

Ramboll India Integrates Circular Design in a Net-zero Airport to Efficiently Manage Water, Energy, and Materials while Preventing Flooding Events

Digital Modeling Reduces Construction Materials and Operating Costs for Significant Carbon Savings

A Net-zero Facility

The Noida International Airport is being designed as the nation's first net-zero emissions airport. When complete, it will promote Indian culture and tourism by connecting western Uttar Pradesh, and the nearby Taj Mahal, with the rest of the world—all while reducing the overall impact on the environment as much as possible. As part of the mission to build the airport with sustainable infrastructure, airport officials tasked Ramboll India with developing a water, wastewater, and stormwater network for the facility that could collect water for reuse while protecting against major flooding events via efficient drainage.

Designing around Airport Facilities

To establish a sustainable water reuse system for the 1,334-hectare project area, Ramboll determined that they needed an 88.54-kilometer drainage network with four retention basins. However, the section sizes, materials, and alignment of various portions of the network would vary based on the development and needs of each phase. For example, phase 1 includes a runway with total airside drain length of 13 kilometers, 13 box culverts totaling 793 meters, and three pipe culverts totaling 242 meters. Ramboll's drainage design needed to accommodate the many complex elements of the airport while ensuring smooth drainage. They soon determined that their past use of spreadsheets and older software could not effectively design and manage this project.

Ensuring Performance with Digital Design

Ramboll realized that creating 3D digital models within OpenFlows SewerGEMS, OpenFlows WaterGEMS, and STAAD could help them create an effective, sustainable water system that seamlessly connected to all elements of the airport. They modeled all required elements – including pumping systems, ponds, and drains of various sizes, as well as their support structures – and then evaluated the performance of different configurations within the same model. At the same time, they implemented various strategies to reduce the use of materials during construction, as well as to reduce the system's footprint. Before finalizing the design, they undertook hydraulic analysis to ensure the size and design of the water system could withstand heavy rains and provide a dependable, cost-effective source of raw recaptured water.

Cost-effective Sustainability

By modeling various options for the water network and testing them with hydraulic analysis, Ramboll determined how to optimize the design to suit the needs of the sprawling, complex facility. The team is now confident that the water network will prevent flooding and ensure

smooth airport operations for at least 100 years, while ensuring significant runoff capture during non-flooding events. Reusing water from retention ponds is expected to reduce consumption of water from other sources by 90,000 cubic meters per year. Additionally, streamlining the materials needed for the network by 8% and reducing the system size will significantly lower carbon emissions during the water network's construction. They incorporated multiple elements to improve overall energy efficiency during operations, including a supervisory control and data acquisition system, smart meters, and smart grids.

Project Playbook: OpenFlows SewerGEMS, OpenFlows WaterGEMS, STAAD

Outcome/Facts:

- Ramboll needed to design a sustainable water network for an airport that would protect against flooding, ensuring continued operations.
- They used digital design and hydraulic analysis to ensure the system would not flood for 100 years, while also capturing significant amounts of water for reuse.
- Ramboll determined how to reduce construction materials by 8% and lower the cost of operations by 20%, resulting in significant energy and carbon savings.

Quote: “This comprehensive analysis and design formed the basis of the airport’s sustainability aspiration of net zero in operations and ensured a reduced carbon footprint in infrastructure development.” – Sorav Arora, Senior Team Lead, Ramboll India



Image Link: https://cdn2.webdamdb.com/1280_EUYZtGEMnO24cTAP.jpg?1671635799

Image Caption: Ramboll determined how to reduce construction materials by 8% and lower the cost of operations by 20%, resulting in significant energy savings. *Image courtesy of Ramboll India.*

Author: *Sandra DiMatteo is the industry marketing director for water at Bentley Systems. She can be reached at sandra.dimatteo@bentley.com.*