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Structural Health Bridge Evaluation with Static and Dynamic Tests

Gheorghiţă Boacă[1]
[1]*Facultatea de Construcţii şi Instalaţii , Universitate tehnica „Gh. Asachi" , Iaşi*

Summary

This article describes the norms in force for static and dynamic tests performed on bridge structures.

Because currently on the road began to move very large capacity vehicles and passing speed of 100 km / h, most bridges made with older than 20-30 years to be technical expert to determine they can be left in operation without a major intervention, or if possible intervention to increase bearing capacity, or need a new bridge implementation.

Attempts should be made to new bridges, with a ninth composition, special, or important bridges.

Static load that is subject to a bridge should be on a schedule set to obtain the most adverse effects.

For static tests, road convoys will travel at a speed of max. 5km / h until the characteristic positions, where they will stop and will be stationed until it stabilizes the superstructure.

For dynamic tests, the shares are given by the convoys, they must move at a constant speed. A greater impact can be achieved by creating uneven.

In order to make a comparison between the results of the test data in situ, and the results of calculations is necessary to know the values of actions requiring the bridge and their position on the bridge.

Measurements to be carried out during the tests are compared with values measured in a sleep state, the bridge is loaded with useful actions.

KEYWORDS: bridge, monitoring, test, static, dynamic, technical health

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1. INTRODUCTION

Obtaining information it provides a structure such as a bridge, driven by popular uploads necessary to establish the level of service, require testing.

The results obtained from measurements during the tests, compared with the results of the calculation.

Static and dynamic tests are meant to highlight how the bridge behaves uploads acted useful to determine with greater accuracy following:

- Bearing capacity

- Structural stability

- Elastic structure

- Deformations and movements characteristic areas

- Difference from the results of calculation

Attempts should be made to new bridges, with a ninth composition, special, or important bridges.

The tests should be performed and the old bridges if:

- There is an overhaul that changed the original composition

- It would increase traffic, or traffic capacity on the route of a convoy is interposed particular

- To overcome life and need any type of restrictions

- The bridge is of economic importance and / or national high, requiring regular testing program

Actions which are used for the tests

1. Static testing:

- Different types of convoys

- Special construction machinery

- Weights

2. Dynamic tests

- Different types of convoys

- Vibrating devices

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In order to make a comparison between the results of the test data in situ, and the results of calculations is necessary to know the values of actions requiring the bridge and their position on the bridge.

Measurements to be carried out during the tests are compared with values measured in a sleep state, the bridge is loaded with useful actions.

During the tests is envisaged observation of apparatus for measuring and evaluating the values given by them to determine:

- Maximum arrow;

- Movements Basic infrastructure and equipment;

- In the most sought - specific deformations;

- Size and opening cracks in concrete bridges for static tests, and

- Development of maximum arrow;

- The most requested areas - development of specific deformations;

- Development of open cracks in concrete bridges.

Items that are considered to be important for the measurement will be provided with two measuring devices, to make a comparison between the values recorded.

Devices that are used to make the cercare must:

- Be checked metrology;

- Indicate with precision the appropriate measurement type you made.

2. STATIC TESTS

Static load that is subject to a bridge should be on a schedule set to obtain the most adverse effects.

Value expressing the effectiveness of a test is given by the ratio of the size guardians result of sizing, the useful loadings calculated by different methods S_{stat} and extent of the effort that resulted in charges has undergone bridge S_n.

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$$E_{fstat} = \frac{S_{stat}}{S_n} \qquad (1)$$

Depending on the value date of the report, one can say how much the bridge may be subject to traffic requirements or restrictions are necessary.

To consider that the bridge is subjected to static load, should be made a progressive loading can have a single cycle of loading and unloading, or more cycles of loading and unloading.

If a single cycle, the loading is done in steps, up to maximum efficiency and unloading can be accomplished in one step, or in reverse order of loading steps.

If it made more successive cycles of loading and unloading, then cycles will be done in ascending order of their effectiveness.

The test is considered done, when the schemes were carried load test measures were made in the measuring instruments and readings to see how the response of the bridge.

Reading measuring devices is just the opposite of the value stabilizes. It is possible that failure to reach the actions of the sample in the loading position of the scheme you want, to achieve a higher efficiency of load in an intermediate position, which requires a continuous surveillance of the measuring instruments.

Installation of measurement is recommended to be several days before to see the influence of temperature differences. In order not to influence too much the temperature tests are recommended during periods influenced by atmospheric factors condition (temperature, wind, precipitation).

Reading levels indicated by measuring devices is made prior to 1 hours, then 15 min, the start of the test. After the start time of the test are reading the periods of time, indicating the timing of implementation of each scheme of loading, unloading respectively, and stabilizes over the load effects. After removing the load, the readings continue as long as between two successive readings are no differences.

We can consider that a bridge has a corresponding reaction in static tests, if:

- No signs of failure or loss of stability;

- Did not affect the functionality of the bridge;

- Cracks appeared and their behavior falls within the limits imposed by technical rules;

- Maximum arrows f_{el} fall within the limits imposed by technical rules;

- Arrows elastic as compared to the corresponding arrows f_{tot} , is less than the value K_1 of the table.

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- The bridges we f_{rem} arrows remaining, compared with the corresponding arrows f_{tot}, is lower than the K_1, given in Table 1.

- For bridges that have been put to action with static efficiency equal to or greater, shall be considered as the ratio of residual f_{rem} arrows, and arrows corresponding f_{tot} be less than the $\frac{K_1}{2}$

- Work unit of maximum demand sections are

Table 1

Construction materials		K		K1	K2
		$E_{fstat} \leq 1,0$	$E_{fstat} \leq 1,2$		
Iron	Welded joints	1,05	1,05	0,10	0,40
	Riveted joints	1,05	1,05	0,15	0,40
Reinforced concrete		1,00	1,10	0,25	0,50
Prestressed concrete		1,05	1,15	0,20	0,45

It should be borne in mind that all the time but will run tests to observe strictly the behavior of the bridge. If irregularities are found in the manifestation of the bridge, stop testing. If the values recorded by measuring instruments falling within normal limits, and the bridge is appropriate behavior can skip to the next stage of loading.

If tests are carried out, other than known and will be executed under a test project.

If you try to bridge the great structure that attempts should be running under a test project, which is specified in the test parameters.

If after carrying out tests shows that the bridge did not fit within the appropriate, shall be required to take immediate action

3. DYNAMIC TEST

Dynamic tests are normally applied only after the static tests were performed and behaved structure within acceptable limits. Like the static tests should be made a careful tracking of all the affected test to stop the test if there is an excess of allowable limits.

Dynamic load test arrangement must achieve a static efficiency at typical sections than 0,7.

To determine the dynamic behavior of the bridge to boot, are used primarily road convoy or rail, which will move in both directions. The test starts with a convoy movement speed of 10 km / h and gradually increased up to speed design.

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Measuring devices must be able to take measurements continuously throughout the test. Recording measurements can be analyzed after the test.

Dynamic test provides the following calculation:

Dynamic coefficient

$$\Psi_{măs} = \frac{f_{din}}{f_{stat}} \text{ or } \Psi_{măs} = \frac{\varepsilon_{din}}{\varepsilon_{stat}}$$

f_{din} - maximum measured in an arrow point, dynamic convoy crossing a certain speed;

f_{din} - measured in the same spot where the arrow was measured f_{din}, the load applied to the same convoy lie in which the f_{din},

ε_{din} - The maximum deflection measured at a specific point, dynamic convoy crossing a certain speed;

ε_{din} - specific deflection measured at the same point where the measured ε_{din}, the static load applied in the same convoy in which the position ε_{din}

- Natural frequency of the bridge;
- The frequency bridge when the action of the sample is measured near the ground;
- Decremented logarithmic of depreciation. Its value is defined as the natural logarithm of the ratio of two successive amplitudes of the same sign, or contained within a period.

Test result gives the maximum speed at which degradation begins to occur, it may make a comparison between the deformation and displacement, or stress can cause the characteristic sections.

4. CONCLUSION

This article describes the norms in force for static and dynamic tests performed on bridge structures.

Because currently on the road began to move very large capacity vehicles and passing speed of 100 km / h, most bridges made with older than 20-30 years to be technical expert to determine they can be left in operation

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without a major intervention, or if possible intervention to increase bearing capacity, or need a new bridge implementation.

Technical expertise is based on visual and nondestructive testing, which, possibly for lack of funds, provides only characteristics of the materials. The very few times to make determinations of the bridge behavior under real conditions of exploitation, in stating deformations, displacements, stress, etc. .. However, it is highly unlikely that the tests are being carried out in extreme weather conditions, winter or summer, when the bridge acts such tasks.

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