

INFRASTRUCTURE NETWORK REHABILITATION: A REAL MATTER WHERE NEW METHODOLOGIES OFFER HIGH TECHNICAL AND COST-EFFECTIVE SOLUTIONS

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PAPER

Executive summary

The objectives of the rehabilitation plan were the following:

- Establish a global audit and condition evaluation of the bridges over 20m in Bulgaria
- Select the structures that can cause, at short or mean term, a lack of safety for users
- Propose repair/replacement solutions for critical structures
- Develop an exhaustive a 10 years comprehensive inspection/maintenance/repair plan for the bridge network

In this context, the present document will show:

- The preparation works that have been done to perform the projects in the best conditions
- Routine inspections of the 1312 bridges over 20 meters
- Conclusions that have been made concerning the network condition
- Selection of the critical structures for detailed inspection and repair, and the setup of the maintenance director scheme

Preparation works

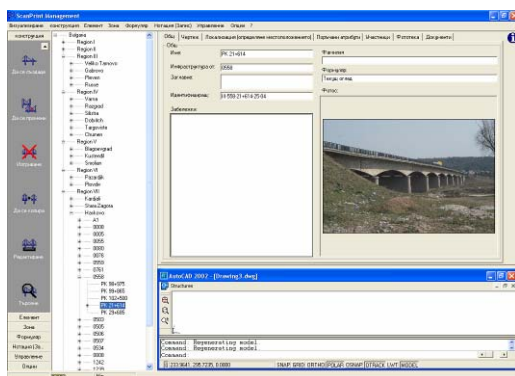
Database system

The natural first step to modernize any practice is to start implementing a database system. A database is a logical solution to organize large quantities of data that years of successive inspection can produce. It allows organizing data in a flexible manner, includes facilities to add, modify or delete data from the database, ask questions (or queries) about the data stored in the database and produce reports summarizing selected contents. An essential choice when implementing a database is to decide on the most appropriate organization of data tables, as those tables constitute the backbone of the system and will generally dictate any evolution afterwards.

The Advitam ScanPrint® database system has been used for this project

Starting point

The Bulgarian Road Executive Agency (REA) compiled an Excel file, including various data concerning each structure (region, department, road, kilometric point, road class, assumed type, material, length and construction data of the bridge, etc...). This file has been organized and implemented into the database system.



Database system ScanPrint® with initial data

Inventory

The inventory is the basis of the network management. It shall include complete and useful information and documentation on each structure to help for diagnosis and global analysis of the network.

In the National Norm for Technical Inspection and Maintenance of Road and Bridges, Bulgarian regulations define a bridge “technical passport”, which shall contain for each structure all technical and administrative data. The content of the technical passport has been reviewed with the administration, adapted to actual needs, and computerized into ScanPrint, along with an output print format which has been copied from the normative document model. At the end, 284 fields, with pre-defined multiple choices for better consistency, have been defined and included in the computerized technical passport. Routine inspections will allow filling in the computerized passport with current and exhaustive information.

<ul style="list-style-type: none"> важени класа #мс Премоствано препятствие #мс Брой отвори #дължина #мс Ширина на наст. #мс Ширина м/у парапети #мс Върхна конструкция #мс Долна конструкция #мс Година Технически Паспорт # Ширина # 2. Височинен габарит # 3. Товарносилност # 4. Постояни ограничения за движения # 5. Обща дължина на моста # 6. Премоствана илост # 7. Коммуникации по моста # 8. Обход на моста #мс 9. Структурно положение #мс 10. Нивелетно положение # 11. Предпазна ограда # 12. Парапети # 13. Настийка 	<ul style="list-style-type: none"> # 14. Хидроизолация # 15. Отводни мепи # 16. Дилатационни Фуги # 17. Антикорозионно покритие # 18. Върхна конструкция # 19. Лагери # 20. Стълбове # 21. Устои # 22. Крила #мс 23. Откоси и конуси #мс 24. Премоствано ирепятствие # 25. Нивелачен репер # 26. Данни за проекта # 27. Данни за строителството # 28. Година на въвеждане в експлоатат # 29. Реконструкции и основни ремонти. # 30. Основни прегледи и специални обс # 31. Особени събития #мс 32. Други данни
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Adapted and computerized technical passport

Routine inspection forms

As for technical passport, inspection forms have been extracted from the National Norm. Inspection forms are organized per element material and are composed of various inspection points corresponding to the different types of defects to be noted by inspectors for each element. Initial normative forms did not allow to fix the criticality level of each defect, which caused subjective answers depending on the inspector and did not allow a consistent analysis of the park. Also, the organization of the forms per element material would not allow evaluating the overall bridge condition, as for instance, the importance of a concrete deck would be the same as for concrete abutment.

The forms have been reviewed along with the National Laboratory for Roads and Bridges, and computerized into ScanPrint®:

- Definition of objective defect qualification and quantification
- Re-organization of the form per element type and function (deck, pier, abutment, expansion joint, etc...) and subdivision per material. At the end, 13 inspection forms have been created, including each 90 defects.
- Integration into the database of accurate defect description files to help inspectors

Media and document library

Computerized Inspection forms and technical passport have been completed to include:

- A list of 13 normalized pictures for each bridge (general view, view from bellow the deck, bearing detail, etc...)
- A list of documents related to each structure (calculation notes, drawings, etc...)

Normalized pictures will be gathered during routine inspections. Document will be scanned or computerized, and integrated step by step by the REA.

Training

8 inspector teams composed of one inspector from the REA and one inspector from Mostconsult (local consulting office) have been trained by Advitam to the use of the ScanPrint® Inspection module. Training was achieved into 5 days, including theoretical and practical sessions. Inspectors quickly handled the inspection software.



Theoretical training



On-site training

Inspectors have been provided with all necessary inspection equipment (ScanPrint® Tablet PC and accessories, binoculars, digital camera, tape meter, etc...)

Routine inspections

Achievement

From mid of october to mid of december 2003, inspectors traveled around the country and gathered information and pictures about the 1312 bridges. Advitam provided technical assistance in the various regions to finalize the training.



Sofia



Vratza



Gabrovo



Schumen



Blagoevgrad



Pazardjik



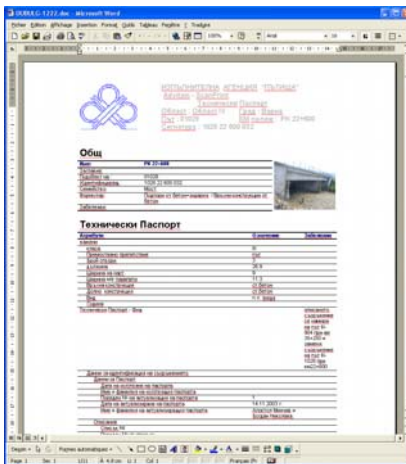
Stara Zagora



Burgas

Database consolidation

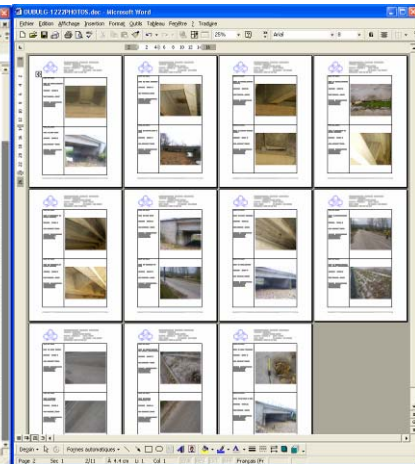
From the beginning of the inspection to the end, data was regularly transmitted to the REA through Internet when available. Through a fully computerized, however accurately controlled, process, people from the administration were able to visualize the inspections advancement, as well as the data that came up from the consolidations. Sufficient tests have been achieved to check the data consistency. Results were very satisfying as they allowed a precise study of the bridge network. In a Web interface, three reports have been set online for each bridge:



Technical passport



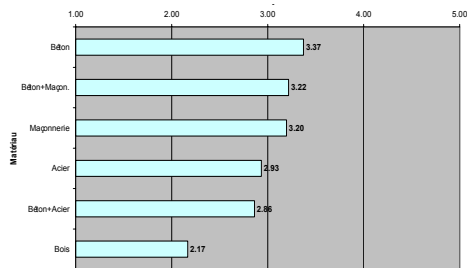
Inspection form



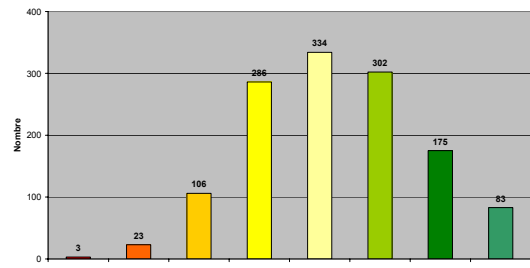
Defect Photo Report

INSPECTION SUMMARY	Inspected Structures	Questions answered	Pictures taken
Region 1	188	37 890	4 259
Region 2	162	31 572	2 517
Region 3	181	32 424	3 869
Region 4	140	30 821	2 727
Region 5	142	27 007	2 702

Comparative analysis of the bridge network



Mean condition rating per structure type



Bridge final rating (inc. importance)

Probably due to their age, masonry structures show the worst condition (mean rank = 3.20), whereas concrete structures are in better condition (mean rank = 3.37). In any case, 15% percent of all bridges necessitate a short term repair (rank <3). Taking into account the importance of the structure on the network, 28 identified bridges will be destroyed or replaced.

CHOICE OF CRITICAL STRUCTURES AND DETAILED INSPECTIONS

Selected criteria

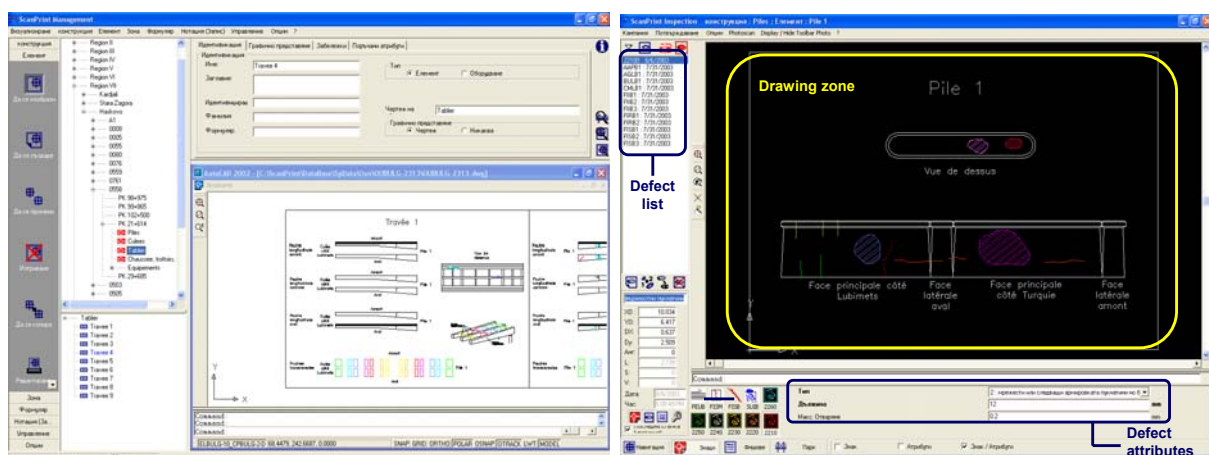
15 structures have been chosen for detailed inspection according to the selected criteria:

- The Structural Condition Rating
- The localization on a European Corridor
- The structure dimensions
- The general appearance, thanks to the pictures taken during the routine inspections

Preparation of the detailed inspections

From the available documentation and the information that has been gathered during the routine inspection, detailed inspection drawings of the 15 selected bridges have been created and computerized into ScanPrint®.

ScanPrint® includes as a standard, a list of more than 200 graphical structural defects, along with their selected attributes (length, depth, etc...) and description files and pictures to help inspectors.



Bridge detailed inspection drawings

Defect integration into ScanPrint®

Training

A five days theoretical and practical training has been provided to inspectors from the REA and Mostconsult.

Realization of the detailed inspections



During this phase, defects have been reported on the drawings along with their attributes and pictures.

MAINTENANCE DIRECTOR SCHEME AND CONCLUSIONS

1312 bridges over 20 m

As a conclusion to the project, the REA has been provided with the following information system:

- Database with information about all bridges. This information may be accessed by many means and be easily transmitted to local administrations:
 - ScanPrint interface
 - Excel tables resuming information
 - Web interface containing inspection results
- Software and trained teams to periodically inspect the bridges condition. The correct following of the inspection calendar defined in the Bulgarian norms is now facilitated.
- Software to help the decision about actions of maintenance. The systematic link between defects and respective actions to undertake can now be done automatically.
- Preliminary repair projects for 15 critical bridges. These projects will serve as basis to launch repair works and can be used as reference in terms of actions and costs for future similar projects, including:
 - Defect total quantities from detailed inspections, which allowed to state directly on the necessary light repair budget for the 15 bridges
 - Recommendations for heavy repairs (replacement of equipments as bearings or expansion joints, structural reinforcement, etc...)
 - Recommendations for further investigations (durability tests, monitoring, etc...)
- A global maintenance director scheme on the 1312 Bridges, stating when to re-inspect the bridges, according to their technical and final condition rating, and to the criteria selection. A global decision tree has been worked out with the REA in order to step towards a global preventive maintenance management plan of all bridges over 20m in 10 years.

What about the 4000 bridges?

The initial project has been performed on the 1312 bridges over 20m of the Bulgarian Network. In 2004, the REA was able to conduct the same project for all bridge under 20m, for a total of 4000 bridges.

Advitam has not been present during inspections, and provided technical assistance only during report and analysis phases.

FROM THE BULGARIAN REA

Reference Information:

Organization Name: Road Executive Agency (REA)
 Questionnaire Completion Date: 31.08.2007
 Name of Contact: FASEP / Mr. Milosh Potzkov
 Contact Numbers:
 Telephone: 9861484 Facsimile: 9521412
 Position Title: Chief Secretary

Reference Project Information: Provide the following information about the referenced project.

Reference Project Information:

Customer Organization/Office: Road Executive Agency (REA)
 Project Title: Bridge Management System & Condition Assessment for Bulgarian Road Bridges.

[...]

		High				Low
1.	QUALITY OF SERVICE: This area deals with compliance of contract requirements, to include appropriateness of personnel and technical excellence.	<input checked="" type="checkbox"/>	4	3	2	1
2.	TIMELINESS OF PERFORMANCE: This area deals with the contractor's ability to meet milestones and delivery schedules, to include responsiveness to technical direction, completion of efforts on time including wrap-up and contract administration.	<input checked="" type="checkbox"/>	4	3	2	1
3.	PRICE/COST CONTROL: This area deals with the contractor's ability to control price/cost escalation during performance to include appropriate budgetary estimates, current/accurate/complete billings/invoices, relationship of negotiated costs to actual, claim submissions, cost efficiencies, and change order issues.	<input checked="" type="checkbox"/>	4	3	2	1
4.	CUSTOMER SATISFACTION: This area deals with the contractor's commitment to satisfaction and cooperative/reasonable businesslike behavior with own staff and customers to include: effective management, responsiveness to contract requirements, operates with honesty and integrity, prompt notification of problems, flexible and proactive qualities, effective contractor-recommended solutions, and effective subcontracting and teaming arrangements.	<input checked="" type="checkbox"/>	4	3	2	1

[...]

() Not Applicable () Yes () No If yes or no, please explain:

Milosh Potzkov
 (M. Potzkov)
