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MONITORING OF BRIDGE OVER THE DANUBE-BLACK SEA CANAL AT AGIGEA

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Abstract

Topo-geodetic methods are in many cases the only one methods allowing the absolute determination of the size and direction of the movement of a building or area of land with constructions as well as the determination of the movements and deformation made by other methods.The monitoring of constructions on a timeline is a very complex process, which requires a rigorous planning. In order to be able to diagnose, it is necessary to analyze thoroughly the characteristics of the structure. The paper aimed to present this paper the process of monitoring Agigea is the first cable-stayed bridge made in Romania, and until 2002, span over waterway 162.5 meters was the highest road bridge span from country. Cable-stayed structure is 246.65 meters long.

***Key words**: monitoring, bridge, displacements and deformations*

INTRODUCTION

Buildings and constructions are constantly changing by the influence of time, temperature and environment changes, there occur shifts and deformations. For bridge structures, these changes are most obvious and frequently monitored, as they may affect the functionality and safety of the structure (Palamariu, 2010).

A good logistics and deformation analysis of bridges can optimize the route and reduce the costs and time of transportation of exceptional transports.

The monitoring of constructions on a timeline is a very complex process, which requires a rigorous planning. In order to be able to diagnose, it is necessary to analyze thoroughly the characteristics of the structure, to be more specific, it is highly important to analyze the materials of which the building has been realized from, also all the environmental factors that interact with the building and the actual state of it (Figure 1), (Herban, 2006). The subject of building management implies compulsory periodic inspections and measurements in order to track how the building behaves when it is exposed to the elements and to prevent eventual failures.

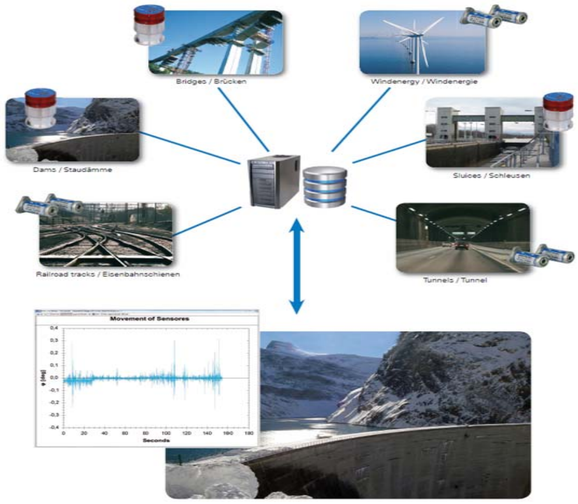

Figure 1. Monitoring of the structure

It is known that land surveying has a interdisciplinary character which gives us the much needed support from the general theories of construction in order to correctly study the behavior of the building or to do special research on it. When monitoring the behavior of a building it is required to have specialists from different fields of research in order to be provided with the most efficient and sustainable solutions. Furthermore it is a requirement for each expert to be in the know of all the basics about the other experts' fields of study. Our society has to head in an upward direction in order to prevent problems with the help of the engineers who can provide new solutions.

In academic studies and engineering works, it is required to determine height differences between points or the height of points itself in those applications such as measurements of national or local networks, vertical applications of bridge, dam and infrastructures, maintenance and control measurements, determination of vertical crustal movements, motorway, railway, sewerage and pipe line measurements.

MATERIALS AND METHODS

Control measurements can be performed in a variety of ways depending on the structure. In practice, control measurements are performed with the help of geodetic measurements, the basic goal of which is to capture any geometric changes in the measured object. Displacements and deformations are determined. This means defining the position of changes and the object's shape with respect to the environment and time. The size of the vertical displacement can be predicted or interpolated in advance.

The case study for this paper is Bridge over the Danube - Black Sea channel at Agigea located on Route 39 at km 8 + 988, it is a cable-stayed bridge, asymmetrical, one pillar located on the left bank of the canal to Constanta (Figure 2)

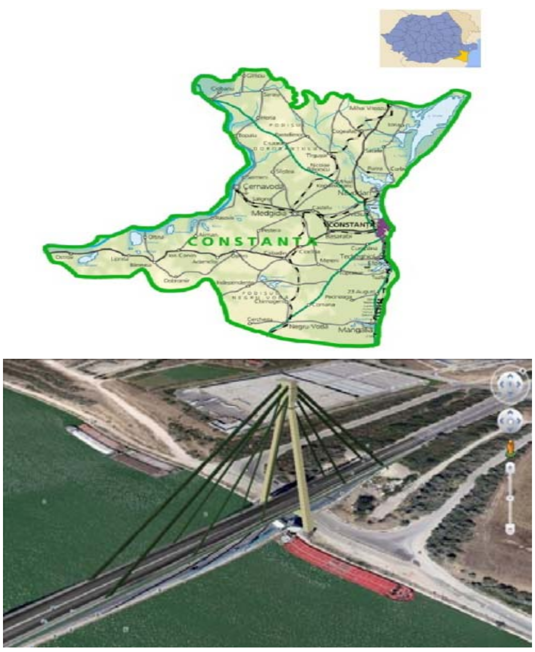

Figure 2. Location of the Bridge over the Danube

The superstructure of the bridge over the Danube - Black Sea channel at Agigea has a total length of 269,50m, composed of two distinct parts, separated by an expansion joint with the opening of 15cm specifically a cable-stayed structure, towards Constanta, covering three 44,00m openings, 162,00m 40,50m and an independent structure towards Mangalia, having a length of 23,00m, which ensures DN 39 crossing over the road on the right bank of the canal.

Establishing the compaction of the construction is generally made with the geometric precision levelling with mobile benchmarks embedded in the construction, moving in the same time with them, constrained by other fixed points outside the building that mak up the support network.

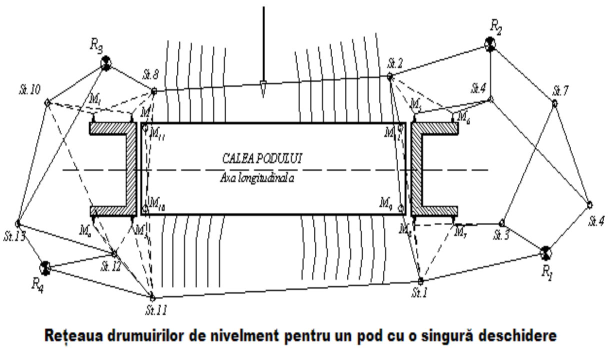

Figure 3 The Geometric precision levelling (Musat 2006)

Depending on the goal, the shape and size of the object examined, the geometric levelling network can be realized as closed polygons, or traverses approximately parallel to each other. In order to determine the values of deformations (subsidence) in the characteristic points of the bridge using this method there were performed geode

Special tracking of the behavior of a construction involves, besides identifying the technical condition of the building and its effect on the ability to exploit it, including identifying the causes of the changes that the building supports. In addition, it involves the ability to make the diagnosis and propose constructive solutions and appropriate measures to ensure its future through expert reports based on the findings of the technical condition of the building.

Analyzing the technical documentation which led to the implementation of the project Agigea, it was noted that two years after the commissioning of the bridge cable-stayed respectively in May of 1985, was made an adjustment of the tensile stresses in the beams.

Figure 4. Construction of the bridge

From measurements made in February of 1992, there was an increase in the maximum deformation of the main opening by 12 mm from the reference measurement performed on 18 June 1983. This increase was driven by the measurements in different weather conditions. To be more specific, the measurements of 1983 were performed during the summer when the temperature was high, while the ones in 1992 were performed during the winter, which impacted the accuracy.

By using real-time deformation observations when performing measurements, designers or the construction team shall receive information on the deformations of the construction, data that can be immediately compared with those established in the project, enabling in this way the consideration also of other charging schemes, if the deformation limits given in the project are not respected.

Figure 5. Measurements realized in our time

Of particular importance in determining the actual value of travel on a building subjected to stress is how the points, both the reference and the control ones are materialize, preserved and how they make up the network of reference and observation network.

The surveyor should plan the creation of the monitoring network so as to ensure the framing area of interest and a uniform distribution of landmark control (Figure 7).

RESULTS AND DISCUSSIONS

Displacements and deformations of the bridge are the result of loads acting on it:

a) loads due to the influence of external disturbing factors, such as weather and / or tectonic (wind, temperature, precipitation, earthquakes);

Figure 6. Bridge colaps

b) load from weight of the structure (uneven subsidence of the bridge leading to the emergence of strains);

c) loads imposed by the functional destination of the building (traffic)

Causal elements, which could lead to weakening the resistance of the bridge over the Danube - Black Sea channel in Agigea, can be grouped as follows:

a) failure due to design (structure as a whole, including foundation or parts of the structure can not take actions in accordance with local design criteria);

b) failure due to exceeding load levels (local loading conditions exceed the anticipated loads);

c) failure due execution of construction (improper execution of the construction, poor quality of construction materials);

d) failure through damage (damage successive result of the construction, lack of maintenance program)

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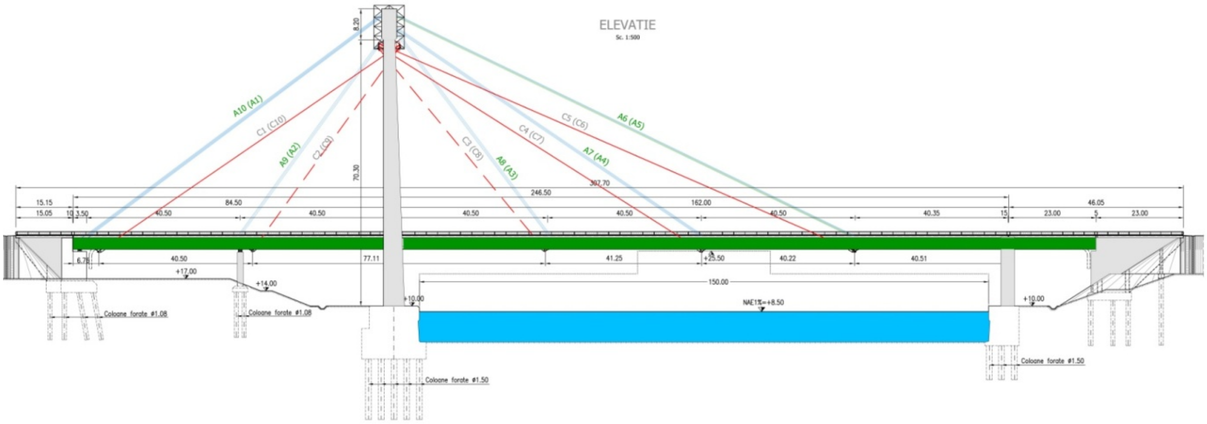

Figure 7. Structure of the bridge (Rusu 2016)

CONCLUSIONS

The purpose of monitoring the behavior of a building on a timeline is to obtain information to ensure suitability construction for normal operation and improvement of construction activity, assessing conditions to prevent incidents, accidents, failures and to adopt appropriate measures to mitigate damage, loss of human lives and environmental degradation risk (natural, social, cultural).

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