Bridges' World

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Considerations on defectation condition assessment

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Summary

Assessment of bridge condition implies a great responsibility both from the personnel involved in performing the operations and from the administrator of the bridges. Importance is given by the fact that based on the current condition as an overall index and on the observed degradations one may establish the works program indicating the afferent emergencies and costs.

In the assessment of the technical condition of the bridges in Romania a study has been conducted. This study involved specialists from CESTRIN and from GETEC Company from France. In a cooperation partnership jointly financed by Romanian National Administration of Roads (NAR) and French Minister of Finance, more than 1000 bridge from the national roads network were inspected. The project was carried out in the European Union pre-accession programs and it encloses the structures situated on the two pan-European corridors, which are covered by TINA (Transport Infrastructure Needs Assessment).

The two methods presented hereby have common characteristic but also differences. They both respect the general criteria for condition assessment by visual inspection but they differ by complexity and detail level.

In the method developed by GETEC, the inspection of a bridge has more objectives: knowing the assets and completion of existing databases; assessment of structural condition and the cost required for its restoration; determining the priority and emergency for sorting the maintenance and rehabilitation interventions.

KEYWORDS: bridges, administrator, assessment methods, inspection, degradations, strategy, maintenance, reparation, rehabilitation.

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1. INTRODUCTION

Assessment of bridge condition implies a great responsibility both from the personnel involved in performing the operations and from the administrator of the bridges. Importance is given by the fact that based on the current condition as an overall index and on the observed degradations one may establish the works program indicating the afferent emergencies and costs.

While the assessment methods are more detailed and based on exact measurement the evaluation of the condition is more correct.

Administrator's responsibility consists in selecting those assessment methods which better describe actual situation and those evaluators that master the knowledge required in application in practice of the selected methods.

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2. BRIDGE ASSESSMENT METHODS

The study consisted in field inspections with mixed teams and technical condition evaluation using two methods: the one currently in use in Romania and a method developed by experts from GETEC with respect to the regulations from France. These methods are similar because they are both based on visual inspection and on the experience of the inspector. They differ by the level of detailing involved and the accent they put on different elements.

2.1. Romanian method

Bridge inspection in Romania is conducted with respect to AND522-2002 and the Degradation Manual [2]. No supplementary manuals or guides were drafted so far. Even efforts were made, the works to an "Inspector's Manual" were stopped due to lack of financing.

In this method, inspection implies filling-in an inspection form with structures' important data and degradations as they are identified by inspector. Degradations are grouped by main sub-systems of the structure.

An important chapter is given to the functionality.

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According to the regulation AND522/2002 (*Instructions for bridge condition assessment*), five quality indices (C_i) and five functional indices (F_i) are defined. Degradations are identified respectively for each index, according to the degradation manual or to disfunctionality and importance is established for each one. According to the importance, a rank is given and the maximum of these ranks is deducted from 10, the highest value of each index. Progressively each value C_i and F_i is obtained.

Finally, the overall condition is expressed by the total condition index computed with formula $I_{ST} = \sum_{i=1}^{5} C_i + \sum_{i=1}^{5} F_i$. Based on this the technical class of the bridge is established and based on it one may decide the strategy of maintenance, reparation or rehabilitation of the bridge.

The advantage of the method is its simplicity. For calculation of the quality indices or the total condition index no complex formula is required.

The minus of the method is represented by the high level of subjectivism. For each item of degradation intervals of ranking are given without indicating precise criteria for each and every rank.

2.2. The method used by GETEC Company - France

Today, in France more evaluation methods are used for assessment of technical condition of highway bridges. This trend is due to the decentralization of the responsibility of administration of roads and bridges to the departmental level. Having the possibility to choose, administrators are in period of search of the best method. Further we will present the method developed by GETEC for departments Moselle and Haute Savoie from eastern France [3], which was used in our study.

In this method, the inspection of a bridge has more objectives: knowing the assets and completion of existing databases; assessment of structural condition and the cost required for its restoration; determining the priority and emergency for sorting the maintenance and rehabilitation interventions. Three categories of documents are drafted:

Notebook of the structure, a sort of identity card of the bridge which allows:

Identification;
Recording of technical and geometrical characteristics and functional importance;
Notes of the environment where the bridge is situated and the utilities suspended on the bridge;
Visualization of the structure using sketches and photos.

Visit notebook, a sort of bridge health card of the bridge that allows:

Recording and evaluation of the pathology affecting each sub-system;

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Giving a representative mark for condition (severity index);
Appreciation of complementary actions and intervention necessities;
Indication of emergency measures that must be done;
Evaluation of the cost of intervention works;
Visualization of the degradations using sketches and photos.
Synthesis notebook, which allow on the network:
Grouping the main evaluation data (IG, IF, etc.);
Combining the quality and functional parameters for determining the global mark for each structure (emergency index IU);
Classification of the structure according to this index for determining intervention priority;
Analysis of the assets.
As mentioned before, the method establishes for each element a severity index (IG) and a functional index (IF).
The severity index depends on degradation and importance of the element in the structure. Its computation has the following principle:

$$IG = [A \times (B + C + D + E) \times F]$$

IG takes values from 8 to 360, the higher the value the higher the degradation.

Table 1.Signification for the components of the severity index

	Component	Description
A	Importance level	It refers to the relative level of importance of the pathology in its position context. The level might be: low importance; medium importance; very important.
B	Exposure risk	It refers to the exposure of the pathology according to its location on the structure. It might be: low exposure; medium exposure; high exposure.
C	Environment effects	Which is the influence of the environment on the pathology. It might be: low importance; medium importance; very important.
D	Structure's condition	General condition of the structure surrounding the pathology. It might be: good condition; medium condition; bad condition.
E	Stress	Structure is in a stress condition that might induce fatigue phenomenon: less important; of medium importance; very important.
F	Group of risk	If affects elements that have little direct influence on limit state of the structure; If affects elements with important but indirect influence on limit state of the structure (on long term); If the pathology affects parts with direct influence on the limit state of the structure.

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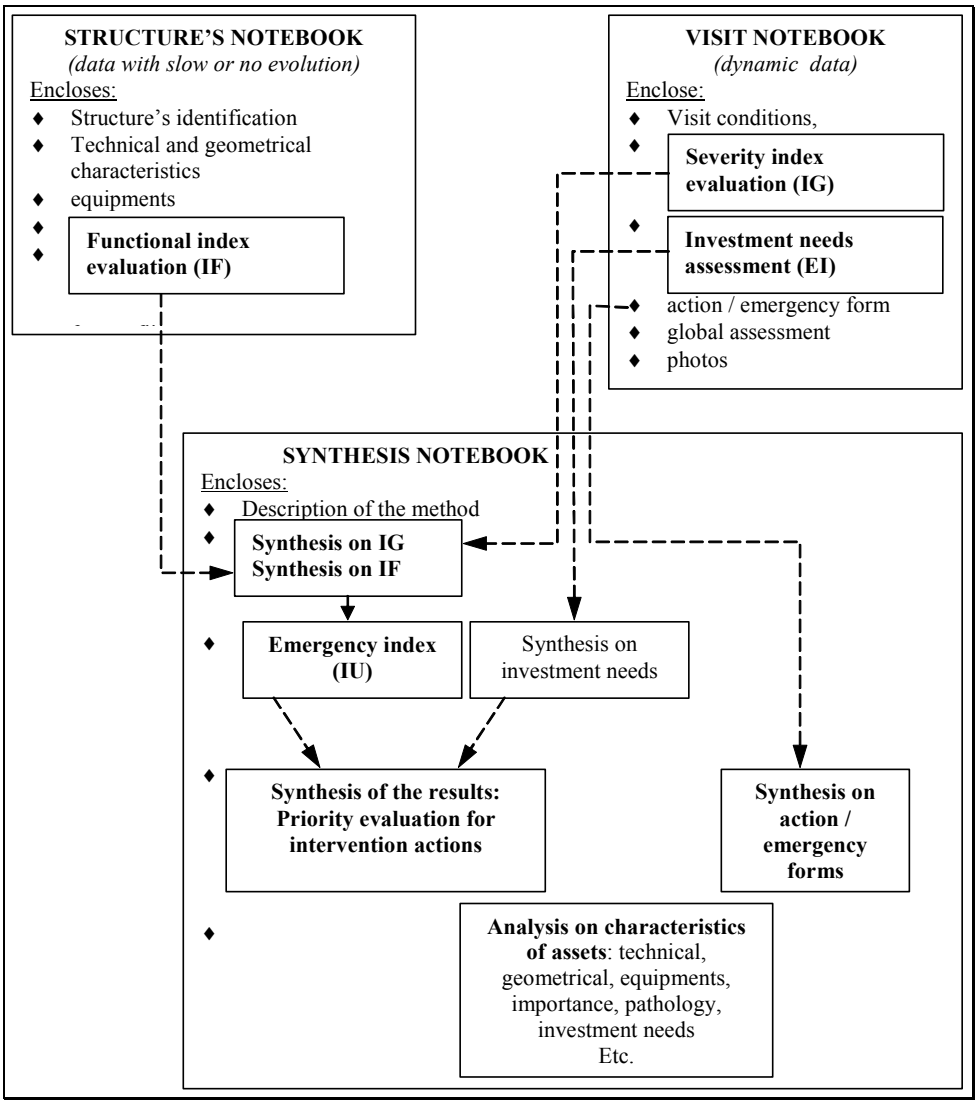

Fig. 1. The method for GETEC system

The functional index has the following computation principle $IF = N1 + N2 + N3 + N4 + N5$.

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Table 2. Significance of the components of the functional index

	Component	Meaning
N1	Function importance of the carried road	Inter-regional road; Main network; Other networks; Less used.
N2	Detour	Detour impossible; Detour longer than 10 km; Detour shorter than 10 km; Detour less than 1 km.
N3	Pedestrian traffic	Important pedestrian traffic; Few pedestrians; No pedestrians.
N4	Risks for the user in case of collapse	Important risks (habitation or traffic downstream); Medium risk (utilities posted on bridge) Low risk; No risk.
N5	Importance of the structure	According to its maximum spanning: The structure has a spanning has a spanning ≥50m The structure has a spanning has a spanning ≥10m The structure has a spanning has a spanning <10m but ≥2m The structure has a spanning has a spanning <2m and the hydrological area ≥2m^2

IF takes values from 0 to 20.

For each structure an emergency index IU might be computed: $IU = \sqrt{(18 \times IF)^2 + IG^2}$.

IU has the minimum value 8 and the maximum 509.

The parameter 18 has been chosen to keep IF in dimensional balance with IG. It is possible to use IU as a priority indicator.

3. CONCLUSIONS

The two methods presented hereby have common characteristic but also differences. They both respect the general criteria for condition assessment by visual inspection but they differ by complexity and detail level.

These two methods were used in parallel for over 1000 bridge in order to make a comparison between them for the future assessment of the pan/European corridors on the territory of Romania.

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