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IMPACT RESISTANCE CONSIDERATIONS OF ROAD RESTRAINT SYSTEM REALISED ACCORDING TO STAS 1948

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Abstract: The paper presents the results of experiment made using a pendulum for road restraint systems with damping elements, according to STAS 1948. Deformable parapets are created to protect the vehicles and other participants at traffic from danger and serious injury. The results of the experiment are very important for the knowledge of the type of parapets that are used on the roads.
Keywords: shock, test, parapets

INTRODUCTION

One of the major tasks in road transport is ensuring an adequate level of safety for road users. To maintain and improve road safety, it is often necessary to install certain devices on the road, which are designed to hold vehicles and pedestrians from entering into hazardous areas. These devices are called railings or protection devices for roads. Shapes, sizes and execution details of metal parapets projects are determined by type, whose diversity is very high. Metal guardrails road is divided into three categories according to technical class of the road and the retention of thereof: semi heavy, heavy and very heavy.

The restraint system studied is semi heavy and was created according to STAS 1948. This is a type of guardrail of metallic elements, with a single row of sliding elements, joined together with screws, mounted on a metal pillar supporting the brake caliper by means of a metal profile and a shock absorber. Deformable parapets metal components are made of S235JR, S275JR, 08kp or other similar instruments, whose characteristics in terms of chemical composition, allows galvanizing immersion in molten zinc bath [1], [2].

STAS SR 1948-1 and 1948-2 present schemes for common types of fences. These types are not limiting. Shapes and sizes to fences, other than the usual are presented in type projects. For these projects it is needed the impact test in authorized polygon according EN 1317.

EN 1317 is a European standard without these schemes, parapets are realized only after the type projects. For these projects is necessary the impact test. It describes in detail the impact test procedures, test site, test vehicle, vehicle equipment, speed and angle of impact or result processing and calculation of indices of severity ASI. It establishes that the test report include detailed descriptions and design specifications of the article tried to allow verification of compliance installed device under test, including performance requirements of the foundation or anchor / fixing soil [3], [4].

PREPARATION OF THE MATERIALS AND THE ACHIEVEMENT OF TESTS

The tests were done in production hall inside BETAK SA. For execution of the tests was chosen using a pendulum weighing 2780 kg. In order to achieve the pendulum was used a crane hook, a support and a roll. The roll has a diameter of 1300 mm and a height of 480 mm. Its height is specially selected in order to comprise entirely slide of the parapet. The pendulum has a length of 9 m and a weight of 2780 kg for the first case and 4000 kg for the second case. Raising it to a height of 800 mm from the ground at the lowest point of the pendulum was made using a forklift truck. Its release was done using an angle grinder. Catching it in the concrete floor was performed using four mechanical anchors on each pole. The slide was caught by pole using M16 screws. Parapet height at the point of impact was 750 mm. In the proximity of center of gravity of the pendulum was installed a system of measurement and data collection with acceleration sensor.

Impact guardrails were made perpendicular to it. The pendulum movement speed was 4.06 m / s.

Given that these types of fences are installed on bridges, in places where the limit the speed of vehicles is 50 km / h, was chosen as a reference a vehicle with an average weight of 900 kg having in the first case the speed about 50 km / h and in the second case the speed about 65 km / h.

Figure 1:2780 kg pendulum

Figure 2: 4000 kg pendulum

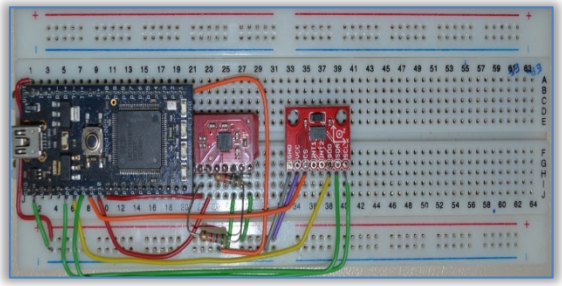

Figure 3: system of measurement

The parapet has a weight of 17, 76 kg / ml and is made by a slide with 7 holes, L = 6200 mm, g = 2.5 mm, 3 pillars I10 with soles, 3calipers g = 3 mm, 3 dampers g = 4 mm. The dampers and the calipers were fixed with screws M16x40 and M12x35 screws on poles. Tested parapet length is 6 m. The pillars are caught up in the concrete floor with mechanical anchors. The distance between the pillars is 3 m. This project is Betak`s property and is protected by law.

The blow was applied to the slide's center on the middle pillar.

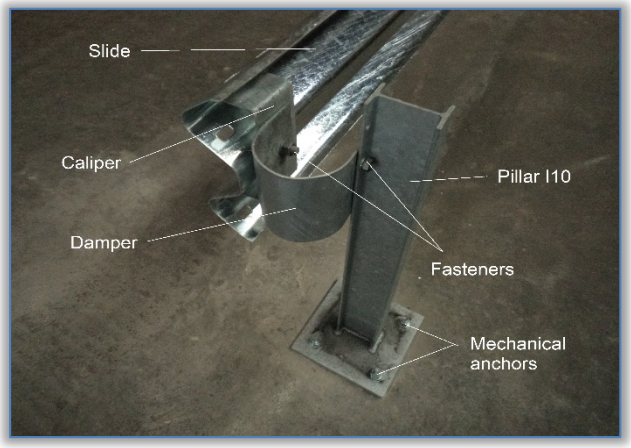

Figure 4: The semi heavy restraint system studied

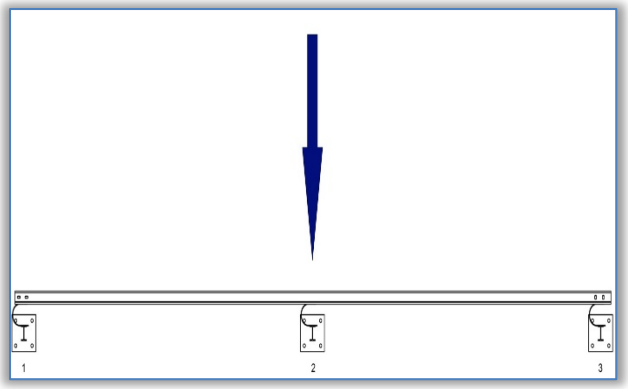

Figure 5: Impact direction

a)

b)

Figure 6: Overview before impact
for case 1 and case 2

a)

b)

Figure 7: Overview after impact
for case 1 and case 2

a)

b)

Figure 8: Top view after impact
for case 1 and case 2

Figure 9: Pillar deformed on the edge

Figure 10: Slide broken in the area of pillar

Deformation of safety barriers during testing is characterized by dynamic deflection, working width and the impact severity index ASI for the evaluation of parapet. For the calculations were taken into account the mathematical formulas presented in SR EN 1317. Table 1 presents the calculated and measured values for the case 1 and case 2.

Table 1: Results

Case	Calculated Dynamic deflection D_N [m]	Measured Dynamic deflection D_m [m]	Calculated working width W_m [m]	Measured working width W_N [m]	ASI
Case 1	0,248	0,240	0,441	0,435	5,86
Case 2	0,305	0,295	0,575	0,566	5,21

CONCLUSION

In the first case the maximum dynamic deflection of the parapet, measured after the test was 0,240 m and 0,435 m of working width. The acceleration severity index (ASI) was calculated using data transmitted by the accelerometer mounted in the pendulum. Using

SMA (Signal Magnitude Area) it can be observed the pendulum motion, from which it may could extract the data used to calculate the index. In this case ASI is 5.80, which indicates that the security impact of the occupant of a car that loses direction of the road is small. It can have major injuries from the impact. In this case, the energy was absorbed most of the shock absorber, damping elements and caliper. Damping elements are deformed considerably, pushing the pillar to rotate about 45 degrees. The pillars at the ends, the calipers and the shock absorber have not been deformed at all.

In the second case, the impact energy is higher, but the barrier has been able to retain the pendulum. The maximum dynamic deflection measured after the test was 0.295 m and 0.566 m working width. In this case ASI is 5.21, which indicates that the security impact to the occupant of a car that loses direction of the road is small in this case too.

In this case, the energy was transmitted mostly in the slide and pillar. The damping elements are slightly deformed, the pillar has stopped rotating, and it was deflected from the base, on the edge. The slide reached the pillar and was broken in that area. The pillars at the ends and the calipers were not deformed at all, only the dampers were deformed.

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Note:

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References

[1] STAS 1948/1, Lucrări de drumuri. Stâlpi de ghidare. Prescripţii generale de proiectare si amplasare pe drumuri, 1991.

[2] SR 1948-2, Lucrări de drumuri. Parapete pe poduri. Prescripţii generale de proiectare şi amplasare, 1995.

[3] EN 1317-1 Road restraint systems – Part 1: Terminology and general criteria for test methods, 2011.

[4] EN 1317-2 Road restraint systems – Part 2: Performance classes, impact test acceptance criteria and test methods for safety barriers including vehicle parapets, 2010.

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