Bentley®

Case study

Arcadis fast-tracks design of critical flood protection structures

Leveraging STAAD® for advanced structural analysis and OpenSTAAD™ for automated workflows reduced modeling time by 95%

Creating a climate resilient future

To support urban coastal communities in becoming more resilient to climate change and catastrophic superstorms, Arcadis has been focusing their efforts on numerous flood protection and mitigation initiatives. Their strategy combines robust flood protection and drainage systems with innovative solutions like multifunctional levees, attractive stormwater plazas, and vibrant, community-centered waterfront parks.

"These types of projects have increasingly become important after climate change and superstorms, such as Hurricane Sandy", said Musthafa Shaju, principal engineer at Arcadis.

With a proactive approach to water resilience, Arcadis aims to reduce the gap between resilience planning and resilience implementation and has been working on projects around the world to make the journey towards urban water resilience more accessible.

In the last two years, their engineering team has worked on three large flood management projects across cities in the United States. The projects required designing key components of coastal flood protection, including several flood gates, flood walls, and monoliths. To optimize delivery of these flood mitigation projects and promote continued water resilience, Arcadis initiated a program to fast-track analytical modeling of flood management structures, standardizing and streamlining design and modeling workflows.

Time-consuming manual processes

For the three different U.S. projects, Arcadis designed 20 flood gates, 25 flood walls, and monolith structures, which resulted in a repetitive and time-consuming design process. "Engineers spend a significant amount of time on analytical modeling of these structures," explained Shaju. For example, a typical flood gate model can take anywhere between eight and 16 hours to model completely. "Applying structural loading again takes up a similar amount of time," he added. Designing the structures for these three cities took about 1,000 hours, 25% of which time was spent applying structural loads alone.

Based on their experience with these three projects, and an expected significant increase in future flood management projects due to climate change and rising sea levels, it became clear to Arcadis that design standardization and automation was non-negotiable. They realized that they needed a more efficient and automated solution that delivered fast, intuitive, and accurate results. To accelerate design of these structures required advanced structural modeling and analysis technology.

Project summary

Organization

Arcadis

Solution

Structural Engineering

Location

New York City, New York; Indianapolis, Indiana; and Dallas, Texas

Project playbook

STAAD

Project overview

- Extreme weather, exacerbated by climate change, has resulted in the need for flood protection and mitigation projects around the world.
- To improve efficiencies in project delivery, Arcadis initiated a program to fast-track analytical modeling of flood protection structures.
- The project required automating and standardizing time consuming, manual design workflows.

ROI

- Leveraging STAAD and OpenSTAAD, the team reduced average modeling time from 16 hours to just 30 minutes.
- By automating and standardizing structural design and analysis, they also saved one to two hours on quality control and assurance.

“With innovative use of STAAD and its OpenSTAAD API, the team was successful in fast-tracking project design, maintaining consistency and assuring quality.”

-Musthafa Shaju, Principal Engineer, Arcadis

Bentley technology helped the Arcadis engineering team collaborate and improve infrastructure delivery and performance.

The digital solution reduces turnaround time on critical flood management projects.

Automating and standardizing structural design

As an alternative to manual modelling in STAAD for creating analysis models, the team explored OpenSTAAD, the API forSTAAD, which, in turn, was backed by a user interface based on Microsoft Excel for data input. The integrated digital solution completely automated model creation and loading application of flood gates and flood walls.

“The key driver was the availability of detailed OpenSTAAD documentation, through which we were able to exploit STAAD automation,” explained Shaju.

Excel provided a familiar platform for end users, along with sufficient input validation built in to control the data inputs. Arcadis was able to exploit the strength of Excel and combine it with detailed OpenSTAAD documentation to develop the automation code for STAAD, resulting in a completely reliable citizen development application.

Leveraging Bentley software, Arcadis automated the manual modeling process of flood gates step-by-step until the entire creation of analytical models could be done at the click of a button. “We further explored application of loading, load case, and combination creation, and were successful in automating these as well,” said Shaju.

Arcadis has scaled their solution for modeling and analysis of other flood management structures, like developing an automated digital workflow for iterative analysis to check deflection control of swing gates with pretensioned bracings, achieving a 99.5% target precision convergence.

Digitalization accelerates delivery and supports sustainability

Using Bentley technology helped the team collaborate and improve infrastructure delivery and performance. Compared to 16 to 32 hours using traditional methods, the Bentley-based solution reduced analytical modeling time by 95%. “With the automated solution, we were able to create analytical models in one click for swing gates and flood gates; and with correct geometric inputs, the STAAD model could be created within minutes,” stated Shaju. The consistency and accuracy of the models saved an additional one to two hours in time on quality assurance and quality control. “This helped in timely delivery of fast-track projects, some of which had more than 10 of such designs to be performed,” said Shaju.

By implementing various digital design automation workflows, Arcadis accelerated early design processes and significantly improved efficiencies in flood management and mitigation projects, reducing turnaround time. Their successful implementation of advanced structural analysis and automation workflows has led to evaluating and adapting these processes for future initiatives, providing sustainable solutions to ensure urban water resilience. “Based on learnings from this development, my team is continually developing other automation tools and scaling these initiatives,” concluded Shaju.

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