Accidental use of earth bodies as flood defence
The Vlaardingen case study

Verhagen, Henk Jan

Publication date
2016

Document Version
Final published version

Citation (APA)

Important note
To cite this publication, please use the final published version (if applicable).
Please check the document version above.

Copyright
Other than for strictly personal use, it is not permitted to download, forward or distribute the text or part of it, without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license such as Creative Commons.

Takedown policy
Please contact us and provide details if you believe this document breaches copyrights.
We will remove access to the work immediately and investigate your claim.
Accidental use of earth bodies as flood defence

The Vlaardingen case study

Report on the Railroad dike in Vlaardingen

Henk Jan Verhagen*

June 8th, 2016

* Section of Hydraulic Engineering,
Delft University of Technology, P.O. Box 5048, 2600 GA Delft, The Netherlands.
Tel. + 31 15 27 83348; Fax: +31 15 27 85124
e-mail: H.J.Verhagen@tudelft.nl
Communications on Hydraulic and Geotechnical Engineering
2016-01

ISSN 0169-6548

The communications on Hydraulic an Geotechnical Engineering are published by the Department of Hydraulic Engineering at the Faculty of Civil Engineering of Delft University of Technology. In the first years mainly research reports were published, in the later years the main focus was republishing Ph.D.-theses from this Department. The function of the paper version of the Communications was to disseminate information mainly to other libraries and research institutes. (Note that not all Ph.D.-theses of the department were published in this series. For a full overview is referred to www.hydraulicengineering.tudelft.nl ==> research ==> dissertations).

At this moment this series is mainly used to disseminate background information related to other publications (e.g. data reports with data underlying journal papers and Ph.D. theses). Recent issues of the Communications are only available in digital format. A notification will be sent to interested readers when new issues are released. For placement on the notification list, please send an e-mail to h.j.verhagen@tudelft.nl.

Older versions (before 1986) were published as Communications on Hydraulic Engineering.
A number of internal reports were not published in this series, but are also available via this website.

Postal address for the Communications is: TU Delft, Faculty of Civil Engineering and Geosciences, department of Hydraulic Engineering, Stevinweg 1, 2628CN Delft, Netherlands. Permissions for republishing parts (figures, data), can be obtained from the responsible publisher, ir. H.J. Verhagen

© 2016 TU Delft, Department Hydraulic Engineering; Henk Jan Verhagen
Accidental use of earth bodies as flood defence

Sometimes earth structures are made for some other purpose as flood defence, but prove to be important for flood defence in a later stage. This also results in a multifunctional flood defence, although the intention was opposite.

An example of such a development can be found in the city of Vlaardingen (10 km west of Rotterdam) in the Netherlands. The city of Vlaardingen has been inhabited for several millennia. The original village was founded at the mouth of a tidal creek, the Vlaarding. Already in 175 BC a dam was constructed in the Vlaarding, including an (automatic) discharge sluice [DE RIDDER, 1999]. It was a culvert sluice with a valve made from logs. The location of the dam in the Vlaading is marked A in figure 1.

In mediaeval times the Vlaarding lost importance and a new discharge channel, the Vlaarding Vaart (B) was constructed. At the place where this channel crossed the dike a new discharge sluice was constructed. The part of the channel between the dike and the tidal river was used as port; in those years Vlaardingen developed as an important fishery harbour.

Around 1880 is was decided to construct a railroad from Rotterdam to Hook of Holland. Construction works started in 1886. This railroad was constructed on an embankment, so it was elevated. The main reason for this elevation was that water crossings with bridges was more simple. Also an embankment was needed because of the soft soil at that location. At the crossing of the railroad and the harbour channel a (mobile) bridge and a safety lock was build. This lock was only to be closed during high storm surges in the tidal river to prevent flooding of the harbour area. In December 1884 during a storm surge the water level in Vlaardingen reached 3.20 m above MSL. Probably the area between the railroad dike and the old dike was flooded at that time, although the storm surge report [ANONYMUS, 1895] does not indicate serious damage for that area.

In 1895 a new port was dredged south of the railroad (Koningin Wilhelminahaven) and a new housing area was made between the old sea dike and the railroad near the Koninging Wilhelminahaven.

In 1916 a large flood occurred in the northern part of the Netherlands. As a reaction the local water-board of Delfland decided that also the seadike in Vlaardingen had to be improved. This implied removal of several houses, warehouses and public buildings along the existing dike (Hoogstraat). Because this was not acceptable for the municipality of Vlaardingen they suggested to the waterboard to make the railroad embankment a real seadike and build a new (double) safety lock in the harbour channel (including a new railroad bridge). [ROTTERDAMS NIEUWSBLAD, 1916; ALGEMEEN HANDELSBLAD, 1916]. This would also protect the new expansion of Vlaardingen south of the existing
dike. This resulted in a heightening of the railroad to 4.35 m above Mean Sea Level, a crest width of at least 6 m and a clay cover of 1 m thickness.

Eventually this was done, dike improvement was paid by the waterboard and the municipality took charge of the sluice and new bridge [ALGEMEEN HANDELSBLAD, 1919].

In the period until 1950 the municipality expanded towards the railroad. Housing remained north of the railroad, while industry was created south of the railroad.

The housing area Vettenoord and Oostwijk has a height of approximately Mean Sea Level. The quay height of the Koningin Wilhelminahaven is 2.0 - 2.5 m above MSL. Other parts of the industrial area were raised somewhat more, some places are 3.5 m above MSL.

Although the waterboard required a clay cover of the railroad dike, it did not really became a good quality flood defence; the core consisted of sand and water could relatively easy flow under this dike. In 1953 the storm surge level in Vlaardingen reached a level of 3.71 m above MSL. This level was still below the crest level of the railroad dike, but because of the sandy core quite some seepage occurred at the inner side of the dike. Fortunately this seepage did not lead to piping and the railroad dike survived the storm surge.

Because no serious damage occurred in 1953, improvement of situation did not get a very high priority. In 1995 the situation was improved to meet the present day standards. At this moment the required height is 4.55 m above MSL. To improve the situation in fact a new dike adjacent to the railroad has been constructed with an actual height of 5.5 m above MSL.

A new cover layer was made. The actual height of the dike (south of the railroad line itself) is of 5.5 m above MSL.

Apart from seadefence and railroad track this dike also acts as a green separation between the living areas north of the dike and the industrial area south of the dike. The photographs in the figure below clearly illustrates this.

In summary, the main objective to build this piece of infrastructure was to create a railroad. Later it also got additional functions as sea defence and separator between various types of land use.
Cross sectional profile of the present dike. The thin line is the actual profile, with a maximum height of 5.5 m above MSL, the dash-dot line is the required height of 4.5 m. In this drawing and photos the riverside is on the right, the railroad tracks are on the horizontal part on the left side, with a height of approx. 4.5 m above MSL. The road on the river side (right) has a height of 2.90 above MSL, the road on the landside (left) has a height of 0.3 m above MSL (drawing from the Ledger of the Delfland Waterboard, photos Google streetview).

References

ALGEMEEN HANDELSBLAD [5-12-1916] *De waterkering van Delfland*

ALGEMEEN HANDELSBLAD [15-12-1919] *advertentie openbare aanbesteding.*

ROTTERDAMS NIEUWSBLAD [27-07-1916] *Verhoging Hoogstraat*

ANONYMUS [1895] *Verslag over den Stormvloed van 22/23 December 1894*, Algemene Landsdrukkerij