Repeat Flooding in Downtown Lisbon

Climatic changes, including sea level rise and frequent extreme rainfall events, have increased the risk of flood events in the city of Lisbon. The surrounding areas of the Portuguese city have also seen rapid urbanization in recent years, leading to soil imperviousness that has resulted in even more flood occurrences in the region. Most of the time, flood events are a consequence of heavy rainfall, which occur in single or multiple subcatchments.

Lisbon’s existing infrastructure is not adequate to ensure efficient drainage during these storm events. Consequently, inundations in Lisbon, particularly in the downtown, have become a recurring event in recent years. Between 1900 and 2006, Lisbon registered 84 inundations, and between 2008 and 2014, 15 inundation events occurred.

Beyond the material costs, the impacts can affect human health and life, which brought the urgent need for a disruptive approach with a new EUR 170 million Drainage Master Plan for the Lisbon Municipality.

Adopting a Disruptive Solution, Shifting from Reactive to a Proactive Mindset

Building underground water reservoirs in downtown Lisbon is one possible strategy to contain and prevent flood events in the city. However, it was determined that the impacts of construction in the historic downtown area was not an option. Therefore, the alternative strategy was to deviate the flow of water from the risk areas and tunnel it to the Tagus Estuary.

However, the viability, effectiveness, and advantages of this complex and disruptive engineering solution needed to be fully analyzed and quantified prior to implementation. To avoid the reactive management approaches from the past (build first and check the consequences later), this time a proactive approach was presented. The strategy in the Lisbon municipality was to take advantage of all the available information, knowledge, and technology to develop a comprehensive plan and to study different scenarios before implementation. Bentley’s state-of-the-art urban flood simulator became a key element on the development of this proactive approach, allowing the city to comprehensively model alternative scenarios.

Complex Realities Require Complex Modeling

The urban flood simulator was used for the development and implementation of a dynamic and integrated model to study the drainage and overland flow for several return periods. The main purpose was to compare the existing situation with the future scenario after the implementation of the tunneling strategy.

Fast Facts

- MOHID Studio and OpenFlows FLOOD was used to implement a detailed, high-resolution 2D model of the most critical area of Lisbon. By combining the stormwater model with an overland model, it was possible to make different scenarios and assess what would be the best solution to deviate water from the critical zones.
- Historical events were reproduced for model validation during implementation; the validated model was used to analyze different return periods.
- The best trajectory and size of the tunnels was determined by evaluating the model scenarios.

ROI

- The new flood mitigation infrastructure will avoid 20 big floods over 100 years, saving hundreds of millions of euros.
High-resolution computational meshes were applied with more than 500,000 nodes, corresponding to a spatial resolution of 4 meters. These computational meshes were based on interpolations from up-to-date topography and planimetry data layers.

The rainfall considered was based on different return periods and historic events, the soil conditions were assumed to be high humidity (low infiltration capacity), and two different sea level scenarios were analyzed.

Validating Expensive Interventions with Economical Technologies

The implemented modeling system allowed the team to positively reproduce the frequent inundations occurring in downtown Lisbon recently.

The comparisons between the existing situation and the proposed solution allowed the team to clearly identify the proposed solution as a valid and effective option, significantly reducing the inundation area.

Find out about Bentley at: www.bentley.com

Contact Bentley
1-800-BENTLEY (1-800-236-8539)
Outside the US +1 610-458-5000

Global Office Listings
www.bentley.com/contact

© 2019 Bentley Systems, Incorporated. Bentley, the Bentley logo, OpenFlows, and OpenFlows FLOOD are either registered or unregistered trademarks or service marks of Bentley Systems, Incorporated or one of its direct or indirect wholly owned subsidiaries. Other brands and product names are trademarks of their respective owners. CS22756 07/19