International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Impact Factor (2012): 3.358

The Method of Assessing Risk Management at Various Stages of the Life Cycle for the Problem of Diagnostics of Technical Condition of Buildings

Svitlana Tsiutsiura[1], Olexander Terentyev[2]

[1, 2] Kyiv National University of Construction and Architecture, 31, Povitroflotskiy Ave, Kyiv 03680, Ukraine

Abstract: ***The concept of life cycle management is based on the idea of the construction (building) as a single information object, around which are the various processes - design, construction, operation, repair and diagnostics of technical condition, each of which uses and adds information about the object.***

Keywords: examination, the technical condition of the building, an assessment method category.

1. Introduction

The concept of the life cycle of construction projects (buildings) is complex, and its implementation may take quite a long time. Where exploitation, and there service, repair and diagnostics of the technical condition. Therefore, we consider the implementation of information system management technical operation, maintenance, repairs and diagnostics of technical condition of buildings and structures (ICM TO DTB).

2. The Problem

Consider the concept of the modern approaches to the description of control systems Tots which is fully maintained in a life cycle approach [2].

Description ICM TO DTB.
ICM TO DTB is designed for the following tasks:
Quality management TO DTB:

- monitoring the status of objects in operation;
- planning, accounting, control, analysis, and control of scheduled (preventive) repairs and/or overhauls to the state of objects;
- configuration management objects - configuration, deployment, conditions of operation.

The concept of ICM TO DTB lays down the following basic principles [2]:

1) The control object in the system is maintenance passport (SMP) equipment.
2) SMP combines the information about:
   a. the technical condition of the object (the log records by status) - data monitoring, inspections, measurements, diagnostics, testing, faults, etc.;
   b. operations performed on the object (operational, maintenance, etc.) - data on jobs, resources and time spent, indicators of living conditions and quality of execution.
3) The data source for the control TO DTB object are the data of monitoring of technical condition of operation (self-test, expert evaluation, etc.) and data of previously performed works TO DTB recorded in SMP. Based on these data, the analysis of the current state of the object and the decision about the necessity of working TO DTB according to the technology.
4) Managing work TO DTB is due to the management SMP for the chain of technological operations through the point of information collection and control compliance with the technology of the work.
5) To ensure the reliability and relevance of data collected, as for monitoring the condition of operation and in the works TO DTB used automate data entry through integration with airborne and ground-based diagnostic and control equipment, equipment SCADA, controllers, means of automatic identification.

The basis for the implementation of these principles is the data about the object of construction - design - engineering data, maintenance and operational data, characteristics, requirements for operation. These data should be formed at the stages of design and construction and be available at the stage Tots in a natural way, without any re-introductions. The inevitable procedure of amending the specification should cover all stages and TO DTB.

In Fig. 1. consider the concept of the ICM TO DTB for buildings and structures.

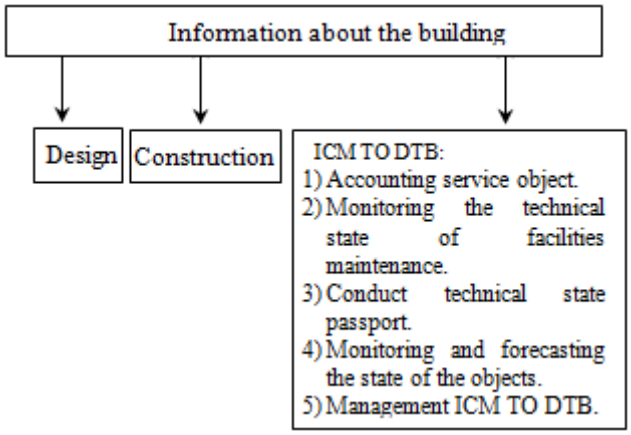

Figure 1: The concept of IMS Todd for buildings and structures

3. Risk Assessment at Different Stages of the Life Cycle of Buildings

Stage of the life cycle of a building or structure can be described by the following sequence: idea, planning, design, tender, construction, operation, reconstruction and decommissioning. These stages are characterized by different quantities and the nature of the risk [1].

Project. Risk analysis is extremely important at the conceptual design stage. In most cases, security is ensured regulatory models and coefficients that apply to whole groups of relevant structures. Responsible for project safety can be achieved by recycling norms for the application of the project. They take into account the unusual and random loads: earthquake, floods, strong winds, fires in tunnels and so on. It is important to conduct a detailed analysis of these loads to estimate the uncertainty of the physical models and their impact on the building project.

Tender. For complex tenders, the selection is done similarly to the choice of model risk in the stages of planning and design. At this stage, the estimated number of criteria : cost, the probability of exit of the budget, construction schedule, safety of the technology used, the quality of the final product and so on. In domestic practice, these parameters do not always take into account properly. Often in projects provide different levels of security for the society and construction workers. These risks should also be considered in the overall assessment.

Construction. At this stage risks include the quality and cost of construction, safety of construction workers. Applied methods of risk assessment and reliability is closely linked to quality control and production work on the construction site.

Operation. Decisions made at this stage related to various aspects of risk and safety. Here there is a check on the validity of the assumptions made during planning and design. For this stage developed different standards for risk analysis.

Reconstruction. Unlike the design stage additional cost for safety improvements at the stage of reconstruction is big enough. Therefore, in each case, the reconstruction requires the use of detailed physical models and direct estimation of reliability. Great importance is the application of probabilistic methods of calculation using estimates of experts, the history of the project and monitoring results and observations. In many cases, the reconstruction can achieve great savings through research to ensure the reliability of the structure.

Decommissioning and dismantling of the building. The life cycle of the building, including its decommissioning, it is necessary to consider already at the stages of planning and design. The structure and methodology of the evaluation decisions concerning decommissioning of facilities are not fundamentally different from the structure of decision making on the construction.

Methods of calculation of reliability of buildings.
When calculating risk and ensure the safety of buildings used deterministic and probabilistic methods.

Deterministic methods are based on the design using specific values of the coefficients of reliability. In these methods introduces some assumptions in relation to variable strength $(x_1, \ldots, x_n)$ and load $(y_1, \ldots, y_m)$. Thus a certain margin between the calculated strength R and the load S is created with common reliability factor y_0. There fore, this condition is written as:

$$R(x_1, \ldots x_n)/S(y_1 \ldots y_m) > y_0 \quad (3.1).$$

The reliability coefficients reflect incomplete knowledge of real geotechnical situations, and their magnitude depends on the experience gained in the design and operation of facilities. The safety factors help the designer in the expert assessment of the situation, but they are neither directly nor indirectly do not consider the accident and the damage associated with them.

For most standard tasks, deterministicly approach has its limitations. The adoption of large values of the coefficients of reliability raises the costs of construction and often do not allow to implement progressive and beautiful design solution. A balance must be struck between the degree of conservatism and uncertainty that must be considered. For example, a too conservative approach when building on soft soils will not allow the possibility to apply new developments. On the other hand, the lack of a proper assessment of the risks associated with construction on soft soils, it may be very unpleasant consequences.

Probabilistic methods are more progressive in their security structures is evaluated in terms of the possibility of failure Pf. In this case, it is assumed the potential deviation of the different parameters. Parameters are treated as stochastic variables.

Probabilistic calculation methods are divided into methods using the so-called levels I, II and III.

Method using the I-th level recommended by the Eurocodes. They used a series of private safety factors, which are divided or multiplied variables, resulting in the so-called design values.

When the methods of calculation using the 2nd and 3rd levels of reliability requirement facilities is expressed in terms of probability of failure or accident:

$$P\,[R(x_1, \ldots x_n) < S\,(y_1 \ldots y_m)] = P(Z < 0) < P_{fo} \quad (3.2),$$

where P_{fo} - is a reasonable likelihood;
Z - is the reliability function.

4. Conclusion

Methods of calculation with the use of the 2nd and 3rd levels are implemented using software systems that use, for example, finite element method. These methods are predominantly used in the calculation of complex structures.

In this respect, of great interest is a numerical technique for calculating the reliability of buildings and structures DARS. The method is based on constructing the so-called response surface, which is used to assess the reliability of the structure. This assessment is valid using the method of the directed testing, which allows us to estimate the probability of failure of major components. The joint use of response surface and method of the directed testing enables a low-cost machine time and resources to conduct probabilistic reliability calculation very complex engineering buildings in the spatial setting.

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Author Profile

Mrs. Svitlana Tsiutsiura is Doctor of Technical Sciences, Professor, Professor of Department of information technology; academician of the Academy of construction of Ukraine. In 1988 he graduated from the Kyiv technological Institute of food industry, faculty of automation of technological processes, qualification – “automation engineer”. In 1995 I was awarded the scientific degree of candidate of technical. Sciences; in 2007 the degree of doctor of technical Sciences. Academic rank Professor of education of Ukraine awarded in 2008 is the Author of over 200 papers, including 6 textbooks, 1 monograph. Direction of scientific activity – management of investment, innovation, it project and budget development programs; development of expert systems and decision support, document management systems certification of personnel; information technology standards development, subsystems, licensing and accreditation; optimization of logistic processes in supply chains.

Mr. Olexander Terentyev received B.Sc. and M.Sc. degree in information and computer science and the PhD. degree in information technologies" Kyiv national University of Construction and Architecture, Ukraine, in 2001, 2002 and 2009, respectively. Since 2006 associate professor, and since 2009 associate professor at the Department of information technology, Kyiv national University of construction and architecture, Ukraine. From 2002 – junior research fellow, and from 2008 to the present time – senior researcher, head of sector studies of buildings and structures of the State enterprise “State research Institute of building production, the Ministry of regional development of Ukraine”. The author of numerous research, design and many other scientific works.