

2D modelling of urban flooding, Dubai, UAE

The Emirate of Dubai is hosting EXPO 2020, an international showcase of emerging technology and innovative ideas from around the world. In addition to the construction of the EXPO facilities, the Emirate will construct an extension to their existing rapid transit rail system to ferry visitors to the EXPO facilities. This project is referred to as EXPOLink 2020, and Jacobs was tasked with its delivery and commissioning before the opening of the EXPO.

Dubai is a dry desert country, with mean annual rainfall totals approximately 10 mm/year. It is also one of the fastest urbanising countries in the world, a trend which is expected to continue well into the future. Due to the dry environment, little attention has been paid to drainage infrastructure master planning in the past.

The combination of rapid development and a lack of drainage infrastructure has led to widespread urban flooding during the heavy rainfall in recent years. The Dubai Municipality requested that all design efforts for the EXPO facilities and EXPOLink 2020 incorporate projected flood levels to reduce the risk of damage to infrastructure assets and loss of human life.

A 2D hydraulic model was needed to perform the analysis for this project because of the complex flow patterns in the urban environment. The timeframe to complete the modelling for the project was short, therefore Jacobs selected Flood Modeller to execute the study.



Key facts

- Dubai annual rainfall totals approximately 10mm
- Flood Modeller was selected due to its fast and robust 2D ADI solver and range of productivity tools that streamlined the project
- Little attention has been paid to drainage infrastructure master planning in the past
- 2D hydraulic model was needed to perform the analysis for this project due to the complex flow patterns in the urban environment
- The modelling included four hydrologic events as well as worst case scenarios for flooding resulting from pipe bursting

Flood Modeller provides three advanced 2D solvers, tried and tested on projects throughout the world for extensive hydraulic and environmental studies. For this particular project, the 2D ADI solver was selected as it offered a combination of features that were necessary to deliver the project successfully:

- A fast and robust solver that accelerated the model calculations
- A range of productivity tools that streamlined the model build process
- It integrated both hydrologic and hydraulic modelling
- Various graphical output options that allowed for easy presentation and sharing of the results

Case study

A topographical 3m grid surface was created from laser scanning survey data to create a detailed topographic surface for the project. The runoff calculations were performed using a combination of direct 2D runoff calculations on the surface, as well as 1D hydrology to calculation runoff from lateral drainage areas onto the surface. This approach compressed the timeframe for modelling while making the best use of the available data.

The modelling included four hydrologic events (50 and 100 year events, 6-hour and 24-hour durations) as well as worst case scenarios for flooding resulting from pipe bursting (potable water, irrigation, cooling water, and sanitary force main).

To quickly obtain the final 2D depth and water surface elevation grids and meet the challenging project programme model simulations were run simultaneously on 11 cloud based computers.

Following review of the results by the Municipality the results were used in the design of the stations along the proposed EXPOLink 2020 route.

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