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中欧低碳生态城市合作项目

CASE STUDY

Case Study

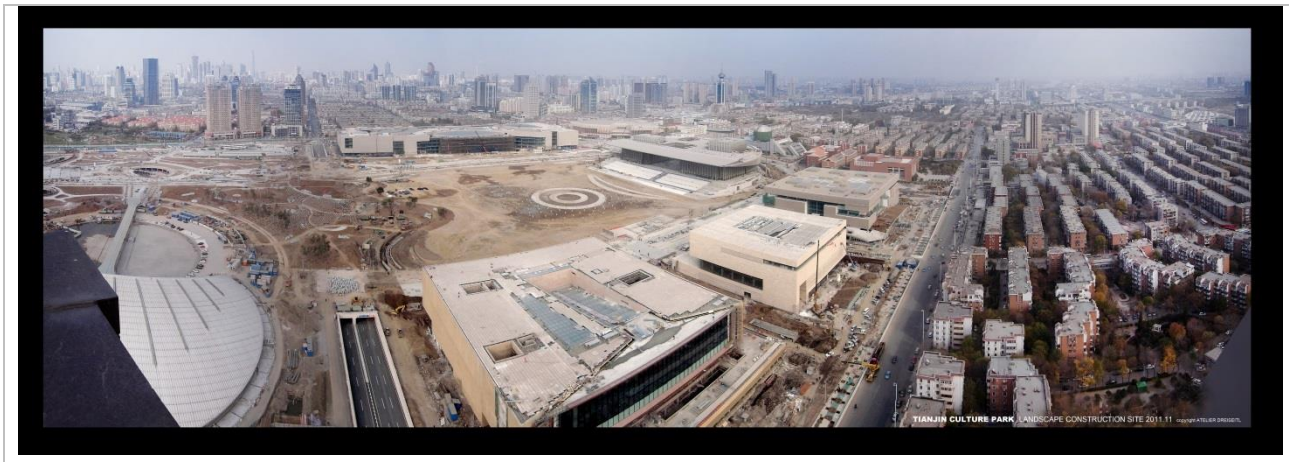
Water Management

Tianjin, China: Tianjin Cultural Park (TCP): Water Sensitive Urban Design and Sponge Cities

Problem to resolve: Tianjin's City Center suffers a high risk of flooding

Primary Tools: →**Tool WM 3**

Response: Creation of a recreation aerea which doubles as water retention zone



Construction phase of Tianjin Cultural Park area and Lake (Ramboll Studio Dreiseitl)

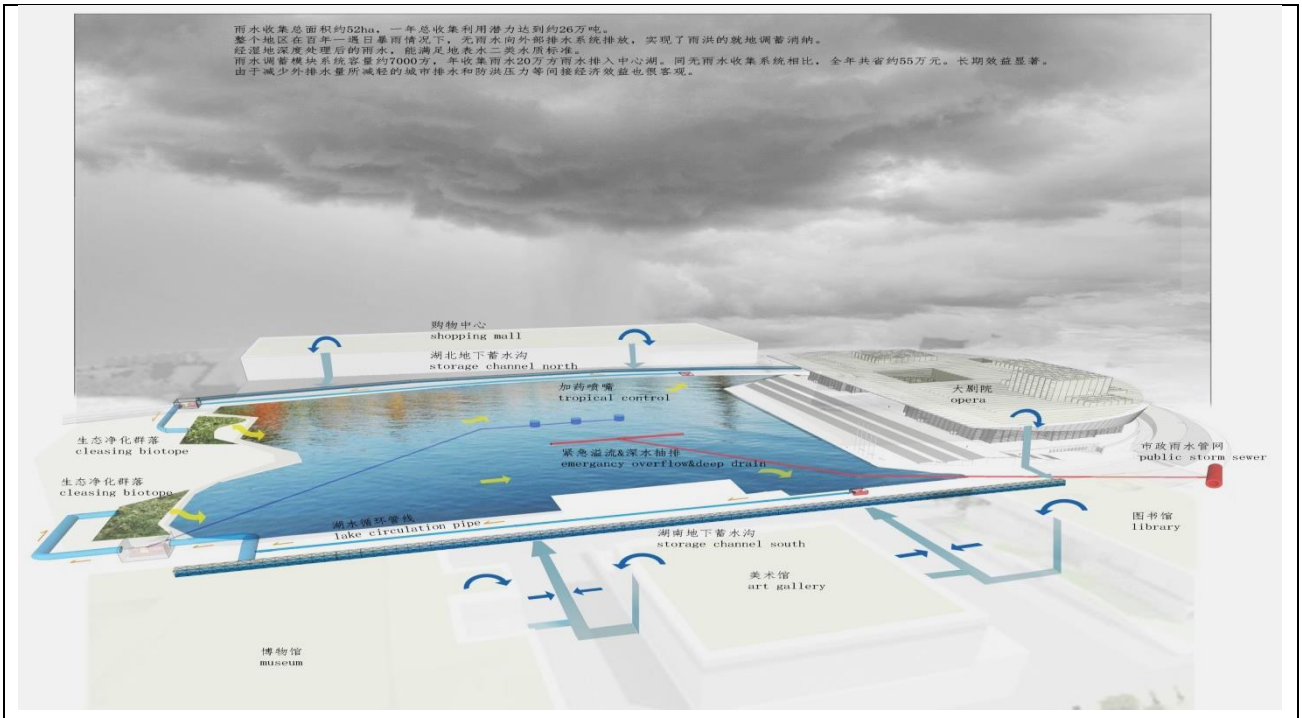
Background.

This project intends to reduce the flood risk of the existing drainage system of the city centre of Tianjin, while providing an economic and ecological solution for the stormwater management. At the same time, the city wanted the establishment of a monumental lake to provide character and identity in such a significant cultural area to become an attraction for citizens. On top of that, the lake takes the role of microclimate mitigation and flood retention, while providing biodiversity and various ecosystems.

Tianjin is one of China's top five cities, not just in size and population but also in terms of business investment. Located just half an hour south-east of Beijing by high-speed train, Tianjin is also close to the sea. The high-water table needs to be maintained to prevent seawater encroaching inland and the dry, harsh climate does not preclude flooding.

In the design of the new cultural district, located between the new opera house and existing city hall, a main goal was to increase outdoor comfort and create dynamic, social pedestrian routes. The lake waterfront is aesthetic with dramatic views to the opera house and the exciting Museum, gallery and library frontage. Avenues of trees and planting shield the waterfront from the cold Mongolian winds while at the same time storing water for irrigation.

The lake is a stormwater feature, a balancing pond which can effortlessly handle a 1 in 10 year storm event and buffer a 1 in 100 storm event. Generous tree plantings link subsurface, decentralised retention trenches which feed the lake via a cleansing biotope. The urban lake has its own natural biology and reduces temperature extremes. Its scenic beauty sets the scene for Tianjin's most outstanding new cultural architecture, the Opera house and the surrounding museums.



Tianjin Cultural Park Lake Water Rotation Diagram (Ramboll Studio Dreiseitl)

In the Tianjin Cultural Park "most of the stormwater is considered as a superior quality source of water, which will be drained off into the centre lake after initial purification, retention and storage through massive decentralised channels and pipes. The rest of the stormwater should undergo a preliminary purification and should be detained in the ditch before being discharged into the municipal pipe network. That will decrease the pressure on the municipal network to a minimum. The strong stormwater flow exceeding the design standard can be discharged towards the lake or the municipal pipe via an emergency pipe in the ditch. The total area is 90.09 ha, divided into 22 Subcatchment areas. The design frequency is selected as P=3a, the total retention volume is 7000 m^3 which largely relieves stress on the municipal drainage network, and improves flood protection standard compared with frequency of 0.5~1a adopted by Tianjin at present. The volume of emergency overflow & deep drain into municipal systems (750L/s). The stormwater used for feeding the central lake helps to save a cost of 550 thousand RMB per year (cost of 2012). The peak outflow of the entire ground is reduced from 24.8m^3/s to 2.2m^3/s. The flow of emergency overflow into the municipal system is 750L/s (10 years return period). The rainwater is reused for refilling the lake after purification, it saves 550,000 RMB per year.

Lake Circulation and Purification System.

The central lake will hold and disperse the incoming rainwater which cannot be drained away. The high dust content in the rainfall increases the organic input into the water; it can increase the lake's trophic level, and provide phytoplankton with excellent condition for growing. This would result in rapid growth of algae and deteriorate the appearance of the central system, which, in the worst case scenario, could lead to the water overflowing and creation of strong smell. For this reason, a circulation and purification system guaranteeing the water quality has been devised. On the hand, the water will be treated before entering the lake. This will ensure that as a few nutrients as possible could find their way into the circuit. The phytoplankton heavily depends on these nutrients to grow and multiply; phosphor particularly plays a limiting role in this case. A phosphor concentration below 0.03mg P/l is thus aimed for. However, the rain already contains 0.3 mg/l, which highlights the importance of treating it before it enters the lake.

The aim of water recycling and purifying is to reach class III in national quality standard for surface water. The centre lake will circulate and purify the lake water with a constant rate of 400m^3/h through skimmers, pipe loop and the processing of cleansing biotope. Besides, the reclaimed water treatment equipment in the treating room will pre-treat the reclaimed water before flowing into the cleansing biotopes and the lake. Trophical control equipment will activate extra P-removal treatment besides the ecological purifying steps. The cleansing biotope is the key design component, including the design of the aquatic plants, filter substrates and pipelines.

Bird's eye rendering of Tianjin Cultural Park (Ramboll Studio Dreiseitl)

Lake Design. Morphology design of the lake was established and optimised by computer modelling based on the parameter of water volume balance, hydraulic dynamic calculation and eutrophication control. The target is to produce a three-dimensional graphic with natural self-purifying capacity which is also well-merged with the form of embankment. Gentle sloping-down of the lake body facilitated the elaborate sealing layer. The normal water level of the lake is 2.2m with the highest 2,5m and lowest 2,1 m. Deepest point at the bottom of the lake is around 3m from lake surface.[1]"

Credentials:

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Editors: Kosta Mathey and Florian Steinberg.

Sources:

[1] Tianjin Cultural Center Design Report, Ramboll Studio Dreiseitl