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与大海共生长的安全海水屏障： 荷兰瓦登工程

A Safe Water Barrier Growing with the Sea: The Wadden Works Project, the Netherlands

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项目地址: 荷兰阿夫鲁戴克大堤
项目面积: 堤坝长度32km, 新形成的自然区域面积1 500 hm²
项目委托: 荷兰水道及公共工程部艾瑟尔湖管理处
项目团队 (HOSPER): Jonas Strous、Hilke Floris、Peter de Ruyter、Remco Rolvink、Jorrit Noordhuizen
项目合作: DHV集团、荷兰海洋资源和生态系统研究院
设计时间: 2008~2010年

Location: Afsluitdijk, the Netherlands
Area (size): 32 km of dike, 1,500 hm² of new nature
Client: Ministry of Waterways and Public Works, IJsselmeer Department
Project Team (HOSPER): Jonas Strous, Hilke Floris, Peter de Ruyter, Remco Rolvink, Jorrit Noordhuizen
Collaborators: DHV, IMARES
Design Period: 2008 ~ 2010

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摘要 ……
 堤岸类的海水屏障对于保护人们的安全是非常重要的。荷兰的海岸工程正在迈向一个新的时期, 我们将不再局限于如何最大程度地减少负面效应, 而是追求如何才能创造出更多的正面效益。本方案展示了着眼于更广义程度上的环境、生态以及社会利益的方式将最终取代那些局限的技术方法。

关键词 ……
 堤岸; 人工干预; 自然过程

Abstract ……
 Sea barriers such as dikes are essential for safety. It is now time for the next step in the evolution of Dutch coastal engineering. Rather than merely minimizing negative effects, we now wish to create positive effects. This vision is an example of how the narrow technological approach can be abandoned in favor of an approach which addresses a broad range of environmental, ecological and social interests.

Key words ……
 Dike; Intervention; Natural Process



结合自然的建造

堤岸类的海水屏障对于保护人们的安全是非常重要的, 尤其是在荷兰这样的大部分国土都位于海平面以下的国家。荷兰在海岸工程方面有着悠久而丰富的历史。长期以来, 荷兰涌现出了许多技术革新。近年来, 在我们试图与自然进行互动的的方式上, 发生了一场重大的文化变革。直到20世纪60年代, 荷兰的一些重点水资源保护项目所造成的负面效应才逐渐引起人们的关注和重视。随着人们不断努力减少这些负面效应, 我们的思想认识也发生了根本性的转变。东斯海尔德大坝就是一个很好的例子。该大坝最初被设计为一个封闭

性的屏障, 但随后被重新设计成一个开放性的潮汐屏障。如今, 荷兰的海岸工程正在迈向一个新的时期。我们将不再局限于如何最大程度地减少负面效应, 而是追求如何才能创造出更多的正面效益。本方案展示了着眼于更广义程度上的环境、生态以及社会利益的方式最终将取代那些局限的技术方法。

最近的一些测评结果对荷兰阿夫鲁戴克大堤的长期安全性提出了质疑。曾经作为最重要的基础堤坝之一的阿夫鲁戴克大堤已经无法满足安全要求。克服这些缺点的传统方法是将堤坝加高几米, 并对堤坝的表面进行彻底重修。瓦登工程项目作

为阿夫鲁戴克大堤的4个未来远景方案之一, 它所采用的方法则完全不同。该项目不再一味地增加堤坝的高度, 而是通过建造人工盐沼进行横向的扩展。这将建立一个强大的、与大海共同“生长”的新屏障。该方法所涉及的技术其实已有几百年的历史, 其利用了自然界中泥沙的沉积过程, 通过运用相对简单的方式加快这一自然过程。

瓦登工程的前景

传统的固堤方法需要对长达32km的阿夫鲁戴克大堤进行加高加厚。这种大规模的人工干预将对堤坝具有文化历史价值的

现存面貌造成严重影响。在瓦登工程中可以预见, 它的安全措施将会为该地区带来可持续的、整体的发展。

根据瓦登工程项目的规划, 现有堤坝的竖向高度将不再增加, 而是通过布满泥滩的盐沼——这种盐沼在瓦登地区很普遍——进行横向扩展。这将创建一个自然的、强大的、低维护的海水屏障。它会随着海平面的上升而不断扩大, 而且能够减轻外部的海浪冲击。盐沼的宽度将介于400~600m之间, 且花费不会超过可用预算。盐沼和堤坝之间将修建一个大约100m宽的“缓冲区”, 该“缓冲区”将与堤坝形成一个小角度, 从而与堤坝完美契合。



3. 阿夫鲁戴克大堤区图
4. 盐沼中的自行车道
5. 盐沼中的步行道
6. 阿夫鲁戴克大堤沿线的瓦登工程及盐沼
8. 科伦沃德滩气象信息中心, 以及大桥和观景点。
© Lucas Kukler
3. Location of the Afsluitdijk
4. Cycle route across the salt marshes
5. Footpath across the salt marshes
6. Profile of the Afsluitdijk (current situation)
7. Wadden Works and salt marshes along the Afsluitdijk
8. Climate Information Centre at Kornwerderzand, with bridge and observation point. © Lucas Kukler

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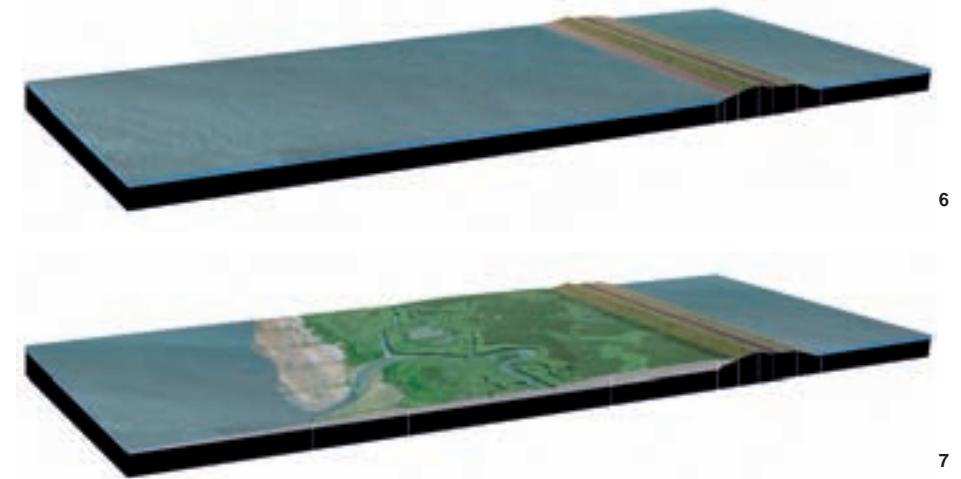


该理念的设计出发点是要保留堤坝的文化历史价值（其历史可追溯到1932年），同时提升其生态价值。出水闸和背风堤的巧妙结合将减缓两天一次的淡水侵入这一不应有的现象所造成的影响。该项目还产生了“河口区”的概念，成为淡水和咸水之间的过渡区。

本项目所需的沙土来自艾瑟尔湖，这些沙土将创造一个拥有不同寻常的生物多样性的“水下景观”，为多种鱼类和鸟类提供理想的栖息地，从而形成1 500hm²的具有休闲娱乐功能的自然保护区。瓦登工程项目还将新建两座桥梁供水路和陆路交通同时使用，并将成为弗里斯兰省和北荷兰省的“关口”，同时保障瓦登海和艾瑟尔湖之间视线的通畅。这两座桥将跨越并连接当地的水道和受保护的古迹，巧妙而优雅地解决当前由于交叉口和狭口过多所导致的过于混乱的结构问题。半咸水过渡区内淡水和咸水之间的相互作用能够制造出“蓝色能源”。最后，与前面提到的几点同样重要的是，将在科伦沃德滩修建一个公共气象信息中心。

可持续娱乐项目的分期建设

瓦登工程项目还将创造一个吸引游客的景观，以推动该地区旅游业和娱乐休闲业的发展。第一步是升级现有的设施，并



开展科伦沃德滩公共气象信息中心的分期建设。该中心主要通过寓教于乐的方式，对外开展荷兰的水利工程历史、气候变化、能源以及当地的生态环境方面的教育和宣传。该中心的规模和影响力都将逐步发展壮大，到2020年将成为数条步行道和自行车道的连接枢纽。而登乌弗镇的重点将集中在文化和历史方面，布瑞赞德克镇的重点在于提供宁静的开阔空间。当前还制定了有关在艾瑟尔湖南岸建造海滩和相关设施的计划，但尚未确定。

创新和国际关注

在如此大的尺度上将海滨自身纳入安

全概念范围的海岸工程是史无前例的。在这里，地区的自然价值得到了强调，景观也变得更加多样。同时，该工程对其丰富的文化历史的尊重也使围堤的原貌得以呈现。“建造结合自然”这一概念正迅速发展壮大，到2020年将成为数条步行道和自行车道的连接枢纽。而登乌弗镇的重点将集中在文化和历史方面，布瑞赞德克镇的重点在于提供宁静的开阔空间。当前还制定了有关在艾瑟尔湖南岸建造海滩和相关设施的计划，但尚未确定。但遗憾的是它未能实现——由于政治和财政原因，所提交的4个方案都难以付诸实施。但这其中所提及的诸多理念都将经过检验，进而融入到一个更加谨慎和传统的方案中。LAF



Building with Nature

Sea barriers such as dikes are essential for safety, especially for the Netherlands — a country in large part located below sea-level. The Netherlands has a long and rich tradition in coastal engineering. There have been many technical innovations, but recently there has also been a dramatic cultural change in the way we try to interact with nature. Until the 1960s, little attention was devoted to the negative impact of major water protection projects. A radical shift in thinking followed, with efforts made to minimize any detrimental effects. The Oosterschelde Dam is a good example. This dam was initially designed as a closed barrier, but redesigned as an open tidal barrier. It is now time for the next step in the evolution of coastal engineering in the Netherlands. Rather than merely minimizing negative effects, we now wish to create positive effects. This vision is an example of how the narrow technological approach can be abandoned in favor of an approach which addresses a broad range of environmental, ecological and social interests.

The recent evaluations have raised some doubt about the long-term safety of the Dutch Afsluitdijk (“enclosing dike”), one of the most important primary dams, no longer

meet safety requirements. The conventional means of rectifying the shortcomings would be to increase the height of dike by several meters and to entirely resurface it. The Wadden Works Project, one of the four visions that have been made for the future of the Afsluitdijk, takes an alternative approach. Rather than increasing the height of the dike, it is to be extended laterally by means of artificial salt marshes. This will create a robust water barrier which actually “grows” with the sea. The technique to be employed is actually centuries old. It relies on the natural processes of silt accretion, which can be accelerated using relatively simple means.

The Wadden Works' Vision

Using conventional methods of strengthening the dike would require the 32 kilometers Afsluitdijk to be enlarged and newly cladded. This large intervention has serious consequences for the current cultural-historical valuable profile. In the Wadden Works' vision, the safety issue has been used to bring about a sustainable, integrated development of the area.

Under the Wadden Works Project, the existing dike will not be raised (increased in height) but expanded laterally by means

of salt marshes overgrown mud flats that are often seen in the Wadden area. This will create a natural, robust and low-maintenance sea barrier which will grow with the sea as the water level rises and break the incoming waves. The salt marshes, which may be realized within the available budgets, will be between four hundred and six hundred meters in breadth. Between the salt marshes and the dike itself a raised “buffer zone” of some 100 meters will be established, which joins the dike at a slight angle. The concept has been designed in such a way as to retain the cultural historical values of the dike (which dates from 1932), while enhancing the ecological values. An ingenious combination of outlet sluices and leeward banks will mitigate the effect of the unnatural bi-daily fresh water incursions. The concept also provides for the inclusion of “estuarine” areas, being transition zones between fresh and salt water.

The sand required for the project will be obtained from the IJsselmeer (Lake), which enables an “underwater landscape” of unusual diversity to be created. This will provide an ideal habitat for many species of fish and birds and form a new nature reserve of 1,500 hm² offering recreational

opportunities as well. The Wadden Works project will also include two high bridges for the simultaneous passage of ships and road traffic, which will become the “gateways” to Friesland and Noord Holland, and will provide an unobstructed, fantastic view over the Wadden and the IJsselmeer itself. They will straddle local waterways and protected monuments, forming an elegant solution to the current rather chaotic situation with its many junctions and bottlenecks. “Blue Energy”, derived from the interplay of fresh and salt water, can be generated in the brackish transition zones. Last but not least, a public Climate Information Centre is to be built at Kornwerderzand.

Phased Development of Sustainable Recreation

The project will also serve to create an attractive landscape for visitors, providing a boost to tourism and leisure in the region. The process will begin with an upgrading of the existing facilities and the phased construction of the Climate Information Centre at Kornwerderzand. This centre will inform and educate visitors about the history of hydraulic engineering in the Netherlands, climate change, energy and the local ecology



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in an accessible and entertaining way. The centre will be developed gradually, both in size and importance, and by 2020 it will become the hub of several walking trails and cycle routes. The focus at Den Oever will be on culture and history, while Breezanddijk will offer tranquility and wide open space. There are also plans, as yet unconfirmed, for a beach area with all associated amenities on the southern side of the IJsselmeer.

Innovation and International Interest

Never before has the foreshore itself been incorporated into the safety concept on this scale. At the same time, the natural values in the area are enlarged and the experience of the landscape becomes more diverse. “Building with Nature” is rapidly becoming an international trend, drawing increasingly

great interest in creating sustainable sea defenses by means of natural processes. Also, the design respects the rich cultural history: The original Afsluitdijk remains recognizable. This was recognized by the general public as the project was selected as favorite in a public survey in 2010, nevertheless this vision has not been brought into reality due to political and financial reasons. It was not possible to realize any of the four submitted visions as is. However, many of the described concepts will be tested and incorporated into a final more sober and traditional plan. **LAF**

9. 靠近弗里斯兰省海岸线的盐沼地可供开展休闲活动
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10. Basic profile of Wadden Works © Lucas Kukler
11, 12. Afsluitdijk current situation