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ABOUT NOISE MONITORING IN CITIES

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Substantive provisions of the national standard draft "Acoustics. Noise monitoring of cities" are considered. The concept of environmental noise monitoring, its destination and a field of application are given. The operational and inlet Russian, International standards and the European directives used at realization of monitoring are listed. As the main noise indexes for the monitoring purposes rating levels are set, which are defined on the equivalent continuous and maximum A-weighted sound pressure levels separately for day-time, evening and night, and also composite whole-day rating levels during period day-evening-night. For rating of tonal sound and sounds with strong low-frequency content alongside with the indicated quantities will use also appropriate rating sound pressure levels in octave frequency bands in which the basic power of sound is concentrated. The expediency of selection evening-time period from day-time period is scored despite lacking the special demands to noise in the evening time in practice of sanitarian noise rating. For the purposes of noise estimation limit values of the entered noise indexes are fixed, comparison with which of actual or predicted values of noise indexes allows to reveal violations of noise demands and to allocate the noise sources, which are responsible for fixed violation. The concept of operating noise maps is entered and rules for noise mapping are described.

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TECHNICAL OF VIBRATING DIAGNOSTICS OF BRIDGE SUPERSTRUCTURES

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For maintenance of accident -free operation and preservation of existing park of road bridges is necessary regular technical of vibrating diagnostics their actual status with especially careful vibrating monitoring of bearing elements of bridges. The decision of the given problem consists in the following: to spend technical of vibrating diagnostics without suspension of transport flows and for several flights simultaneously, including flights above water or above other road, that is rather inconvenient at traditional methods of measurements. The special attention is given to reliability of the received results at the expense of application of exacter devices and perfect techniques of data processing on the basis of introduction of advanced achievements of science and technology that will allow to create mobile vibrating diagnostics the express train - laboratory.

1. INTRODUCTION

Development of a complex of actions on restoration of a technical condition or radical modernization of parameters of bridge park up to a level certain by modern norms of designing, often appears insufficient. Actions on technical diagnostics on which estimate an actual technical condition of transport constructions with the purpose of definition of an opportunity of the miss on them of modern loadings and development of technical decisions on accident-free operation of transport constructions for satisfaction of requirements of the present are originally defining.

Within the limits of technical diagnostics works on survey and measurement of designs of constructions with revealing existing defects, to survey of a technical condition with an estimation of physic-mechanical properties of building materials not destroying methods and definition of conditions of the further safe operation are performed. Theoretical calculations of designs of flying structures on test loading, and also static and dynamic tests by automobile loading are made. Calculations according to carrying capacity of flying structures on modern loadings, service and residual resources of transport constructions are carried out.

The control is intense - is deformed statuses of transport structures is carried out at static loading of researched elements of bridges, within the framework of which the general movings both deformations of a structure and his parts are measured.

During the vibrating control of bearing elements of bridge designs changes of the basic dynamic characteristics of flying structures, such as are investigated: frequencies (periods) of own and compelled fluctuations; factors of attenuation of fluctuations and their logarithmic decrements; dynamic factors.

Traditional test methods of bridges are the static and dynamic tests spent at a stop of a natural transport stream with corresponding forms of specialized time loading [1, 2]. These methods do not reflect a real picture of dynamic influence on the bridge of a stream of vehicles, have low efficiency and do not meet modern requirements, in connection with high intensity of movement.

For registration progibogrammes and vibrogrammes various mechanical devices which reliability of measurements depends from of some favorable circumstances are used. For example, universal device Geigera and manual vibrograf series BP1-3 [3]. The basic lack of similar devices is the bad reliability of measurements at registration of frequencies of fluctuations of a flying structure below 3÷5 Hz as has an effect of inertia a pendulum of the device.

Use also the device operating by a principle of bridge Uitstona [3]. The basic lacks of the given device: the low efficiency caused by necessity of glueing of tensoresistors to the investigated design; a relaxation of a wire of tensoresistor and a glutinous seam that reduces accuracy of measurements; impossibility of a reuse tensoresistor after calibration.

Being based on regular tests of transport constructions known in the world, and expedient now it is considered the most progressive carrying out only dynamic tests for a casual transport stream with the purpose of revealing of limits of preresonant, resonant and normal work of constructions.

2. OPTIMIZATION OF THE DECISION OF THE PROBLEM

The optimum decision of a task in view consists in the following: carrying out of technical vibrating diagnostics of bridges without a suspension of transport streams; inspection of several flights simultaneously, including flights above water or above other road that is rather inconvenient at traditional methods of measurements; increase of reliability of the received results, due to application of more exact devices and modern techniques of processing of results; introduction of the advanced achievements of science and technology for creation mobile vibrating diagnostic the express train-laboratories.

Dynamic tests in such format are possible at presence of the instrument maintenance corresponding a modern level allowing with a high degree of reliability to register the characteristic of oscillatory processes, and also to spend their multipurpose spectral and correlation processing [3]. For definition of dynamic characteristics of oscillatory process vibrogrammes are transformed by means of a method of correlation on the basis of the theory of casual processes and multichannel systems. Correlation allows to reveal linear dependence between two or more time samples, that is vibrogrammes which are fixed by the vibrating converters located in different points of the investigated design.

The essence of a method of correlation consists in the following. If the design is exposed to casual influence in the form of a transport stream the spectrum of reaction measured in any point of a design, reaches a maximum on the same frequencies on which there is a maximum of a spectrum of influence from time loading in the form of the compelled frequencies or own frequency characteristics of the construction. To divide these maxima, it is necessary to use that fact, that on own frequencies all points of a design to vibration, both in a phase – 0º, and in an antiphase – ±180º, that is synchronous oscillatory process. Simultaneously, on the compelled frequencies a design to vibration basically at intermediate values of a phase between 0º and ±180º, that is nonsynchronous oscillatory process.

Therefore, on an investigated design establish a no many vibropacks, that provides reception of the maximal peak values of measured sizes. Usually it is the middle and a quarter of a flying structure. In the middle of flight the amplitude of fluctuations of the first harmonic is maximal, as there is bunch standing waves, and in a quarter of flight is bunch the second harmonic of fluctuations. The analysis, written down vibrogramm on their function of mutual correlation, allows to identify precisely frequencies of own fluctuations of a bridge design.

The presented method of correlation can be used both during discrete technical vibrating diagnostics, and at a stage of continuous monitoring because, can be built in the corresponding software.

At such scheme of arrangement vibropacks on investigated designs for registration of a full spectrum of fluctuations of a flying structure it is desirable to have a plenty vibropacks, placed on all length of flight. As an alternative variant, accommodation vibropacks at end faces of bearing elements of bridge designs that allows to carry out research of oscillatory process at once on all harmonics, due to «shortening-lengthening» of the top and bottom fibres of a material in elements of a construction is possible at fluctuations of bend [4].

By results of dynamic tests with use of corresponding mathematical methods there was an opportunity of reception of characteristics of static work of designs of transport constructions, and with their help to solve the general problem according to carrying capacity: bearing ability of transport constructions.

3. THE METHODOLOGICAL CONCEPT OF DYNAMIC TESTS FLYING STRUCTURES OF BRIDGES

For perfection of an estimation of an actual technical condition of transport constructions in view of display of moral and physical deterioration of designs, the methodological concept modern the express train-method of technical vibrating diagnostics of constructions on the basis of dynamic tests of flying structures, see fig.1 is developed.

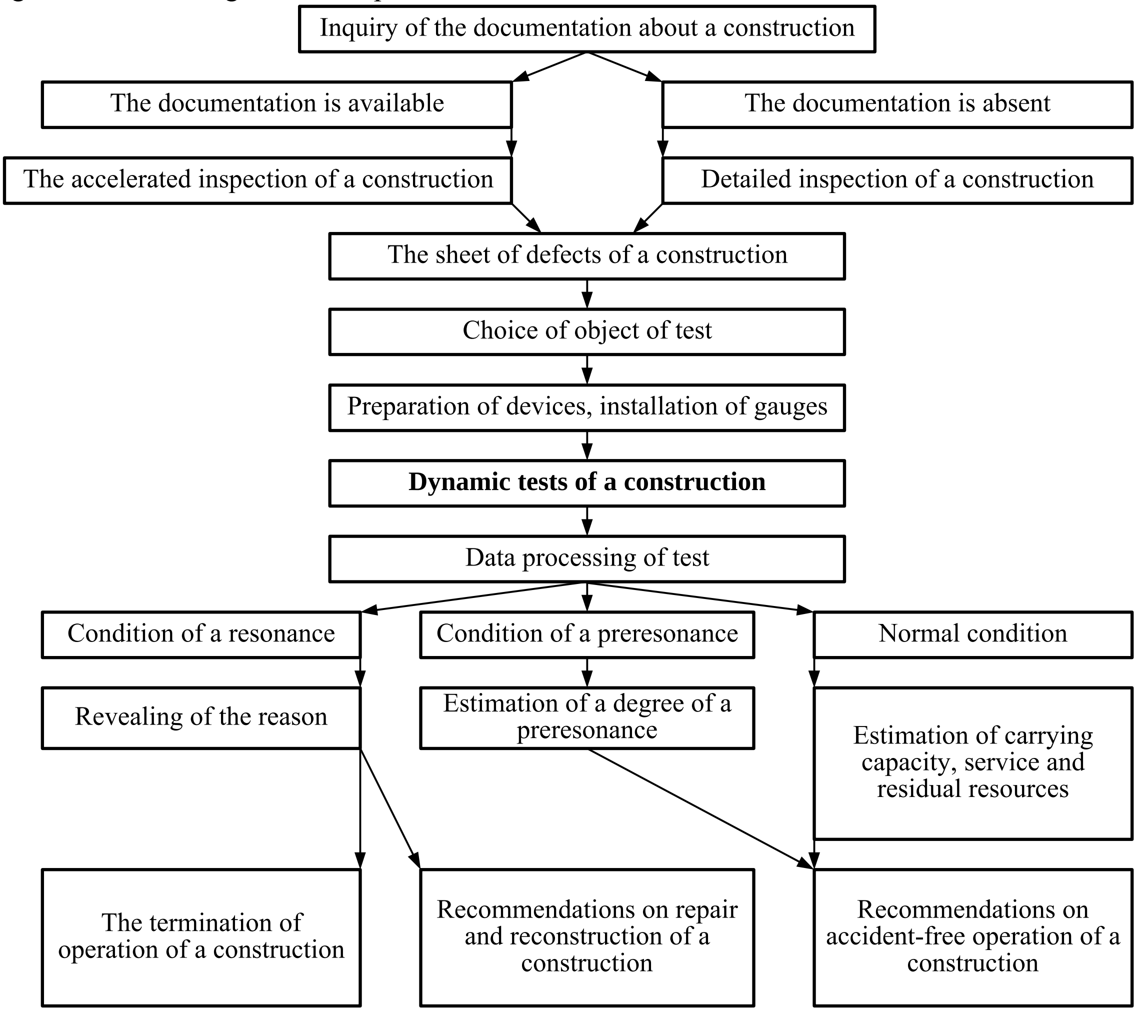

Fig. 1. The block diagram technical vibrating diagnostics transport constructions

The traditional methodology of technical diagnostics leans on a principle of paramount revealing of criteria of defects, physical and an obsolescence. Owing to what, the objective analysis of defects enables to develop theoretical bases of definition of making components of a technical condition, carrying capacity, loss of a service resource and an estimation of a residual resource.

4. FEATURES OF DEFINITION OF DYNAMIC CHARACTERISTICS THE BRIDGE

At movement of the car on the bridge arise both own fluctuations, and the compelled fluctuations due to vibration of various elements of the car (a body, a suspension bracket). Therefore, it is necessary to define values of frequencies and amplitudes of the given fluctuations and to establish an interval of a divergence between them for an establishment of a resonant, preresonant or normal condition of a transport construction.

For the express train-definition of frequency of own fluctuations f_c at engineering calculations the formula of a following kind is applied

$$f_c = \frac{5}{\sqrt{y_{cm}}}, \tag{1}$$

where y_{cm} – static deflection of a beam (in sm) under action of the time loading located on flight and a body weight of a beam which is equal:

$$y_{cm} = \frac{\left(P_м + \frac{5}{8}Q\right)l_p^3}{48EJ}, \tag{2}$$

where $P_м$ – weight of the reference car; Q – body weight of a beam; l_p – settlement length of flight; E – the module of elasticity of a material of a bearing element; J – the moment of inertia of cross-section section of a beam.

Frequency of the compelled fluctuations $f_в$ it is defined from expression of a kind:

$$f_в = f_c\sqrt{\frac{1+\mu}{\mu}}, \tag{3}$$

where μ – factor Puassona.

Dynamic factor $1+\mu$ for the compelled fluctuations it is equal:

$$1+\mu = \frac{1}{1-\frac{\upsilon \cdot l_p}{\pi}\sqrt{\frac{\overline{m}}{EJ}}}, \tag{4}$$

where υ – speed of movement of the car (m/s); $\overline{m}$ – weight per meter of a flying structure.

The dynamic deflection at movement of the car on a flying structure will be equal to product

$$y_д = (1+\mu)\cdot y_{cm}. \tag{5}$$

Fluctuations of the investigated bridge design, caused by impact or movement of the car, are registered by measuring systems. The further processing of the received information is carried out on a personal computer by means of the specialized software which allows to process the received signals and to define amplitudes and frequencies of own and compelled fluctuations, and also characteristics of attenuation of own fluctuations and dynamic factor.

The factor of attenuation ε the estimation is defined in a mode of vibration of the bridge when there is own fluctuation after influence of temporary loading from a flying structure ε it is done under the formula:

$$\varepsilon = \frac{1}{t_i - t_0}\ln\left[A(t_0)/A(t_i)\right], \tag{6}$$

where $A(t)$ – amplitude bending around vibrogramm in the beginning of the chosen range (the moment $t = t_0$) and in its end (the moment $t = t_i$) in that area vibrogramm where transients have come to the end, and the bridge vibration in a free mode.

After the period of own fluctuations and factor of attenuation is certain, logarithmic decrement under the formula is defined:

$$\delta = \varepsilon \cdot T_c, \tag{7}$$

where T_c – the period of own free fluctuations of a flying structure.

Static $y_{пр}$ and dynamic $y_{д}$ deflections are defined directly on the schedule vibrogramm oscillatory process, see fig. 2.

The dynamic factor is defined as the attitude of a kind:

$$1+\mu=\frac{y_{д}}{y_{пр}}, \qquad (8)$$

where $y_{д}$ – distance from zero reading up to value of the maximal amplitude; $y_{пр}$ – distance from zero reading up to average value vibrogramm when loading is in the middle of flight.

After the dynamic parameters describing oscillatory process of a flying structure are certain all, the received results allow to execute comparison with normative values [5] and to draw a conclusion on a technical condition of a flying structure which can be normal, preresonant or resonant.

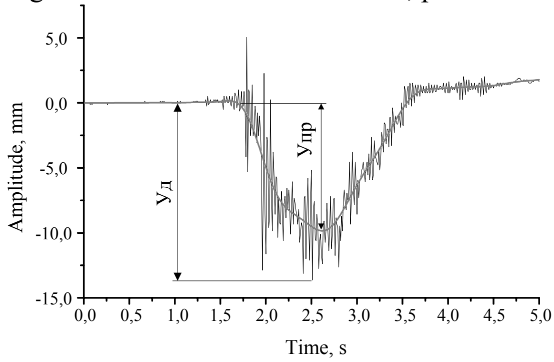

Fig.2. Progibovibrogramm of oscillatory process

5. THE SPECTRAL ANALYSIS VIBROGRAMMES DYNAMIC WORK FLYING STRUCTURES OF BRIDGES

The analysis of multichannel systems allowing by research of time records of a signal to receive the necessary information on investigated bearing elements of flying structures of transport constructions is put in a basis of the developed method of spectral processing vibrogramm.

The developed method of the spectral analysis vibrogrammes allows step-by-step way to study dynamic work of a cutting flying structure of the bridge under influence of mobile loading during movement on flight and after it nfluences of loading and fig. 3 is defined by three stages of influence of the car which characterize frequency parameters of a bridge design, see.

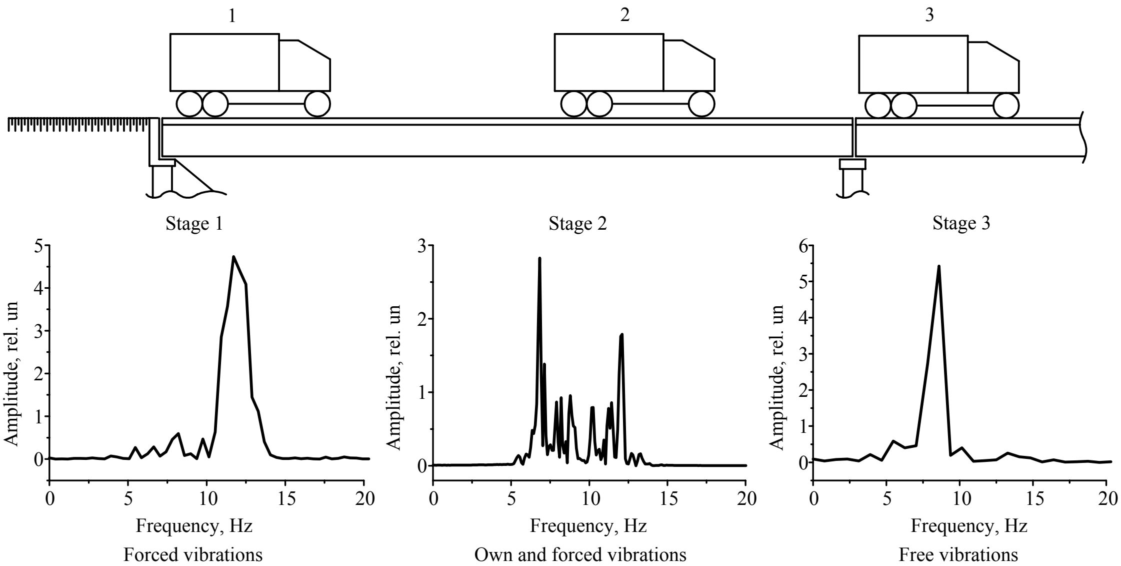

Fig. 3. Stages of the spectral analysis vibrogramm transport constructions

To stage 1 there corresponds a spectrum of frequencies when the flying structure is shaken on the compelled frequencies due to fluctuation of mobile loading. Duration of a stage 1 depends from characteristics of rigidity of a bridge design, the the flying structure is more rigid, the stage 1 is more long. Smoothness of call of loading on a bridge span also influences entry conditions of back reaction bearing designs under influence of mobile loading, that also defines duration of a stage 1.

The stage 2 is characterized by change of a spectrum of frequencies when the flying structure starts to make joint own and compelled fluctuations. And the amplitude of own fluctuations is more than amplitude of the compelled fluctuations in some times.

Last stage 3 corresponds to free fluctuations of the bridge in conditions of absence of any external mobile loading. On a spectrum of frequencies the unique maximal peak defining value of the basic frequency of own free fluctuation of a flying structure of the bridge is allocated.

The presented method of the spectral analysis vibrogramm allows to define an interval of a divergence between frequencies of own and compelled fluctuations which characterizes dynamic work of a flying structure of the bridge in conditions of movement of a natural transport stream in a mode of real operation.

6. THE CONCLUSION

Operating experience of road and city bridges of all kinds testifies that a technical condition of many of them do not meet normative requirements of accident-free operation, and actual service life is non-comparable below normative.

The described express train-method of technical diagnostics of transport constructions allows to estimate real residual durability (safe operation) bridge designs in view of the valid spectrum of loadings and intensity of movement, than rational capital investment on carrying out of repair work and sequence of inspection and repair of bridges depending on their real condition is reached.

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