

ANAS WAY TO BRIDGE MANAGEMENT

ANAS APPROACH TO BRIDGE MANAGEMENT

Road conditions play a considerable role in determining the duration of operational suitability of a network. The use of a technology assessing fatigue properties, structural conditions and the integrity of the loading capacity is thus of vital importance. ANAS, through the evaluation of these critical parameters, develops methods to determine the remaining useful life of a structure, to estimate the scope and intervals of maintenance and to improve quality and the resulting operational suitability.

A longer operational suitability reduces road works and generates financial savings ensuring the optimization of the available resources. These objectives are met by ANAS through the adoption of automated measuring system. The system, which can be



applied either for the specific analysis of an affected road section and for large projects, can be used for different purposes during road lifetime, from predictive analysis aimed at design, to estimation of road renovations/maintenance, works quality assurance, etc.

An automated measurement system is less resource and time consuming, provides a wider quantity of useful data and in the meantime considerably reduces traffic interference

The latest automatic system developed by ANAS is based on a laser scanner diagnosis which allows the collection of a point cloud used to generate the 3D model of each bridge. The tool allows to catalog each single structural element of the bridge and to automatically generate the CAD files. The elements acquired by laser scanner are fully compatible within existing National Road Data Base. The software automatically detects anomalies on the surfaces, defines the presence of defects and determines the most appropriate maintenance interventions, their cost estimates and their level of urgency, basing on a library of "causes-effects" developed on ANAS long experience. The maintenance strategy is obtained by comparing different options and associating a score to each possibility. The final ranking allows the adoption of a strategy in line with the available maintenance budget.

In order to improve the maintenance process for bridges, ANAS developed several systems, leading to two main approaches:

- professional specialized studies based on accurate field survey (this approach is more appropriate in case of severe defects or of singular structure with particular importance);
- automatic management of maintenance using dedicated software tools.



SHARING KNOW HOW

ANAS is ready to implement a new approach for monitoring and maintaining bridges part of national networks. The final goal of the assistance is to consent the independent management of the road structures, through the provision of methodologies and instruments, the implementation and running of the management system and staff training. Training is a key factor for the success of an integrated system for management of road infrastructure lifecycle, ANAS is ready to provide comprehensive training, speaking, coaching, and mentoring services for organizations worldwide. The assistance is customized based on the actual needs of the authorities and road institutions.

The innovative technical solutions, which include also the development of new software, are tailored thanks to the expertize of ANAS' Directorate for Research and Development and its Road Experimental Centre in Cesano.

ANAS AT YOUR SERVICE

- DEFINITION OF THE MONITORING AND MAINTENANCE PROCESS FOR BRIDGES
- SUPPORT IN ORGANIZATION AND BUDGETING
- TRAINING ON MONITORING AND MAINTENANCE OF BRIDGES
- ➤IMPLEMENTATION OF AN ADVANCED BRIDGE MANAGEMENT SYSTEM -STEP 1: DATA BASE
- PROCUREMENT ASSISTANCE FOR BRIDGE MONITORING AND DATA ANALYSES AND RECORDING
- SUPERVISION OF BRIDGE MONITORING AND OF DATA ANALYSES AND RECORDING
- ➤ HIGH CONSULTANCY FOR SPECIFIC BRIDGES
- IMPLEMENTATION OF AN ADVANCED BRIDGE MANAGEMENT SYSTEM -STEP 2: MANAGEMENT SOFTWARE
- ► ASSISTANCE IN PROCUREMENT OF MAINTENANCE INTERVENTIONS
- ► QA/QC ON MAINTENANCE INTERVENTIONS





ANAS: YOUR

> DEFINITION OF THE MONITORING AND MAINTENANCE PROCESS FOR BRIDGES

The development of a Manual for Bridge Monitoring and Maintenance, setting out the technical and procedural requirements to be adopted, constitutes the basis for an efficient management of road structures.

The manual covers the full lifecycle of the process, including field control, evaluation, design of interventions, procurement and works aspects. Special references will be made to:

- list of defects and cause-effect library;
- list of interventions, including standard duration and costs;

- standards for data acquisition, including monitoring of special bridges;
- data recording and processing for bridge assessment;
- definition of maintenance plans optimizing cost-benefit;
- criteria and systems for Quality Assurance / Quality Control (QA/QC).

The Manual will be developed starting from the review of current practice and through seminars including benchmarking with other countries.



SUPPORT IN ORGANIZATION AND BUDGETING

Draft of the organizational structure dedicated to bridge management within the relevant institutions, including:

- definition of the staff in terms of number and qualifications and analysis of the needs for new hiring and/or requalification of the existing personnel;
- estimate of external activities in the field of monitoring, data recording and maintenance process;
- evaluation of the annual budget of the new organization and the operational activities based on available international standard costs.

Processes will be analyzed in depth and draft procedures will be issued, in accordance with international quality standards.

TRAINING ON MONITORING AND MAINTENANCE OF BRIDGES

Training is the key factor for the success of a change management initiative. Thus, a training program is proposed within the relevant institutions, including a study tour in Italy, aimed at providing:

- dissemination on new approach to the management of road bridges, based on following modules:
 - general overview of the new process;
 - focus on methodologies for monitoring (from traditional to latest technologies);
 - focus on data recording and data processing;
 - focus on software for bridge management: data input, data analyses, identification of interventions and maintenance planning;
 - focus on maintenance works contracting and supervision.
- training on specific activities to be carried out by the staff in charge of each phase of the process. The scope is the preparation of the personnel and the certification of their capacities/competencies.

ANSWER TO MONITORING

> PROCUREMENT ASSISTANCE FOR BRIDGE MONITORING AND DATA ANALYSES AND RECORDING

Preparation of draft technical specifications for execution of the bridge monitoring and data analysis and recording, based on the following functionalities:

- preparation of a survey plan, with: accurate identification of structures to be surveyed, geo-referencing of the structures, progressive determination of the start and end of surveys;
- retrieval in the archives of all available documents related to bridges, scanning of the documents and storing on the Data Base of the Bridge System;



- recording of data acquired on bridges: clouds of 3D points, geo-referenced digital photos, results of specific inspections;
- analyses of the data using the Bridge System functionalities: modelling of the structures, damage analysis (identification of defects and their severity), etc.

Support in tender organization assistance during the procedure for assignment of the activities.



➤ IMPLEMENTATION OF AN ADVANCED BRIDGE MANAGEMENT SYSTEM STEP 1: DATA BASE

Core of the proposal is the supply of a Bridge System composed of a Data Base and Management Software capable of analyzing, processing and viewing clouds of geo-referenced points and photos taken on bridges, for an extensive use on a large number of existing bridges.

Functionalities of Bridge System includes:

- identification of the geometric characteristics of bridges and cataloguing of the structural elements;
- management (entry, modification, deletion) of defects present on structural elements (corrosion of bars, lesions, detachments of material, mildew, geometric irregularities, etc.);
- viewing of 3-D models of bridges with defects;
- interactive generation of CAD files of elevations and sections.

Results of monitoring should be transferred and recorded in the Data Base by the bridge surveyors. The software must enable the data uploading (including geo-referenced point clouds, photographic data and data collected through instrumental examinations) through a web interface.



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SUPERVISION OF BRIDGE MONITORING AND OF DATA ANALYSES AND RECORDING

Performance of checks on the quality and accuracy of the survey and on all the elements that are responsible for the final quality of the data collected. Main activities are:

- verification of data acquisition procedures and the equipment used by the surveyor, in terms of application of international standards and instruments accuracy;
- control on the employed personnel, in order to verify the capacity of the surveying staff and the correct application of the procedures;
- provision of training procedures to certify the quality of the staff employed for the execution of the surveys;
- check of the data delivered and recorded in the Data Base, selecting samples and verifying the format and the correctness of the input through verification on the field.

HIGH CONSULTANCY FOR SPECIFIC BRIDGES

For non-standard bridges (such as long cable-stayed bridges or located in crucial connecting zone) it is recommended to execute accurate monitoring activities, providing a dedicate consultancy. After the GPS identification, a geometric survey and technical inspection of the bridges must be carried out in order to assess the preservation conditions of structures and the presence of any damage or materials degradation.

Furthermore, a tailored monitoring protocol should include nondestructive tests and dynamic characterization exams, based on thermographic survey, test on concrete, ultrasonic test, sclerometric test, carbonation test, magnetometric survey, dynamic tests based on frequencies, static loading tests, etc.

In addition, a Permanent Monitoring can be designed, as a set of procedures to ensure the control of structural conditions.



► IMPLEMENTATION OF AN ADVANCED BRIDGE MANAGEMENT SYSTEM

STEP 2: MANAGEMENT SOFTWARE

Supply of added modules to the Bridge System for the automatic generation of prioritized Maintenance Plans, aimed at optimizing the resources. The internal algorithms will take into account the catalogue of defects, the cause – effect library, the list of interventions, including standard duration/costs.

In detail, the Bridge System will provide a series of functionalities enabling the structural diagnosis with related levels of seriousness, in order to determine:

- state of structural element and level of bridge reliability;
- severity of each damage, and need for more detailed examination;
- most appropriate maintenance works;
- estimation of costs, duration and levels of urgency for each work;
- ranked list of intervention plans;
- maintenance programming and budgeting.

IDGES



► PROCUREMENT ASSISTANCE OF MAINTENANCE INTERVENTIONS

Assistance in the procurement of design and works contracts for maintenance on bridges, including the definition of:

- technical specifications for preparation of design and execution of works aimed at bridge maintenance;
- guidelines for preparation of contracts, including:
 - introduction of performance indicators to be used for QA/QC;
 - methods for evaluation of performance levels of deliveries;
 - application of bonuses or penalties.
- criteria of evaluation of bids;
- support in tender organization and assistance during the procedure for assignment of the activities.

> QA/QC ON MAINTENANCE INTERVENTIONS (BASED ON PERFORMANCE INDICATORS)

Performance of quality assurance / quality control activities over the bridge maintenance interventions. The activities should be executed by field auditors through evaluation and testing of the quality during the maintenance process. Audits will cover the performance of different Supply Partners (material suppliers, works contractors, etc.). The performance will be checked taking into consideration the indicators stated in the contracts. QA/QC activities will be supported by an advanced software, the Performance Evaluation Management System (PEMS). The PEMS is a key tool for the evaluation, the analysis and the improvement of the reliability of all Supply Partners involved in the maintenance of the bridges.

The input for the evaluation of quality derives from the results of the audit activities (on-site audits, documental audits, laboratory tests).

Based on the results of these analyses, PEMS automatically evaluates Quality Indicators of the Supply Partners involved in the bridge maintenance process.



A N A S : YOUR NEW P A R T N E R

ANAS is an Italian State owned company, fully owned by the Italian Ministry of Economy and Finance, subject to the control and supervision of the Italian Ministry of Infrastructures and Transports.

ANAS long history began in 1928 with the creation of the National Roads Agency (ANAS), its mission was and still is to design, build, operate and maintain the Italian road and highway network, thus participating in the Country modernization and development.

At present ANAS manages more than 25,000 km of National Roads and Highways which include, due to the peculiar morphology of the Italian peninsula, around 15,000 bridges and viaducts and 1,200 tunnels, constantly monitored by thousands of cameras and sensors.

Furthermore it implements infrastructure projects by managing more than € 10 billion of road construction projects, acting as planner, designer, contracting authority and work supervisor.

ANAS structure consists of a General Management in Rome and 20 Regional Offices and of a staff of approx. 6,000 people. Its annual turnover amounts to more than €1.5 billion.

In recent years the Company started to operate also on foreign markets, proposing to the competent ministries and road operators as a possible partner or consultant for the planning, design, construction management, supervision and maintenance of the road and highway network. The international activities are carried out by the subsidiary company **ANAS International Enterprise** which manages all ANAS foreign contracts acquired before 2012.

In 2012 ANAS obtained the UNI ISO 9001/2008 quality certification, confirming the Company engagement in implementing and applying an efficient system of management.

The environmental protection is considered by ANAS a key aspect in design, implementation and management of road and highway networks.

The Company thus promotes the adoption of policies, guidelines and procedures aimed at reducing the environmental impacts.



ANAS INTERNATIONAL ENTERPRISE SPA

A Single Shareholder Company of ANAS Group Via Giovanni Giolitti, 2 - 00185 Rome - Italy Phone +39 06 444 66 555 Fax +39 06 444 66 558 Email international@stradeanas.it