Summary

Schiphol expansion

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‘A view of the future’

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Summary

Through an investigation of the specifications from reports of several organisations it appears that Amsterdam Airport Schiphol will reach its capacity limit in the future. It is therefore desirable to expand the airport's potential capacity before it reaches its limits. The investigation of *PTR Offshore Designers* shows that optimising the airport at its current location can best solve the capacity problems of the airport in the short term. This corresponds rectilinear with the vision of the Dutch government. However, on account of the ground surface limitations and the exceeding of sound, safety and/or environmental regulations the airport will not be able to continue its developments at its current location beyond the year 2020. An increase of the capacity created through an expansion located in the North Sea area, named 'Nieuw Holland', is therefore a better option and will be necessary in the long term. There is also the potential for 'Nieuw Holland' to serve as an expansion for other busy European airports that will face similar capacity problems in the future. The main question of this investigation is therefore: "What is the most suitable location in the North Sea for the expansion and how will 'Nieuw Holland' be designed?"

For this purpose an analysis of all the different demands and boundary conditions that the location will have to satisfy has been made. In this analysis all the following aspects have been taken into account: water depth, seawater currents, wind directions, ecology, geology, shipping, the connection between the new location and the existing Schiphol airport and the execution and costs. Specifications for these aspects originate in part from the Directorate-General for Public Works and Water Management (Rijkswaterstaat), the Netherlands Organisation for Applied Science Research (TNO), Royal Boskalis Westminster nv (Boskalis) and the Royal Dutch Meteorological Institute (KNMI). This investigation shows that the most suitable location for expansion is located approximately 23 kilometres from the coast of Noordwijk and 44 kilometres to the centre of Schiphol as the crow flies.

At this North Sea location an artificial island will be constructed. A polder variant is outweighed by its disadvantages concerning drainage, seepage and the possibility of flooding. The north, south and west sides of the island will be protected by a coastal construction including a shoulder construction. On the east side of the island this shoulder construction will be superfluous as the waves striking the eastern shore are significantly lower. After researching the most suitable coastal construction, the covering materials were specified. The base of the coastal construction will consist of sea sand with a filter construction of crushed rocks on top. Heavy akmon elements will protect the head of the shoulder. Furthermore, the coastal construction is calculated on a probability of flooding once in every 10,000 years, which corresponds to the security level of the 'Randstad' coastal defence. There is a maximum wave turnover discharge of 10 litres per second per running meter applied, after which the definite crest height of the dike was calculated.

There is a spatial plan for the artificial island designed to make it as compact as possible but with all the required facilities taken into account. Besides the standard airport facilities, such as a terminal and a hangar, a drinking water company, a wastewater treatment plant and a harbour will also be located on the island. With these facilities, together with some other facilities that include the safety facilities at 'Nieuw Holland', the island will be almost completely self-sufficient. The needed capacities of all these facilities are based on a rough prognosis of the numbers of airplane traffic and passengers in 2020. The total surface area of the island adds up to approximately 500 hectares, of which almost half of the surface area consists of paved or tarred area. By using sophisticated technology, trailing suction hopper dredgers will heighten the largest part of the island. This procedure will be executed in several phases. Approximately 177 million cubic meters of sea sand will be required for creating the entire island. Other floating equipment will build up the solid coastal construction.

A new large-scale project such as ‘Nieuw Holland’ creates new opportunities in the field of water management. The recent innovations here led to the decision of utilising water at ‘Nieuw Holland’ in as many ways as possible. Most of the precipitation will be collected and stored in water-basins on the island, from where it can be re-used for sanitary and other purposes at the various facilities. New technology in the domain of desalination and purification of seawater will provide enough drinking water for the island. Some of the water from the precipitation storage may also be purified for use as drinking water. At the other end of the water cycle there is a wastewater treatment plant on the island that will purify all effluent. In case of emergencies the airport will be able to rely on a couple of additional drinking water transport pipes, which will be housed in the construction that connects the island with the mainland. In cooperation with Tauw, a consulting and engineering company, and with help from the ‘Leidraad Riolering’ manual, several sewage system calculations and simulations have been made.

A special rail connection will be designed in order to let ‘Nieuw Holland’ function efficiently. An investigation into the different types of connection variants revealed the numerous pros and cons, which were then weighed against each other to choose the best option. With regard to especially safety and future maintenance criteria, a submerged tunnel was chosen as the best option for this specific project. In a later phase of the design project a variety of boundary conditions were set for the professional design of the tunnel. The execution methods for installing the tunnel below the sea floor are handled in detail. Focus is given to a part of connection wherein it is made clear how the construction is designed and how the critical construction loads are calculated. Lastly, an impression is given of the rail connection along the mainland.

After defining the exact island design and the accompanying tunnel construction with the mainland, a construction budget, exclusive of the water management and structural engineering aspects, was drafted for the entire project. After calculating the required quantity of materials needed, parameters were drawn up. After the multiplication of the parameters with the required quantity, the construction costs for the entire island, including the coastal construction, came to approximately 2.16 billion euros and the submerged tunnel connecting the island with the mainland came to approximately 795 million euros, bringing the total cost of construction to approximately 2.95 billion euros. Concerning the duration of construction, the building of the submerged tunnel is the leading factor because this can only be done during specific times of the year. The expected construction duration amounts to approximately four years. The construction of the island itself will only take two to three years, after which the building of the various different facilities on the island can begin. The expectation is that this will take approximately three years, after which ‘Nieuw Holland’ can be operational.

With the unlimited possibilities available these days, this expansion of Amsterdam Airport Schiphol in the North Sea will definitely start a new chapter in the history of Dutch Civil Engineering.

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