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Title: ‘FATIGUE OF HYDRAULIC STEEL STRUCTURES’

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Introduction:

This report is the final product of the Working Group activities. It contains a detailed analysis of the current engineering practice and offers guidelines for a more uniform, systematic approach to fatigue related issues. The report provides a summary of the appropriate design tools, analysis methods, technical codes, other guidelines and best practices. It gives examples of both correct and incorrect solutions, provides the discussion of crucial issues and presents the lessons learned from fatigue failures of hydraulic structures. Apart from the design, the report also provides proper recommendations and best practices for the repair of different fatigue damages and for the management (particularly monitoring and assessment) of structures exposed to fatigue.

The existing guidelines and norms that handle fatigue of structures in other fields have thoroughly been reviewed and recommended if and where appropriate. The matters that have been investigated include:

- Nature of fatigue in hydraulic structures, significance and specific character of fatigue damage; Identification of fatigue loads, their sources, characters and correlations. Modeling these loads for analytical purposes; Requirements and boundary conditions of fatigue management, e.g. gate service life, permissible damage, accessibility for repair, conditions imposed by maintenance; Fatigue analysis methods and their assessment in view of hydraulic structures. This includes a study of literature and a critical discussion of the existing design codes; Relevant material aspects of fatigue, like fatigue behavior of various steel alloys, connectors, welding details etc; Detailing and construction of hydraulic gate components that are crucial in view of fatigue prevention; Monitoring, field inspections, assessment and maintenance of fatigue sensitive details; Available repair techniques of fatigue damage and other methods of service life extension; General conclusions and recommendations.

Context Issues

In response to the general guidelines of PIANC, the Working Group paid special attention to the following two groups of context issues: Relevance for the countries in transition and Issues overlapping the challenges of Climate Change.

As concerns the first point, the investigation field of the Working Group – fatigue of hydraulic steel structures – is relevant for any country that maintains waterborne infrastructure. This includes the Countries in Transition. Efforts have been made to receive contributions from these countries to the discussions and other activities of the Working Group.

As concerns the second point, there is no direct link between the fatigue of hydraulic structures and the issues brought upon by the climate change. Indirectly, there is a link because climate change has impact on the design loads of hydraulic structures, including fatigue loads. For fatigue, however, the most critical parameters of these loads are their variation frequency and amplitude. For some locks increased water levels do have a significant effect on the amplitude of the fatigue load, however the correlation of these parameters with the climate change is not considered particularly strong, according to the current views.

Nevertheless, there are scenarios that forecast not only a general increase of hydraulic loads as a result of climate change. They also predict the increased frequencies and amplitudes of these loads. The Working Group paid attention to such forecasts and included the relevant discussion and/or references in appropriate sections of the report.

NOTE: The objective of this report is to provide information and recommendations on good practice. Conformity is not obligatory and engineering judgement should be used in its application, especially in special circumstances. This report should be seen as an expert guidance and state of the art on this particular subject. PIANC disclaims all responsibility in case this report should be presented as an official standard.

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