THE USER OF RUBBER MATERIALS TO REDUCE NOISE TRAMLINES

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VŠB-TU Ostrava, Faculty of Civil Engineering, in cooperation with the Dopravní podnik Ostrava, a.s., ODS - Ostrava, a.s. a company Intertech Ltd. proposed a new type cover plates with the absorption properties of the surface, allowing ride the vehicles. The panels were laid on the test section of length 50 m in Ostrava tram line Zábřeh using security features. The aim of the training is to acquaint the public with knowledge of the technology proposal for the production and laying of the panels, but also with the results measured on the test area in terms of noise reduction and overall contribution to traffic safety.

Key words: cover plates, abstract format, template, abstract structure

1 Introduction

Dopravní podnik Ostrava (Transport Company of Ostrava), as the operator of public transport in Ostrava, also operates an extensive network of tram lines, which are mostly conducted in built-up area. Based on the results of the measurements of noise and vibration on the selected track with a cover consisting concrete cover plate panels were asked VŠB-TU Ostrava, FAST, Department of Transport building on cooperation within the project team, "Reducing noise in tram transport. The designated groups are deals with the dissemination and subsequent reductions in noise and vibration tram traffic, whether driving themselves or tramway sets of design and location of structural elements of the tramway superstructure. Within this group pass input noise and vibration on the middle cover plate tram line.

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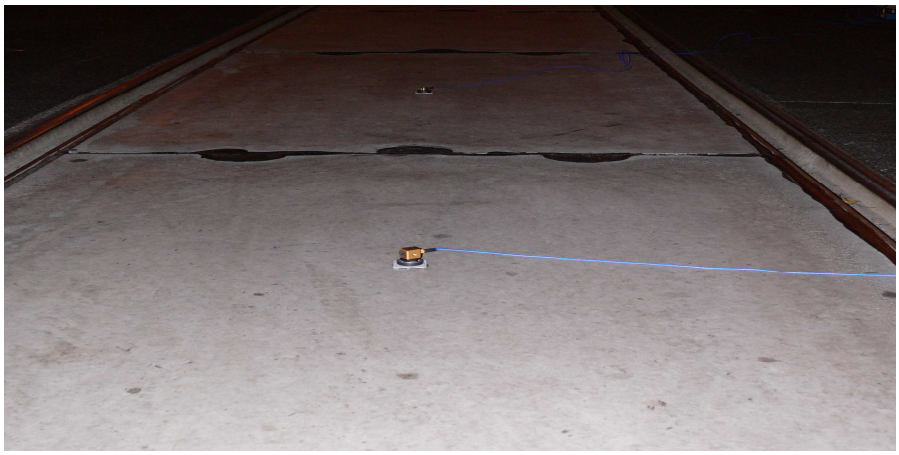

Fig.1: Measurement of vibration and resonance of its own cover plate

2 New elements and materials

At present, introduced into service the new elements that prevent the spread of noise or reduce it significantly. This is essentially a flexible materials based on rubber or polyurethane. The structure of such elements will form the absorbent surface, thus contributing to reduce the spread of noise and then the vibrations of passing tram sets. Absorptive use of such materials involves not only good for reducing noise, but also visually separated from the surrounding strip tram road traffic and contributes to direct pedestrians to designated crossing points.

In the first phase of cooperation has changed the surface cover plate panel, the panel of the taxi was replaced by a layer of hardened recycled rubber. The reason for this change was an effort to use recycled devour flexible material, the optical separation of the tramway from the surrounding road band and also meet the requirements of communication service block such a unique enable tramline belt motor vehicles.

In the next stage of cooperation were on the test section of tram lines in length, about 100 meters of newly laid on a revised and compaction of the bottom of the tramway plain body vibration mats brand CONIRAP on the thickness of 24 mm.

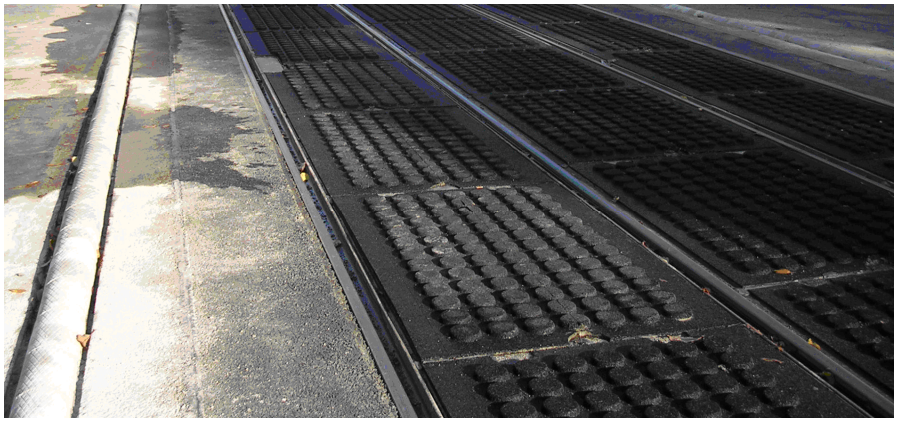

Fig.2: New cover plates with a rubber layer in the test section

Fig.3: The installation of anti-vibration mats CONIRAP

The test area that other elements were used as the feed rails and consolidator CONIPUR M 800 polyurethane grout joints and panel alignment light concrete with the top layer of elastic liquid polyurethane dressing Masterflow 155th.

Fig.4: Spray rails and consolidator polyurethane CONUPUR M800

3 Measurement of noise caused by operation of tram sets

Concrete cover plates with a rubber coating were newly laid in the test section length of 50 meters on the street racing in Ostrava-Hrabůvka. Tramway belt is flanked on both sides two traffic lanes road communications shoulder lanes and fences surrounding the gardens on one side and the fence of the cemetery on the other. The grassy lanes and behind the direction of the lines are unique grown stormy.

Measurements took place at test section in August and October last year and the original condition of the tram lines with moderate concrete cover plates and subsequent implementation of the test section with a newly laid in cover plate panels with a rubber layer.

To measure the noise level meter was used type 2250B firm Brüel & Kjaer. To speed passage 40 and 50 km/h $^{-1}$ with tolerance ± 2 km/h $^{-1}$ and two different distances from the axis of sound level meter taxi about 7,5 and 15,0 m. The measurements were always 5 driveways tram measured reference section. Tram ridden measured section inertia, without actuate the acceleration pedal.

In the idle state before and after measurements were also recorded levels of background noise, whose value has always been more than 10 dB lower. Measurements were always at night from about 23.30-2.30 hours when traffic on surrounding roads was very small.

These measurements were carried out in accordance with the basic regulation setting out the hygiene levels of noise and vibration for outdoor space, indoor and working environment, which is Government Regulation No. 148/2006 Coll. on health protection against adverse effects of noise and vibration with effect from 1. 6. 2006.

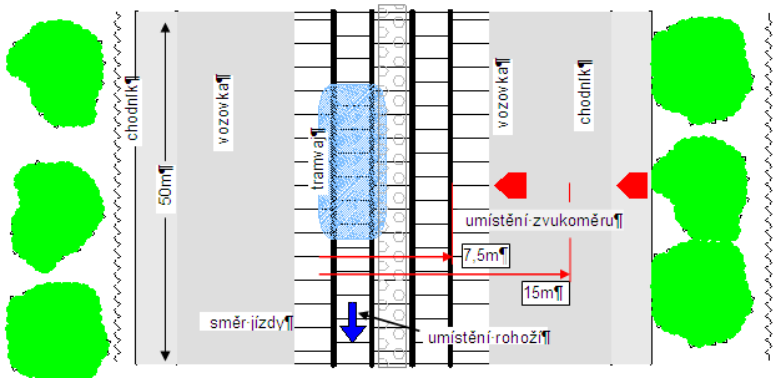

Fig.5: Scheme of arrangement of the test section

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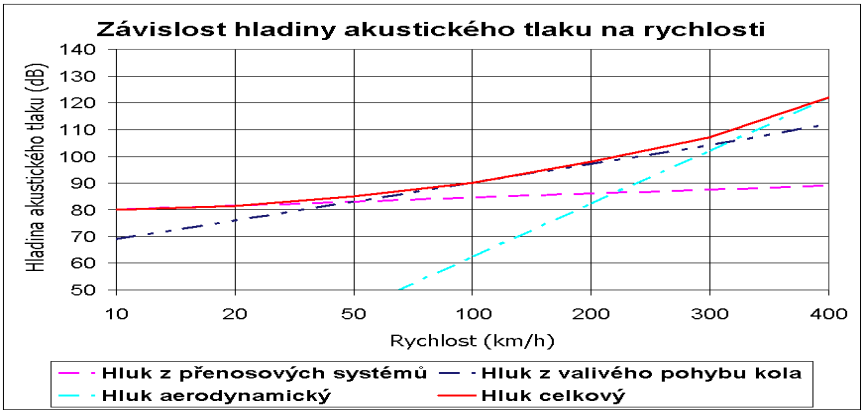
The measurements were evaluated using the equivalent noise level and spectral analysis of noise levels.

Equivalent noise level is the value noise assessment, indicating equivalent, or other characteristic eventually maximal noise for a specific time interval. This measurement is appropriate in terms of hygienic assessment of acoustic environment or change the working environment, however the evaluation of acoustic properties of structures is not sufficient explanatory power.

By contrast, spectral analysis of the noise level is more suitable for technical evaluation of construction (to determine the major frequency components and the design of appropriate protective measures). Using the spectrum noise levels is possible when a sufficient number of measurements, to assess the frequency of which is indicated by the change in design tram line, the absorbing effect of embedded element or influence grinding rails.

Graph 1: Graph of dependence of sound pressure to speed



The assessment levels, depending on the speed of sound is clear that the tram sets prevails in outer space at low speeds the vehicle and start driving noise generators and other auxiliary equipment. At higher speeds (approx. 40 km /h) prevails above all the noise caused by the contact wheel and rail. At such speeds above 200 km/h is already dominant aerodynamic noise.

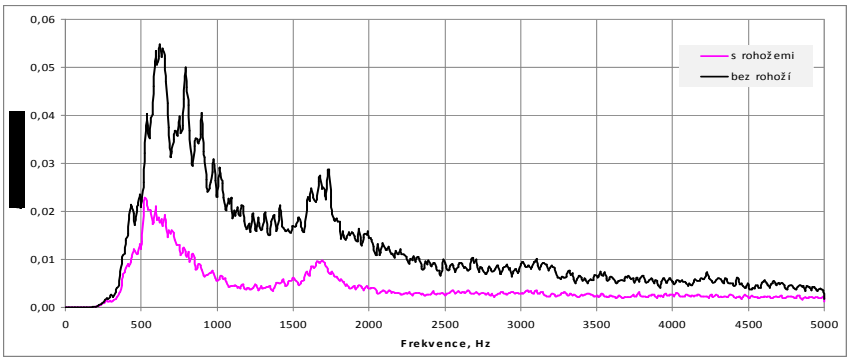
4 Conclusion

Application of legislative measures for reducing noise and vibration according to the Act 258/2000 Coll. and Government Regulation No. 148/2006 Coll. leads in practice to the introduction of new materials and technologies in the implementation of road construction especially in built-up areas.

For the possibility of declaring attenuation properties of rubber mats appointed to measure the noise emitted by the reference section of the tram passing measured before and after the installation of mats. Were measured and evaluated the resulting equivalent sound level $L_{Aeq,}$ L_{Aeq} and $_{4s,\ 4p\ cut}$ [dB] for the frequency band from 0 to 20 kHz and 500 to 5000 Hz, for 2 speed trams passing reference section, and measured for two different distances sound level meter taxi from the center of the track.

Was also evaluated amplitude spectrum $(FFT)_A$ sound pressure p_{Acute} ap [Pa] in the frequency bands from 0 to 20 kHz and 500 to 5000 Hz for a representative records of transit.

Graph 2: Average spectrum pressure acoustic sound level meter at a distance of 7,5 m and speed reference passing tram 40 km/h



Currently implementing further noise and vibration test in the relevant section of the tram lines are built anti-vibration mats and applied polyurethane components after completion of construction works and implementation of pilots. Measurements carried out mainly at night. The measurements will be a source of data for evaluation of knowledge both from the impact of building new lines and features of the operational condition of the rails and wheels of a passing tram vehicles for the dissemination of noise and vibration.

Based on the measurement of vibration the best results were with anti-vibration mats CONIRAP on the thickness of 24 mm, with the top layer of elastic liquid polyurethane dressing MASTERFLOW 155. Our present measures confirmed, that it is suitable to use elastic materials in the subgrade (anti-vibration mats), and also in the space between rail and other tram track equipment.

Fig.6: MASTERFLOW ® 155 RG Elastic liquid dressing for reinforcement and fastening of tram tracks and machine features.

Reference literature

1. ČSN EN ISO 3095 Železniční aplikace – Akustika – Měření hluku vyzařovaného kolejovými vozidly, 09/2006.
2. Nařízení vlády č. 148/2006 Sb. o ochraně zdraví před nepříznivými účinky hluku a vibrací.
3. PANULINOVÁ, Eva. Spektrálna analýza jazdy električkového vozidla. In Dynamics of Civil Engineering and Transport Structures and Wind Engineering. Proceedings of the 4th International Conference: Slovak Republic May 26-29, 2008 Papradno, Podjavorník. Žilina: EDIS, 2008. pp. 113-116. ISBN 978-80-8070-827-6.
4. PANULINOVÁ, Eva. Comparision of noise emmisions for various types of trams. In Journal of Civil Engineering. Košice: TUKE SvF, 2008. pp. 89 – 98. ISSN 1336-9024
5. SKOTNICOVÁ, Iveta, ŘEZÁČ, Miloslav, VAVERKA, Jiří.: Odhlučnění staveb. Appearance. ERA Brno, 2006, 134pp. ISBN 80-7366-070-9.
6. SKOTNICOVÁ, Iveta, ŘEZÁČ, Miloslav, HUDEČEK, Leopold, OŽANOVÁ, Eva.: Odhlučnění tramvajové tratě s krytem, Ostrava 2008
7. FOLTA, Zdeněk, HRUDIČKOVÁ,Milena.: Měření hluku a vibrací pro Dopravní podnik Ostrava a.s, Ostrava 2009
8. MASTERFLOW® 155 RG, http://www.basf-sh.cz