LES RECONNAISSANCES GÉOTECHNIQUES ET DIAGNOSTICS

Martin van der Meer
Fugro Water Services

Les digues fluviales et maritimes

Journée technique commune CFGI-CFMS-CFMR
Paris, 27 Janvier 2011
CONTENTS

- Introduction
- Flood Risk Management
- Fugro’s REAL® - pilot Pays-Bas
- Conclusions
Flood Risk Management – Multi layer strategy

- mitigation / evacuation
- spatial planning
- prevention
### Knowledge Transfer Floods NL vs USA

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Flood Control 2015

SOLUTIONS FOR SMART FLOOD CONTROL

> LOADS
> STRENGTH
> DECISIONS

WWW.FLOODCONTROL2015.COM
 CONTENTS

- Introduction
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REAL® Rapid Engineering Assessment of Levees

DATA ACQUISITION

ELEVATION MODELS

REAL-TIME MONITORING

SUBSURFACE MODELS

WATER LEVEL SCENARIOS A EN B

STRENGTH ASSESSMENT SCENARIO B

STRENGTH ASSESSMENT SCENARIO A

AUTOMATED STRENGTH ANALYSIS
REAL TM Levee Control

Flood prevention managers base decisions and policies - along with other matters - on river forecast systems and identified risks. Most assessment programs however do not address the geological levee failure mechanisms. The REAL™ (Rapid Engineering Assessment of Levees) method incorporates the levee’s geological failure mechanisms to get a clear view on levee safety risks and thus improving flood risk management. REAL™ is based on the recursive character of the evaluations for large stretches of levees and the need to perform these assessments, both efficiently and economically.

REAL™ is a GIS based automated levee assessment method which enables FAST4D® grid analyses and batch processing (developed by Deltares) of different failure mechanisms using sophisticated algorithms, surface and subsurface models. The models consist of different types of data (LiDAR, HEM, boreholes, CPT’s and water levels).

REAL™ enables:
- Systematic consistency in studying the different levee failure mechanisms
- Multi water level analyses, such as high event scenarios
- Quick insight in altered assumptions and insights in physical phenomena
Dike ring 10 ‘Mastenbroek’, NL
Dike ring 10 ‘Mastenbroek’, NL
Dike ring 10 ‘Mastenbroek’, NL

- total dike length 48 km
- decomposed to 70 sections
- consulting safety maps?

Base Data
- Dike DTM & Geo data
- Subsoil model
- Hydro geological model

Mechanisms & models
- Uplift / heave
- Underseepage / piping
- Slope stability
- (…)

Conditions
- Fixed water level
- Rising water level
- (…)
Data & Subsoil Model

AHN2 & FLI-MAP

3D subsoil model

CPT or Boring with location (xyz)

Model of de cpt/ borings in place

Lithology:
- clay
- loam
- silt
- sand

www.fugro.com
Piping / Specifications

Mechanism & model
- Uplift
- Piping / Bligh
- Piping / Sellmeijer old
- Piping / New model NL
- Slope Stability / simple
- Overtopping / simple
- ...

Settings
- Creep factor Bligh: 15
- Entrance line: outer toe
- Seepage length margin: 0 m
- Top layer heave factor: 0,6
- Top layer margin: 0 m
- Hydraulic Response: 70%
- Ditch level: NAP -1,3m
- Traffic load: -

Water Level
- Free selection
- Predicted
- Actual...

Present as ...
- Safety Factor (-)
- Surface Deficit (m)
- Failure Probability (1/y)
- ...

Show also ...
- Flooded foreland
- Safety Report
- Inspection Results
- DAM calculations

Safety Factor
- < 0.9
- 0.9 - 1
- 1 - 1.1
- 1.1 - 1.2
- > 1.2

100 m
Slope Stability / Fixed water level

DAM module
Automated MStab Slope Stability Calculations
Uplift & Piping / Rising water level
Piping / Sensitivity Analysis

**Worst case**

- 1 / 10,000 water level: +0.3m
- Thickness cover layer margin: -0.5m
- Creep factor Bligh: 21
- Response factor groundwater: 1.0
- Seepage length margin: -5m

**Best case**

- 1 / 2,000 water level: 0
- Thickness cover layer margin: +0.5m
- Creep factor Bligh: 15
- Response factor groundwater: 0.6
- Seepage length margin: +5m
Piping / Fixed water level / Safety Report

Settings

1/2,000 water level 0
Thickness cover layer margin 0
Creep factor Bligh 15
Response factor groundwater 0.7
Seepage length margin 0
Piping / Fixed water level / Flooded foreland

Model of high water conditions
CONCLUSIONS

- Integrated Flood Risk Management (prevention, spatial planning and mitigation) needs solid data

- High quality data sets provide added ‘users value’ when combined and used for REAL® solutions

- See also presentation FLI-MAP & Geo data Rhône river dikes (Sylvain)
Merci
Back-up slides
Uplift / Fixed water level / Inspection

Inspection data?
- below / at / above fixed water level?
- worse / same / better dike conditions?
Data?
- bla
- bla
Objects / Tree Risk Mapping

Data collection & processing

Analysis

- DTM
- Dike safety profile
  - Location and width zone of influence object (RD and NAP)
  - Part zone of influence interfering with dike safety profile

Results

Grid calculations to assess available object space
3D subsoil model - validation
Sacramento Valley

10 year event

REAL® method

Sta 190+00
Sta 195+00
Sta 200+00

Does not meet Piping Requirement - -
Does not meet Piping Requirement -
Meets Piping Requirement +/-
Meets Piping Requirement + +

Does not meet Slope Stability Requirement- -
Does not Slope Stability Requirement -/+ 
Meets Slope Stability Requirement +/-
Meets Slope Stability Requirement + +

Robla Creek

NEMDC-West
NEMDC-East
Sacramento Valley

100 year event

REAL® method

Does not meet Piping Requirement - -
Does not meet Piping Requirement -
Meets Piping Requirement +/-
Meets Piping Requirement + +

Does not meet Slope Stability Requirement - -
Does not Slope Stability Requirement -/
Meets Slope Stability Requirement +/-
Meets Slope Stability Requirement + +

Sta 190+00
Sta 195+00
Sta 200+00

Robla Creek

NEMDC-West
NEMDC-East
# Geo Risk Management – Leading countries

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