Envisioning Indoor Accessibility in the Duke University Brodhead Center

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Background

- Although Duke provides online resources to promote outdoor accessibility on campus, there is no ongoing work to expand this into indoor spaces.
- Our project seeks to fill this gap through two different means
  - First, through the creation of a tactile map to help those who are visually impaired navigate through indoor spaces.
  - Second, through the development of a system to mark accessible features and model accessibility in indoor spaces.
- The Brodhead Center sees heavy traffic, from both members of the Duke and Durham community
- This semester, our project focused on developing a prototype tactile map for the Brodhead Center, in addition to developing a fluid model of accessibility for the center.

Methods

Tactile Maps

In developing the tactile maps for the project, floor plans of the Brodhead Center were obtained and simplified from Duke Facilities Management. Accessible features of the space were marked through field surveys and the Brodhead Center's ADA Compliance Reviews. Features marked included: accessible restrooms, drinking fountains, elevators, automatic door openers, accessible entrances, information kiosks, and high and low seating. All markings were replicated online on Adobe Illustrator and Photoshop, and maps were simplified to exclude spaces closed to the general public. Two dimensional maps were then shared to the Design Hub team at the Duke Innovation Co Lab, who then translated the map into a three dimensional prototype.

Computational Fluid Dynamic Model of Indoor Accessibility

In modeling indoor accessibility and marking accessible features of the center, the team is working on a Computational Fluid Dynamics model of accessibility in the Brodhead Center. By running this model through high-performing GPU clusters, we looked for the most accessible pathways for individuals to navigate from one area to another.

We developed a prototype of the Computation Fluid Dynamics model for the basement floor of the Brodhead Center. Further work will be done to determine the dynamic interaction between different trajectories and how large crowds affect the efficiency of travel to validate universal design.

Results

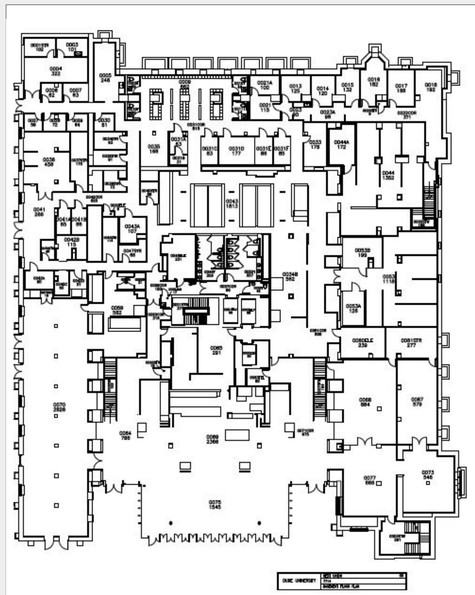


Figure 1: Brodhead Center Original Floor Plan

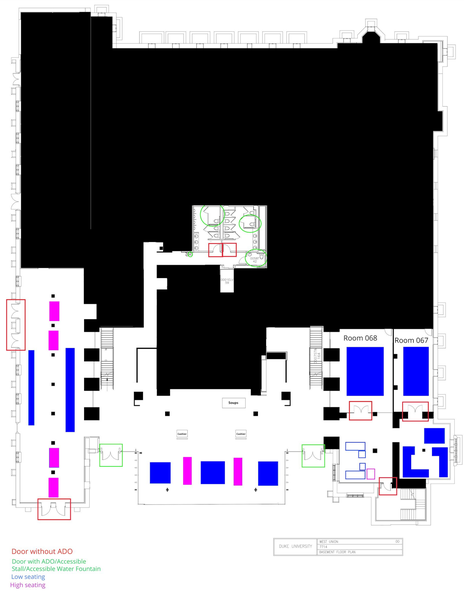


Figure 2: Brodhead Center Floor 1 Simplified Map. (This was conducted for every floor of the Bordhead Center)

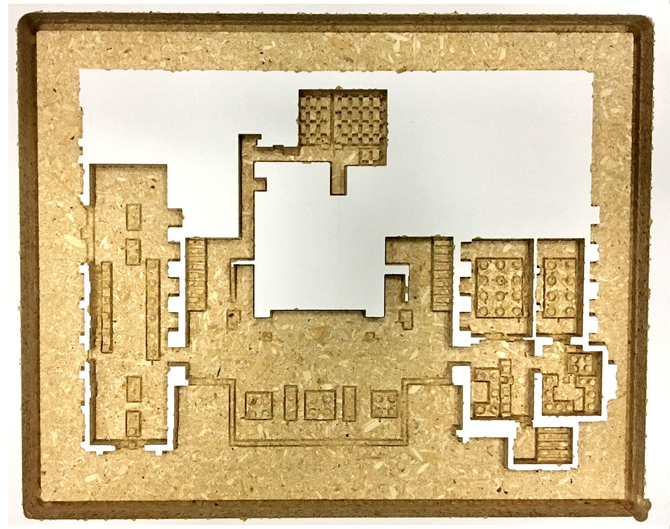
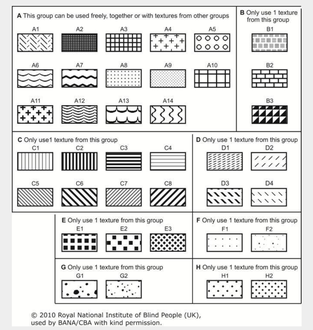


Figure 3: Brodhead Center Tactile Map

Figure 4: Computational Fluid Dynamic Model

Red arrows represent that there is pressure building up along those sections of the map. Generalizing to people with physical disability, this means that it is harder for individuals to move through these areas. The model is currently in a crude form and will be iteratively redesigned to encompass the entirety of the Brodhead Center and show how people with physical disabilities move throughout the building during high foot-traffic hours.



Future Steps

Iterate — Refine tactile maps to create future versions that encompass more accessibility details for those with visual impairments.

Investigate — Construct generalized algorithm for analyzing the accessibility features of different Duke buildings.

Create — Host all data and maps on a website for public use by Duke students, staff, and faculty.

Discussion

- Promoting indoor accessibility on campus is critical to ensuring that all students, staff, faculty, and members of the community with disabilities feel welcome at Duke University.
- This semester, our project team focused on several different objectives. Over the course of several months, we worked together to design tactile maps, and worked on using computer simulation technology to model how people move within spaces.

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