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Crowdsourcing Building Porosity Data Collection to Support Flood Mapping and Resiliency Planning

In the summer of 2021, over a dozen students, researchers, and faculty armed with altimeters measured the porosity of campus buildings with a focus on entry points, including windows, doors, and vents. This group was part of the MIT Porosity Hunt, a citizen-science effort using the MIT campus to test emerging methods and instruments to study potential impacts of climate change—specifically future storm scenarios—on infrastructure. A collaborative effort between the Urban Risk Lab, led by director and associate professor of architecture and urbanism Miho Mazereeuw, and the Office of Sustainability (where Mazereeuw also serves as a Faculty Fellow), the hunt aimed to enhance MIT's resilience to climate change impacts like flooding and extreme heat events. Over three days, participants cataloged openings in dozens of buildings across campus to support flood mapping and resiliency planning.

Fast Forward: MIT's Climate Action Plan for the Decade commits MIT to develop a campus Climate Resiliency and Adaptation Roadmap. The roadmap is grounded in the science of a campus-based flood risk model developed by a cross-functional team including MIT Office of Sustainability (MITOS), MIT Center for Global Change Science, MIT Urban Risk Lab, and contributions from staff, faculty, and student researchers.

The hunt efforts are integrated with the MIT Climate Resiliency Dashboard, a tool available to the MIT community that visualizes potential flooding impacts of future storm scenarios to inform preparedness and adaptation planning. The dashboard's debut marked a big advancement in MIT's resiliency planning, but with a significant limitation: flood modeling treats buildings as solid blocks, disregarding their varying porosity. Working with Ken Strzepek, a MITOS Faculty Fellow and research scientist at the MIT Center for Global Change Science, the team identified the need for building porosity data to understand how much water may enter a building in these scenarios.

Surveyors often collect and map this information, but the "hunt" approach was able to leverage the MIT community to collect data quickly and engage students, faculty, and researchers as resiliency stewards for the campus. By engaging the community in these efforts, projects like this encourage awareness so that if a piece of infrastructure on campus fails, someone is more likely to notice and help bring to light any vulnerabilities caused by the impacts of climate change.

Implementation

MITOS and the Urban Risk Lab recruited more than a dozen students, who were joined by faculty, staff, and researchers to map the porosity of 31 campus buildings. The buildings were chosen based on connected basements, understanding that water reaching one basement could potentially flow to another. Urban Risk Lab research scientists Aditya Barve and Mayank Ojha created a mapping app and chatbot to support consistency in reporting and ease of use. Students were guided through measuring openings, adjusting for elevation to correlate to the City of Cambridge base datum, and evaluating the materials and quality of

the opening. The collected data can inform safety as well as provide an understanding of potential damage to research or disruption to campus operations from future storms.

Preliminary Findings and Deliverables

Over just three days, the team mapped 1,030 porosity points that were used to update the campus surface and sub-surface flood model. The integration of these porosities into the flood model has enabled the research team to test how the campus receives stormwaters during a variety of current and future anticipated rainstorm scenarios. The updated modeling reveals that there are buildings and basements that might flood during rainstorms and that some locations have a higher probability of flooding than others across the range of scenarios. Once the model is validated by professional engineers, MIT's resiliency and adaptation planning team will prioritize next-step studies for recommending specific adaptations to existing buildings that mitigate projected stormwater.

Outcomes and Future Directions

After the first round of data collection was complete, work continued at the basement level. Katarina Boukin, a PhD student in civil and environmental engineering and MITOS PhD Student Researcher, focused on methods of collecting data beneath buildings at MIT to understand how they would be impacted if flood water were to enter. By looking at absolute elevation and porosity data from the outside, this data can be connected to how water may flow inside buildings. With the added data from the Porosity Hunt, a more complete picture of vulnerabilities and resiliency opportunities is being generated and updated through the resiliency dashboard.

The Porosity Hunt and data collected additionally serve as a study in scalability, providing valuable insight on how similar research efforts inspired by the MIT test bed approach could be undertaken and inform practice and research beyond MIT.

PhD student Katarina Boukin and junior Eva Then were instrumental in the Porosity Hunt, capturing data around campus and synthesizing it for future use. Photo credit: Ken Strzepek

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