MEASUREMENT AND EVALUATION OF WEAR FROGS SWITCHES ŽSR

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Abstract

This paper deals with the measurement and evaluation of wear frogs switches ZSR. One of the main problems is the oversize wear. The possibilities analysis of this problem is offered through a set of switches and monitoring of selected parameters. One of these parameters is also monitoring the vertical wear.

Keywords:

Correlation analysis;
Frog tip;
Linear model;
Switch;
Vertical wear.

1. Introduction

The basic and important condition for effective management and maintenance of traffic road is recognition of its real condition. The path to this knowledge is a system of measurement, monitoring and diagnostics traffic road [3]. One of the methods of diagnosis of switches also measure the wear of mobile components, mainly tongues and frogs. Oversize wear frogs mainly on modernized sections of line ZSR is becoming an increasing problem in relation to the manufacturer for unrecognized claim. So Research and Development Institute railways in Žilina was tasked to monitor 40 pcs frog of switches on the network ZSR periphery of OR Trnava.

2. Area of monitoring

As part of the monitoring were selected 40 pieces frogs in railway stations, railway stations Veľké Kostoľany (6 pcs), Piešťany (7 pcs), Nové Mesto nad Váhom (6 pcs), Leopoldov (8 pcs), Brestovany (4 pcs) and Trnava (9 pcs). In this paper we will only deal with measurements on switches shape 1:14-760.

Measurements were carried out so far in three stages at intervals of 0, 4 and 9 months. He used the laser device to measure the rail profile CONTOUR (Fig. 1).

Fig. 1: CONTOUR device.

In switches were measured following parameters:

- horizontal wear,
- vertical wear,
- wear wing rail,
- wear frog tip,
- groove width,
- depth of groove.

In this paper we will discuss only parameter vertical wear. According to valid regulations ZSR TS 3 Track superstructure is a service leader most vertical wear a frog in a place where the wedge width is 40 mm and larger, the speed limit:

- $V \geq 100$ km/h, max. 6 mm,
- $40 \text{ km/h} < V < 100$ km/h, max. 9 mm,
- $V \leq 40$ km/h, max. 12 mm.

The values of the vertical wear frog are measured in the longitudinal direction as the difference height of the upper point rails and the measuring point of the frog tip, which is the width of 40 mm (Fig. 2).

Fig. 2: Longitudinal section of frog.

3. Vertical wear of frog

The results of measurements of the vertical wear each frogs shaped 1:14-760 are in the following Table 1. Measurements are evaluated only against the tip.

Table 1: Vertical wear of switches 1:14-760.

No.	Railway station	No. Switch	Form of switch	Vertical wear (mm)			
				1 st stage (05/2012)	2 nd stage (09/2012)	3 rd stage (09/2013)	Average
1.	Veľké Kostoľany	13	J 60 1:14 760	0	0.0	0.2	0.1
2.	Veľké Kostoľany	16	J 60 1:14 760	0.3	0.1	0.2	0.2
3.	Veľké Kostoľany	15	J 60 1:14 760	0	0.2	0.1	0.1
4.	Piešťany	6	J 60 1:14 760	0.4	0.3	0.4	0.4
5.	Piešťany	15	J 60 1:14 760	0	0.1	0.3	0.1
6.	Piešťany	11	J 60 1:14 760	0	0.2	0.5	0.2
7.	Piešťany	18	J 60 1:14 760	0.1	0	0.1	0.1
8.	Leopoldov	15	Obl 60 1:14 760	0.3	0.1	0.4	0.3
9.	Leopoldov	17	Obl 60 1:14 760	0.3	0.3	0.3	0.3
10.	Leopoldov	13	J 60 1:14 760	0	0.3	0.2	0.2

4. Statistical treatment of results

Correlation analysis examines the existence of ties - the correlation between the monitored characteristics (variables - vertical wear over time). To express the degree of correlation was examined for the possible sets of coefficients of correlation used as the most appropriate choice Pearson coefficient of correlation R pairwise two variables x, y . If the value of R can be considered to be statistically significant, it was detected by testing hypotheses on R , with the proviso that the choice of $(x_1, y_1), (x_2, y_2), \dots, (x_n, y_n)$ is derived from the populations of two-dimensional normal distribution. Were tested hypotheses: $H_0: R = 0$ versus $H_1: R < > 0$, on the surface of the test $\alpha = 0.05$ [2].

Dependence between variables x and y was considered statistically significant at the $\alpha = 0.05$ test if the rejected hypothesis $H_0: R = 0$. Regression analysis determined the shape of the observed dependence. When examining dependence vertical wear at the time were used linear and nonlinear regression models.

Distribution of regression models:

- linear: - polynomial,
- multiple linear,
- lineared nonlinear: - exponential model,
- logarithmic model,
- hyperbolic model,
- sinusoidal model.

The shape of the linear model is levied dependence is given by the regression equation:

$$y = a + bx \quad (1)$$

The shape of the non-linear polynomial model of second instance in which the best results are achieved by the regression equation:

$$y = a + bx + cx^2 \quad (2)$$

Where a, b, c are the regression coefficients,

y is the dependent variable,

x is the independent variable.

To calculate the estimate of the regression coefficients was used the method of least squares. Significance was established models of the F-test. Regression coefficients of equations (1) and (2), and achieved coefficients of determination for the studied addiction, are shown in Fig. 3 and 4 and Table 2.

Fig. 3: The linear model of vertical wear of switches 1:14-760.

Fig. 4: Nonlinear model of vertical wear of switches 1:14-760.

Table 2: Results of statistical processing.

Form of switches	<i>n</i>	<i>a</i>	<i>b</i>	<i>c</i>	$R_{\alpha,0.05}$	<i>R</i>	Correct?
1:14-760	30	0.1342	0.0084	-	0.361	0.393446	OK
1:14-760	30	0.14	0.004	0.0003		0.395348	OK

5. Conclusions

For the final determination of vertical wear of switches 1:14-760 shaped is desirable to extend the set of studied further measurements. It would be possible to work with larger files and possibly also to deal with other mathematical models, appropriate to examine the relationship between the wear and working load of switches. Monitoring of these switches will continue measuring the fourth stage in the first half of 2014, and will be monitored to evaluate other independent variables.

References

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