



REMR Technical Note OM-MS-1.14

REMR Management System for Tainter Dam and Lock Gates

Purpose

To provide information about the REMR Management System for tainter dam and lock gates.

Background

Over the past 100 years, the U.S. Army Corps of Engineers has designed and constructed numerous civil works structures such as locks and dams on the navigable inland waterways and coastal systems as well as dams for power generation. Recently, however, the potential for such undertakings has become limited, and the need for maintenance of the present facilities has become more significant. Many of these structures require, or will require, significant repairs to ensure safe and efficient operations. To aid in the planning and budgeting for maintenance and rehabilitation of these aging facilities, a series of REMR Management Systems are being developed. These computerized maintenance management systems help provide a more effective means of monitoring facility conditions (see REMR Technical Note OM-MS-1.1 (U.S. Army Engineer Waterways Experiment Station (WES) 1998a).

Overview

A REMR Management System has been developed for tainter dam and lock gates. Like previous REMR Management Systems, this one is a collection of standardized condition inspection and rating procedures and personal computer-based database management. The software produces a variety of reports for work planning and budgeting.

Condition Index Rating

As with other REMR Management Systems, the primary driving element is the condition rating process. The condition ratings follow the standard REMR Condition Index (CI) scale from 0 to 100. As described in REMR Technical Note OM-CI-1.2 (WES 1998b), the CI is used to group structures into three zones. The numbers and zones indicate the relative need to perform REMR work because of deterioration of the functional and structural characteristics of

the structure. The CI calculation is based primarily on objective field measurements, with some dependence on subjective observations of problems.

Application of the management system begins with an inspection of a tainter dam or lock gate according to standard procedures. A series of critical measurements are made on each gate, each related to one of the distresses in Table 1. The condition indexes for the individual distresses are combined by a weighted average to give the overall condition of the gate.

Functional CI

The functional CI is based on field measurements and observation of structure defects. It includes both safety and serviceability considerations. These field measurements are related to 11 functional distresses, listed in Table 1. As an example, a misalignment, X , of 152 mm (6 in.) could be measured. If the limiting value of this movement, X_{max} , is 229 mm (9 in.) ($X/X_{max} = 1.7$ mm (0.67 in.)), observation of Figure 1 gives a functional CI near 54. This is a Zone 2 condition in which an economic analysis of different repair alternatives is recommended. A similar procedure is used for the other distresses in Table 1. The CIs for the individual distresses are then combined by a weighted average to give the overall functional condition of the tainter gate.

Table 1 Tainter Dam and Lock Gate Distresses	
Distress	Description
Noise/jump/vibration	Abnormal noise, jumping, or vibration during gate operation
Vibration with flow	Vibration of gate as water flows underneath
Misalignment	Twisting of gate between piers or lockwalls during lifting
Anchorage assembly deterioration	Movement of embedded anchorage system and damaged components
Trunnion assembly wear	Displacement between pin and bushing
Cracking	Breaks in structural steel components
Dents	Disfiguration of the steel components
Corrosion/erosion	Loss of steel due to interaction with the environment
Cable/chain plate wear	Wear on the skin or bearing plate due to sliding action of cable or chain
Leaks	Water passing around the gate
Seal condition	Condition of the seals

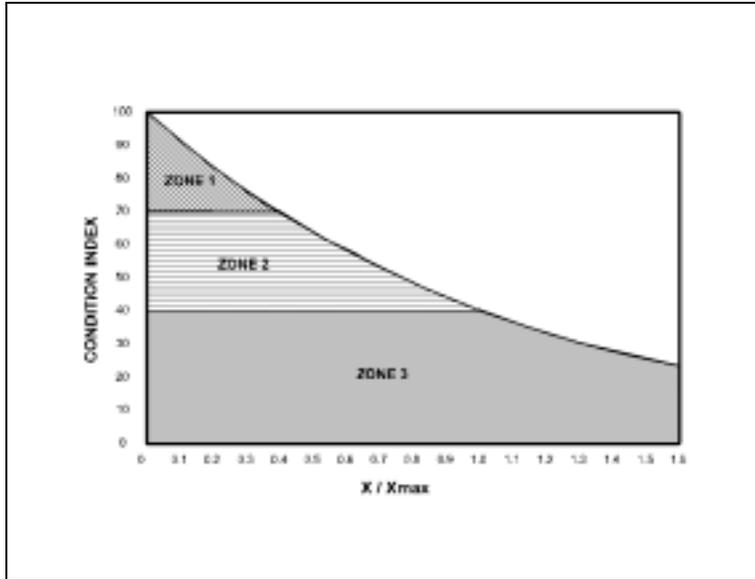


Figure 1. Condition index related to X/X_{max}

Structural Considerations

The effect of structural deterioration on safety is difficult to account for in classic structural analysis techniques and is not easily quantified. Therefore, expert opinion is used to develop rating rules that assess structural condition based on subjective safety requirements. This means that rating rules were developed to simulate an experienced engineer making safety judgments based on inspection notes or data. Certain distresses characterize the structural adequacy and safety more than others. These distresses are more critical to the overall safety of the structure and are called structural distresses.

To alert an engineer to a potential safety problem or to an already existing problem, structural notes are attached to the structural distresses under certain circumstances. Structural notes simply state that the given structural distress may indicate that a serious structural problem exists and further investigation is strongly advised.

Benefits/Savings

This computerized REMR Management System provides procedures for performing condition surveys, consistent and quantitative condition assessment, and database management. Combined with economic analyses, these procedures allow efficient maintenance and repair (M&R) budget planning through the evaluation of current condition and comparison of various M&R alternatives based on life-cycle costs. The ultimate goal is to achieve the best possible condition for tainter dam and lock gates at any funding level.

The collection of consistent, uniform condition assessment data will allow the generation of typical curves reflecting rates of deterioration. The combination of historical condition data and expert opinion should allow prediction of changes in the CI based on maintenance history, operating conditions, and applied M&R policies.

Status

The REMR Management System for tainter dam and lock gates has been tested and is being implemented throughout the U.S. Army Corps of Engineers. Training sessions for Corps personnel have been completed, and the program will undergo updates and revisions as necessary. A technical report, REMR-OM-17 (Greimann, Stecker, and Nop 1995), has been published to document the procedures used. The most current REMR software is available on the internet at <http://www.cecer.army.mil/fl/remr/remr.html>.

References

Greimann, L., Stecker, J., Nop, M. (1995). A Condition rating procedures for tainter dam and lock gates, Technical Report REMR-OM-17, U.S. Army Construction Engineering Research Laboratory, Champaign, IL.

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