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THE SHOULDER OF THE NEIGHBOURING COUNTY IS ALWAYS "GREENER"

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Abstract

Although the shoulder of the road is not an integral part of the road structure, but it has still a significant influence on the lifetime of the pavement. Many people consider the design, construction, and maintenance of the shoulder as a side (secondary) activity in the construction of the main track (pavement structure + earthwork), even though many practical examples prove that a wrong designed shoulder or its careless maintenance drastically reduces the quality characteristics of the pavement, maintenance costs will increase, and its lifetime will be shortened. Despite this, it is still common practice to pay not sufficient attention to the design and maintenance of the shoulder. During the research work, we focused on the answer to how the importance (financial consequences) of shoulder maintenance can be quantified in Hungarian practice to prove to the decision-makers the true value of this relatively cheap activity (in some cases serious financial consequences). We also pointed out the opportunities and risks of the recently transformed Hungarian road maintenance system (privatized road network maintenance service) in the mentioned topic.

Keywords: road maintenance, road shoulder, pavement deterioration, road drainage, life cycle costing

1 Introduction

Both Hungarian and international road construction and maintenance practices regulate the geometric characteristics of roads and the quality of the materials that can be used. During maintenance, the road maintenance institution must deal primarily with the problems that were committed intentionally or unintentionally during the design and construction phase [1, 2]. However, during maintenance, there are changes that have not yet been regulated in detail, measured or measurable, which have the same effect on the service life of the road pavement structure [3, 4] as the roadside ditches. The task of the latter is to prevent water from entering or under the pavement structure or to divert it from there if it has already entered. The road shoulder, as an important geometrical element of the road; it greatly affects the service life of the entire road pavement structure, not on-ly with its width, but also with its quality. In addition to its being a traffic safety risk, a shoulder made based on an insufficiently careful design and/or of inadequate construction quality can easily lead to the rapid destruction of the pavement structure.

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2 Description of relevant Hungarian regulations and practice

The design of road shoulder has to be planned based on transversal (cross) fall and its load bearing capacity may vary depending on the role (significance) of the road in question. Nowadays, on newly built 2x1 lane roads, a wide stabilized bench is designed in Hungary so that driving off the road pavement surface does not cause an accident with a serious outcome. The internal regulations, the relevant Technological Specification [1] describe the two most important shoulder mainten-ance activities. In addition to high-volume mechanized works, manual shoulder maintenance operations are also regulated [2] and beyond these, the geometrical requirements and material of the road slope, as well as their maintenance works are specified. The two main types of shoulder failure/deterioration are rutting and blow out (Fi-gure 1).

Figure 1 Typical failures of road shoulders - on the right, rutted, too wide shoulder with improper fall; on the left, blown up shoulder (Photo: Zsolt Bencze)

The two most important shoulder maintenance techniques: shoulder milling and shoulder reshaping, requiring different machines. In the former case, grader (Figure 2.), while in the latter one, a special target machine - a self-propelled shoulder milling machine (Figure 3.) is used as the control machine in Hungary. In addition to the shoulder, repairing the drainage ditches can be considered also as an important technological step, since the completion of only one element (just the repair of poor shoulder leaving the bad quality of roadside ditches or profiling the ditches without repairing road shoulder), cannot ensure the expected improvement in the service life of pavement structure [3].

Figure 2 A grader used by Hungarian Public Road Non-Profit Liability Company (Photo: Csaba Tóth)

Figure 3 Madro SP-1500 shoulder milling machine in work (Photo: Csaba Tóth)

2.1 Shoulder cutting

The technology of the shoulder maintenance by cutting has been used for a long time and is widespread in Hungary. In addition to the road grader (70 machines are in use by the MK - their average age amounts to 34 years), its machinery needs are: loading machine, transport vehicles, vehicle equipped with sweeper adapter, brigade transporter(s), if necessary, vibratory roller, shoulder roller [4].

Advantages:
- Its productivity is high, up to 3-5 km per day, depending on the con-struction of the earthworks and the thickness of the layer to be removed.
- The condition of pavement edge does not affect the work [5].
- Workers' dust load is lower during work (depending on the soil's water content).

Drawbacks:
- The excavated soil is almost completely unusable for backfilling, as it separates in large, continuous blocks.
- The work area extends (it is rather long) being riskier from a traffic safety point of view.
- Periodic half-lane road closures may be necessary during loading.
- The location of the completed work is often unsightly and requires follow-up work (hill, debris falling into ditches).
- The excavated soil must be transported to a temporary depot and treated to make it more reusable (more expensive transportation and treatment).
- Use with extra care on sections with paved ditches (soil entering the ditch).

2.2 Shoulder milling

There is no significant practice of milling maintenance in the Hungarian road en-gineering. Only the operator firm of state public roads has 5 single-purpose ma-chines and 2 adapter-type devices that can be mounted on a universal device car-rier. Shoulder maintenance by milling has been a technology used in Hungary since 2003. Due to the small number of single-purpose machines, this technology is not wide-spread. Its machinery requirements in addition to the shoulder milling ma-chine itself: transport vehicles, a vehicle equipped with a sweeping adapter as needed, brigade transporter(s), vibratory roller, shoulder roller.

Advantages:
- The existing machinery fleet are relatively new with adequate operational safety.
- The milled soil is readily suitable for backfilling, its grains are small and crumbly (lower transportation and handling costs).
- The working area is more transparent, it can be carried out with fewer tools and personnel present.
- The shorter working area is less risky from traffic safety point of view.
- Periodic half-lane road closure is not necessary during the work, it can be carried out with continuous traffic flow.
- It can be used more efficiently on urban sections with paved ditches (soil does not get into the ditch.
- The finished working area is more aesthetic and does not require any additional work.

Drawbacks**:**
- Coming from its single-purpose nature, the machine cannot be used for any other activity.
- It cannot be used for traveling, since it has just a walking speed (5-10 km/h), it needs a tow truck and a trailer for transport, even in the case of nearby working area.
- Its day's work performance is low, 1-3 km/day depending on the building of the earthwork and the thickness of the layer to be milled; it is highly sensitive to the moisture content of the soil to be treated (mainly for cohesive, clayey soils).
- The condition of pavement edge affects the work the (broken off edge does not provide adequate support or guidance for the milling screw);
- Workers' dust load is higher during work (the soil's water content affects)

3. Capacity calculation

The reprofiling of blown-up and overfilled shoulder is a continuous activity on the Hungarian public road network. For these activities, 70 road graders and 7 single-purpose machines are available [6]. Table 1 shows the time intervals in which these works could be carried out on the nearly 32,000 km long Hungarian public road network managed by the company using the technological speed of the given machine chain.
Calculation inputs:
2 x 32,000 km = 64,000 km - considering the two sides of the roads
100 working days/year-limited by machine maintenance and eventual break- l downs

Table 1 Shoulder norm calculation

Available machines	**Number of available units**	**Total working length** [km]	**Technological speed** [km/day**]**	**Network norm (standard) time need** [year]
Road grader	70	64,000	3,0	3.04
Shoulder milling machine	7	64,000	2,0	45.71

Using the two technologies together, the network standard time need amounts to 2.85 (~3) years. In other words, with the available machine park, all the shoulders of the Hungarian public road network could be fixed in 3 years. But this is only a theoretical figure, because the average road shoulder corrections were carried out between 1,600 and 2,500 km in recent years due to the limited financial resources available. At this rate, instead of the theoretical 3 years, it may take between 25 and 40 years to repair the entire "shoulder network" – if the repaired shoulders do not have to be fixed again until the end of the rather long cycle time (40 years).

The deterioration of the road section shown in Figure 1 can clearly be explained by the defective shoulder. If this maintenance intervention was carried out in time, the service life of the pavement structure would be 15 years, in addition to the planned traffic volume increase. It can be easily seen that, at the current construction prices, the national economic costs coming from resurfacing, continuous pothole repair and additional maintenance works are orders of magnitude compared to the main-tenance costs of a shoulder and a roadside ditch.

4 Concluding remarks

The effect of the water in and under the pavement to various elements of pavement structure and subgrade has already been investigated and presented in Hungarian [7-9], but also in international publications [10-12].
The Hungarian example presented can draw attention to the fact that one of the most important elements of road maintenance is (also) largely neglected in our country. The condition of the shoulder is an important factor that greatly affects the duration of the pavement structure, yet it receives unfairly little attention during road-related financial planning. In Hungary, there is also a big difference between the practices of various county road maintenance units, if the shoulder condition is taken into consideration. Where they constantly monitor the condition changes in shoulders is continuously monitored and the financial conditions for intervention are ensured, they can save more at the national economic level, compared to the maintenance units neglecting shoulder maintenance. Those who "cultivate the shoulder" always have a freshly worked, brown surface, while "the grass turns beautifully green for those who are careless".

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