

Paper 1 - Presentation of the PIANC Report n°106 on Locks

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ABSTRACT: This introductory paper of the Brussels International Workshop (Oct 2009) on “Innovations in Navigation Lock Design” introduces the report 106 published by PIANC in August 2009. Main objectives and issues are highlighted in this paper. This report has been achieved by the INCOM Working Group 29 of PIANC from 2006 to 2009.

1 INTRODUCTION

Locks are key structures for the development of the navigation in canals and in natural rivers where weirs regulate water levels to enable navigation. They may also be strategic infrastructure for port development.

In lower elevation regions, such as New Orleans and the Netherlands, locks are structures in dikes and also have an important task in flood defence.

In 1986, PIANC produced a comprehensive report of 445 pages on Locks (PIANC, 1986). For about twenty years this report has been considered as a world reference guideline, but it now needs updating to include new design techniques and concepts. PIANC decided in 2006 to launch a new Working Group (WG) to update the report, and this present report is the result.. The new report must be considered more as a complement to the 1986 report than a replacement version, and focuses on new design techniques and concepts that were not reported in the former report. It covers all the aspects of the design of a lock but does not duplicate the material included in the former report. Innovations and changes that have occurred since 1986 are the main target of the present report.

The core of this report has three major parts. The first part (Section 3) presents an exhaustive list of design goals associated with locks. This section is particularly important for decision makers who have to launch a new project. The second part (Section 4) reviews the design principles that must be considered by designers. This section is

methodology oriented. The third part (Section 5) is technically oriented. All main technical aspects (hydraulics, structures, foundations, etc.) are reviewed, focussing on changes and innovations occurring since 1986. Perspectives and trends for the future are also listed. When appropriate,, recommendations are listed.

Major changes since 1986 concern maintenance and operational aspects, and more specifically how to consider these criteria as goals for the conceptual and design stages of a lock. Renovation and rehabilitation of existing locks will be an increasingly important topic for the future.

In natural rivers, locks are usually associated with movable weirs, and in coastal areas with flood protection structures. In 2006 PIANC published the InCom-WG26 report “Design of Movable Weirs and Storm Surge Barriers” (PIANC 2006). That report can be considered as a companion report to the present report as locks and weirs have many design aspects in common. Some design aspects are not discussed in this report since they have already been developed in the InCom WG26 report on weirs (for instance: multi-criteria assessment for comparison of design alternatives, ...).

Section 2 of this report also includes more than 50 project reviews of existing (or lock projects under development) which describe the projects and their innovative aspects. Some purely innovative and untested concepts are also mentioned as references although with no guarantee of validity.

2 AIMS OF THE INCOM-WG29 AND TERMS OF REFERENCE

The objectives of the InCom-WG29 have been defined by the Terms of Reference (ToR) proposed by the Inland Navigation Commission (InCom) and approved by the PIANC Executive Committee (ExCom) in late 2005. These PIANC committees required establishing a comprehensive review of modern technologies and research results used to design and build navigation locks. A clear commitment was that only concepts and technologies not discussed in the previous PIANC 1986 report were to be considered and reported in this new report.

So, topics investigated here include:

- a) Design objectives and optimization goals for locks
- b) Innovative lock design concepts
- c) Innovative technical solutions.

Recent lock projects of interest are listed, reviewed and analyzed. Detailed **Project Reviews** are provided on the DVD attached to the report.

Recommendations for studies needed at the conceptual and design stages of a lock are established.

In addition, maintenance and operational requirements are discussed and listed.

A relevant **reference list** has been prepared. Documents were analysed and compared by the WG to give engineers, designers and authorities a reference list allowing them to access relevant information to solve their problems.

To assist continuity and to avoid duplication of existing PIANC material the former 1986 PIANC Report on Locks is included on the attached DVD (Directory A3). In addition, its Table of Contents is given in Annex I of the present document. These should be used as support to this report and as a baseline of standard practice.

3 WG29's DVD

Due to publishing constraints the number of pages of the InCom-WG29's hardcopy report was limited. Therefore additional information has been saved on a companion DVD (attached to this PIANC hardcopy report). Care should always be taken to use the current versions of standards and other publications that might supersede the versions on the DVD.

This DVD includes the following directories:

- A1: The Project Reviews of 56 lock projects.
- A2: PIANC'2009 Lock Report (pdf)
- A3: PIANC'1986 Lock Report (pdf) – in French and English
- A4: PIANC Dictionary on Locks & Waterways
- A5: LIST of LOCKS (Worldwide list)

- Additional information to various sections of this report (Directories B) such as:
 - o B4.6.1: Salt Water Intrusion
 - o B4.6.5: 3D Video Modelling of Construction Process
 - o B5.2: Hydraulic (Manoeuvring, Fendering, ...)
 - o B5.5: Gates and Valves
 - o B5.7: Lock Equipment
 - o B5.8.5: Lubricants and Bio Oils

- Various technical guidelines (Directories C) :
 - o C1- Estoril'2006 - PIANC Congress Papers
 - o C2- Beijing'2008 - AGA-2008 Papers.
 - o C3- Navigation Lock - Ecluse de Navigation (by N.M Dehousse, 1985) in French
 - o C4- Corps of Engineering, USA - Reports on Innovation
 - o C5- Chinese Codes
 - o C6- French Guidelines - Lubaqua (CETMEF)
 - o C7- Fish Passage In Lock
 - o C8- Corrosion Protection
 - o C9- Planning of Lock Maintenance (example)
 - o C10- European Code For Inland Waterways (CEVNI)
 - o C11- Ship Impact
 - o C12- Seismic Impact of Lock Gates
 - o C13- ISPS Code 2003 - IMO (Safety and Security of Ship and Port)
 - o C14- Panama Third Lock Lane
 - o C15- Seine Nord Europe Canal (France)
 - o C16- Three Gorges Locks, China
 - o C17- Specifications for Lock Design (Lanaye Lock, Belgium)

- Sponsor Company's References (Directory D):
 - o Bureau GREISCH (B)
 - o IMDC (B)
 - o TECHNUM (B)
 - o Planning and Design Institute for Water Transportation (PDI), China
 - o Guanxi Xijiang Navigation Construction Co. Ltd. (China)
 - o Compagnie Nationale du Rhône (CNR, France)
 - o Grontmij / BGS Ingenieurgesellschaft mbH (D)
 - o Delta Marine Consultants (NL)
 - o Rijkswaterstaat (NL)
 - o ISPH (Romania)
 - o IDOM (Spain)
 - o Ben C. Gerwick, Inc. (USA)

- InCom WG29 meeting pictures, (Directory E)