MITRE GATES: MAINTENANCE – PIANC WG 154

**by**

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1. **INTRODUCTION**

Mitre gates are by far the most common navigation lock gate type in the world. Over their lifetime, mitre gates require maintenance for repairs and to extend the lifetime. Care taken in the gate design and maintenance strategies can result in gates that require less maintenance and can be repaired with less outage time. The recently published PIANC WG Report No. 154 covers international mitre gate design and summarizes the current state-of-the-practice and best practices in mitre gate maintenance.

1. **MAINTENANCE**

Before the mitre gate is put into service, it is important that is designed with ease of maintenance in mind. This includes allowing easy accessibility for inspection and repainting, easy replacement of components susceptible to wear and damage, easy handling by maintenance personal during lifting or jacking, and standardising replacement parts. Standardisation of river system mitre gate design helps to reduce part inventory, improves consistency in repair and replacement methods and reduces overall maintenance costs. After the gate is put into service, the first two steps of maintenance are inspections and instrumentation so that problems are identified early when they are easier to repair and schedule for repair.

Methods of repair depend on the extent of repair required to the gate, gate weight, site accessibility, and navigation interruption. Smaller gates can be lifted out of place and worked on in-the-dry. Larger gates may require lock dewatering and jacking. In-place gate weights needs to be verified before any lifting or jacking of the gate is done. Things to consider in the total gate weight calculations are original gate weight, repairs or changes to the structure, added coating weight, debris weight, ice loads, and silt loads. Larger gates may be designed with jacking points so that the gate may be moved vertically using hydraulic jacks for removal or maintenance or work with the pintle or other work under the gate, such as seals. The jacking procedures and stabilisation system need to be designed for each operation needed. If the gate needs to be lifted for repair, lifting pick points need to be designed for in-place gate weight and the desired handling for maintenance.

1. **SPARE PARTS**

The operation of mitre gates requires stocking spare parts for the most fragile parts on a permanent basis. All these parts, with the exception of the gates themselves, can be split into two categories: 1) Parts whose replacement cannot be foreseen and therefore cannot be scheduled; 2) Those parts which will need to be replaced due to normal wear and tear. Anchorage bars and linkages, pintles, gudgeon pins, diagonal bars and operating strut arm are a few critical parts that are essential to operation. Reasons for having these parts for emergency inventory include: they have long lead times for fabrications, they are small enough to easily store; and historically, they have been known to have higher rates of damage.

For other larger parts such as main framing members, it would be prudent to have an action plan for procurement and repair in an emergency. This may vary on gate and site specific conditions. An action plan may include utilising a cofferdam to inspect and/or repair a pintle. An example of such a cofferdam is shown below. Considerations include sealing, assembly and the sizes of the gate recesses and lock sills to which it must adapt if used for identical and common locations.

Some examples of parts kept in inventory for normal wear and tear include: pintle bushings, gudgeon pin bushings, anchorage bushings, gate actuator parts and sensors, fenders, seals, and instruments for the measurement of levels and of actuator movements. Contact blocks are wear items but are typically planned with larger scale maintenance and not kept as a spare part.

1. **SPARE GATES**

Typically, the acceptable time period for navigation interruption is much shorter than the time required for major repairs or replacement. This is why there is a need for spare mitre gates that can be placed into operation in a relatively short amount of time. For spare gates, a lifecycle analysis needs to be performed to determine the costs of navigation interruption compared to the costs of having spare gates. Historically, some critical locks have had spare gates sitting on site for quick replacement while other locks have had sectional spare mitre gates that can be assembled to multiple heights to accommodate multiple lock sites. There are also locks that do not have spare gates. The number of spare gates must therefore be based on the likeliness of an accident and maintenance operations happening simultaneously. Depending on gate size and crane capacities, sometimes gates are stored at locks, on barges or in special buildings to preserve their condition.

1. **DEBRIS AND ICE MANAGEMENT**

Debris and ice can cause operational and maintenance problems. High volume air bubbler systems have been used effectively to move ice and debris from the gate recess area such that the gate may fully move to recess position. High volume bubblers are also used across the lock chamber upstream of the gates to help limit ice movement into the chamber and gate area. Low volume air systems or propeller systems can be attached to the gates to prevent the buildup of ice on the gates. Permanent or portable steaming wands are used to cut ice from lock recess walls or gates.

**REFERENCES**

PIANC. (2017). Report of Working Group 154: Mitre Gate Design and Operation, PIANC, Brussels.

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