Maintaining Megastructures as Young Heritage? Postwar Works of Civil Engineering and Conservation in the Netherlands

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Historical background

The four megastructures under discussion are all situated in the main rivers of the Dutch Delta that flow into the North Sea (fig. 1). The rivers are, by nature, constantly under the dynamic influences of sea tide and weather conditions; these cause, in every respect, great fluctuations in quantity and quality of the water which are difficult to control. They are at the same time of vital importance for the Netherlands as (bulk) transportation routes and as the main source of drinking water supplies and sprinkling in agriculture. For more than two ages, the national Rijkswaterstaat (RWS, Department for Water Management and Infrastructure) has been responsible for the control and management of the major water ways (both natural and man-made). After two disastrous floods (1916 from the Zuiderzee and 1953 from the North Sea), the national government approved special acts and budgets for successive projects of hydraulic engineering to shorten the coastline for natural safety. These unprecedented projects, prepared by RWS, relied heavily on new developments in science, testing and construction technology (e.g. caissons, pre-stressed concrete).

Whereas civil engineer and responsible Minister Cornelis Lely has become famous as the 'father of the Zuiderzee (South Sea) Works', RWS engineer Johan van Veen deserves to be acknowledged as the 'father of the Delta Works'. Van Veen had already elaborated various propositions for an enduring improvement of the major water ways, dykes and for the control of water level and salination in the South West of the Netherlands from the 1930s on. Time and again he had warned about the bad condition of the dykes in the Delta, but his suggestions for building a holistic system of megastructures were pushed aside as too expensive during the difficult decades of economic crisis and war-time destruction.

The making of the 32 km-long *Afsluitdijk* (Closure Dyke, completed 1932) with its two series of discharge sluices and the northeast polder as the first reclamation in the former Zuiderzee, now IJsselmeer (1942), was already a great burden on the national budget, just as the military and civil defense. Soon the relatively fast completion of the Zuiderzee Works and the successful use of caissons for the closing of the dykes after the 1944 and 1953 floods became important references for the 'feasibility' of future projects of hydraulic engineering like the multi-purpose canalisation programme for the river Rhine, the Delta Works and the Zeeland Bridge.

Hydropower near Hagestein

The visor-like weirs near Hagestein in the province of Utrecht were built between 1954 and 1958 as the first pair in a series of three almost identical constructions in the Lower Rhine (the others being located near Amerongen and Driel). Their main purpose was, and still is, to control the water levels of the river and its branches (for navigation) as well as their quality (for farming and consumption), particularly to prevent too much inlet of salty water from the North Sea. The weirs enabled to manipulate the currents like a huge tap that could be switched on or off by a new system of hydraulic engineering works. The locations were chosen to create a shortcut of the existing river curves by means of a new canal with sluices, while the weirs were built in the river (fig. 2). These allowed the vessels to pass through in all seasons, while the water level could now be adjusted in dry periods to a navigable minimum.

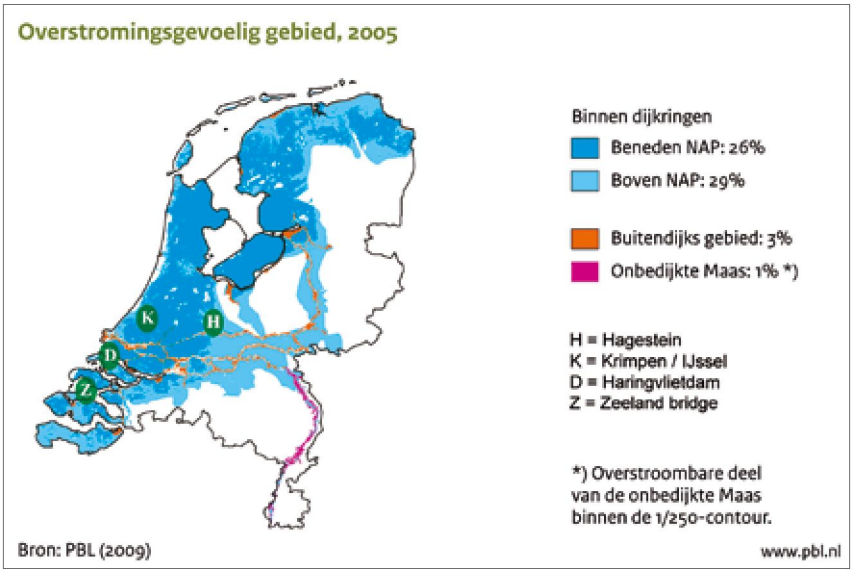

Fig. 1. Locations of the four megastructures based on PBL map

Because RWS was aware of the wide visibility of the works, private architect Wouter Hamdorff was engaged as aesthetic supervisor. He plastically articulated the eye-catching concrete arches and upper engine rooms. The steel 'visors' were an invention of RWS engineer Pieter Blokland and primarily shaped by economic considerations to save material; semi-spheres were most appropriate to resist the water pressures. The curved flood gates, each 48 m wide and about 9 m high, are the result of an extraordinary and, at the time, very innovative concept of water management, which also included concern for the agricultural environment and for the fish.

Yet, only the Hagestein weirs were also provided with a hydropower installation inside the central pier (fig. 3). Precisely these have been selected for statutory protection as monuments, as will be explained later on. Hydropower was rarely applied in the flat Netherlands, but new interests in economising and multiple-purposing led to the Hagestein experiment. In this case, a Kaplan turbine was to be driven by the incoming river flow (of about 3.80 m average) and connected with a generator to feed the provincial electricity company of Utrecht (PUEM) for further distribution among the households. The novel concept foresaw that the produced electricity would also be used to operate the whole flood gate system as an autarkic entity. The turbine was positioned in a pre-cast hollow area shaped like a snail-shell in the central pier. Incorporated in the concrete constructions were also an elevator and an underwater inspection gallery as well as fish-sluices. All this implied detailed planning at an unusually early stage. Anyhow, the making of this megastructure demanded great skills of hydraulic engineering, modern construction, architectural design, precise calculation, and cooperation.

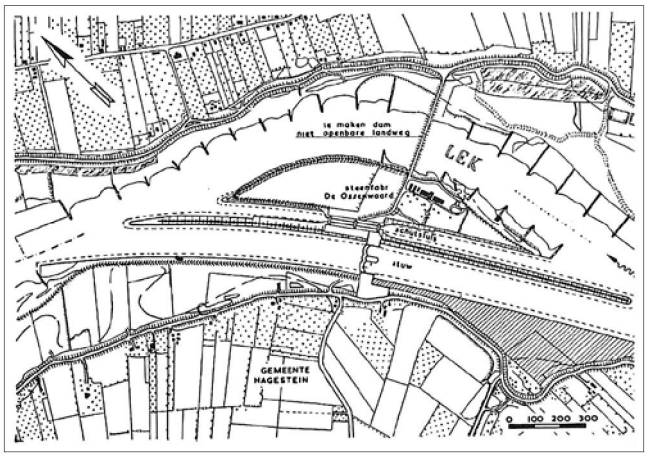

Fig. 2: Situation Hagestein canalisation and weirs

'Lock of Holland'

Similar skills were needed for the semi-open Storm Surge Barrier that was built above and in the Hollandse IJssel, a

Fig. 3: Hagestein visor weirs closed

Fig. 4: Storm Surge Barrier Hollandse IJssel from the air

frequently navigated river east of Rotterdam in direct connection with the North Sea. The oldest part of this two-fold 'Lock of Holland' (1954–58) was the first 'Delta Work' to be completed, even before the related act was approved. The movable barrier, the largest of its kind at the time, was constructed immediately after the 1953 flood with the aim to protect the densely populated area against pre-calculated risks of high sea water. The innovative design was made by architect J. A. G. van der Steur junior and RWS engineer H. G. Kroon. The 80-m-wide flood gates combine rectangular doors with a curved truss construction at the inland side. The almost identical secondary flood gate was inserted in 1976 as a back-up. The enormous steel doors, hung on steel cables in 45-m-high lift towers of reinforced concrete, are usually in the highest position (fig. 4). If necessary, by pressing a button they can be quickly let down to close the river off from the sea.

Nowadays, colour plays an important role to inform people about the position of the flood gates. The conspicuous towers are lit in red when the gates are down (on average three times per year) and blue in normal situations (fig. 5). In the case of a total closure, ships can pass via the specially dug 'bypass' canal and its sluices in the west. Floodgates, sluices and simultaneously built traffic bridges – the first permanent connection between the adjacent towns – were named after Jacob Algera, who was the responsible Minister of the Delta Act.

Haringvliet dam and sluices

The multifunctional megastructure in the Haringvliet estuary, stretching over 4.5 km between the islands of South Holland, is the sixth Delta Work in line (1957–71). It is a crucial link in the water management as the 'tap of Europe' (fed by Rhine and Meuse) and also in the natural defence and the provincial road system. The central part consists of an unparallelled series of 17 discharge sluices, each 56.5 m wide to handle the just balance between fresh and salt water. They are placed between 18 bold concrete constructions with 34 steel slides and an overarching system of pre-fabricated triangular Nabla girders to support the upper road (fig. 6). The whole is built on an invisible foundation of about 22,000 piles and an 80-m-wide slab of reinforced concrete. The construction of the two massive dams at the sides was aided by the relatively new cable car technology.

However, the first part of this closure endeavour was the construction of the separate navigation lock, for which even a contemporary polder was created. This *Goereese sluis* near Stellendam (1960–64) was primarily meant for professional fishers and the transport of the immense amounts of construction supplies, but today it is also used for yachts and the like. The later completed provincial road is interrupted here by a pair of movable bridges (the first with a clamp construction) to let all shipping cross (fig. 7).

The needs of migrating fish were also taken into account when the Haringvliet closure works were drafted. Therefore, some minor openings were provided, just as happened with the floodgates in the Lower Rhine. In practice, though, these in-built passages were less effective than was anticipated. This observation brought more ecological aspects to the fore that were then neglected in the executed Delta Works.

Zeeland Bridge

At the time of its completion in 1965 the 5022-m-long construction across the Oosterschelde estuary was the longest bridge in Europe. Two years later, it was renamed Zeeland Bridge to underline the full engagement of the provincial authorities. They had commissioned and financed this audacious megastructure to be the first permanent connection between the islands of Schouwen-Duiveland and South Beveland. As such, this crucial part of the first over-land traffic route from Rotterdam to Goes was not part but an early spin-off of the state's Delta Plan of 1953 (which, by then, aimed to close four sea-arms by dykes and dams). The bridge was intended to improve the accessibility to and from the islands of Zeeland with the rest of the Netherlands at an earlier stage than the Delta Plan had scheduled. It was built, initially, as a toll bridge with a movable part spanning 40 m for the passage of regular shipping and vessels needed for the construction of the projected dam. The provincial *Waterstaat* engineer J. G. Snip was the driving force behind the innovative design of the slender construction of 52 identical spans, each 95 m wide, based on advanced technologies of pre-fab elements and pre-stressed concrete for reasons of speed and economy (fig. 8). The huge construction in and around the 10 to 30-m-deep Oosterschelde was communicated to the public at large by various means, from books to documentary films and special stamps (fig. 9). To underpin its national significance, the Zeeland Bridge was officially inaugurated by Queen Juliana.

Pride and protest

By irony of fate, the initial appraisal of the heroic works of hydraulic engineering was followed by severe criticism of RWS' technocratic approach of the Delta Works in the late 1970s by various pressure groups, especially when the permanent damming of the Oosterschelde was nearing execution. In response to these unforeseen protests the dam plans were revised. They resulted in the extraordinary semi-open storm surge barrier of 9 km length and as such since 1986 the largest in the Netherlands (Haan & Haagsma 1984). Another effect is that the department has also involved biologists, hydrologists, economists and general managers in its staff during the past decades (Ham 1999). Presently, RWS is trying hard to regain the hearts and minds of the general public as

Fig. 5: Storm Surge Barrier Hollandse IJssel closed

Fig. 6: Haringvliet discharge sluices under construction

Fig. 7: Haringvliet Dam and sluices overview

Fig. 8: Zeeland Bridge under construction

an environmentally cautious organisation. Next to the visor weirs new fish cascades have been constructed, as an additional and better passage facility than the originals, accompanied by new informative signs for passing recreationists.

Fig. 9: Zeeland Bridge from the air

A broader interest in the monumental megastructures of the post-war period would help to raise more support for adequate maintenance and for the vital role RWS plays in the daily safety of the population in the Delta below sea level. Similarly, popular communication, extended by websites, leaflets and publications, is also actively sought by the Netherlands Department for Conservation (RDMZ) and its administrative successors to draw the attention of the public at large to the values of the built heritage for the quality of the daily environment, be it legally protected or not. Typically, the – then not yet nominated – Zeeland Bridge was prominently placed on the RDMZ's website to communicate the message that heritage preservation is in pace with modernity. It also illustrated the homepage of the interactive database that was specially created to document the heritage of the post-war reconstruction period (www.wederopbouw-databank.nl). Such modern image building is symbolic of the recent shifts in Dutch politics and in the organisation of built heritage preservation.

Meanwhile, within RWS and the current Netherlands Agency for Cultural Heritage (RCE) as well as in the Dutch Bridges Foundation (NBS, established in 1992) specific knowledge is being collected and shared with regard to the historic construction of the recent heritage of bridges in the Netherlands from the period 1800–2000 (www.bruggenstichting.nl). RWS has recently participated in successive

'Open Monuments Days' and opened some of its monumental sites (protected or not) to the public at large for visiting, just like the Delta Works have been a prominent goal of excursions right from the start until today. Actually, this interest fits well into the Dutch appraisal of 'the contribution made by Dutch engineers and architects in protecting their people and land against the natural forces of water', as is stated for the World Heritage site of the Wouda Steam Pumping Station at Lemmer.

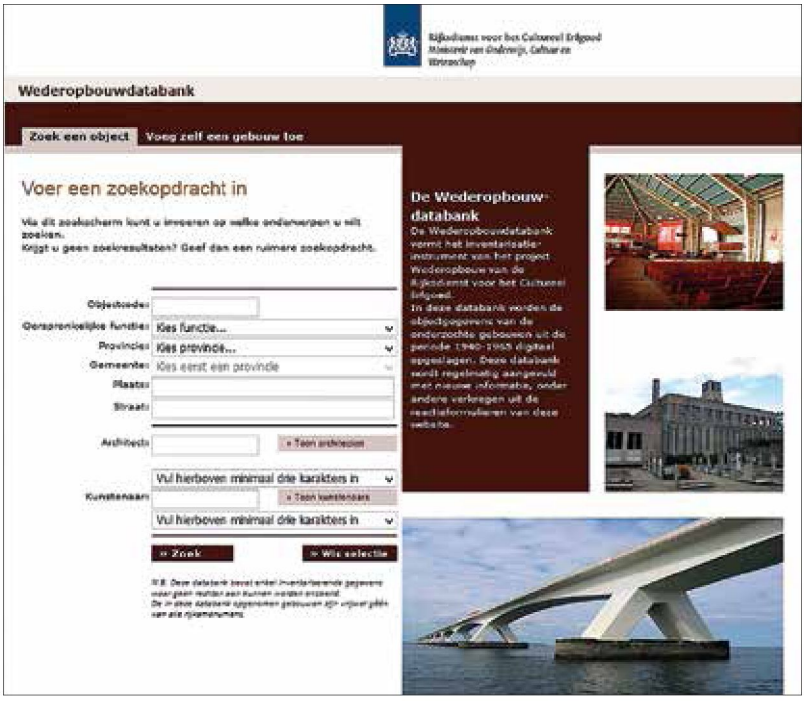

Fig. 10: Homepage RDMZ/RCE wederopbouwdatabank with Zeeland Bridge

Dutch preservation policies

Since 1961 a legal framework was applied to the national protection of listed monuments in the Netherlands, which required a minimum age of 50 years after inauguration. This rule, still valid when the new *Monumentenwet 1988* (Historic Buildings and Monuments Act 1988) was put in place, had brought a chronological demarcation in three major 'stocks' of heritage: 'elder' architecture (built before about 1850), 'younger' architecture (built between 1850 and 1940) and the heritage of the *Wederopbouw* (post-war reconstruction, divided into two periods: 1940–58 and 1959–65). Whereas the young heritage of the Steam period was investigated by nation-wide programmes for inventory, selection and registration, such activities were less supported with regard to the more recent heritage due to shifts in policies and finances. Nonetheless, small teams of experts were engaged for functional category-based desk research of eligible monuments, such as the NBS for bridges. While great efforts were made to communicate that postwar (and war-time) heritage also has great architectural and cultural values and deserves – selective – protection (or at least not to be demolished), the political climate and Dutch State administration changed drastically in favour of decentralisation, privatisation and limitation of listing.

In 2004, a temporary moratorium was set for external applications for protection (mainly for financial reasons). Internally, however, an expert group of the RDMZ (succeeded by the RACM) was commissioned to prepare a provisional selection of 'Reconstruction' heritage for legal protection. But in 2007, the newly appointed Minister of Culture, Ronald Plasterk, intervened personally in the proposed 'categorial' approach by demanding a quick list of 100 'top monuments' built between 1940 and 1958 for priority protection. For this purpose a list of leading architects and a set of ten function-related themes, including traffic annex infrastructure, were compiled. The final selection was published in a booklet and Plasterk made the assignment a public festivity, celebrated with owners and other stakeholders in one of the selected 'top monuments'. Yet, also positive perspectives for maintenance and function are now explicitly required and this has required a lot of time in continuing the registration procedure. The same is valid for the second series of 89 eligible 'top monuments' from 1959 to 1965, publicly presented by the current Minister of Culture, Jet Bussemaker, in the selected Evoluon in 2013 and including three megastructures.

Paradoxes and challenges

Exactly 50 years after its inauguration, the Zeeland Bridge was officially inscribed as a nationally protected monument, accompanied by various public events and the launch of an information point and a documentary film. Also the Haringvliet Dam and the Hagestein weirs were registered very recently. The protection of the Hollandse IJssel storm surge barrier and Algera Bridge was still being awaited when this text was written. Of all selected items of post-war heritage, the structural works of art may perhaps appeal most to our current multi-cultural society and the many immigrant families who have totally different parameters for heritage and history.

The four megastructures are great examples to explain the national pride in hydraulic engineering and infrastructural connection, but they have, unintentionally, to deal with a multiple protection paradox. On the one hand, they function as permanent works to protect the most densely populated areas in the Delta against risks of flooding and salination. This use value will be sustained anyhow and may require

partial replacement of some elements for future safety. On the other hand, the megastructures have become targets of protection themselves, as monuments in need of saving their cultural-historical and aesthetic values against unwanted demolition or disfigurement. The justification for the selection lies mainly in their modern appearance; they function as symbols of infrastructural connection and technological innovation in contrast to the traditional heritage of the past. However, the necessary technical knowledge for maintenance is gradually fading away with the retirement of the original operators (which is especially problematic for the Hagestein turbine). This urges RWS to accept extra responsibility for its own legacy in built form and to transfer the related knowledge to keep it functioning. For all architects, engineers and conservationists the new challenge will be to apply a more inclusive way of thinking for sustaining cultural-historical continuity and saving energy and heritage.

Zusammenfassung

Als Antwort auf die Katastrophen der Nordseeflut von 1953 und des Zweiten Weltkriegs errichteten die Niederländer spektakuläre Ingenieurbauten in ihrem Delta zum Schutz der Küste und als Infrastrukturmaßnahme. Entworfen als technische Kunstwerke, waren diese Konstruktionen von vornherein monumental. Die kürzliche Ernennung von vier ausgewählten Großbauten zu hochrangigen Denkmälern des Wiederaufbaus hat allerdings zu ernsthaften Sorgen über mögliche Interessenskonflikte zwischen Schutz und Funktion, Erneuerung und Instandhaltung geführt. Dies betrifft die Stauwehranlagen im Fluss Lek sowie im Fluss Hollandsche IJssel, den Haringvliet-Damm und die Zeelandbrücke. Dieser Aufsatz skizziert den Kontext und die Schwierigkeiten, die sich aus ihrem Status als Bauerbe in den Niederlanden ergeben.

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Credits

Fig. 1: http://www.pbl.nl/infographic/overstromingsgevoelig-gebied-2005

Fig. 3: Author (screenshot)

Fig. 4: RCE/Siebe Swart

Fig. 5: Wikimedia Commons. (made on 6 December 2013)

Fig. 7: RCE/Marcel Kentin

Figs. 2, 6, 8, 9: RWS

Fig. 10: http://www.wederopbouwdatabank.nl/