UDC 531

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Computerized systems of continuous monitoring of the technical condition of bridge constructions

The article considers the components of continuous monitoring system of the technical condition of construction objects of airport infrastructure.

Introduction

Bridges constructions are an important link in the functioning of the road infrastructure. The presence of an emergency state of bridge structures leads to the exclusion of the decommissioning part of the transport network. In this case, vehicles need to circumvent the emergency bridges using other roads.

The distance between the length of the bypass road (ACB) and the length of the main road(AB) can reach 20 km and more. It causes the negative consequences of the economic and social character (Fig.1).

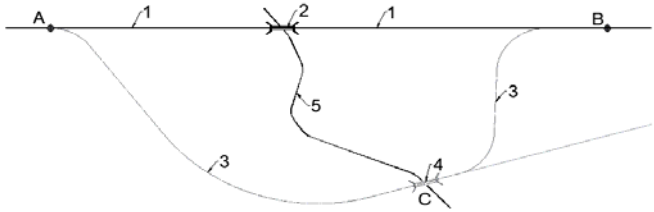

Fig.1. Scheme of a detour road at the termination of the operation of bridge:
1- the main road (A-B), 2 – the bridge is in an emergency,
*3- the road to the detour (A-C-B), 4-*the *bridge in operation, 5- the river.*

Main part

On the roads of Ukraine there are ≈16,5 thousand bridges structures. Most of which is made of prefabricated reinforced concrete of typical designs, built in 60-80 years.

Each year, the number of bridges that require repair, reconstruction or rebuilding are increasing (Fig.2).In order to bring them to a satisfactory technical condition, significant financial investments are needed in the bilding industry.

When operating bridges, in accordance with the existing regulations, it is necessary to carry out their inspection of the technical condition during the period of their operation [1].

Given the large number of bridges on roads that require a more frequent survey, there is a need to develop and implement remote monitoring systems for their technical condition. And in case of exceeding the permissible parameters that

are measured, the automatic inclusion of sound, visual and technical systems for warning about the prohibition of passing cars through an emergency bridge.

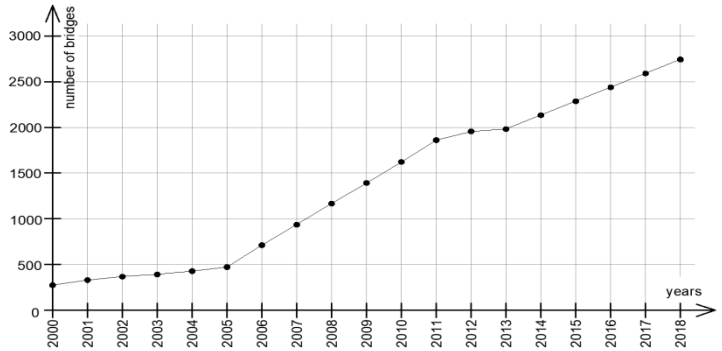

Fig.2. Growth of the number of bridges awaiting urgent repairs [2].

Also, bridges with limited cargo capacity are in operation on the roads of Ukraine. Continuous development of transport allows you to increase the weight of freight traffic, the value of which may exceed the limits of cargo capacity of the bridge. Violation of the mode of operation of the bridge due to the excessive weight of transport can lead to irreversible processes in the elements of the design, which will lead to the termination of its further exploitation.

Main part

The application of continuous monitoring systems of the technical condition (Structural Health Monitoring) the bridge is an individual design solution. Such monitoring systems often consist of the following elements: sensors for measuring physical quantities; data transmission system; signal conversion modules; central module (main computer) (Fig.3).

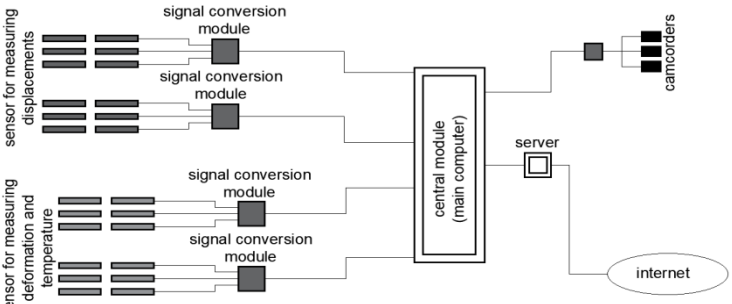

Fig.3 Scheme a connection of the sensors with a central module

Sensor data converted into auxiliary modules is sent to the central module (main computer). Data transmission can be done either by wire or wirelessly. An industrial central computer controls the functioning of the whole system.

Registered, synchronized and accumulated data of measurements can be forwarded to a server which is located at an arbitrary location from the construction object. With the help of the introduced algorithms into the computational system can be obtained accurate data on the static and dynamic parameters of the bridge elements. Persons responsible for monitoring the technical condition of the bridge have access to the server via the Internet. This gives the opportunity to get information on the work of the bridge from anywhere in the world.

The equipment of the monitoring system must conform to the design features of bridge, taking into account the following characteristics: geometric parameters; static scheme of bridge; materials from which it is made; method of exploitation.

One of the options for designing monitoring systems is the use of autonomous measuring modules (Fig.4.).

Fig. 4. System of wireless transmission data [3]

The standalone measuring module allows to measure various physical quantities: oscillation, deformation, temperature, humidity and other). Such a device converts measurement data to digitally, performs computation according to a given algorithm, compensates and sends results to the base station. Data transfer is done wirelessly.The compact structure of the corps (130mm x 85mm x 42mm), small weight (620 gr) and high resistance to the effects of external aggressive environment make it possible for its wide application.

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The built-in elements of the monitoring system on the elements of the bridge will enable in advance to obtain information on the possibility of its destruction, in order to respond in a timely manner to the implementation for the necessary measures. As well as to control the parameters of the technical condition of the construction during the period of performance of work associated with repair,

reconstruction or rebuilding and get information on the quality of the work performed before putting building it into service. Such monitoring systems should be reliable, accurate and durable.

Modern solutions of measuring systems allow them to be used in a wide range of temperatures (-40°C to +80°C) and are characterized by several decades of work. The development and implementation of typical monitoring systems of the technical condition of the bridges (bridges of typical designs) will allow, if necessary, to reuse them on similar buildings.

This type of system should measure: moving an item relative to a stationary object outside the building; reaction of beams on supports; structural deformation (compression, tension); crack opening. In order to obtain more accurate end results of the measurements of the design, it is necessary to take into account the parameters of the external environment: temperature and humidity.

Inference

1. Every year the number of bridges in need of repair, reconstruction or rebuilding in Ukraine's road infrastructure increases.
2. The connection of components of monitoring systems according to the technical state of the bridges can be performed in the leading and wireless ways.
3. The actual scientific issues are the development of typical monitoring systems which, according to the financial costs associated with their manufacture and exploitation, would allow their wide implementation on the bridge constructions.

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