

PIANC Workshop
15-16th October 2009



Part 3: Navigation Locks: Developments in Design Objectives and Methods

Peter Hunter
HR Wallingford, U.K



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Locks: Design Objectives and Methods



- **Economic and Financial Objectives**
- **Environmental Objectives**
- **Design Objectives**
- **Life Cycle Management**
- **Design Methods**
- **Safety**

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Locks: Project Objectives



Economic and Financial Objectives:

- allow larger ships
- increase capacity (e.g. of canal)
- reduce overall transport costs



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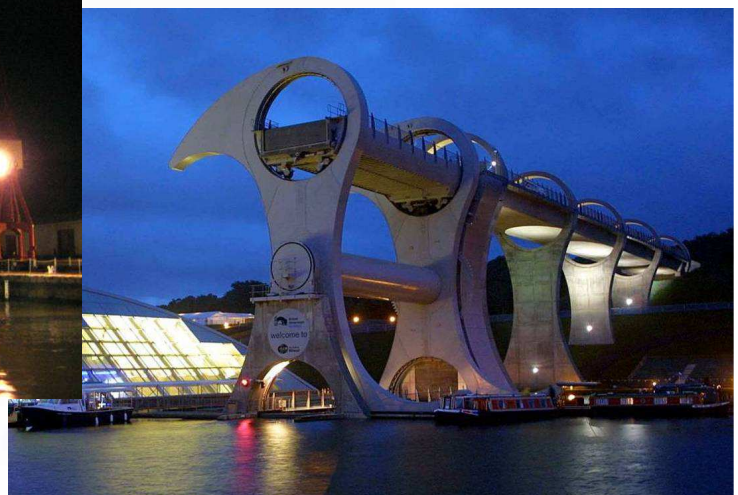


Other Economic and Financial Objectives:

- Reduce construction and maintenance costs
- Increase economic activity: tourism, leisure,



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Design Priorities



Design approach can have four different priorities:

- Design for lowest initial (construction) cost
- Design for minimum maintenance.
- Lowest whole life cost
- Best performance (fastest operation, least down-time)

Whose priorities?



- **Government** - National interest: secure transport routes
- **Owners** - Profitability & Turnover
- **Managers** - Ship numbers, safe operations
- **Employees** - Rewarding employment, security
- **Users** - Efficiency, speed, safety, cost
- **Community** - Employment opportunities, environment



Main Design Objectives

Main design objectives and optimization goals that govern the design of a lock are:

- Reliability - system, structures and operations,
- Faster cycle times,
- Reduced mooring forces
- Minimum water use
- Minimum Saltwater intrusion
- Reduced life cycle cost
- Minimised energy use
- Low *negative* environmental impacts
- Safety and Security




Life Cycle Management



LCM is aimed at providing minimum Whole Life Costs.


**dealt with in MarCom-WG42
Life Cycle Management of Port
Structures (August 2007)**



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MarCom

Report WG42 – August 2007



Life Cycle Management of Port Structures
Recommended Practice
for Implementation

Life Cycle Management



- Design for minimising operating & maintenance costs
- Design for minimising downtime
- Design for minimising whole life costs
- Maintenance Management

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SAFETY: Locks are safety-critical structures



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Safety



Safety in design is increasingly important.

**We are all more risk conscious,
and are in a more litigious society.**

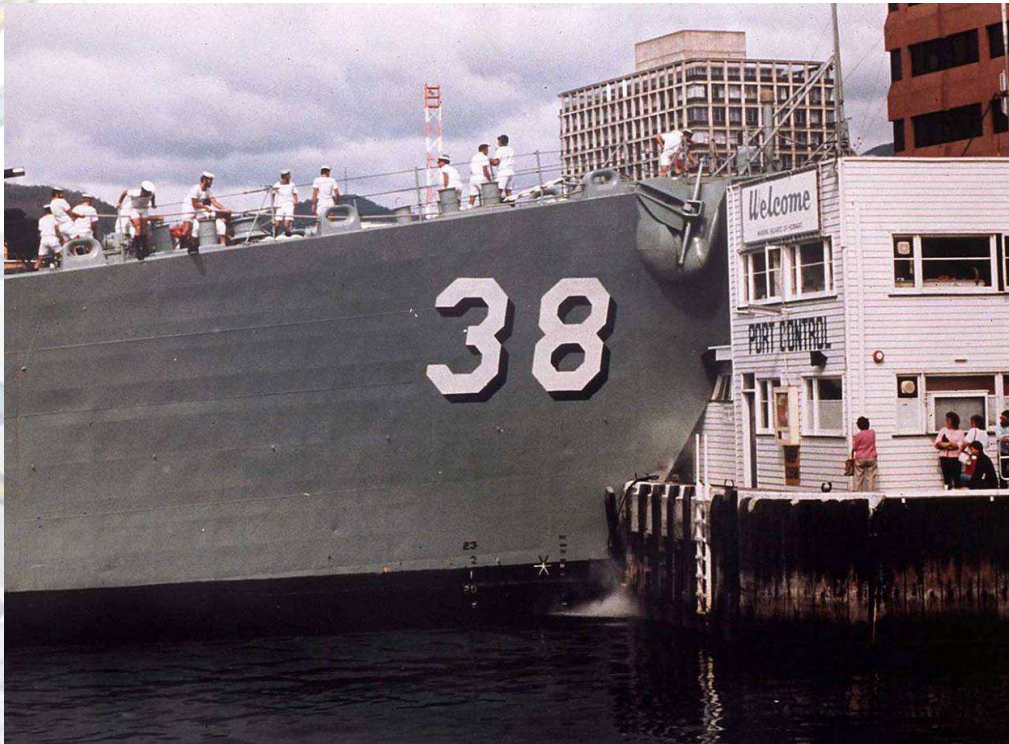
The Report discusses protection of

- **People (users, operators, bystanders)**
- **Locks**
- **Ships**

Safety



Water Edge Safety



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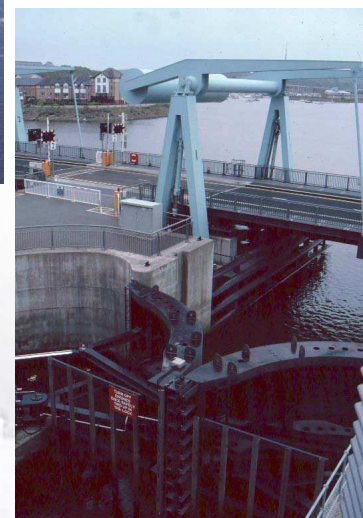
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Safety: Public access – or not?



**The Report includes
Classification of types
of water edge structure**

**with guidelines for
suitable safety treatment
for each category**



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Water Edge Safety Classification.



Description (SUMMARISED)
Class 1 <ul style="list-style-type: none">• Water less than 0.5m depth• Minimal height above water.• No unaccompanied young children
Class 2 <ul style="list-style-type: none">• Water depth between about 0.5m and 1.5m• Well-defined edge not more than about 2m above the water• Presence of people, walking or seated• No unaccompanied young children
Class 3 <ul style="list-style-type: none">• Water more than about 1.5m deep• Well-defined edge not more than about 2m above the water• Unlikely to be near dwellings, bridges, weirs or locks• No unaccompanied young children
Class 4 <ul style="list-style-type: none">• Water more than about 1.5m deep plus one or more additional hazards as below<ul style="list-style-type: none">○ More than 2m above water○ Fast-flowing water○ Presence of vulnerable groups such as children○ Presence of dwellings, schools etc

Design Methods



- “Risk based design” versus “Deterministic approach”
- “Minimum Whole Life Cost” versus “Least construction cost”
- Use of numerical modelling as design tool
- Use “Early Design Tools” for preliminary design stages



Design Methods

Design Tools:

Hydraulic Systems

Structural Design

Mechanical Design

Power and Controls

Codes and Standards

Codes and Standards:

PIANC Report 106

PIANC 1986

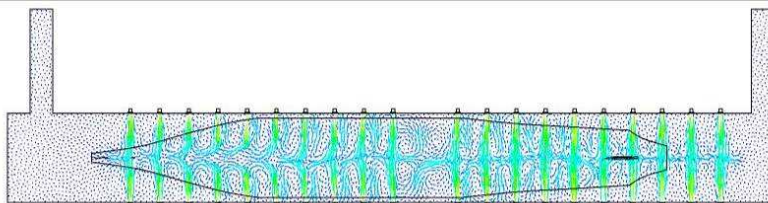
Long list of other codes, standards and guides



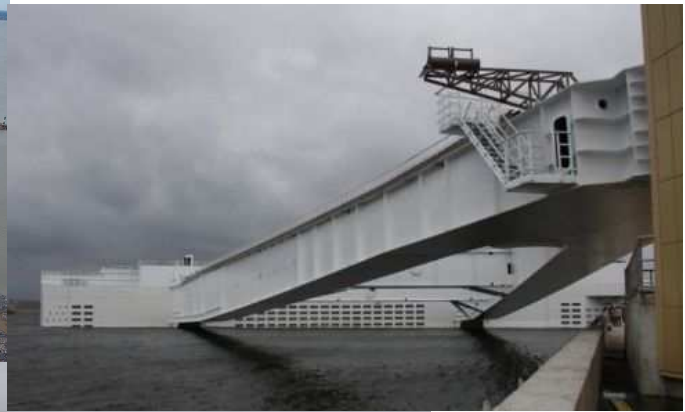
Design Methods



**Inter-dependent
Numerical and
Physical
modelling**



Conclusion



Photos: Halcrow



You will be welcome at PIANC MMX

PIANC Congress 2010
Liverpool, UK

AGA 10 May 2010

Congress 11–14 May 2010

