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Road and Rail Infrastructure V

Stjepan Lakušić – EDITOR



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EDITOR

Stjepan Lakušić
Department of Transportation
Faculty of Civil Engineering
University of Zagreb
Zagreb, Croatia

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A SEMI-AUTOMATIC METHOD OF ASSESSING THE TECHNICAL STATE OF THE STREET NETWORK THROUGH THE SOFTWARE “E.S.T.S.”

Pavăl Flavius-Florin

National Company for Roads Infrastructure Administration, Romania

Technical University of Civil Engineering Bucharest, Romania

Abstract

Knowing the technical state of road networks is necessary because it provides relevant information to infrastructure managers about the need to intervene to make road conditions more viable. At present, in Romania, the assessment of the technical condition of both roads and streets is carried out with the norms and standards in force for roads. The reality shows that the way of approaching maintenance work on the streets is deficient because both the operating conditions and the principles of the urban transport networks are different from the similar conditions existing on the extra-urban road networks. In order to facilitate the methodology for determining the state of degradation of the street network, in the doctoral thesis entitled “Contributions to the procedure for analyzing the technical condition of the street network for the programming of the intervention works” was created a software which can be used for free by any administrator street network and roads because the software created determines the state of degradation for both coefficients from existing roads by existing regulations, and the coefficients proposed for street network in the doctoral thesis. With the use of this software, it is only necessary to move on the ground with IT equipment (tablet or laptop) with internet access and measuring tools, and by real-time completion it is possible to determine in real time the state of degradation of the studied street sector. This tool can only be used by road managers in Romania and its presentation is intended to provide an example of good practice for road administrations in other countries as well.

Keywords: E.S.T.S., technical state, methodology, maintenance

1 Introduction: roads and streets

Road transport infrastructures are essential for the existence and development of human society, given their role in enabling the transport of persons and goods to ensure the functioning of the human society. Their realization is extremely complex due to the fact that they cover the coverage of extremely varied territorial routes, by ensuring the mobility dictated by the high density of the road network in any areas of relief and the optimal conditions for driving the road vehicles. Urban and extra urban road networks must provide high quality traffic conditions and a high degree of safety for all users. The quality and functionality of these networks lead to the development of urban mobility, bearing in mind that most of the routes used for the transport of goods and people cross urban areas more or less crowded and have their destination but also their origin in urban areas. Road infrastructures linking the human settlements are called roads and are located in extra-urban areas, and urban ones, or rather, road infrastructures that are within the range of localities, also bear the name of streets or street tram.

Throughout its life and exploitation, all road transport infrastructure networks suffer degradation both due to repeated traffic demands and variations in the environmental conditions to which they are subjected, as well as inappropriate use in some cases and the lack of a maintenance strategy coherent road structures in the case of streets, due to the lack of specific technical regulations.

Knowing the technical state of road networks is necessary because it provides relevant information to infrastructure managers about the need to intervene to make road conditions more viable. At present, in Romania, the assessment of the technical condition of both roads and streets is carried out with the norms and standards in force for roads. In order to facilitate the methodology for determining the state of degradation of the street network, in the doctoral thesis entitled “Contributions to the procedure for analyzing the technical condition of the street network for the programming of the intervention works” was created a software which can be used for free by any administrator street network and roads because the software created determines the state of degradation for both coefficients from existing roads by existing regulations, and the coefficients proposed for street network in the doctoral thesis.

The software/ application is called “ASSESSMENT TECHNICAL STATE STREET (E.S.T.S)” and is available to any user as possible loaded on a web page created for this very purpose, namely: <https://evaluarestrazi.wordpress.com/>

Applying methods of assessing the technical condition and, implicitly, of maintenance works similar to roads as on roads, often leads to the failure of urban road network administrators to provide the streets with normal running times due to the lack of specific technical regulations. In order to hold and realize a modern and efficient urban road infrastructure due to the constructive differences, functionality and the different loads / loads of the streets compared to the roads, it is imperative to change the way of carrying out maintenance works on the street tram. Roads are terrestrial communication routes in the form of terrain specially designed for road traffic [1]. As a general rule, streets are also recognized as urban transport routes and are practically the transport infrastructure of a locality. In fact, the street is a road in the urban area, which provides, in addition to vehicle circulation and pedestrian traffic [2], Figure 1.



Figure 1 Differences between road (Left) and street (Right)

Urban road structures differ greatly from those in extra urban areas in terms of the demands they face. If on the roads the majority traffic is made up of heavy vehicles, which are in a relatively large number, road traffic is made up of a majority proportion of cars, but in a very large number but there are also heavy vehicles, respectively vehicles public transport such as trolleybuses and buses, which are in a large number (Figure 2.)



Figure 2 Urban road traffic (left) and extra-urban road traffic (right)

2 Evaluation of the technical state of road infrastructures

The existing technical regulations on street networks are applied by assimilating technical regulations on extra-urban roads, as described in the two norms (CD 155/2001: “Instrucțiuni tehnice privind determinarea stării tehnice a drumurilor moderne” – (“Technical Instructions for Determining the Technical State of Modern Roads) / AND 540/2003: “Normativ pentru evaluarea stării de degradare a îmbrăcămintei bituminoase pentru drumuri cu structuri rutiere suple și semirigide” – (“Normative for assessing the state of degradation of bituminous clothing for roads with flexible and semi-rigid road structures”). The characteristics of the road infrastructure on which the technical condition is established are:

- flatness of the running surface;
- surface roughness of road clothing;
- the carrying capacity of the road system;
- the state of degradation of road clothing,

Street degradations have been recorded on heavy-traffic road streets of vehicles with a total mass of less than 7.5 tonnes of cars and vans, but in a very large number. The only heavy vehicles that are allowed to run on the street sectors where these degradations have been recorded are public transport vehicles. But also these heavy-duty vehicles keep the same way of traveling in the locality as light vehicles, more precisely small traffic speeds, with frequent braking and acceleration, and a great number, due to the numerous intersections at the level where successive stop-maneuvers occur. Consequently, as a result of the aggressiveness of the road traffic resulting from this urban traffic, there are injuries to the road structure or to the road surface, which are classified according to the extra urban or urban road category. In order to have a road network in optimal conditions of operation and to carry out the traffic safely, it is necessary to constantly monitor the behavior of the traffic routes in order to identify the areas where it is necessary to intervene through extensive repairs or repairs requiring planning. It is necessary to investigate the technical condition of the street network during the transition period from / to the cold season, respectively September, October, March, April. When identifying situations that can cause degradation of the road structure in the period following investigations, degraded prevention measures will be taken as a matter of urgency, through additional maintenance or repairs.

In order to facilitate the methodology for determining the state of degradation of the street network, in the doctoral thesis “Contributions to the procedure for analyzing the technical condition of the street network for the programming of the intervention works” was created a software, which can be used for free by any street traveler as well as roads because the software created determines the state of degradation both for existing road coefficients un-

der the norms in force and by the coefficients proposed through this PhD thesis for the street network. The software application is called “ASSESSMENT TECHNICAL STATE STREET (E.S.T.S)” and is available to any user as possible loaded on a web page created for this very purpose. With the use of this software, it is only necessary to move on the ground with IT equipment (tablet or laptop) with internet access and measuring tools, and by real-time completion it is possible to determine in real time the state of degradation of the studied street sector. At present, the procedure for determining the technical condition is as follows: The personnel nominated to determine the technical condition, move on the ground to the road infrastructure in question, and after the visual identification and the measurements carried out, complete the following model form, according to the Norm. Ind. CD 155-2001 (Figure 3).

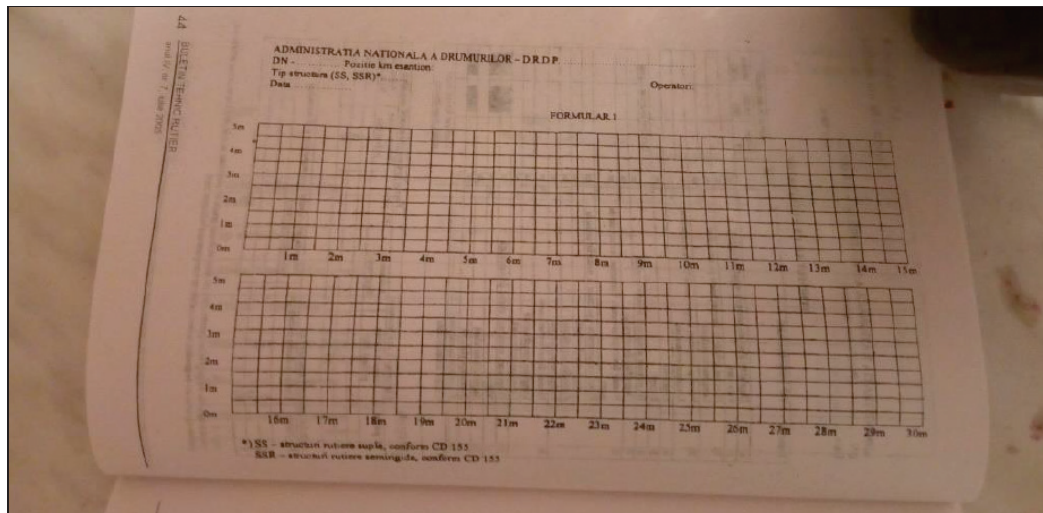


Figure 3 Model template cf. CD 155-2001

Thus, depending on the visual identification function and the measurements made, each identified degradation is denoted in the form by the current number and the specific graphic representation, mentioned in the normative, both the surface degradations and the structural deformations. Two variants of determination were posted on this site, the only difference being the detail of the units of measurement for the sample for which the technical condition is determined. The difference between these will be explained in the following figures 4 to 12:

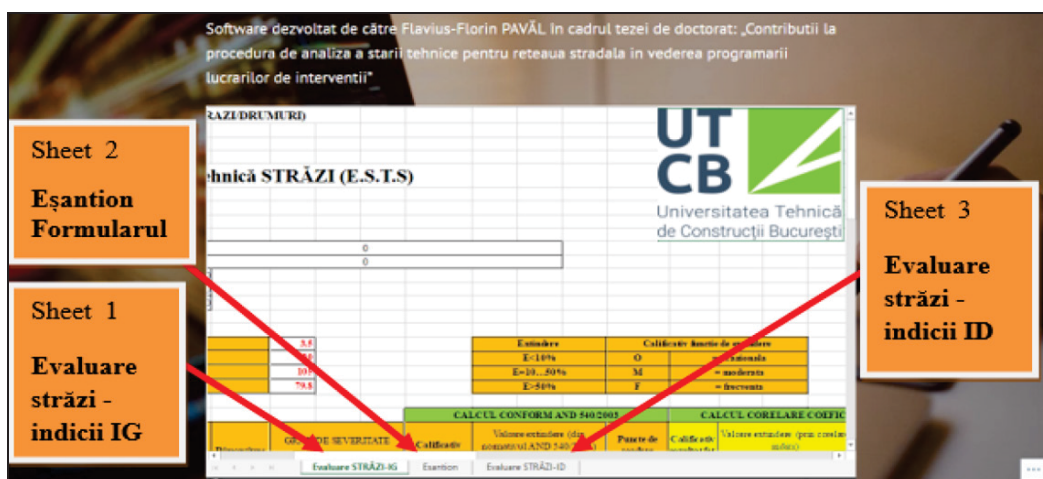


Figure 4 Software Sheets “Street Evaluations”

- The working method consists of 3 sheets (Figure 4): one of which can only fill the length / width of the sample, one blocked completely and only one sample can be filled. This option was chosen to reduce possible fill errors.

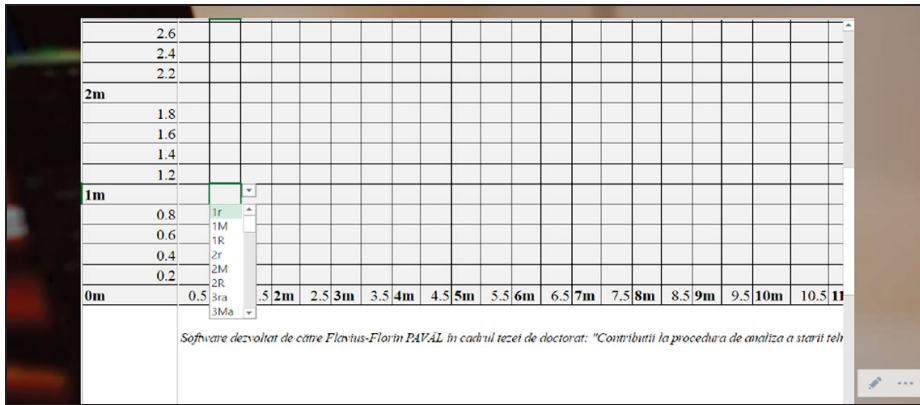


Figure 5 List of degradations for each cell

- Each cell is completed by selecting it, and at the time of selection the list of degradations is generated, where the deficiency identified on the field is selected. The generated list is shown in the following figure: (Figure 5)

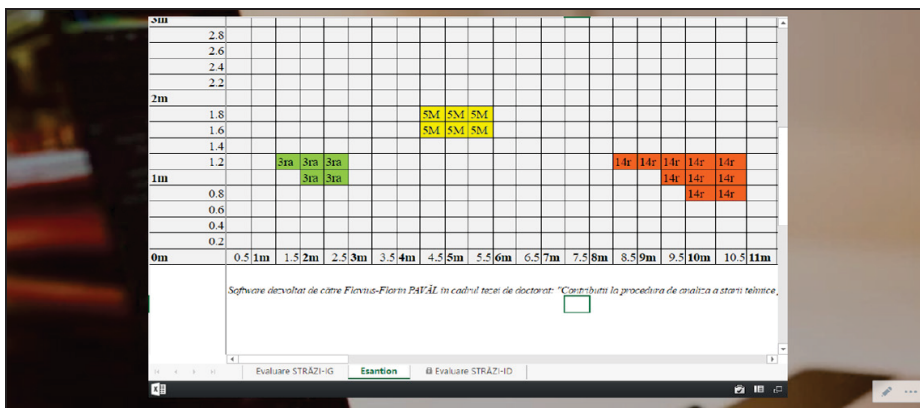


Figure 6 Cells with the degradation from reality

- Add the number of cells related to the dimension of the reality of the degradation, as can be seen in the following figure: (Figure 6)

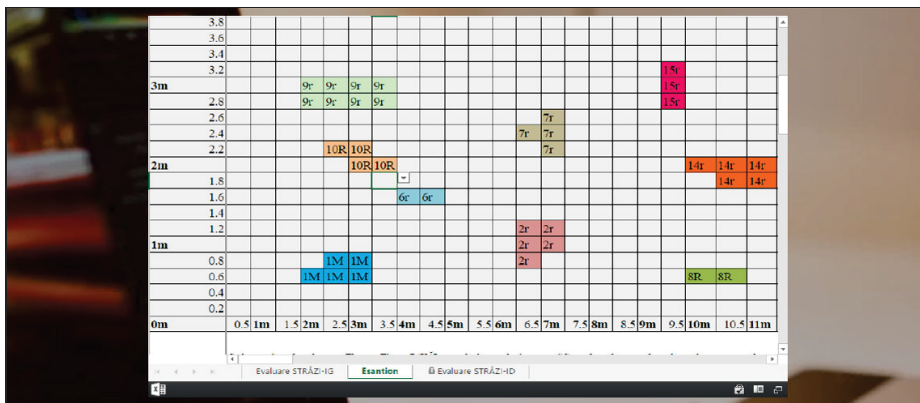


Figure 7 Form for completing the form

- The cells are filled either by selecting and selecting from the generated degradation list or by directly marking the degradation figure / number. In case of a selection error, it is removed by deleting the cell contents;
- For degradations that measure unit length only and not surface, the position cell will be filled, the software recognizing the type of degradation as well as the related unit of measurement. The following is an example of completing the form: (Figure 7)



Figure 8 Filling out the areas in the sheet “Evaluare străzi – indicii IG”

- In the “Assessment of streets – IG indices” sheet, note the length and width of the sample, in order to determine the area, which will be automatically taken over in the calculations and the other sheets. This is filled in at the top of the “Assessment of streets – IG indices” sheet as can be seen in Figure 8:

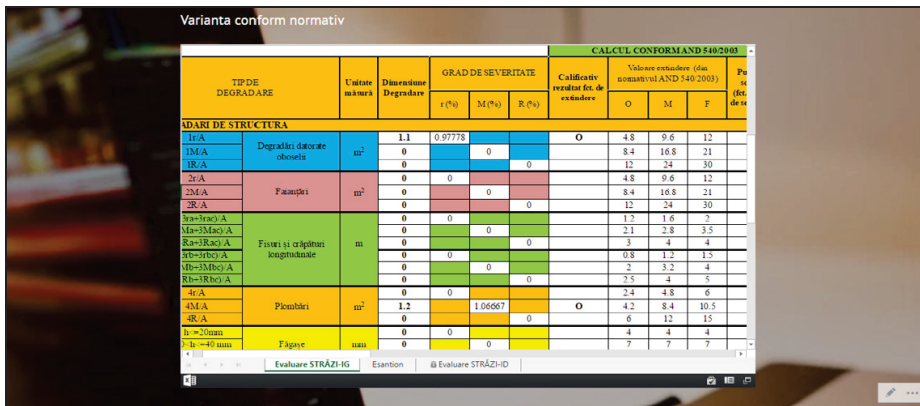


Figure 9 Determination of degradation surfaces automatically

- The other 2 sheets are linked with the “Sample”, once the form is completed, in the first Sheet named “Street Evaluations – IG indices” resulting in the degradation surfaces / deformations and IG indices calculated according to AND 540/2003: “Normativ pentru evaluarea stării de degradare a îmbrăcămintei bituminoase pentru drumuri cu structuri rutiere suple și semirigide” – (“Normative for assessing the state of degradation of bituminous clothing for roads with flexible and semi-rigid road structures”), but also according to the proposal from the PhD thesis, as can be seen: (Figure 9)

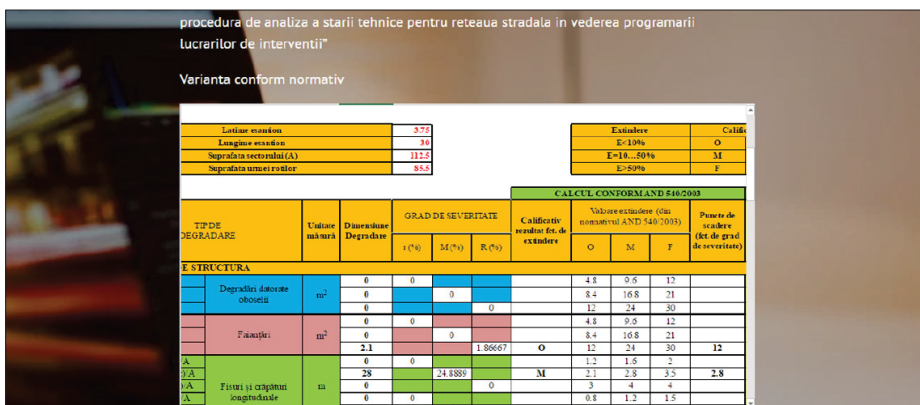


Figure 10 Automatic Determination of Degradation Grades

- In addition to automated determinations of degradation areas or lengths, the software automatically determines degradation ratings according to the normative expansion values. (Figure 10)

Varianta conform normativ									
A	Greș cu afectarea stării de suprafață	m ²	0	0	0	4	8	10	
A		m ²	0	0	0	4	8	10	
	Văhăni	m ²	0	0	0	0,9	2,1	3	
	Suprafață existentă	m ²	0	0	0	3	7	10	
		m ²	0	0	0	4,5	10,5	15	
	Suprafața pietruită	m ²	0	0	0	1,8	4,2	6	
	Suprafață cu ciupitură	m ²	0	0	0	4,2	9,8	14	
		m ²	0	0	0	6	14	20	
	Calitatea asfaltamentului	mm	0	0	0	3,5	3,5	3,5	
						NSU			3,5
I.E St = 100 - NSU									83,6
I.E SU = 100 - NSU									96,5
IG = vit E St*(E SU)									89,81870629

Figure 11 Automatic IG index determination according to AND 540

- At the bottom of the “Road Evaluations – IG indices”, you can see that the IG indexes determined according to AND 540/2003: “Normativ pentru evaluarea stării de degradare a îmbrăcămintei bituminoase pentru drumuri cu structuri rutiere suple și semirigide” – (“Normative for assessing the state of degradation of bituminous clothing for roads with flexible and semi-rigid road structures”), are automatically calculated, but also according to the proposal which is the subject of the thesis previous mentioned: (Figure 11)

Calificativ	Indice de degradare			
	IG of AND 540	IG of teza (pt. strazi)	ID of AND 540	ID of AND 540 revizuit
REA	<=77	<=77	=13	=13
MEDIOCRĂ	77-90	77-90	7,5-13	7,5-13
BUNA	90-95	90-95	5-7,5	5-7,5
F BUNA	=95	=95	=5	=5

Figure 12 Automatically rank the index IG / ID

- Once the completion of the form or the “Sample” sheet is completed, the IG and ID coefficients are determined automatically and automatically in the “Assessment of streets – IG indices” Sheet, in the top right, is automatically given the rating for each index degradation. (Figure 12)

The personnel responsible for the degradation state shall be obliged to fill in the fields related to the name of the studied sector and the area of the studied sample, the rest of the calculations and degradation determinations automatically resulting.

3 Conclusions

At present, in Romania, the assessment of the technical condition of both roads and streets is carried out with the norms and standards in force for roads.

The reality shows that the way of approaching maintenance works on the streets is deficient because both the operating conditions and the principles of the urban transport networks are different from the similar conditions existing on the extra-urban road networks, a situation taken into account in the analytical study of the doctoral thesis previous mentioned.

With the use of this software, it is only necessary to move on the ground with IT equipment (tablet or laptop) with internet access and measuring tools, and by real-time completion it is possible to determine in real time the state of degradation of the studied street sector .

This tool can only be used by road managers in Romania and its presentation is intended to provide an example of good practice for road administrations in other countries as well.

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