RISE
Resilience Innovations

2021 COASTAL COMMUNITY RESILIENCE CHALLENGE
PROTECTION OF BUILDINGS

PB 1: Lowest/First Floor Elevation Mapping & Integration

The First Floor Elevation Mapping & Integration Problems

The first finished floor elevation (FFE) or Lowest Floor Elevation (LFE)[1] of a building provides critical information for understanding structural vulnerability to flood hazards and associated damage costs. In the Hampton Roads region of Virginia, FFEs have been identified as a major data gap. Although some localities have survey information or other data, the primary source of FFE information is FEMA National Flood Insurance Program elevation certificates. Less than 1% of structures within Hampton Roads have elevation certificates, and these certificates are typically only available as digital PDFs or paper copies by locality.[2]

In order to accurately assess the flood damage potential of a building, the FFE must be known to an accuracy found in the elevation certificates (as defined by FEMA's standards and guidelines).[3] Measuring the FFE to this accuracy is currently a manual process which is both time consuming and expensive, which is one reason why coverage is limited.

The value of FFE information gained by accurate widespread mapping can be realized in several ways when integrated with other information. For example, if an FFE map is integrated with information of a property's construction and Base Flood Elevation, the flood vulnerability and potential damage costs to that building (and by extension to a city as a whole) can be estimated. There are other ways the FFE mapping can be used by stakeholders to help mitigate and reduce costs of flooding. It is also felt that the FFE maps, if complete, accurate, and affordable, could be used nationwide to reduce the cost of the NFIP, and make it more solvent.

The Pain Points in Current Solutions

While there have been several efforts to deduce buildings' FFE from remote sensing, photography, artificial intelligence, and other approaches, achieving the necessary level of accuracy has been elusive to date. Getting elevation certificates for properties in a city's floodplain would be time consuming and cost prohibitive.

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[1] Depending on the application FFE or LFE may be more applicable. This Challenge would accept either (or both) FFE and/or LFE as the application it is applied requires. For clarity though, the description of this Challenge will just refer to FFE.

[2] https://www.hrpdcva.gov/library/view/1386/a-regional-approach-to-applying-first-floor-elevation-data-to-coastal-flooding-vulnerability-assessments-in-hampton-roads

[3] https://www.fema.gov/flood-maps/guidance-partners/guidelines-standards

In addition, the required accuracy level of FFE measurements may depend upon its actual use and integration with other data to provide usable information. Assessing FFE estimation methods in the context of the information requirements may yield some early "low-hanging fruit", as well as identify future accuracy requirements.

Solutions Being Sought

The City of Norfolk has been very proactive in addressing its floodplain management needs and represents a coastal community which is willing to support solution development with feedback, guidance, and data.

Preference will be given to those solutions in which the FFE data is integrated with other data (which may be publicly available) to produce a usable decision support tool. For example, a tool which integrates FFE map information with building data to propose specific flood mitigations for each building. Other applications may be considered based on applicability, usefulness, and commercial viability.

For example, when analyzing the FFE map (integrated with provided building attributes such as foundation type, basement, structure values, etc.), queries could be performed by incorporating Depth Damage Functions from FEMA's Hazus program or using the U.S. Army Corp of Engineers NACCS Summary Report regarding Physical Depth Damage Function "Resilient Adaptation to Increasing Risk" (January 2015).

RISE is looking for solutions that develop and demonstrate new techniques to map FFE for cities which allow FFE mapping to be affordable, and applicable to an entire city floodplain.

Such outputs might include (**but are not limited to**):

- Using reliable FFE data merged with the City's available real estate data (building foundation information and structure valuations), a mapping tool could be created with a query dashboard that uses established NFIP insurance assumptions and Depth Damage Function assumptions to generate property-specific and aggregate outputs.
- Approximations of damage as a percentage of the structure's value amongst varying Flood Depths and Annual Chance Return Intervals.
- Approximations of NFIP premiums for standard pre-FIRM and post-FIRM policies ($250k in coverage + $100k for contents) based on distance of FFE from BFE and foundation type. Including an approximation timeline of premium increases over time for pre-FIRM subsidized policies that are actualizing (18% increase per year).
    - Using these outputs, recommendations can be made for specific mitigation solutions with a benefit-cost analysis to show homeowners how projects can pay for themselves over times (especially in the light of an NFIP actualization schedule).
- Aggregate approximations can show how outreach campaigns for various queries (i.e. pre-FIRM, homes with basements having FFE's above the BFE), can provide total premium savings if applied throughout the entire City; showing how many structures fall

within various queries, with total Depth Damage Functions shown before and after mitigation.

We are looking for companies to apply their approach(es) to the AE, AH, AO and VE zones of the City of Norfolk floodplain[4]. The final solution will be estimation and integration of FFE data in ways that are demonstrably useful and valuable to coastal communities around the country and the world.

Please email all questions to KaterinaOskarsson@riseresilience.org

[4] https://www.norfolk.gov/1949/Flood-Zones