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THE IMPULSIVE LOADING INFLUENCE ON DYNAMIC RESPONSE PARAMETERS OF THE VIADUCT TYPE STRUCTURE

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ABSTRACT

Bridges and viaducts are vital structures ensuring ways of communication, so they must be protected from dynamic loads from traffic or seismic activity. For this reason are embedded in their structure dynamic isolation systems for damping and isolating the shocks and vibration to which they are subjected. For a correct choice, from the dynamic point of view of viscoelastic type systems and to estimate their optimal lifetime is required thorough knowledge of the dynamic loads to which they are subjected. In this paper will be analyzed from the experimental point of view, the disturbing signals stemming a heavy vehicle from passing at different speeds over an obstacle positioned transversely to the travel position.

KEYWORDS: viaduct, dynamic, isolation, damping

1. INTRODUCTION

The commissioning of a bridge or viaduct requires a series of experimental measurements from static and dynamic points of view. These dynamic loads are intended to evaluate the bordering of the dynamic response parameters values of the viaduct (bridge) structure within normal values for such buildings. A periodic evaluation of these parameters and their comparative analysis is an effective method to identify defects that may occur both in the viaduct structure and the support devices. This method is developed in the world, being known as the method to investigate the normal functioning of the structures based on nonlinear investigation techniques. In other words, defects that appear at the viaduct and bearing equipment will be identified by the appearance of nonlinear behaviors of some dynamic response parameters.

2. DYNAMIC TEST DESCRIPTION

Dynamic tests analyzed in this paper, aimed at generating impulsive action in order to evaluate the dynamic response of the viaduct with elastic supports, with 5 openings located between km 29+602.75 and km 29 +801.25 on the portion between Tg. Mures and Cluj Napoca. Generating the dynamic loadings made by passing a road-truck scale with mass of 41 t over an obstacle with a height of 40 mm, produced according to STAS 12504-86. Testing was performed for four values of the speed. The truck which was passing over the obstacle had coupled traction: 10 km/h, 20 km/h, 30 km/h and 50 km/h. In the present study will be considered only the test which has the truck speeds of 20 km/h, 30 km/h and 50 km/h. Figure 1 shows the profile of the bridge, and is highlighted the main section located between P2 and P3 cells where dynamic tests were performed.

To acquire acceleration signals it was used a data acquisition board NI9233 with four channels and coupling USB + triaxial accelerometer 4506B003 series 10145 B&K, following the evolution of parameters:

- signal acceleration in time and frequency domain;
- density power spectral;
- spectrogram signal acceleration.

Acceleration signals were analyzed only

the vertical direction (OZ) as they present the most significant values.

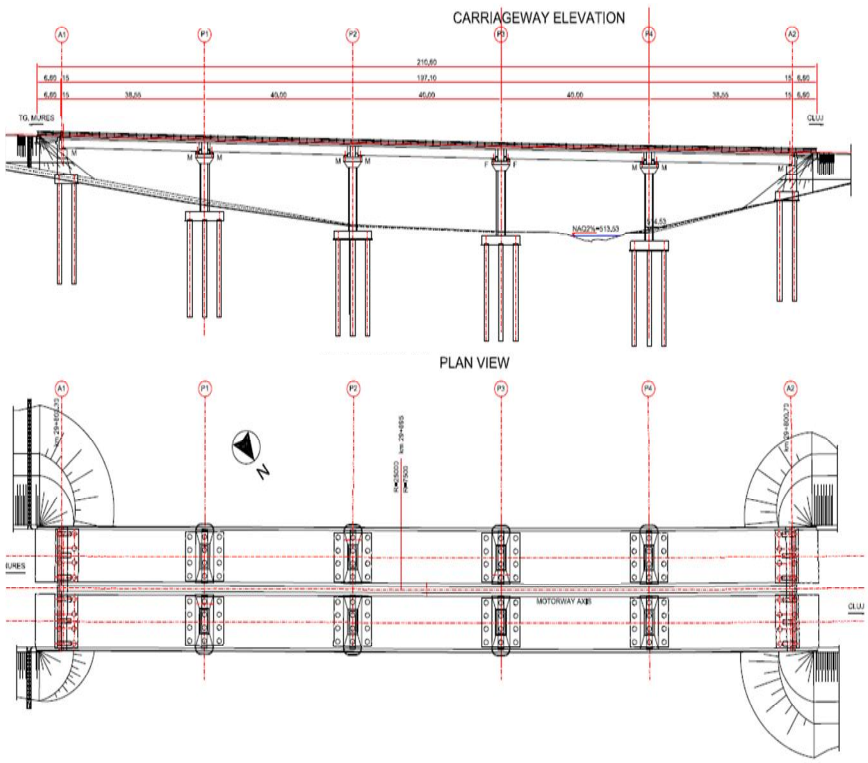

Fig. 1. Profile of the bridge

3. INTERPRETATION OF RESULTS

Dynamic response parameters of the viaduct from the moving truck speed of 20 km/h were shown in Figures 2-6.

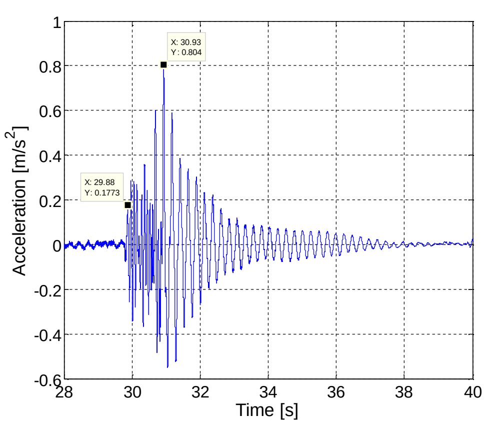

Fig. 2. Acceleration on OZ direction

By analyzing these graphics results the following conclusions can be drawn:

- the maximum acceleration value is 0.8 m/s^2
- the spectral representation of acceleration highlights significant values at 4 Hz and 12.5 Hz
- power spectral density representation shows a significant distribution of signal power on interval frequency from 7.8 to 28.3 Hz and 152.3 to 195 Hz
- spectrogram shows the frequency distribution of the acceleration signal over time.

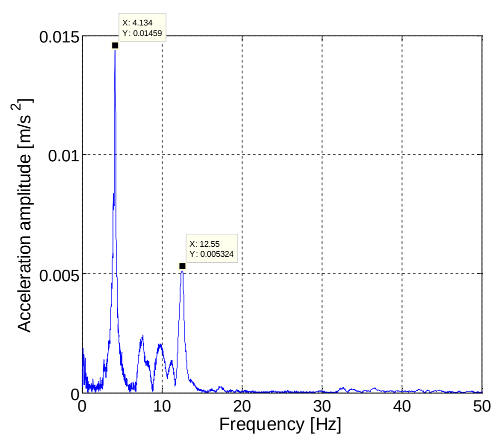

Fig. 3. Spectral representation of acceleration

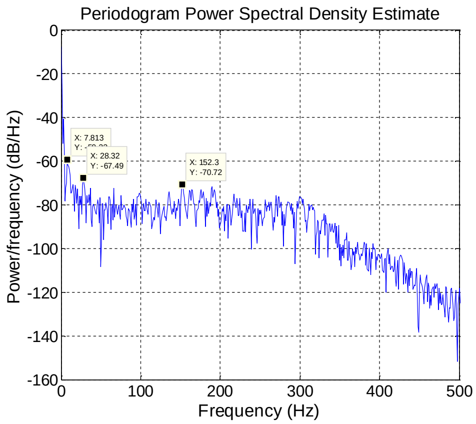

Fig. 4. Power spectral density

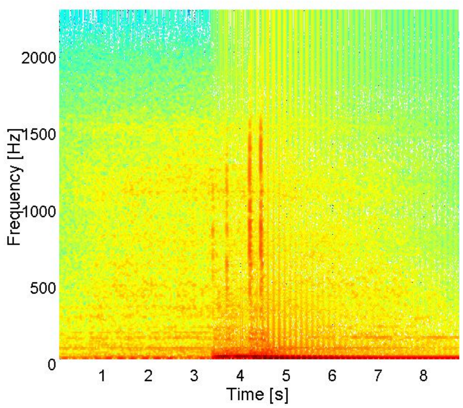

Fig. 5. Spectrogram

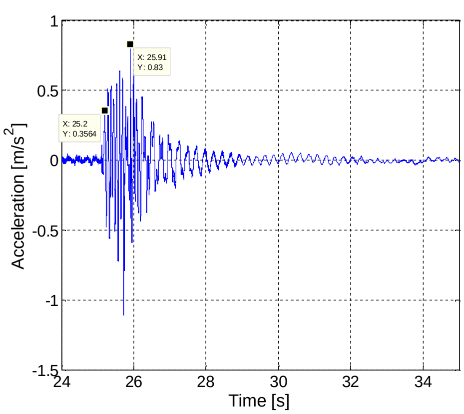

Fig. 6. Acceleration on OZ direction

Representations of dynamic response parameters for truck speed of 30 km/h, are presented in Figures 6-9. The following aspects are dealt with:

- the maximum acceleration is 0.83 m/s^2
- acceleration spectral representation highlights significant values at 4 Hz and 12.5 Hz
- power spectral density representation shows a significant distribution of signal strength on the frequency ranges from 7.8 to 40 Hz and 274-300 Hz.

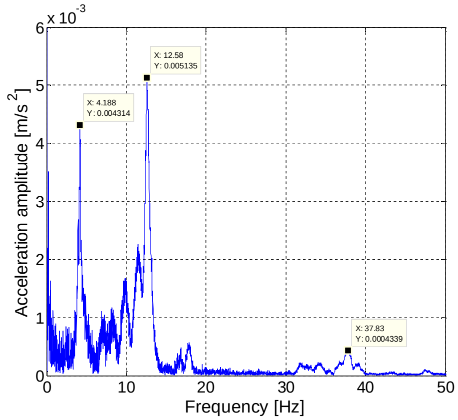

Fig. 7. Spectral representation of acceleration

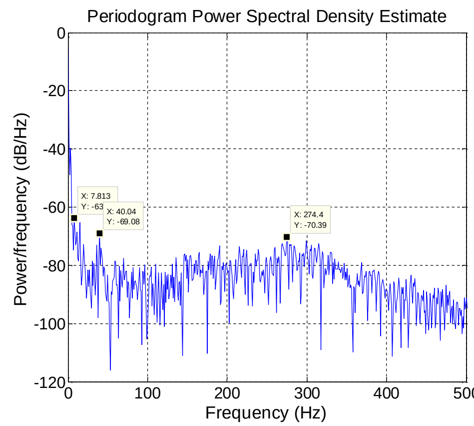

Fig. 8. Power spectral density

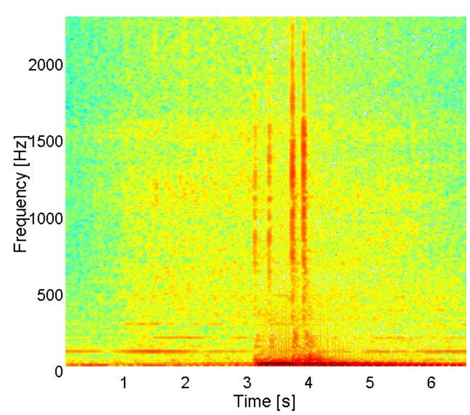

Fig. 9. Spectrogram

Graphic representations of the response parameters for the truck moving at 50 km/h, highlights the following:

- the maximum value acceleration is 1.42 m/s^2;
- acceleration spectral representation highlights significant values of 4.1, 6.9

and 12.5 Hz;

➢ power spectral density representation distribution shows a significant signal strength on the frequency ranges from 7.8 to 28 Hz and 274-320 Hz.

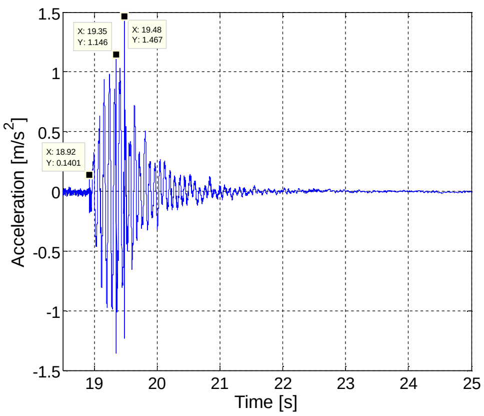

Fig. 10. Acceleration on OZ direction

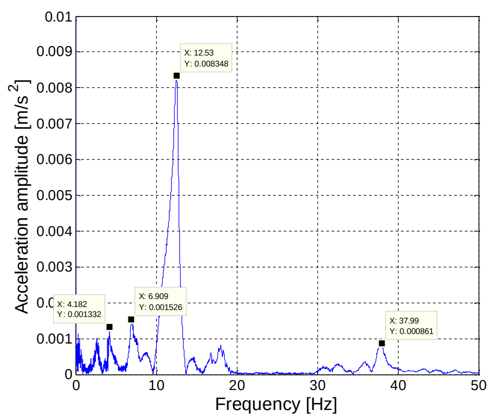

Fig. 11. Spectral representation of acceleration

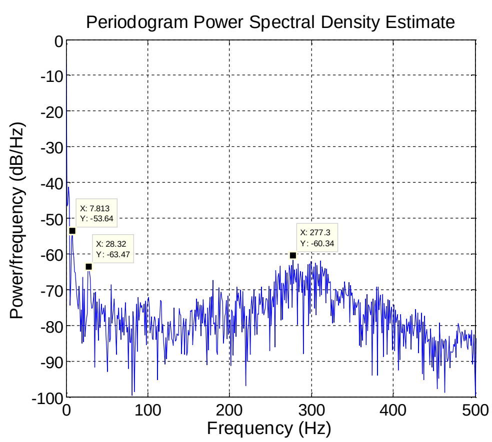

Fig. 12. Power spectral density

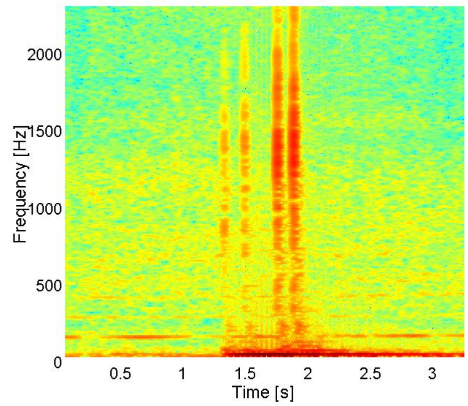

Fig. 13. Spectrogram

4. CONCLUSIONS

From the comparative analysis of graphic representations of dynamic response parameters used to analyze the viaduct section, we can conclude that: while increasing the travel speed of the truck there is an increase of the maximum value acceleration; from the spectral representations of the acceleration signal, it can be seen that while increasing the speed of travel, significant spectral components move from low to high values; the distribution of acceleration signal strength reveals two significant frequency ranges. The first interval shows an extension to higher values only for the speed of 20 km/h, but the second interval moves towards higher values with increasing impact speed; the acceleration spectrogram representation is relevant for signal distribution to the higher frequencies and for the damping duration of the oscillatory motion. Obviously, the crossing obstacle at the speed of 59 km/h presents a spectrum with the highest values and the highest duration of vibration damping.

Acknowledgments

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