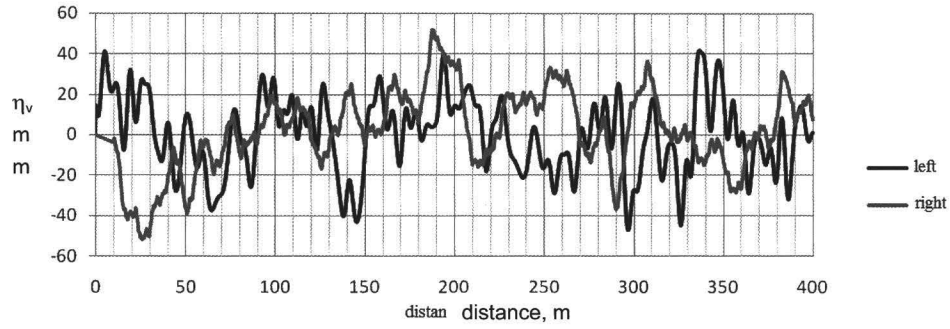

Fig.4 Vertical irregularities (head car)

Based on the data of the construction of electric cars, it's built a spatial model of the head and intermediate cars. For estimating the dynamic parameters it's performed the calculations that model the movement derived spatial models of the head and intermediate cars, as well as of etalons along the straight section and the curves with medium and small radius. Dynamic performance of the head car has been compared to the object-etalon - electric locomotive DC-3, as the object-etalon for intermediate car it's selected a coach car model 68-779 on standard bogie.

Fig. 5 and fig. 6 presents general view of bogies of considered cars.

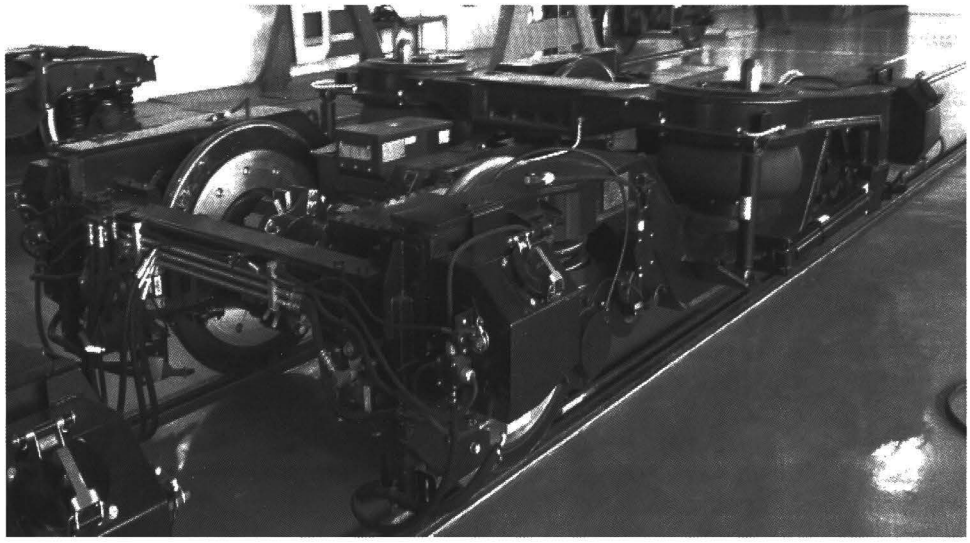

Fig. 5 General view of driven bogie of head car

Then in this article there are calculated the dynamic indicators for modelling the movement of obtained spatial models for a head and intermediate car of an electric train, and also of objects-etalons for a direct section and for curves of average and small radiuses.

Fig. 6. General view of intermediate car`s bogie

Dynamic indicators of a head car were compared to object standard – electric locomotive DC-3, as object standard for an intermediate car is chosen a coach car (model 61-779) on bogies KVZ-CNII. Fig. 7-8 shows the results of calculations for an intermediate car on a direct section of track (as examples).

In addition to the main dynamic indicators there are additional ones: an indicator of wheel wear on driving surface (Is) and a wear indicator on wheel flange (If). In addition the value of these indicators (unfortunately not normalized), allow us to estimate the qualities of studied cars.

Besides the basic dynamic parameters, it is determined another two ones: wheel wear on rolling circle and the index of wheel wear on the crest. The values of these not standardized parameters will allow evaluating the quality of the investigated cars.

Further tables (tabl.1,2) present the dynamic indicators in percentage of studied objects in relation to objects - etalons at all considered speeds of movement: the coefficient of vertical dynamics of the first stage of 1 degree Cdvb, the coefficient of horizontal dynamics of 1 degree Cdgb, the coefficient of vertical dynamics of 2 degree Cdvc, the stability coefficient Cs, the smoothness of movement in vertical and horizontal directions Wv and Wg. Average sizes are specified in the last line of each table on the ranges of speeds.

3. CONCLUDING REMARKS

Results indicate that the main dynamic performances of the head and intermediate electric cars on the direct section do not exceed the limits at speeds up to 220 km / h. The values of dynamic parameters on the medium-range curves do not exceed the allowable values at speeds up to 100km / h, and on the small radius curves - up to 80km / h. In addition, in the considered range of speeds all dynamic parameters of intermediate and head cars are better than the parameters of etalons.

Table 1
Dynamic indicators of an intermediate car on a direct section in relation to objects-etalons

Percents (Direct line, intermediate car)								
V	Cdvb	Cdgb	Cs	Cdvc	Wv	Wg	Is	If
40	61,3	73,2	100,0	47,6	84,1	68,2	100,9	82,6
60	58,7	78,4	102,1	54,5	88,9	66,7	94,4	96,3
80	67,2	82,4	98,7	45,9	88,0	72,0	88,5	82,8
100	74,9	87,9	106,1	52,3	81,8	72,0	87,3	82,4
120	73,0	94,2	100,0	56,8	80,3	71,2	81,5	80,9
140	66,8	105,4	99,9	73,3	81,3	66,7	75,8	75,8
160	79,2	105,5	103,7	90,9	86,5	63,4	72,4	74,5
180	78,5	90,9	106,9	92,1	89,9	60,5	67,2	75,6
200	79,7	85,1	119,4	84,8	90,1	58,3	60,6	73,3
220	83,1	82,3	120,3	88,6	92,9	56,5	52,6	69,0
240	86,6	79,7	117,5	94,6	97,4	55,6	47,9	70,6
260	88,8	77,8	131,1	97,0	100,7	54,9	43,4	74,5
Average	74,8	86,9	108,8	73,2	88,5	63,8	72,7	78,2

Table 2
Dynamic indicators of a head car on a direct section in relation to objects-etalons

Percents (direct section, head car)								
V	Cdvb	Cdgb	Cs	Cdvc	Wv	Wg	Is	If
40	101,9	135,4	99,5	56,3	67,6	95,2	135,3	72,3
60	90,8	132,6	106,8	71,9	79,4	99,0	123,0	74,9
80	96,3	88,0	123,7	61,3	71,4	101,8	94,9	67,6
100	90,6	88,3	124,5	49,0	64,9	92,8	70,5	56,8
120	76,3	79,6	136,6	54,3	63,2	80,2	68,7	46,1
140	63,6	89,8	113,6	47,2	64,4	76,6	60,6	46,4
160	75,9	84,3	134,0	64,0	72,6	68,3	55,9	47,8
180	90,1	82,6	117,6	80,6	78,8	69,5	55,9	47,5
200	84,8	87,9	118,8	90,5	84,6	71,3	63,6	50,8
220	89,3	82,9	104,2	97,4	90,8	78,0	63,5	56,7
240	88,8	90,4	101,6	91,5	95,3	83,2	66,6	64,6
260	82,6	94,9	98,6	91,4	94,4	80,6	69,5	66,5
Average	85,9	94,7	115,0	71,3	77,3	83,0	77,3	58,2

Thus, as a result of the theoretical studies of dynamic loading of the head and intermediate cars of dual- system interregional electric train of JSC "Kryukov car-building company" it's received a confirmation of design speed, which is 200 km / h.

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