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Cognitive maps for structural reliability control

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ABSTRACT

Application of information technologies raises interest to preparation of high-qualified experts, quality management in operation of marine structures. Theoretical positions, principles of functioning, an assumptions and restrictions of decision system are given. Identification of problem area is carried out. Requirements of reliability, efficiency, protection of the information are provided. Methods and means of gathering and transfer of the information, a quality monitoring of the input information, language of inquiries, menu, helps, etc. are described. Graphic interpretation of structure of base of knowledge is given, the features of structure caused by character of tools are described, dependencies of factors the examinations connected with indistinct or probabilistic nature of knowledge are proved. The generalized reliability of offshore structures is determined by multiplication of physical, functional and external wear factors. The three stages of formation of information cone from raw data to information and then to synthesis of knowledge are considered. On every stage the cognitive maps are developed for three levels (meta-, macro- and microlevel).

KEY WORDS: Cognition; structure; quality; reliability; control; information, knowledge.

INTRODUCTION

According to Federal program of water transport renovation up to 2010 the cargo turnover will be increased on 82% from 182 to 332 mln. t. There are 22 ports on Russia Far East from Posyet harbor to Tiksi port. The harbour structures need in investments accounting for development of offshore projects, exploration of Siberia and Yakutiya resources and usage of North transport route. At the present time the main problems are definition of wear and development of design procedures which are taking into account change of reliability during operation. Numerous defects of designs because of errors of designers and builders have turned with the course of time in critical ones. Literature overview as well as results of inspections carried out by Hydrotex Ltd. of 200 berths of Primorsky, Sakhalin and Kamchatka territories show the following peculiarities of berth operation in the Far Eastern region of Russia: a) more than 70% of berths were in unserviceable condition and about a half of them passed through lifetime of 50 up to 80 years that was caused by no investments in construction and maintenance due to decreased freight turnover or due to owner's change; b) wear intensity increased due to lack of resistance to aggressive environment impact (50%), overloading (30%), errors in projects, construction and operation (20%). The construction of 3 drilling platforms near north-eastern Sakhalin offshore make actual the inspection of CGBS under severe ice and seismic conditions.

This makes for evaluation urgency and qualitative variability of structures during its lifetime. It is necessary to consider time factor because standard lifetime does not conform to actual one due to mentioned factors. Main tasks for operation companies are to provide reliability, safety, maintainability and optimization of service modes.
For example, experience of berth inspection show that 90% of sheet piling berths have face panel gradient of average 4% and maximum 10%. However, calculations as per standards and simulation by FEM soft show reserves of bearing capacity. The database available at Hydrotex was systemized and there was assessed quality level as follows: selection of quality indices range and reasons for its completeness; development of methods of how to define value of quality indices; selection of initial data and values of signs controlled; definition of quality indices and comparison with those standard/basic ones; comparative analysis of variants of possible solutions and search of the best one; reasons for recommendations issued for exploiting companies.

The improvement of control requires development of the theoretical basis. By consideration of structures as complex system the accordance of interrelations between elements is necessary for normative quantity restrictions and quality requirements on system as a whole and the coordination of wear criteria of elements and systems.

QUALITY CONTROL

Diagnostic problems

Diagnosis answer on question: "What are the reasons and dangers for structure at observed defects, faults and external effects?". Prognosis answer on question: "What defects, faults and external effects for