The role of Dutch civil engineering in modern port planning in Japan (1870s–1890s)

Iwamoto, Kazumasa; Hein, Carola

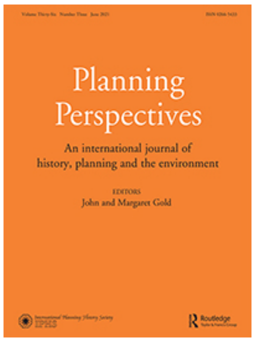
DOI
10.1080/02665433.2021.1906308

Publication date
2021

Document Version
Final published version

Published in
Planning Perspectives

Citation (APA)
Iwamoto, K., & Hein, C. (2021). The role of Dutch civil engineering in modern port planning in Japan (1870s–1890s). *Planning Perspectives*, *36*(3), 617-629. https://doi.org/10.1080/02665433.2021.1906308



Planning Perspectives

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/rppe20

The role of Dutch civil engineering in modern port planning in Japan (1870s–1890s)

Kazumasa Iwamoto & Carola Hein

PLANNING PERSPECTIVES
2021, VOL. 36, NO. 3, 617–629
https://doi.org/10.1080/02665433.2021.1906308

The role of Dutch civil engineering in modern port planning in Japan (1870s–1890s)

Kazumasa Iwamoto [a,b] and Carola Hein [b]

[a]Landscape and Ecology Division, National Institute for Land and Infrastructure Management, Tsukuba, Japan; [b]Department of Architecture, Delft University of Technology, Delft, The Netherlands

ABSTRACT
In the mid-nineteenth century, civil engineering and technological innovation began to play a major role in the modernization and westernization of Japan. From the 1870s to the 1890s, Dutch civil engineers worked with Japanese practitioners on the design of Japanese ports, a key starting point for urban development. This article explores the role of port and port city planning by Dutch civil engineers on the development of Japanese engineering and planning practice following modern construction methods and technology. It explores the degree to which port and water planning proposals that were associated with foreign forces influenced the development of civil engineering-inspired urban planning practice in Japan. The article examines three case studies of port planning: Nobiru, Mikuni and Yokohama. It shows that comprehensive planning proposals by the Dutch engineers, who combined water management and the construction of port basins and breakwaters with city development, were only partially implemented because they were not aligned with Japanese natural and technical conditions. Instead, Japanese professionals stripped the proposals of the urban context and adopted engineering technology. The fascine mattress technique for breakwaters and imported steam dredging machines became key elements for the construction of basins and the maintenance of modern port function.

KEYWORDS
Civil engineering; port planning; Port City planning; Urban Planning; Dutch engineers; fascine mattress

Introduction

Japan's geography, characterized by steep mountains and rapid rivers and threatened by tsunamis, has long presented challenges to transportation and construction. In the nineteenth century, engineered infrastructures, including ports, waterways, roads and railways, made possible the country's rapid modernization. In the 1870s, following the opening of the long-secluded island nation, shipping was a primary form of transportation both among the Japanese islands and between Japan and the world at large. The major Japanese cities were located on the coast or near estuaries. Toshimichi Okubo (1830-1878), appointed as the Secretary of the Interior repeatedly between 1873 and 1875, emphasized the need to build modern ports and develop transportation on the river.[1] The Japanese government therefore invested heavily in the construction of modern ports. They attracted industry with railway networks and factories, which led to rapid population growth and urban expansion.

CONTACT Carola Hein c.m.hein@tudelft.nl

[1]Inayoshi, "Seaport Political History".

Engineering decisions for the construction of a modern port, capable of accommodating modern steam ships, and built using contemporary technology, effectively helped shape the planning of the modern Japanese city.

To speed up modernization, the new Meiji government drew heavily on foreign expertise, inviting engineers from countries such as the Netherlands, the United Kingdom, and the United States to share their knowledge of water management, port planning, railway construction, bridge design and urban development.[2] Japanese practitioners worked with foreign experts, integrating and translating or adjusting their proposals to align with Japanese practices. The Meiji government carefully studied foreign experiences with particular technologies and designs, selecting those that seemed the most promising. In order to complete the national governments' focus on improved sea and river transportation, the governmental Department of Civil Engineering (Dobokuryo) invited six Dutch engineers and five assistant engineers as experts to help establish the new shipping systems through the building of modern ports and the improving of rivers in the period from 1872 to 1903. Focusing on river projects in Japan, researchers have studied the careers of Dutch engineers[3] and the technology they deployed.[4] Dutch engineers carried out several water management projects and achieved the diversion of the three Kiso rivers. They also introduced a water level maker and erosion and flood control in the mountains.[5] Additionally, Dutch engineers designed and partly built modern ports at Nobiru (1878-1884) and Mikuni (1878-1885). These projects benefited from experiences and projects related to modern European ports such as in London and Rotterdam.[6] These projects preceded the port construction in Yokohama in 1888, which many scholars consider the first modern port.[7] The influence of Dutch civil engineers on modern port design, the topic of this article, remains underexplored.

Japan is a particularly intriguing case to explore the impact of the import of planning ideas as several trends coincided there.[8] Working with Dutch professionals, Japanese civil engineers gained expertise in water management and new types of construction for river improvement such as soil-erosion control structures and modern ports.[9] Simultaneously, some of the Japanese who went to Europe to study engineering returned to Japan and, after their return, shared their new engineering skills with their peers. Foreign-taught Japanese engineers, those taught in the country or abroad, and those educated by their foreign educated peers, shaped Japanese modernization. All the Dutch engineers would return to their own countries by the 1900s.[10] Japanese engineers–like architects and planners – carefully selected foreign ideas, tested them in the late nineteenth century and accepted those that fit their needs. Port engineering is an example of such a borrowing from abroad, as Stephen Ward has described it.[11]

Based on the study of original Dutch and Japanese documents including investigative reports, design drawings and survey maps, the article explores the transfer of civil engineering techniques for port planning through three case studies: the ports of Nobiru, Mikuni (Sakai), and Yokohama (Figure 1). Several of the plans for these ports included comprehensive designs for both port and

[2] Hein and Ishida. "Japanische Stadtplanung und ihre Deutschen Wurzeln"; Doboku Gakkai, "The Japanese Civil Engineering and The Foreigners after Meiji Era".
[3] Matsura, "The History of National Land Development in Meiji Era".
[4] Doboku Gakkai, "The Japanese Civil Engineering–History of One Hundred Years of Development–".
[5] Takasaki, "The Study of Van Doorn", 1–28.
[6] Meyer, "City and Port"; Hein, *Port Cities*, 2011.
[7] Kobayashi, "The History of Japanese Port".
[8] Hein, "The Exchange of Planning Ideas from Europe to the USA after the Second World War"; Ward, "The International Diffusion of Planning"; Ward, "Re-Examining the International Diffusion of Planning."
[9] Kanbayashi, *De Rijke*.
[10] Takahashi, "The History of Japanese Civil Engineering".
[11] Ward, "The International Diffusion of Planning".

○Contents of Five Port Projects

Name	Nobiru	Mikuni(Sakai)	Nagasaki	Misumi	Yokohama
Cost(japanese yen)	300,000	300,000	290,000	330,000	2,000,000
Designer	Doorn	Escher, Reijke	Reijke	Mulder	Palmer(English)
Project Type	New Port City	Improvement	Improvement	New Port City	Development
Planning Scale	Port, New town	Port	River	Port, New Town, Train	Port
Presently Condition	Not Working	Working	Working	Almost Not Working	Working
Tarin	×	1911	1897	×	1872
Project term(year)	7	8	12	4	8
Completion Year	1884	1885	1893	1887	1896

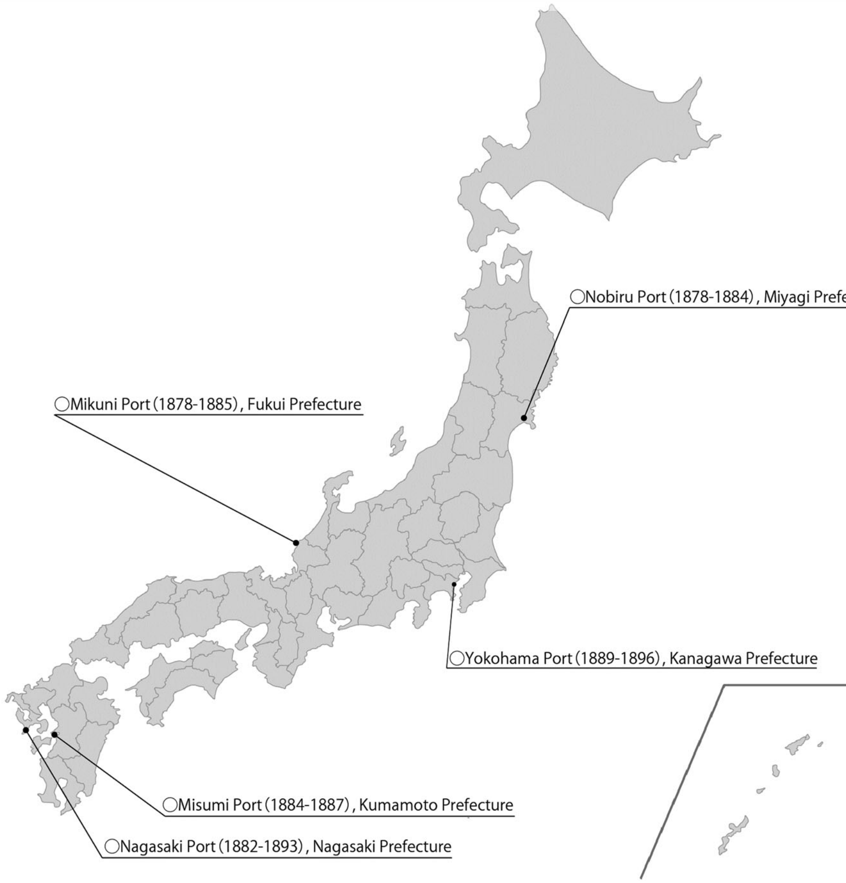


Figure 1. Information on the five port projects. Source: Gasteren, In a Japanese Rapids. Hiroi, The History of Port Construction. Kanbayashi, De Rijke, The Engineer who revivified Japanese Rivers. Kensetsu Sho Okayama Kasen Kozi Jimusho, The Reports and Sentences of A.T.L.Mulder.

urban functions. In the case of Nobiru and Misumi, the Dutch engineers Cornelis Johannes van Doorn (1837-1906) and A.T.L Rouwenhorst Mulder (1848-1901) attempted to design not only the port but also an adjacent new town and land-side infrastructure. In both cases, the new port city project was not realized in its entirety. The foreign professionals often did not to understand the local political, technical and natural conditions. Some of their projects, especially comprehensive port and city planning projects, failed as a result of the particular Japanese natural and water conditions, others due to the particular approach the Japanese took to planning. Instead of adopting the foreign plans in their entirety, Japanese professionals extracted what they needed for their own practice. The next section explores the process of importing the knowledge of modern ports and the impact on Japanese urban form through three case studies.

Modern port construction designed by Dutch engineers

Building a new port city: the case of Nobiru port

In 1876 the Japanese government hired the Dutch engineer Van Doorn. He was asked to build a new port intended for international trade in the Tohoku region in the north of Japan. At the time, the Japanese reportedly had no knowledge of the use of surveying and designing in water engineering.[12] In 1877, based on his analysis of topographical conditions, sediment deposit from the river, water depth and accessibility for a land transportation system, Van Doorn selected the Nobiru area as the best location for a new port. The location in a river delta meant that water depth was shallow, making it difficult for steam ships to moor. Van Doorn therefore proposed an inner port and an outer port (using a breakwater on the eastern edge of Miyako island), a decision that created technical difficulties. In 1878, Masanao Matsudaira (1844-1915), the Miyagi prefecture governor, opposed the project because Nobiru would have been difficult to access for ships arriving from Matsushima Bay, particularly when seas were rough, because the outer port was cut off from the inner port.[13] Van Doorn argued that other locations also had weak points, and that the problems of Nobiru could be overcome by construction.

Van Doorn proposed both port development and a new town with irrigation channels, streets, waterways for tugboats, bridges and dikes.[14] He also introduced new technologies. In those days, most Japanese ports were located in deltas, where dredging was necessary to maintain port functions. In the construction of the Nobiru port, Van Doorn introduced Dutch steam dredging machines that were able to dredge 40 tons per hour.[15] The Dutch steam dredging machines made it possible to establish and maintain the necessary water depth.

The design and construction of the inner port (the outer port would be established in a second step) effectively upended the entire project (Figure 2).[16] The pier positioned at the port entrance was designed with so-called fascine mattresses, a structure made of brushwood to distribute the load. This innovation of Dutch civil engineering was effective in rivers or shoals, however the coast of Nobiru was too deep and the waves too strong, leading to the ultimate failure of the technique in this context. The construction of the port started in 1878 and it was completed in 1882 with an increase in the construction cost.[17] At the time, the new town, which was around 1.1 million square meters and built using land reclamation, was also almost completed. Figure 1 shows the newly planned urban area, with a grid street network, three piers to connect the new town and inner basin, and some public gardens. The branch office of the governmental department of civil engineering was located along the waterway. Port planning clearly reached beyond the area of the port, and engineering practice engaged with urban form (Figure 2). However, sediment flowed to the inner port unexpectedly and a typhoon destroyed the port in 1884.[18] As Van Doorn had already returned to the Netherlands in 1882, his colleague Mulder investigated the

[12]Koninklijke Bibliotheek holding, "The Engineer".
[13]Okada, "The Night Tale of The Development in Tohoku Region".
[14]Tamura, "The Historical geography of Development".
[15]Nishiwaki, "The Visionary Port Construction in Nobiru".
[16]Hiroi, "The History of Port Construction", 22–35.
[17]Ibid, 29–30.
[18]Nishiwaki, "The Visionary Port Construction in Nobiru", 188–202.

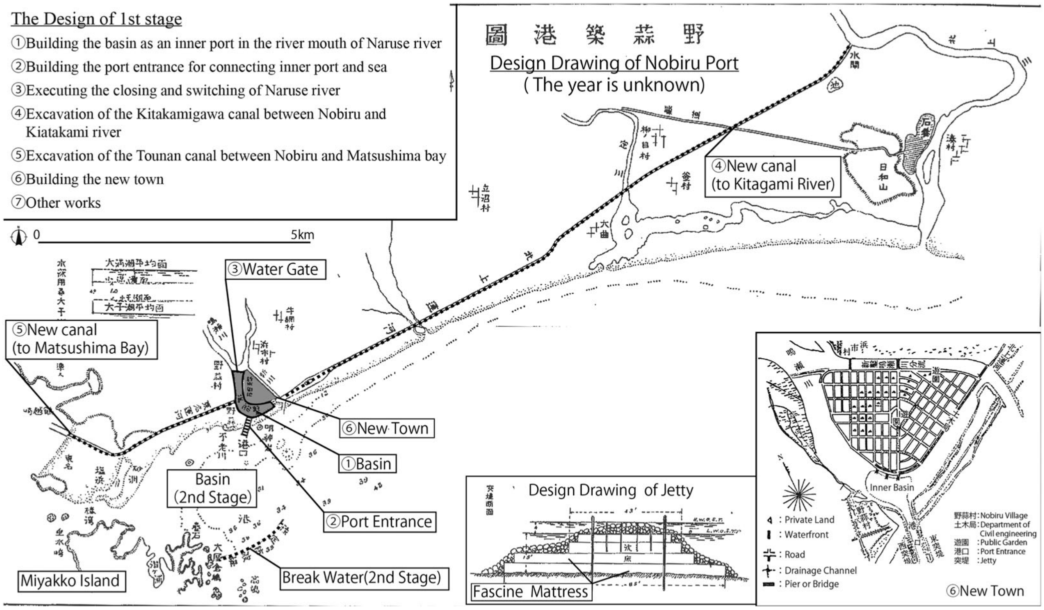


Figure 2. The design of Nobiru port. Source: Hiroi, The History of Port Construction. Tamura, The Historical Geography of Development.

case and highlighted Van Doorn's design errors, in particular the poor selection of location. Following Mulder's report, the Japanese government decided to halt the port's construction. Subsequently, everything was removed from the new town in Nobiru. The port city plan failed, but the engineering technology of the fascine mattress would go on to attract the attention of Japanese engineers.

Improvement of port functions: the case of Mikuni (Sakai) port

The port of Mikuni port was the first completed modern port project. It was designed by Dutch engineers Johannis de Rijke (1842-1913) and George Arnold Escher (1843-1939). Mikuni port had played an important role as a national trade port since the seventeenth century, because it was located on the route of the Kitamae-Bune, the national trading ships.[19] By the 1870s, the function of Mikuni port decreased due to sediment deposits from the Kuzuryu river. In 1875, people living in Mikuni town asked the Japanese government to improve the port. At first, in 1876, the Japanese government assigned Escher to the task of designing the Mikuni port improvement. During that year, he started to survey and design. His proposal included building an arc breakwater for gravel run-out from the Kuzuryu river and making a basin with an average water depth of three meters within the arc breakwater. He proposed that the arc breakwater, with a length of 470 m, should be made using fascine mattresses and stones.[20] A wooden pier completed the arc breakwater. Escher's project included urban elements beyond the port. He even designed an elementary school in Mikuni (Figure 3).[21]

[19]Kato, "Kitamae Ship:.
[20]Hiroi, "The History of Port Construction", 36–47.
[21]Kanbayashi, *De Rijke*, 93–116.

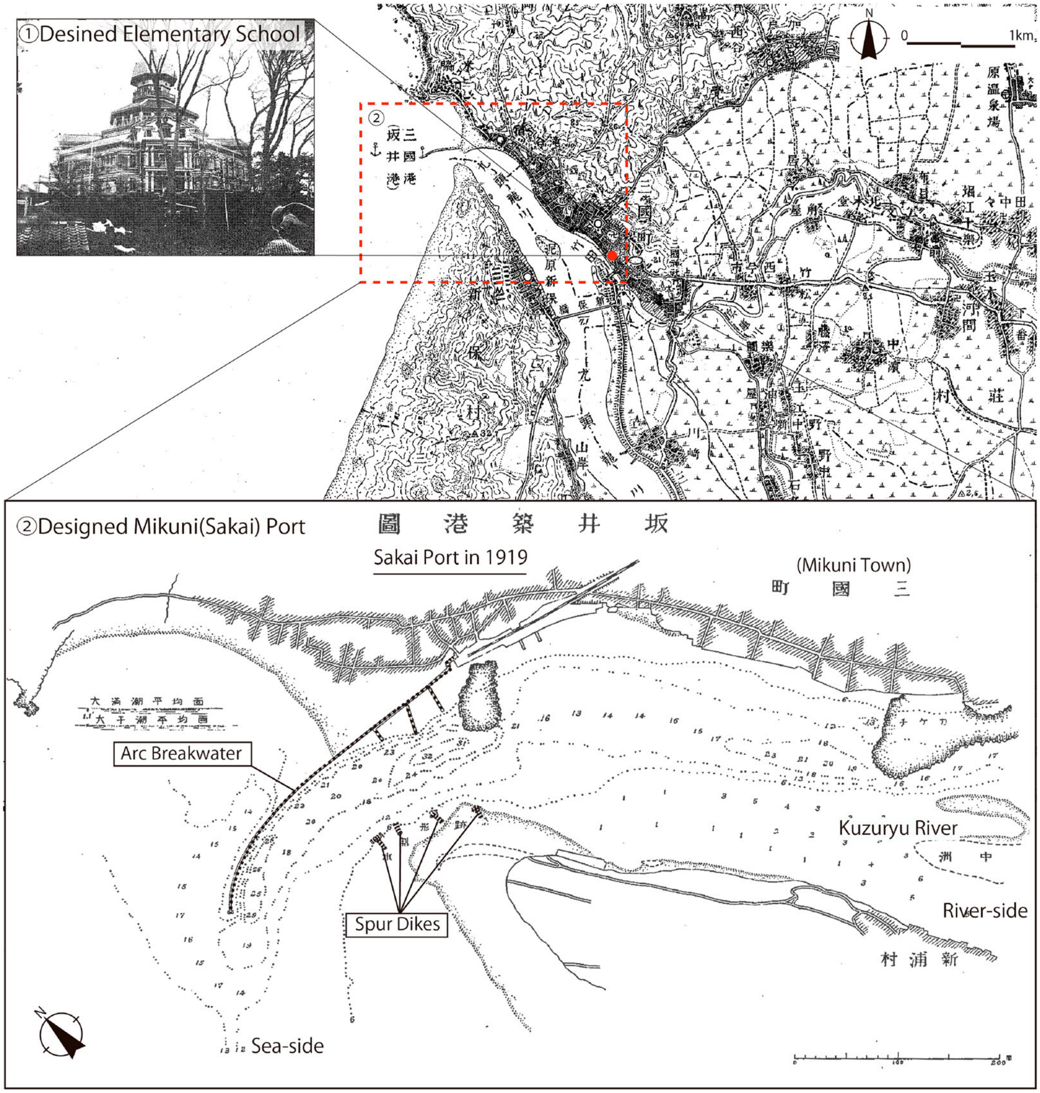


Figure 3. The design of the port and of modern architecture in Mikuni. Sources: Hiroi, The History of Port Construction. Ito, Reminiscences in Japan by the Dutch Engineer Escher. Dainihon Rikuchi Sokuryobu, 1/50,000 scale maps, Mikuni.

After completing the design, Escher's contract with the Japanese government was terminated and he returned to the Netherlands. In 1877, the Japanese government appointed his colleague De Rijke to the Mikuni port project.[22] While working on the project, he changed the design because of a miscalculation in the budget made by Escher and because the structure of the arc breakwater was too weak to withstand the Japanese waves. De Rijke proposed a new design that consisted of five layers of fascine mattresses and wooden piles, bounded by an iron chain. He also added four spur dikes in his design.[23] As a result of the changes to the design, construction costs tripled, and

[22]Mikuni Cho Shi Henshu Iinkai, "The History of Mikuni Town".
[23]Hiroi, "The History of Port Construction", 38–44.

the financial burden increased on the inhabitants. In 1880, without the agreement of De Rijke, Mikuni port opened to trade in the middle of construction, in an attempt to start recouping the construction costs. In 1881, part of the arc breakwater was destroyed by strong ocean waves[24], but construction continued. This project was finally completed in 1885, by which time the total construction cost had increased 7.5 times Escher's original calculation. As a result of the port's completion, Mikuni town gained prominence as a modern port and became a transit point for the shipping route.[25]

This arc breakwater created a strong water flow on the sea bottom. This made it possible to maintain the depth of the water by removing drift sand from the river-side to the sea-side and to defend the water surface against the impact of the ocean waves (Figure 3). The fascine mattress was adapted to slow river flows; a particularly appropriate use.[26] While the port was under construction, the Secretary of the Ministry of Public Works, a politician, and engineer came to the site to learn about the method of construction. What started as a port project led to the transmission of an engineering technology that would facilitate other planning projects.

Development of the port: the case of Yokohama Port

Before building a port, designers must research the topographical features of potential locations. Not all cities, Yokohama among them, meet the geographic requirements.[27] The Japanese government had chosen Yokohama as a site for foreign ships and trades in order to keep foreigners away from the capital, Tokyo.[28] After the opening of Yokohama port in 1859, when strong winds blew, it was impossible to unload goods from trading ships to the port[29], making it unattractive to merchants. The port location nonetheless remained unchanged. By the 1870s, particular kinds of infrastructure had been built systematically in Yokohama, including wide streets between the foreign settlement and Japanese districts.[30] (Figure 4)

In 1872, the first railway connection in Japan was built from Tokyo to Yokohama in an effort to establish a logistics network between the port city and capital.[31] In the 1880s, with funding from reparations paid by the United States to Japan for the Shimonoseki Campaign, a series of military engagement among foreign powers and the Japanese feudal domain of Chōshu, the government started new port construction in Yokohama.[32] Two foreign engineers proposed the port design. Kanagawa Prefecture invited Henry Spencer Palmer (1838-1893), a British military engineer, to join the new port project. He designed two wharves in the Yokohama port. De Rijke disagreed and designed two large breakwaters to surround Yokohama port.[33] Finally, the Foreign Office awarded the new port design to Palmer in 1889, while De Rijke was awarded the same plan by the Department of the Interior.[34]

In 1888, three engineers, Koi Furuichi (1854-1934), Gisaburo Tanabe (1858-1889), and A.T.L. Rouwenhorst Mulder, examined the two plans and concluded in their reports that the contents

[24]Hiroi, "The History of Port Construction", 44–6.
[25]Mikuni Cho, "The Century History of Mikuni Town".
[26]Naimu Sho Doboku Kyoku, "The Abridgment of Civil Engineering Vol. 3".
[27]Okamoto, "The Form of Port City".
[28]Yokohamashi Kikakutyosei Kyoku, "The Urban Planning History of Yokohama Port City", 7–27.
[29]Yokohama Toshi Hatten Kinenkan, "The Tale of The Two capitals, Edo and Tokyo", 50–74.
[30]Okamoto, "The Port City in The Modern Times," 91–140.
[31]Harada, "The Japanese Railway".
[32]Yokohamashi Kikakutyosei Kyoku, "The Urban Planning History of Yokohama Port City", 42–7.
[33]National Archives in Japan Holding, The Report Submitted by De Rijke.
[34]Yokohamashi Kikakutyosei Kyoku, "The Urban Planning History of Yokohama Port City", 34–5.

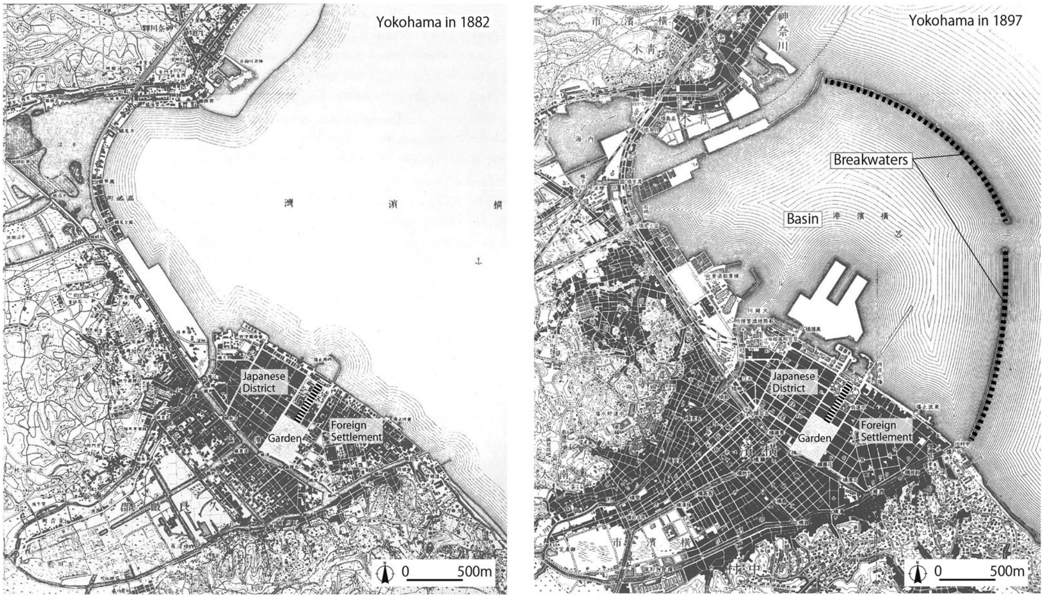


Figure 4. Yokohama port, before construction (left-side), after construction (right-side). Source: Yokohamashi Kikakuchosei Kyoku, The Urban Planning History of Yokohama Port City.

of the designs were nearly identical.[35] In both designs, Yokohama port was surrounded by two breakwaters; training dikes were to be built for the Katabira and Ooka rivers; and a pier was planned in the inner harbour. The principal difference was the structure of the breakwater, especially the degree of difficulty of construction, maintenance, repair and strength. In Palmer's design, the lower part of the breakwater was made of bagged concrete, and the upper part was concrete. In contrast, in Rijke's design, the lower part of the breakwater was built with fascine mattresses, and the upper part consisted of gravel, sand and other materials. Table 1 shows the opinions of the two Japanese engineers, Koi Furuichi and Gisaburo Tanabe. They indicated that Palmer's design would be harder to repair than Rijke's if the breakwater were damaged, given that it was built on soft ground. Mulder also spoke highly of Rijke's design, particularly of using the fascine mattress in the breakwater, while he opposed Palmer's design. Mulder's report argued that the fascine mattress would be able to adapt to any form on the seabed, that it would function long-term, that it had been used elsewhere in the world in places such as in Rotterdam, and that there were many suitable materials available that could be used for the fascine mattress. Mulder mentioned that Palmer's survey result was initially incorrect, and his design was at risk of subsidence on soft ground. Finally, their reports concluded that De Rijke's design was better.

Despite the expert's preference for De Rijke's proposal, the Japanese government ignored these opinions and decided to adopt Palmer's design in 1889 (Figure 4). From previous research, it appears that this decision was part of a diplomatic effort aimed at the revision of the so-called an unequal treaty with the United Kingdom. As was expected, the breakwaters were destroyed during building work.[36]

[35]National Archives in Japan Holding, "The Abstract Submitted by Mulder".
[36]Yokohamashi Kikakutyosei Kyoku, "The Urban Planning History of Yokohama Port City", 41–51.

Table 1. The evaluation of 'Furuichi and Tanabe (left-side)' and 'Mulder (right-side)'. Sources: National Archives in Japan Holding, Comparison of the Construction Method and the Plan about Yokohama Port by Palmer and De Rijke. National Archives in Japan Holding, The Abstract Submitted by Mulder about Yokohama Port Construction.

	Palmer	de Rijke		Palmer	de Rijke
Location of Brealwater	○	○	Forme of Breakwater (Part of North)	△	○
Area of basin	△	○	Forme of Breakwater (Part of East)	△	△
Port Entrance	○	○	Location of Port Entrance	△	○
Height of Breakwater	○	○	Area of Port Entrance	○	○
The Structure of Breakwater (On Hard Ground)	○	○	Ooka River	○	○
The Structure of Breakwater (On Soft Ground)	×	△	Katabira River	△	△
Pier	○	○	Location of Wharf	–	△
Katabira River	×	○	Link with Train	–	○
Conclusion	×	○	Height of Breakwater	×	△
○ : Consent			The Structure of Breakwater	×	△
△ : Revision is necessary			Construction Cost	×	○
× : Dissent			Conclusion	×	○

Conclusion: the influence of Dutch civil engineering on Japanese port planning

With the opening up of the country, Japan had to adapt to international trade with the world. It needed new port infrastructure that offered safe and deep basins for mooring steamships. From these ports, new cities grew, housing residents and workers, and land infrastructures expanded into the developing hinterlands. Dutch civil engineers had a great impact on Japanese port planning – not so much through their comprehensive port and urban planning ideas, but rather through technological advancement. In particular, the use of the fascine mattress technique for breakwaters – a building block for planning – and importing steam dredging machines, proved significant for the construction of basins and the development of modern ports. With these engineering techniques, Japan obtained the ability to build modern port basins. Dutch engineering, in particular the design of breakwaters and the practice of dredging, advanced Japanese port construction.

The foreign experts used new technologies such as the fascine mattresses as a foundation for planning, but their comprehensive plans remained designs, whereas the engineering devices they promoted became a foundation for Japanese planning practice and engineering. In Nobiru, Van Doorn introduced Dutch steam dredging machines and used the fascine mattress to build a breakwater. Escher also introduced the fascine mattress for building a breakwater at the first modern port in Mikuni. In the case of Yokohama, Palmer's breakwater failed while under construction because of low quality concrete.[37] The sloping-type breakwater which Rijke designed, however, was structurally weaker than Palmer's composite-type breakwater. Had high-quality concrete been used, Palmer's solution would have been preferable. The abundance of high-quality materials available in Japan for the construction of the fascine mattress made De Rijke's solution the appropriate one. The fascine mattress was also effective in the construction of Yokohama port[38] (Figure 5). The fascine mattress had already been used in the nineteenth century in the Rotterdam port[39] and in the Maas river, in the project named 'Nieuwe Waterweg (New Waterway)'. Dutch civil engineers exported their modern techniques to Japan, an excellent example of the export of water management practices.

[37]Kanagawa Ken, "The History of Kanagawa Prefecture".
[38]De Rijke Kenkyukai, "The Study of De Rijke".
[39]Barnard, "The North Sea Canal of Holland".

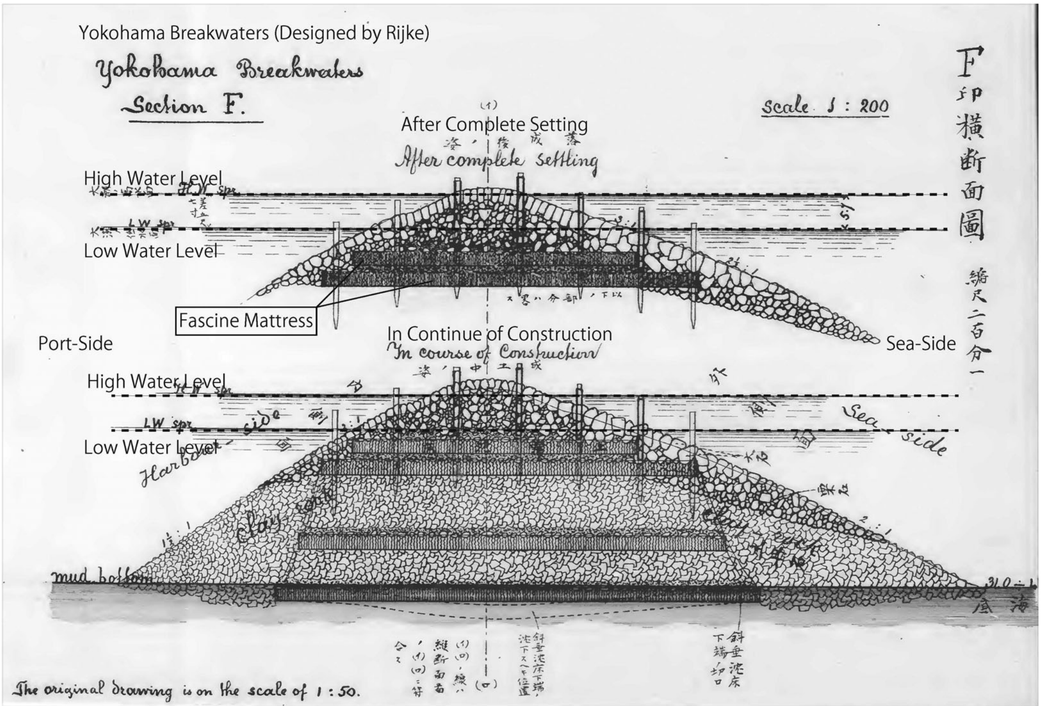


Figure 5. The section of the breakwater with fascine mattresses. Source: National Archives in Japan Holding, The Abstract Submitted by Mulder about Yokohama Port Construction.

Through the three Dutch planning projects, especially the ones for Nobiru and Mikuni, Japanese civil engineers studied and gained knowledge of how to build an artificial basin. Even though the plans for new cities were not realized, fascine mattresses became the building stones for new planning projects in rivers and ports. In Japanese textbooks in 1889, the fascine and fascine mattress appeared as an innovative and useful technique.[40] Once introduced and adapted in Japan, these technologies were reused, to the point that they are perceived as being Japanese inventions. The case of Japanese port planning under the influence of Dutch engineers serves as a call for more research on the role of engineering innovation in the development of planning.

Acknowledgement

This work was supported by JSPS KAKENHI Grant-in-Aid for Young Scientists under Grant Number 20K14943.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This work was supported by JSPS KAKENHI Grant-in-Aid for Young Scientists under [grant number 20K14943].

[40]Tatsumura, "The Techniques of Sand Control and Fascine", 14–70.

Notes on contributors

Kazumasa Iwamoto, Ph.D (Engineering), is working in the Landscape and Ecology Division, National Institute for Land and Infrastructure Management. His research focuses cross-cultural engineering and port planning through the lens of civil engineering. He has worked at TU Delft as a guest researcher, supported by MEXT, from February 2017 to March 2018.

Carola Hein, is Professor and Head of the History of Architecture and Urban Planning, TU Delft. She has published widely on topics in contemporary and historical architectural and urban planning, notably that of Europe and Japan. Her current research interests include transmission of architectural and urban ideas along international networks, focusing specifically on port cities, and the global architecture of oil. Her books include *Routledge Handbook of Planning History* (2018), *Port Cities: Dynamic Landscapes and Global Networks* (2011), *Cities, Autonomy, and Decentralization in Japan* (2006), and *The Capital of Europe: Architecture and Urban Planning for the European Union* (2004)

ORCID

Kazumasa Iwamoto http://orcid.org/0000-0001-8518-6139
Carola Hein http://orcid.org/0000-0003-0551-5778

Bibliography

Barnard, J. G. “North Sea Canal of Holland and on the Improvement of Navigation from Rotterdam to the Sea.” *Washington Government Printing Office* (1872): 51–77.

Dainihon Rikuchi Sokuryobu. *Gomam Bun No Ichi Chikeizu, Mikuni* (1/50,000 scale maps, Mikuni). *Dainihon Rikuchi Sokuryobu*, 1909.

De Rijke Kenkyukai. *De Rijke Kenkyu vol.12* (The Study of De Rijke Vol.12), *Chikikaihatsu Kenkyuzyo Kabushiki-Kaisha*, 2002.

Doboku Gakkai. *Meiji Igo Honpou Doboku To Gaizin* (The Japanese Civil Engineering and The Foreigners after Meiji Era), *Mitsuhide Sha*, 1942.

Doboku Gakkai. *Nihon no Dobokugijutsu –Hyakunen no Hatten no Ayumi* –(The Japanese Civil Engineering–History of One Hundred Years of Development), *Gihodo*, 1964.

Fikui Ken Sakai Gun Mikuni Cho Yakuba. *Mikuni Cho Gaikan* (The Overview of Mikuni Town), *Meiji Insatsu Kabushiki-Kaisha*, 1923.

Gasteren, L. *In Een Japanse Stroomversnelling* (In a Japanese Rapids), *euro book productions*, 2000.

Harada, K., and E. Aoki. *Nihon No Tetudo* (The Japanese Railway), *Sanseido*, 1973.

Hayashi, T. *Gijutsu to Shakai –Nihon no Keiken* –(Technology and Society-Experience of Japan-), *United Nations University*, 1986.

Hein, C. “The Exchange of Planning Ideas from Europe to the USA after the Second World War: Introductory Thoughts and a Call for Further Research.” *Planning Perspectives: Special Issue on Transnational Urbanism (edited by Carola Hein)* 29, no. 2 (2014): 143–151.

Hein, C. *Port Cities: Dynamic Landscapes and Global Networks*. Routledge, 2011.

Hein, C., and Y. Ishida. “Japanische Stadtplanung Und Ihre Deutschen Wurzeln (Japanese Urban Planning and Its German Roots).” *Die Alte Stadt* 25, no. 3 (1998): 189–211.

Hiroi, O. *Nihon Tikukou Shi* (The History of Port Construction), *Maruzen Kabushiki-Kaisha*, 1927.

Home, R. “British Colonial Civic Improvement in the Early Twentieth Century: EP Richards in Madras, Calcutta, and Singapore.” *Planning Perspectives* 31, no. 4 (2016): 635–644.

Hoshino, Y., and D. Kitagawa. “Historical Research for Planning and Construction of MISUMI Port.” *Journal of Historical Studies in Civil Engineering* 23 (2004): 95–108.

Houter, F. Den, and Cees Van Der Meulen. *Rotterdam En De Nieuwe Waterweg* (Rotterdam and the New Waterway), *Schip En Haven, 3. Amsterdam: De Boer*, 1956.

Inayoshi, A. *Kaiko No Seijishi* (Seaport Political History), *The University of Nagoya Press*, 1–62, 2014.

Ito, Y. *Bohatei Kozo Ron Shi* (The History of Breakwater’s Structure Theory), *Technical note of The Port and Harbour research Institute Ministry of Transport Japan*, No.69, 1969.

Ito, Y. *Ranjin Koshi Esseru Nihon Kaisoroku* (Reminiscences in Japan by the Dutch Engineer Escher), *Ryushokan*, 1990.

Kanagawa Ken. *Kanagawa Ken Shi Tsushihen Roku Kindai Gendai San* (The History of Kanagawa Prefecture in Modern and Present Times No.6 Vol.3), *Dainihon Insatsu Kabushiki-Kaisha*, 868–873, 1981.

Kanbayashi, Y. *Nihon No Kawa Wo Yomigaeraseta Gishi De Rijke* (De Rijke, The Engineer who revivified Japanese Rivers), *Soshisha*, 1999.

Kasen Dentou Kouhou Kenkyukai. *Kasen Dentou Kouhou* (The Traditional River Technique), *Chikikaihatsu Kenkyuzyo Kabushiki-Kaisha*, 1995.

Kato, T. *Kitamae-Bune Kikouchi To Koeki No Monogatari*(Kitamae Ship, The tale of trading and Port of Call), *Mumyosya-Syuppan*, 106–113, 2002.

Kumamoto Ken. *Kumamoto Ken Shi Kindai Vol.2* (The History of Kumamoto Prefecture in Modern Times Vol.2), *Shukousha Insatsu Kabushiki-Kaish*a, 1962.

Kensetsu Sho Okayama Kasen Kozi Jimusho. *A.T.L Mulder No Houkoku Oyobi Kankei Bunsho* (The Reports and Sentences of A.T.L.Mulder), 1882.

Kobayashi, T. *Nihon no Minato no Rekishi* (The History of Japanese Port), *Kotu Kenkyu Kyokai*, 1978.

Koninklijke Bibliotheek holding. *De Ingenieur* (The Engineer), No5, 1887.

Konvitz, J. W. "Port Cities and Urban History." *Journal of Urban History* 19, no. 3 (1993): 115–120.

Matsura, S. *Meiji No Kokudokaihatsu Shi* (The History of National Land Development in Meiji Era), *Kajima Institute Publishing*, 1992.

Meyer, H. "City and Port: Urban Planning as a Cultural Venture in London, Barcelona, New York, and Rotterdam. Changing Relations between Public Urban Space and Large Scale Infrastructure." *Intl Books* (1999).

Mikuni Cho. *Mikuni Cho Hyakunen Shi*(The Century History of Mikuni Town), *Mikuni Cho Hyakunen Shi Hensan Iinkai,* 355–468, 1989.

Mikuni Cho Shi Henshu Iinkai. *Mikuni Cho Shi* (The History of Mikuni Town), *Yoshida Nishiki Bundou Kabushiki-Kaisha*, 679–688, 1964.

Mulder, R. *A. T. L. EEN DRIETAL ZEESTRATEN VAN DEN JAPANSCHEN ARCHIPEL* (A Three Streets of The Japanese Archipelago), *in Tijdschrift van het Koninklijk Instituut van Ingenieurs 1892-1893*, 1893.

Mulder. *Tokyo Tikukou Ni Kansuru Mulder Shi Ikensho* (The Submission of Mulder about Tokyo Port Construction), 1881.

Nagasaki Shishi Hensan Iinkai. *Shin Nagasaki Shishi Vol.3 Kindaihen* (The New History of Nagasaki Prefecture in Modern Times Vol.3), *Nagasaki Shi*, 2015.

Naimu Sho Doboku Kyoku. *Doboku Kou Youroku Jin* (The Abridgment of Civil Engineering Vol.3), *Yurindou*, 1881.

National Archives in Japan Holding. *Koushi De Rijke Houtei Yokohama Tikukou Keikaku hokokusho* (The Report Submitted by De Rijke about Yokohama Port Planning), 1888.

National Archives in Japan Holding. *Koushi Mulder Yokohama Tikukou Keikaku Iken Tekiyou* (The Abstract Submitted by Mulder about Yokohama Port Construction), 1888.

National Archives in Japan Holding. *Palmer De Rijke Yokohama Tikukou Keikaku Tekiyou Narabi Koho Taisho* (Comparison of the Construction Method and the Plan about Yokohama Port by Palmer and De Rijke),1888.

Nishiwaki, T. *Maboroshi No Nobiru Tikukou* (The Visionary Port Construction in Nobiru), *Fujiwara Shoten*, 16–37, 2012.

Okada, M. "*Tohoku Kaihatsu Yawa* (The Night Tale of The Development in Tohoku Region)." *Kinkoudou Shyupan Kabushiki-Kaisha* (1977): 188–204.

Okamoto, T. "*Minatomachi No Kindai* (The Port City in The Modern Times)." *Gakugei Syuppan-Sya* (2008): 91–140.

Okamoto, T. *Minatomachi No Katachi* (The Form of Port City), *Hosei University Press*, 200–244, 2010.

Sanada, H. *Nihon Suisei Kou* (The Japanese Construction of Spur Dike), *Shin Nihon Insatsu Kabushiki-Kaisha*, 1932.

Suda, H. "*Funadamari No Keikaku To Bouhatei No Sekouhou (Nobiru Kou)* (The Planning of Basin and The Construction Method of Breakwater in Nobiru)." *Magazine of Japan Society of Civil Engineers* 72 (1987): 8–10.

Takahashi, Y. *Kozuiron* (The Flood Theory), *PhD thesis, Tokyo University*, 1964.

Takahashi, Y. "*Nihon Doboku Gizyutu No Rekisi* (The History of Japanese Civil Engineering)." *Tizin-Syokan* (1960): 93–121.

Takasaki, T. *Meijisyoki Oyatoi Orandajin Tyokoshi van Dorrn kenkyu* (The Study of Van Doorn, Head Dutch Engineer, in early modern times), *Report of the Public Works Research Institute (204), 1–28, 2006*.

Tamura, K. "*Kaihatsu No Rekishichiri* (The Historical Geography of Development)." *Taimeido* (1985): 67–98.

Tatsumura, Y. *Sabokou Oyobi Soda kou* (The Techniques of Sand Control and Fascine), 14–70, 1889.

Unno, F. *Gijutsu no Shakaishi Vol.3 – Seiyo Gijutsu no Inyu to Meijishakai* -(Social History of Technology Vol.3 -Importation of Western Technology and Japanese Society in Meiji Era-), *Yuhikaku Publishing*, 1982.

van den Burg, G. *De Nieuwe Waterweg Poort van Europa* (The New Waterway Gate of Europe), *De bataafsche Leeuw*,1989.

Ward, Stephen V. "Re-Examining the International Diffusion of Planning." In *Urban Planning in a Changing World, the Twentieth Century Experience*, edited by Robert Freestone, 40–60. London: E. & F.N Spon, 2000.

Ward, Stephen. "The International Diffusion of Planning: A Review and a Canadian Case Study." *International Planning Studies* 4, no. 1 (1999): 53–77.

Yokohama Toshi Hatten Kinenkan. *Minato Wo Meguru Nito Monogatari Edo Tokyo To Yokohama* (The Tale of The Two capitals, Edo and Tokyo), *Sato Insatsu Kabushiki-Kaisha*, 50–74, 2014.

Yokohamashi Doboku Kyoku. *Yokohama Kou* (The Yokohama Port), *Yasuda Insatsu*, 1973.

Yokohamashi Kikakuchosei Kyoku. *Minatomachi Yokohama No Toshikeiseisi* (The Urban Planning History of Yokohama Port City), *Yokohamashi Kikakutyosei Kyoku*, 1981.