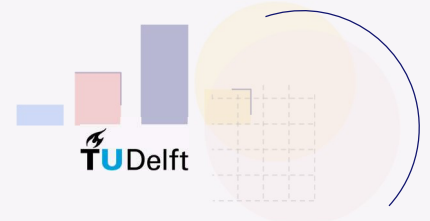# INTERNATIONAL LEVEE PERFORMANCE DATABASE
## EXAMPLE INTERNAL EROSION

**TU**Delft

## HOW TO SEARCH IN THE DATABASE?
The user can specify a search for the following topics

**EVENT NAMES**   **FAILURE MECHANISM**   **FAILURE TYPE**

**DEFENCE TYPE**   **LEVEE LENGTH**   **CREST WIDTH**

**CREST LEVEL**

### YEAR 📅
THE DATABASE ALREADY CONTAINS DATA FOR MORE THAN **150 YEARS**

### COUNTRY 🌐

### DEFENCE TYPE 🛡
THE DATABASE DISTINGUISHES BETWEEN **LEVEE-STRUCTURE COMBINATIONS**, **LEVEES**, **DAMS** AND **DUNES**

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**Add filter criterion** ✕

Select a filter      [ Failure mechanism ▾ ]

Available values                     Selected values

Breach
Horizontal sliding
Instability
Overtopping
Seepage
Slip circle
External erosion
Overflow
No breach

Internal erosion

➡
⬅

OK    Cancel

---

**Add filter criterion** ✕

Select a filter      [ Levee length ▾ ]

Selection criteria

○ Levee length greather than or equal to   ≥   10   m
○ Levee length greather than   >        m
○ Levee length less than or equal to   ≤        m
○ Levee length less than   <        m
○ Levee length between           m
                                 m

OK    Cancel

---

**FOR EXAMPLE:** ↑ FAILURE MECHANISM INTERNAL EROION

**AND** ↑ LEVEE LENGTH GREATER THAN OR EQUAL TO 10M

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## OUTPUT EXAMPLE

- **LOCATIONS.** DIFFERENT CASES THAT SATISFIES THE FILTER CRITERIONS. CHOOSE FOR EXAMPLE THE REAL FAILURE NEAR MISSOURI RIVER 2011.
- **ARTICLES.** DIFFERENT RESEARCH PAPERS ABOUT YOUR SPECIFIC SEARCH. FOR EXAMPLE, THE ARTICLE BY PAUL RISHER AND STANFORD GIBSON ABOUT APLLYING MECHANISTIC DAM BREACH MODELS TO HISTORIC LEVEE BREACHES
- **DATA.** GEOMETRY AND SOIL CHARACTERISTICS, HYDRAULIC BOUNDARY CONDITIONS, OBSERVED SIGNS ET CETERA



**Hamburg Breach 6/13/2011, 9:30am (USACE)**

**OBSERVED SIGNS**: signs that internal erosion was occurring have been observed before the levee crest settled below the water level.

1000 km                                              © OpenStreetMap

| | | | |
|---|---|---|---|
| ☐ | Sherburne, USA · USA · null · Sherburne · Real failure · Levee failure at Sherburne, USA | ℹ | ⬇ |
| ☐ | Horse Creek, Colo. · USA · Colorado · Horse Creek · Real failure · Levee failure at Horse Creek, Colo., USA | ℹ | ⬇ |
| ☑ | Missouri River 2011 · USA · Iowa · Hamburg · Real failure · Near the city of Hamburg, Iowa, during the 2011 high water a levee failed leading to a wide breach and other levee breaches due to the high water level in the polder. | ℹ | ⬇ |

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### WHAT CAN YOU DO WITH THIS INFORMATION?

#### DESIGN, ASSESSMENT AND MANAGEMENT ⚒

**WHY?**
Full-scale testing is **CHALLENGING** and **COSTLY**
Historical failures provide **INSIGHTS** into the real failures
Very few systematically gathered **LARGE-SCALE** datasets.

**ILPD PROMOTES**
learning about failure **PROCESSES** and failure **MECHANISM**
Learning from what went **WRONG** during past flood events.
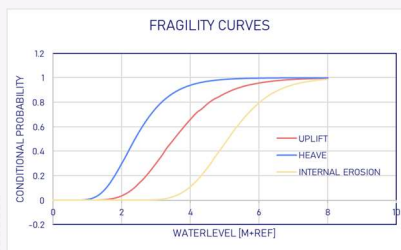
**HAMBURG BREACH**
With the use of the data the **GRAIN SIZE DIAMETER** and **PERMEABILITY** is determined.
This Closes the **GAP** between model calculations and practice
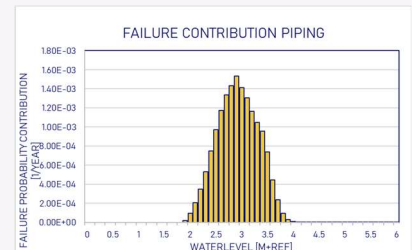And so models can be **IMPROVED**

#### CRISISMANAGEMENT ⚖
**FRAGILITY CURVES** where made for the **HAMBURG BREACH**, based on **HINDCASTING** of the breach. Now **AWARENESS** for inspection is created And research on the implementation of **EMERGENCY MEASURES** can be performed.



FRAGILITY CURVES

— UPLIFT
— HEAVE
— INTERNAL EROSION

CONDITIONAL PROBABILITY — WATERLEVEL [M+REF]

#### DATA SCIENCE 🔍
The **FAILURE PROBABILITY** for the Hamburg levee is equal to **1/64 YEAR**. With this **DATA-DRIVEN RESEARCH** our **PHYSICAL KNOWLEDGE** is enriched.



FAILURE CONTRIBUTION PIPING

FAILURE PROBABILITY CONTRIBUTION [1/YEAR] — WATERLEVEL [M+REF]

## MORE INFORMATION
WE WELCOME NEW CONTRIBUTIONS AND USE OF THE DATABASE. WOULD YOU LIKE TO SUBMIT ENTRIES? OR NEED MORE INFORMATION?
VISIT **LEVEEFAILURES.TUDELFT.NL** OR CONTACT US AT **LEVEEFAILURES@TUDELFT.NL**