Overview of the handbook
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Introduction
Levees and their use
Levees are raised, predominantly earth, structures (also called dikes, digues or flood defence embankments) that are not reshaped under normal conditions by the action of waves and currents.
Their primary objective is to provide protection against fluvial and coastal flood events along coasts, rivers and artificial waterways. Levee systems are only as good as their weakest parts.
For levees to perform well on the occasions when they are loaded in storm or flood events, evidence-based assessment, good design, effective adaptation, good inspection and routine maintenance are vital.
Introduction

Background to the Handbook

- Flood and storm events around the world continue to lead to critical flood defence failures resulting in tragic losses of life and the devastation of large areas.

- In September 2008, organisations from six countries (France, Germany, Ireland, the Netherlands, United Kingdom, and the United States of America) expressed a desire in principle to participate in an international project to learn from one another’s experiences and to share the effort to produce good practice guidance – The International Levee Handbook (ILH).

Objectives of the Handbook

- To provide a comprehensive and definitive guide to good practice in the evaluation, design, implementation, maintenance and management of levees.

- To provide a non-prescriptive reference intended to be used in conjunction with national codes and standards, to provide decision support and guidance.

... recognising that levees are only part of good flood risk management which should also embrace as aspects such as:

- Flood abatement
- Flood emergency management
- Elevation of land or buildings
- Flood resilience of buildings
- Land use planning
- Relief for victims
- Flood insurance

(c.f. Gilbert White, 1942)
Scope of the Handbook

The handbook contains information that is useful for both existing and newly designed levees, riverine, coastal and estuarine. The operation, maintenance, assessment and emergency management of existing levees are treated first followed by the design of new levees or their adaptation.

The handbook does not address levees constructed for purposes other than flood protection, or ‘soft’ coastal defences such as beaches, dunes or natural high ground. Also, it does not cover the design of other water retaining structures. Appurtenant structures are addressed where they influence the performance of a levee structure or its operation.

ILH Structure
Target Readership

- The handbook’s structure reflects two major readership groups:
  - levee managers
  - designers

- Possible levels of competence for its use:
  - a technically competent practitioner with a broad (but not necessarily expert) knowledge of the field of application wishing to arrive at the best approach for a particular levee or levee system.
  - the intelligent client (i.e. a client with a technical background, but no particular specialist knowledge) seeking sufficient background information to understand the main issues and general procedures likely to be followed by an experienced practitioner.

About the team

- National Level
  - National Management Team: 1 representative per country
  - National Advisory Group: 1 representative per country
  - National Project Representatives: 1 representative per country
  - National Technical Editor: 1 technical editor per country

- Working Level
  - Project Management Team: 1 representative per project
  - Technical Editorial Team: 1 representative per country
  - Chapter Leaders: 1 person per chapter
  - Chapter Teams
  - International Reviewers: 1 representative per chapter

- Main Decision Level
  - Project Technical Lead (Jonathan Sayer)
  - Executive Steering Board (ESB): 3 representatives per country
  - Executive Review Board (ERB): 1 representative per country
  - Wider Review Board (WRB): 1 representative per country
Key issues:

- Through the ILH a number of key issues were identified, examples of key issues discussed in more detail in the ILH include the following:
  1. Understanding (types of) failure
  2. Structural failure types
     a) levee owner/operator awareness?
     b) levee management life cycle
  3. Tolerable Risk or identifying and managing Residual Risk
  4. Levee assessment – system vs segment
  5. Tiered Approach
  6. Vegetation management
  7. Balance of competing factors

1. Understanding (types of) failure

- Structural 'Failure’
  - Mechanisms such as deterioration, damage, or other processes that lead to a breach

- Hydraulic 'Failure’
  - Mechanisms such as overtopping, overflow, or through-flow at an hydraulic elevation or load below the design standard which does not cause damage or breach. These are considered to be a failure to perform.
2.1 Understanding structural failure types – levee owner/operator awareness

- **Deterioration**
  - Generally slow process by which resilience or standard of protection is reduced. Deterioration is best managed by good maintenance.

- **Damage**
  - Rapid deterioration such as scour and slippage (commonly during a flood) that does not cause a breach but which requires immediate repair or emergency action.

- **Breach**
  - Catastrophic collapse (often at high water level). Results in significant loss of crest and causes substantial loss of water.

- Time and causation chains are significant in distinguishing between the above.

2.2 Understanding structural failure types - relation to levee management life cycle

Levee deterioration and damage in routine levee management (O&M, assessments)

Managing damage and breach before, during and after severe events

Allowing for external change (loading, land-use) and effect on probability or consequence of failure
3. Tolerable Risk or identifying and managing Residual Risk

- All countries acknowledge that risk cannot be entirely eliminated. The flood risk analysis of each possible intervention will determine residual risks, which then need to be evaluated in terms of how acceptable or tolerable they will be to stakeholders.

4. Levee assessment – system vs segment

- Most countries doing some type of assessment for levee segments
- A few are doing flood systems analysis linked to levee condition and probability of failure
  - UK probabilistic flood systems analysis (MDSF2) uses a frequency-based approach to levee failure (via fragility curves for different levee condition grades).
  - This allows back-attribution of the residual risk in the flood plain to levee segments.
5. Tiered Approach

- Risk-based approach in which the amount of effort put into further investigation and analysis is adjusted according to a preliminary assessment of the severity of the problem and the magnitude of the consequences of failure.
  - In Europe actions related to levees (inspection, assessment, mitigation, etc.) are strongly driven by the determined consequences (e.g. urban vs rural) should the levee fail to perform
  - USA still aspires to a largely standards-based approach, but reality is perhaps different

- Can save time and money in time-consuming and expensive flood risk analysis

- Can be used in all aspects of the source-pathway-receptor framework, with the effort used at each stage to assess each aspect of flood risk being proportionate to its relative importance.

6. Woody vegetation management

- Hot topic in USA

- European countries participating have similar challenges (funding, public perception and pressures, environmental regulations)

- Length of time addressing the challenge varies, and approaches to woody vegetation management vary
7. Balance of competing factors

- All countries are aiming for the right balance between social acceptability, environmental impact and economic viability in managing levees

Many other issues

- Impact of encroachments
- Interface H&H and geotechnics disciplines
- Levee assessment vs design
- Maintenance vs emergency management
- Sparse data
- Steady state vs transient seepage analysis
- Internal erosion especially at transitions
International Levee Handbook

International Collaboration

ILH drafting principles

- A risk, performance and systems based approach.
- Hierarchy of material
  - Principles
  - Issues
  - Methods
  - Examples
- Methods have a hierarchy too
  - Rules of thumb – always included
  - Explicitly solvable equations – include all the main ones
  - Computational models – short summaries and references
- *International Levee Handbook*. Hence we tried to:
  - Avoid main methodology text relating to one country and generalise information in principles/issues framework
  - Give examples from several countries
  - Recognise individual countries might have (or need to produce) country specific guidance
A mine of information to dip into

- 1254 images
- 420 equations
- 130 key contributors
- 28 logos
- 6 pages of acknowledgements
- 4 kg of international best practice

Thank you

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To download the International Levee Handbook go to: www.ciria.org/ILH