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Influence of the Environment and Behavior of Bridge – River Channel System

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Summary

The article highlights the importance of studying over time the bridge – river channel interaction zone, the place where a series of events and phenomena occur resulting in serious condition or collapse of bridges.

The introductive part, presents a number of damaged bridges, where the main cause was the scouring of the foundations combined with decrease of the riverbed level due to several causes, including illegal or incorrect exploitation of ballast excavations.

The second part analyzes the computer based informational system (informatics system). Simultaneously, the importance of databases use is detailed, especially for the study of the phenomena connected to bridge – river channel interaction zone.

The final part of the article present the databases required to an efficient informatics system, specific to bridge – river channel interaction mainly the database with information concerning the behavior in time of bridge in interaction zone.

KEYWORDS: bridge, informatics system, database, river channel, riverbed, bottom sill, bank protection

1. INTRODUCTION

Technical situations that occurred at several highway bridges in the last years highlighted a large range of damage types which were studied over time by specialists in books, congresses and seminars of roads and bridges and in articles in journals. Among the most important degradations witnessed, one might mention, particularly:

- *decrease of the lowest water level* in bridge zone with consequences in exposing the elevation-foundation joint or the upper part of the foundation system.
- *erosion of the streambed with change in thalweg elevation*, phenomenon associated with decrease of lowest water level;
- *degradation of banks;*

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- *horizontal deviation of the waterway*, particularly, due to failure of banks;
- undermining of bank protection works.

These types of damage emerged to a high number of bridges. A number of typical bridges are presented, as examples:

a. Bridge in Roman, DN 2 km 328+437 (fig.1, 2 şi 3)

Fig. 1. Pier no. 6 of the bridge over Moldova River, at Roman, which failed due to undermining

Fig. 2. View on the deck of the bridge over Moldova River, at Roman, after failure of pier nr.4

Fig. 3. Elevation of the bridge over Moldova River at Roman, after consolidation

b. Bridge at Clit, DN 3E km. 56+414 (fig. 4 şi 5)

Fig. 4. Displacement of the abutment from the initial position and destruction of wingwalls

Fig. 5. Failure of backfill behind the abutment

c) Bridge at Sadova on DN17, km.0+412 (fig.6)

Fig. 6. Decrease in level of lowest water in bridge zone

d) Bridge at Dorneşti, DN17A km77+803;

Fig. 7. Bridge at Dorneşti: displacement of the channel toward banks, before and after consolidation

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e) Bridge over Siret at Ion Creangă, DJ 207C km. 6 + 075 (fig.8)

Fig. 8. Bridge over Siret river at Ion Creangă – consolidation and safety works at pier 10

2. INFORMATICS SYSTEM - CONCEPT

The physical processes which occur in time in the bridge – river channel interaction area both in bridge elements and in waterway impose the follow up and control.

Also, these processes are characterized through factual entities expressed either as numerical values collected from equipments or as perceptions or observations from humans generically named data, which are translated into information to reduce de uncertainty for a better understanding of situations and phenomena.

Information represents, as generally admitted, the fundamental support of the control and is necessary to formulate strategies to achieve objectives and to verify their practical application.

To reach the target previously presented, it is necessary the creation of an informational system to study bridge – river channel zone. The system must include the entire complex of activities: collection and recording information; processing and using the results to maintain the bridge in operation in designed parameters. As most of the operations are fulfilled using the computer, the informational system becomes and informatics system.

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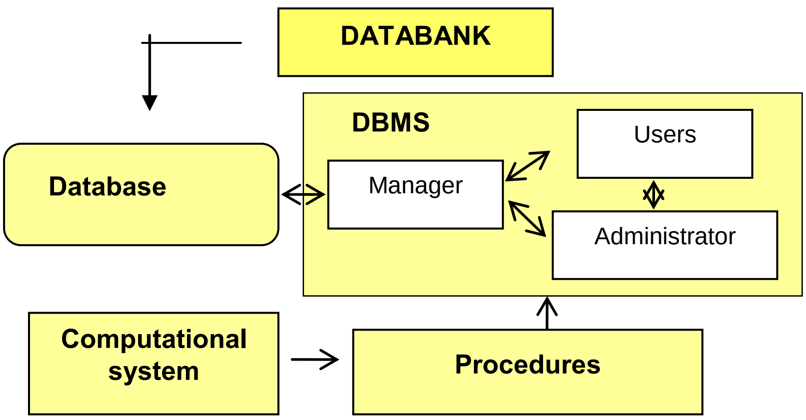

Fig. 9. Information system

In the operation of informatics system an extremely important role is played by databank, which represents the ensemble formed by: database, ITS management system, computational equipment, and procedures required to administrate the data.

2. DEVELOPMENT OF THE INFORMATIC SYSTEM

To a correct operation of the proposed informatics system more databases are required:

- General information database (mainly from construction project and drawings) including: name and identification of the bridge, year of construction, position, details on the geomorphology of the site, constructive solution, materials, geometric elements, images of the bridge, Fig. 10;
- Topographic data including general plan of the site and its adjacent zones, inventory of site measurements and overall plan;
- Detailed geographical data of the site,
- Hydrological regime data;
- Geotechnical structure data;
- Technical database containing bridge records. Bridge technical book must include: identification data, Fig.11; geometrical and constructive elements on infrastructure (abutments, piers, bearings), superstructure, deck, works in bridge zone; significant data on bridge history (design, construction, maintenance/repair/rehabilitation works); evolution of the condition; quantitative information about behavior in time; tests and lab results; damage reports; expert reports;

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- Legal documents database concerning design, construction, operation (maintenance, follow up) activities.
- Database on bridge – river channel interaction. It includes data about the behavior in time arising from the follow up process: transverse profiles of the channel in bridge position, upstream and downstream; condition of scouring; condition of bank protection works and direction dams; displacement in time of the infrastructures; evolution of the thalweg in spring, in summer, and in fall, fig.12.

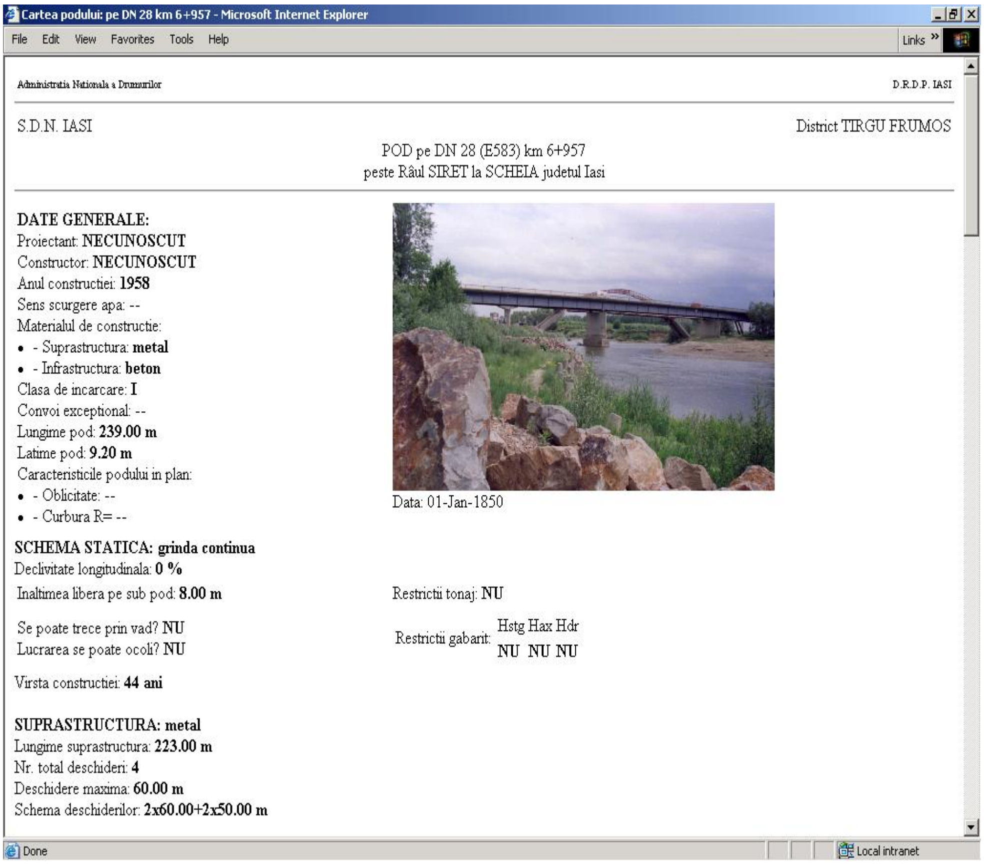

Fig. 10. Database interface

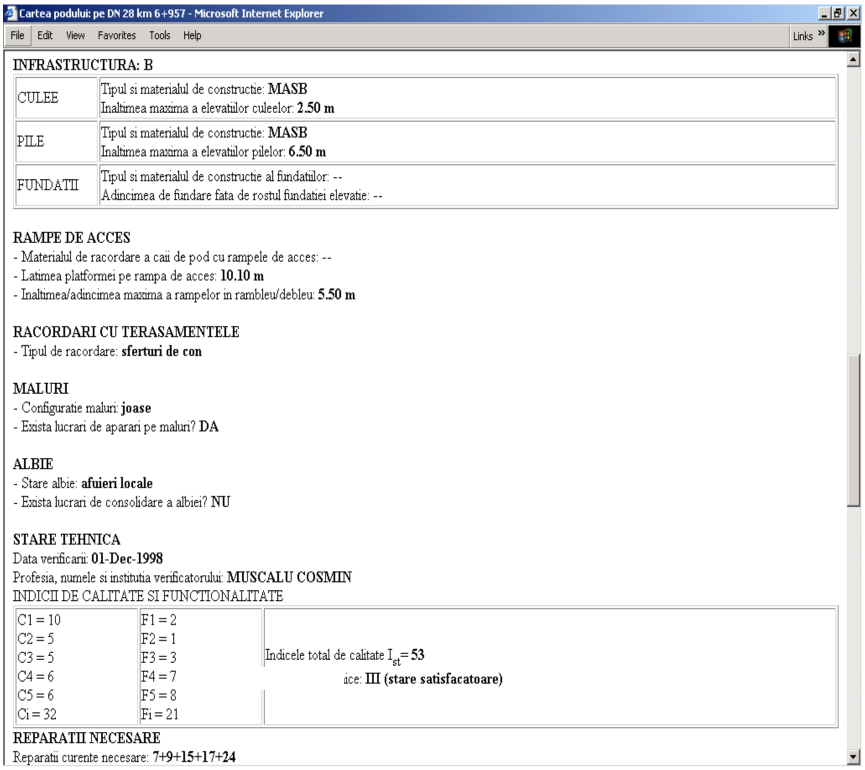

Fig. 11. Interface of the database

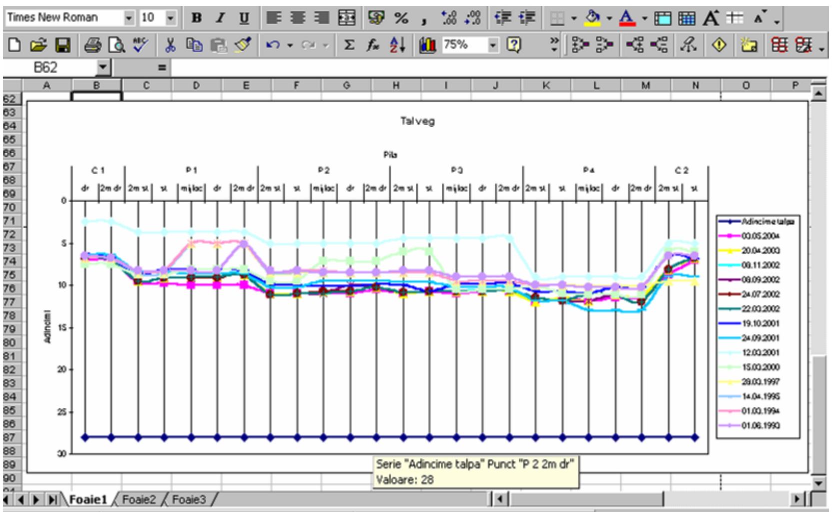

Fig. 12. Situation of thalweg in relation to foundation bottom

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3. CONCLUSIONS

1. Phenomena in bridge–river channel interaction zone are of great importance, and examples of damaged bridges due to this cause are increasing in number in our country.

2. Follow up of the behavior in time of the bridge – river channel interaction zone warrants creation of an informatics system, where the database plays a significant role, in correct assessment of the condition of the bridge, as well of the zone, for a well documented and effective decision.

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