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Technical Status of Waterworks and Water Regulating Hydraulic Structure Installations Meliorationuse

GurynV.A., Radchuk M.I*

National University of Water Management and Natural Resources Use, Rivne, Ukraine
*Corresponding Author: Radchuk_Maxim@ukr.net

Abstract The main criteria for determining the reliability of the culvert and water control structures reclamation purposes. The analysis of the technical condition of culverts and water control structures on the basis of which are characteristic of their damage and requirements to ensure their operational reliability. This technique allows to determine the suitability of the building for further use on the basis of visual inspection and robustness of concrete elements of buildings.

Keywords Reliability, Waterworks, Technical Condition, Defects

1. Introduction

Some waterworks on reclamation systems are operated more than 45 years, though their lifetime is 40 years, so there raises questions of their technical condition and suitability for further use

One of the main tasks of exploration of hydraulic structures is to ensure trouble-free operation for their entire working time [1].However, because of a variety of environmental conditions, design features and other reasons, it is not possible to exclude the danger of the accident [2].

The basic requirements that determine the reliability of the culvert and regulating facilities include[1]:

1) A guarantee of safety for human life and health, property and the environment;
2) Maintaining the integrity of the object and its major parts and other requirements that ensure the use of the object for its intended purpose and the proper functioning of the process;
3) Providing opportunities for the development of the facility;
4) The creation of the necessary level of convenience and comfort to users and operating personnel.
5) Limitation of the degree of risk by means of realization the requirements for no-failure operation of functioning of protective devices, survivability of structures, etc.

Technical condition (TC) of waterworks is characterized by the values of the parameters set by the technical documentation at a certain time, under certain conditions, and includes safety and reliability.

Reliability, depending on the destination of the object and the conditions of its use, is characterized by: no-failure operation, durability, maintainability and safety. All categories of reliability are interrelated (Figure. 1).

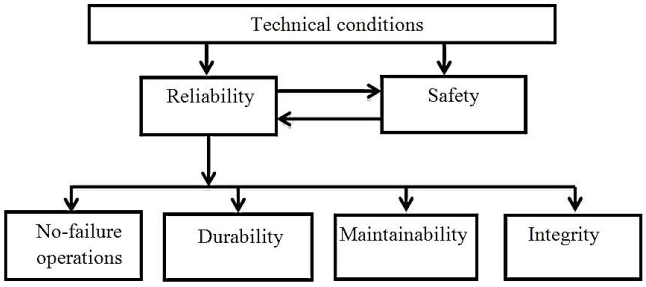

Figure 1. Connection between categories of reliability

On the safety of the building for its intended use, as a whole, and in particular, affect the reliability of all the properties.

In their turn, these properties depend on the strength, stability, duration and recovery of other indicators. Generalized scheme of interaction of properties of reliability is shown in Fig. 1.

Analysis of the relation between reliability properties shows that the reliability of the whole object is characterized by a lowest value of a parameter. Ratio of various properties of reliability in their interaction is complex and not in all cases can be determined because of the complexity of this interaction.

However, determining the reliability of a real object properties, such as saving of concrete elements can be expressed in terms of their strength, give us a real idea of the usefulness of the object for further use.

2. Methodology

2.1. Methods of Reliability Analysis

In general, the method of analysis of reliability of the object consists of the following steps[5]:

1) identification of the object (purpose, scope, functions, structure, redundancy, maintenance system and repair, operation modes, external influences);
2) determining the purpose of the analysis (nomenclature and required values of reliability, criteria of exploration quality of the object, the possible consequences of failure, failure criteria and limit states);
3) determination of the initial data (source data acquisition and its preliminary processing for reliable elements and components of the object analogues, calculation of reliability indices of elements, distribution of reliability through the system elements);
4) analysis of the system;
5) determination of the results of analysis (comparison with indicators of reliability, required and (or) the recommendations and measures to ensure essential reliability rates, which may include design review, identification of weaknesses, imbalances, regimes, replacement of units with a high risk of failure, the development of alternative ways to improve reliability of the compromise analysis and estimation of design options).

2.2. Mechanism of Bounce Structures

During the operation the damages of the waterworks are accumulated, varying quantitatively and qualitatively. Minor defects, which are left unattended, can lead to serious violations of the integrity of structures, as well as accidents. Reliable operation waterworks is possible if during the operation effective measures are taken to eliminate defects or reduce their harmful effects.

Generalized failure mechanism may be represented as a block diagram (Figure. 2).

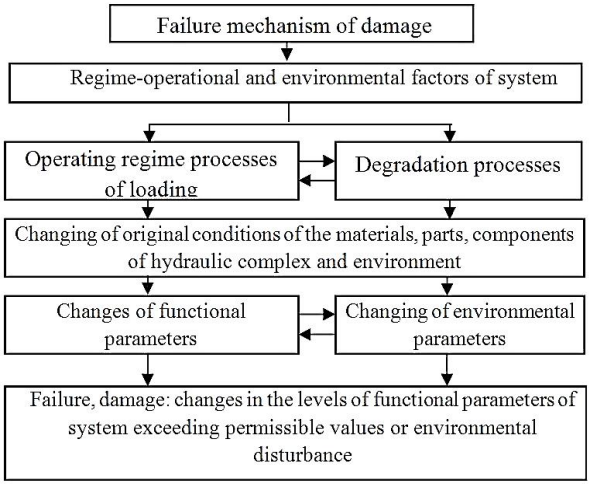

Figure 2. Block diagram of the mechanism of failures formation

Complex of operational factors affecting the elements of the system in the long-term operation, causing elements in the physical and physical and chemical processes, also known as the processes of degradation.

During constant operating loads the development of degradation processes leads to a change in the strength of the initial state of the material elements and troubles between them, as well as to changes in environmental parameters.

The main way to increase the operational efficiency of hydraulic structures should be considered the improvement and development of such methods: assessment of reliability and safety, taking into account the aging process; estimation of durability; analysis of critical loads and conditions associated with hydraulic, hydrology and other factors, optimization and operation of surveillance strategies based on the analysis of real data under the long-term operation of hydraulic structures.

Survey of topside culverts and water regulation of hydraulic structures included the registration of such damages: cracks in concrete and reinforced concrete structures, flaking concrete surface; destruction of beta surface; stripped reinforcement of concrete surfaces, corrosion of reinforcement; identify areas of concrete leaching, filtration of water through the construction and filling; subsidence, landslides slopes.

2.3. Categories of Technical State

Depending on the existing damage, the technical conditions of hydraulic structures can be divided into five categories:

1) Normative - technical category of state in which all the quantitative and qualitative characteristics of the technical state of the structure (element) conform to the values in the project or regulatory documents.
2) Usable - category of technical condition in which some of the characteristics of technical condition of items or structures in general do not meet the design requirements or standards, but existing violations of requirements, specific operating conditions do not lead to malfunction, and there is provided the necessary operational suitability
3) Limited-usable - the category of technical condition of items or structures in general, in which their performance is provided by changing the mode of operation.
4) Inoperable - condition of the structure in which it is unable to perform its functions.
5) Limit state - condition of the structure in which its further operation is not allowed for reasons of danger or impractical from ecological or economic reasons.

According to these technical conditions assessment should be conducted on a more significant damage.

Analysis and evaluation of the reliability of culverts and regulating facilities of reclamation systems were based on qualitative and quantitative methods of reliability analysis, which were based on analysis operating conditions,

identifying of the causes and mechanism of the influence of failures, identifying indicators of reliability elements, including the organization of maintenance and repair.

3. Results

According to the results of field surveys and culvert regulating facilities there were set specific types of injuries, which include: the deformation and destruction of tiles (Fig. 3), and the destruction of sea ling material between the head part and the tube (Figure. 4).

Figure 3. Destruction of tiles TP - 100

Figure 4. Degradation of the material between the terminal and these align tube RTP-100

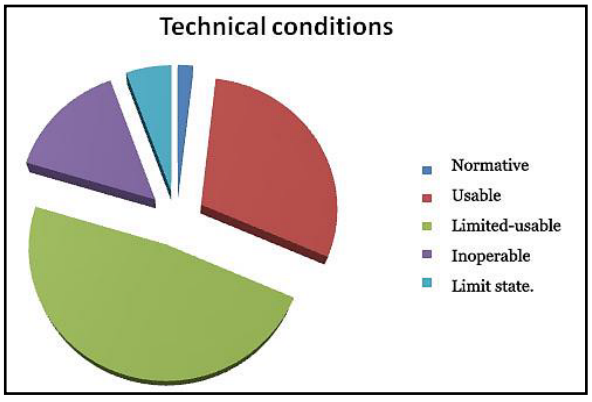

Figure 5. Distribution of technical states culvert and regulating facilities for 38 years of operation

The actual performance of technical condition of hydraulic structures were set on the basis of data on injuries of waterworks, figure 5 shows the percentage distribution of the technical condition of culverts and regulating facilities for 38 years of operation.

Above 80% of waterworks of reclamation systems related to the technical conditions in which they do their functions as they are intended.

Distribution of damage identified in the elements of waterworks showed that a large concentration of damage is inherent to the tailrace.

Determining the strength of the concrete was conducted under field conditions by non-destructive method. On the basis of data on the strength of the concrete strength as made a time graph of dependence between culvert pipes and regulating facilities (Fig. 6).

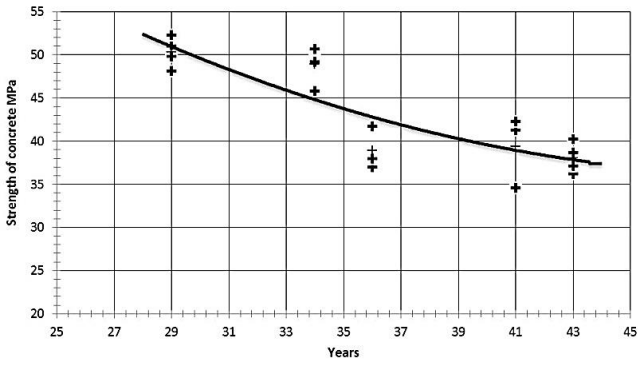

Figure 6. The graph of dependence of concrete strength of waterworks

The graph shows that the strength of concrete culvert pipes and water regulation structures varies between 36 - 51 MPa. Strength of concrete structures for the working term of 38 years decreased by 18% at the design safety margin of 40% .

4. Conclusions

1) Damage analysis of waterworks elements showed that a large concentration of damage is inherent in the tailrace.
2) The results of field surveys of water regulation and culverts installed such characteristic lesions: the destruction of sea ling material between the head part and the pipe, deformation and destruction of tiles.
3) The strength of concrete of culvert pipes and water regulation structures is sufficient to prolong their service life. Strength of concrete structures, the actual life of which is 38, with the standard life of 40years, has decreased by18%at the design safety factor of40%.
4) More than 80%of waterworks reclamation systems related to the technical condition in which they perform their intended function during 38years of operation, and 20% require thorough repairs.

REFERENCES

[1] DBNB.1.2-14-2009 "General principles of safety and structural safety of buildings, structures and foundations", Kyiv Ukraine Ministry of Regional Development 2009

[2] Huryn V. A., Radchuk M. I. “Assessment of the reliability of fastening ribbed slabs slope water management facilities” // Bulletin NUWMNRU (61). Scientific publications 2013 -p.52-65.

[3] Methodical recommendations from the technical operation of building sand adjacent territories. - K.:Technical Centre Union, 2002. – p. 112.

[4] Kaveshnikov N. T. “Maintenance and repair of hydraulic structures “/ N.T. Kaveshnikov . - M.: Agropromizdat , 1989 . – 272 p.

[5] E. A. Bakulin “Effect of safety factor intended to assess the safety of buildings with increased level of responsibility.” - Journal of NAU 2004. № 4

[6] A. N. Dobromyslov “Reliability assessment of building structures by their appearance” / / “Design and calculation of building structures” : Collection of articles / LDNP. - SPb, 1989 . - p. 76-85 .

[7] Karpenko A. O. “Analysis of research in the field of the reliability of reinforced concrete elements with high-strength concrete.”- K. 2011.

[8] “Recommendations for evaluation of reliability of building structures by external characteristics (TsNIIPromzdany). - GOSSTROY USSR, Moscow 1989 – 102 p.

[9] GOST R54523-2011 "Port waterworks rules survey and monitoring the technical condition" M.: Standartinform,2012.

[10] DBNV.2.4-3: 2010 "Waterworks. The main provisions" K.: Ministry of Regional Development of Ukraine, 2010.

[11] Naumenko I. I. “Reliability of structures and drainage systems ”I. I. Naumenko. -Kyiv, 1994. –424 p.