The HYDRA-modules

Determining the necessary crest levels in 50, 100 en 200 years

The "Water board of Delfland" has to renew the ledger of the Delflandse dike (the primary embankment along the Nieuwe Maas and the Nieuwe Waterweg). In this document the criteria which the dike has to meet have been described regarding: direction, shape, size and construction. Furthermore the legal dike area has to be indicated.

In this area the regulations of the district water board are valid and building activities are regulated. Among other things the area is determined by the dimensions of the present and future dike, the latter being the so-called spatial reservation. To determine the spatial reservation first the future crest levels of the dike have to be calculated.

Choice of: climate scenarios & boundary conditions

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Dike height (DTH) calculation for scenario with the Hydra-B model

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(geotechnical) Stability calculation

↓

Spatial reservation

↓

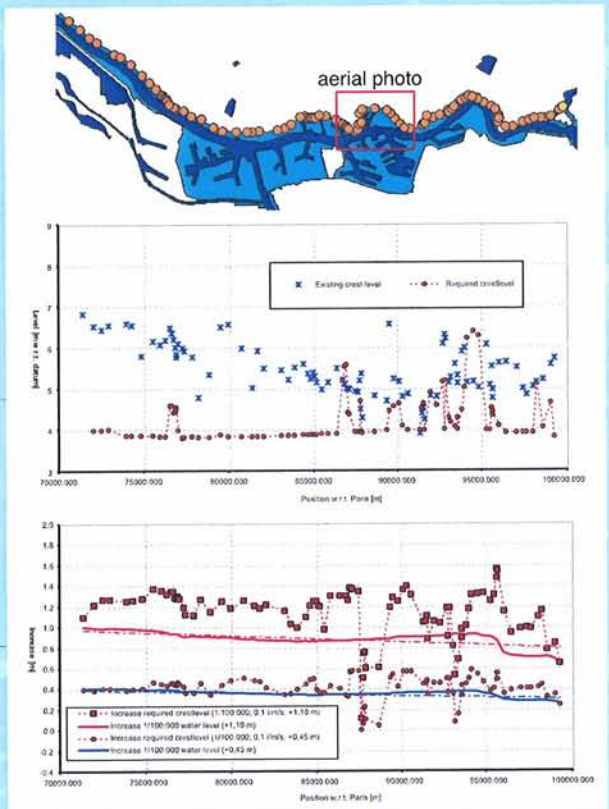
Updated dike ledger

Based on choices made regarding climate scenarios for different points in time and boundary conditions the future crest levels are determined. Based on the results of these calculations geotechnical stability calculations are performed and the future width of the dike is determined. After that the spatial reservations are recorded into the status document as future width of the dikes.

Choices for determination of necessary crest level for different points in time are:

Safety philosophy:		Dike ring approach instead of dike section approach
Climate scenario (maximum)		• Technical Advisory Committee (TAW) guideline sandy coast seawards of Maeslantkering • Water Policy 21st century (WB21) landwards of Maeslantkering
Sea level rise	50 years	0.2 m (TAW), 0.45 m (WB21)
	100 years	0.6 m (TAW), 1.10 m (WB21)
	200 years	1.2 m (TAW)
Storm climate		additional 40 cm on sea water level
River discharge		influence for dike ring 14 negligible
Risk of failure of Maeslantkering		1/1,000 (sensitivity analysis for 1/100)
Storm duration		33 hours (instead of 29 or 38 hours)

Resultaten dijkhoogtebepaling voor zichtduren



Necessary crest level now and in 50 and 100 years (WB 21 scenario). The 1 in 100,000 years condition is used as the anticipated section frequency to obtain the defined partial dike ring frequency of 1/12,500.

Principal: Hoogheemraadschap van Delfland

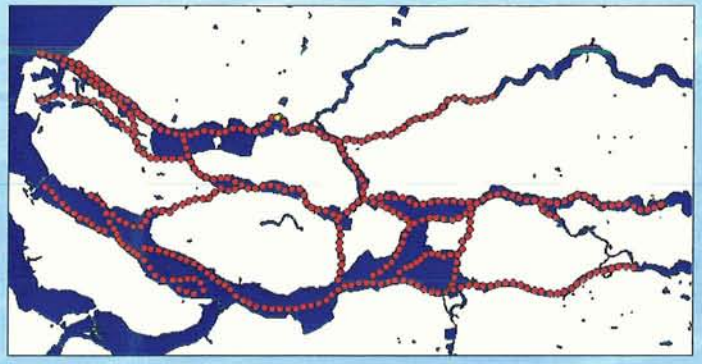
Consultant: Alkyon Hydraulic Consultancy & Research

Advisors: RWS-RIZA, Prov. Zuid Holland

HYDRA-B

How high should the dikes be in the tidal river area?

Location map of the tidal river area

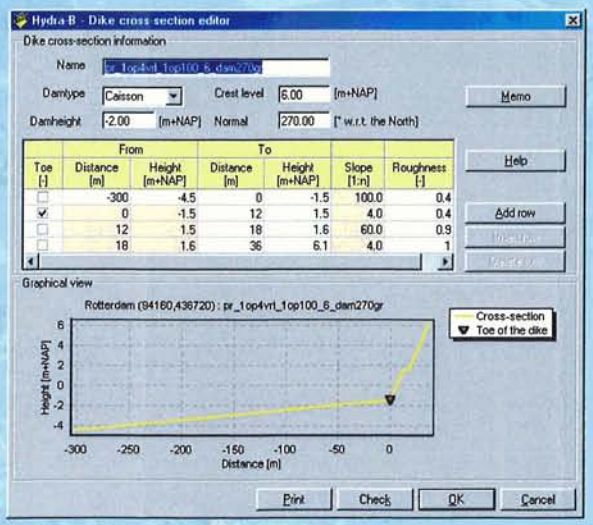


Input for every location

Database with resulting water levels and wave parameters for combinations of discharge, wind speed, wind direction, seawater level and position of storm surge barriers (open/closed).

Dike information

A dike cross-section can be defined, including the dam and/or foreland, by means of a cross-section editor.



Failure mechanisms

The following failure mechanisms can be applied:

- water level overflow
- wave run-up
- wave overtopping

Tidal river area

The tidal river area of the Rhine and Meuse situated in the transition area of the North Sea.

Threats

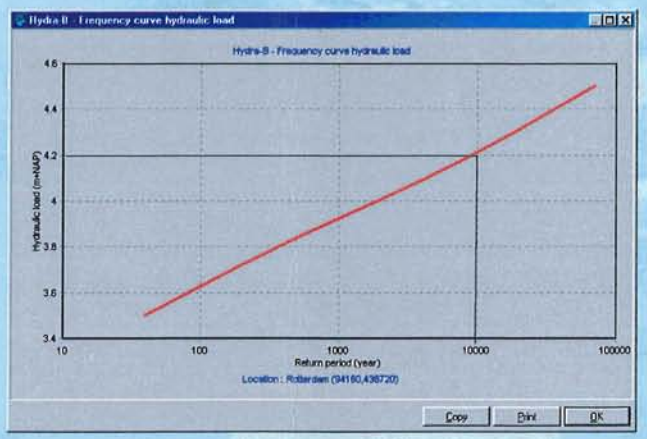
- Rhine and Meuse discharges
- wind speed
- wind direction
- seawater level Hoek van Holland
- sea level increase

Locations

The required crest levels can be determined for several locations.

Output

- design water level
- required crest level
- overtopping discharge
- frequency curve

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Location                          = Rotterdam
  X-coordinate*                   =  94160 (m)
  Y-coordinate*                   = 436720 (m)

Failure mechanism                 = Overtopping
Critical overtopping discharge    = 1.00 (l/s/m)

Frequency:     Hydraulic load:
   1/ 1000          3.922 (m+NAP)
   1/10000          4.213 (m+NAP)

* Dutch Geographic Coordinate System
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Ministry of Transport, Public Works and Water Management
RIZA, P.O.Box 17, NL-8200 AA Lelystad
Telephone +31 (0) 320 298411
www.riza.nl

The HYDRA-modules

How high should our dikes be?

How high should the dikes be to live safely?

Dikes are tested by means of hydraulic preconditions.
HYDRA modules are used for this dike assessment.

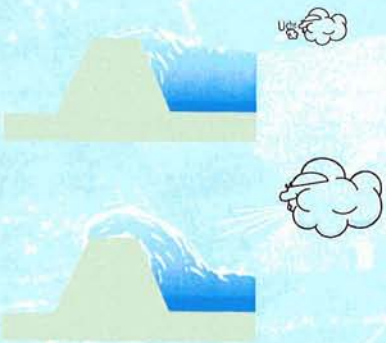
The following HYDRA-modules (partly still in development) are available:

- HYDRA-M for the lake area
- HYDRA-B for the tidal river area
- HYDRA-VIJ for the IJssel-Vechtdelta
- HYDRA-K for the coastal area (RIKZ)
- HYDRA-0 for the upper reaches of the Rhine and Meuse River (this model is not probabilistic)

Pertinent threats depend on the water system

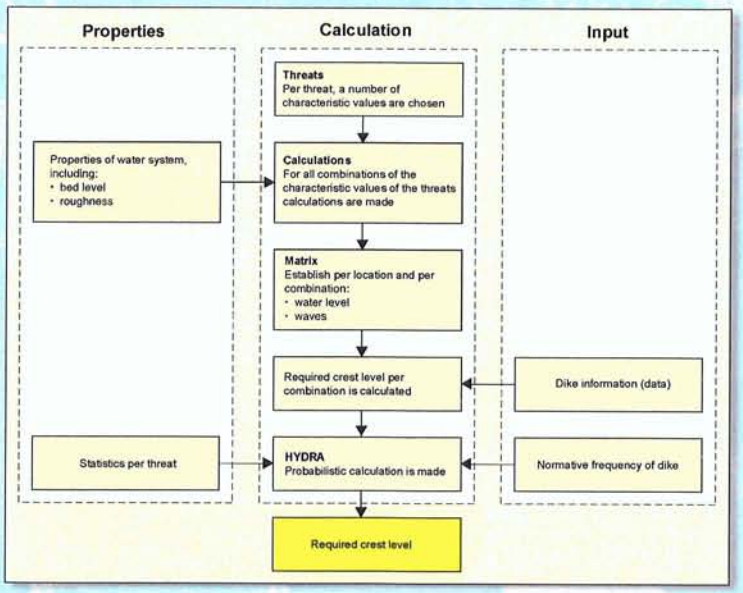
Possible threats to dikes can be:
- waves
- wind
- seawater levels (failure of storm surge barriers)
- lake water level
- river discharge

and combinations of the above.



Probabilistic models
Often, combinations of threats are the most dangerous.
By combining the threats and the probabilities of these threats, the necessary crest levels are calculated.

Overall outline of required crest levels



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RIZA, P.O Box 17, NL-8200 AA Lelystad
Telephone +31 (0) 320 298411
www.riza.nl
RIKZ, P.O Box 20907, NL-2500 EX Den Haag
Telephone +31 (0) 70 3114311
www.rikz.nl