

### Progress Report: Accessible Construction Education through Virtual/Augmented Reality Discipline Explorations (ACE-VADER)

This Amplify Momentum Initiative aims to leverage the latest technologies utilized in the construction field and construction education, such as Augmented/Virtual Reality, to create experiential modules for a precollege program. The purpose of this new precollege program is to recruit a diverse group of students to Georgia Tech’s School of Building Construction (SBC). The Bachelor of Science in Building Construction (BSBC) program at SBC was revitalized in Fall 2020 after a decade long period of being sunset. The revitalized BSBC program, with Georgia Tech’s signature technology and innovation focus, presents a vast opportunity for growth both in its size and diversity. The summer precollege program sampled the technology- focused BSBC curriculum, our diverse faculty profile, and the significant industry support we have from the many construction companies in the region. The inaugural SBC pre-college summer camp took place between June 13th to June 24th, 2022 and fifteen students participated.

The camp curriculum included: 1) Building Information Modeling (BIM)-enabled pre-construction processes, 2) Hands-on construction and quality-control using AR and infrared technologies, 3) Practice with emerging technologies in construction, and 4) Industry Interactions.

#### 1) Building Information Modeling (BIM)-Enabled Construction Processes

In this module, the students were given lectures on masonry construction components and materials and the basic concepts of BIM. Then they practiced with a variety of BIM software such as Revit, Masonry iQ, and Navisworks in a computer laboratory (Figure 1). Using the software, they practiced quantity takeoffs, cost estimating, scheduling, and 4D simulation. They created a BIM model of a single wythe concrete masonry wall and estimated construction costs and schedule (Figure 2).



Figure 1. Lab session on BIM-Enabled Construction Processes

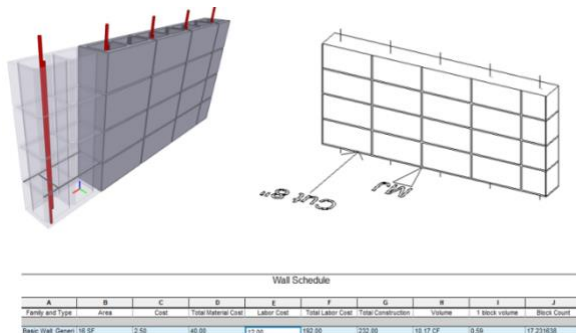


Figure 2. Student Work from the BIM Session

## 2) Hands-on Construction and Quality-control Using AR and Infrared technologies

In the second module, first they spent half a day on constructing their own 32” tall walls, based on their BIM models. Professional masons demonstrated and aided their construction, playing the role of the subcontractors (Figure 3). After the construction, the students utilized augmented reality to compare their as-built wall with their BIM-based designs and cost/schedule estimates (Figure 4). Furthermore, the students applied infrared thermography scans to examine the rebar installation in the wall they built. The above hands-on experiences enabled the students to understand why technology-based construction planning and estimates are essential for better decision-making and cost-savings in construction projects.

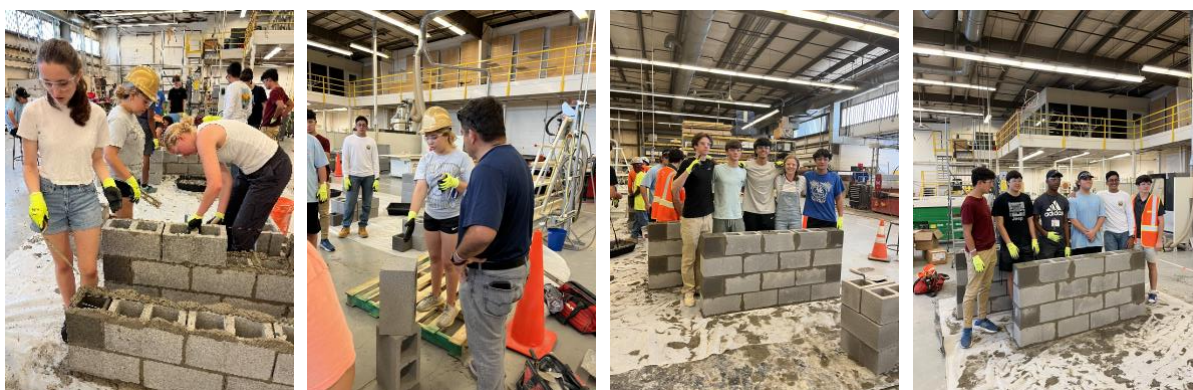


Figure 3. Students constructing their previously designed masonry walls

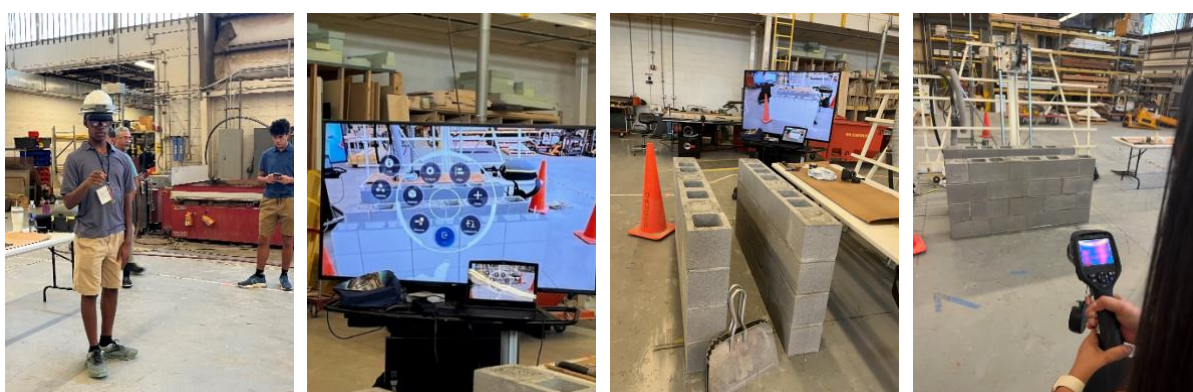


Figure 4. Use of AR in Quality Control and Comparison of REVIT Model to As-Built Walls

## 3) Emerging Technologies in Construction Projects

In this module, the students experienced various emerging technologies, including a dog-inspired construction robot, drones and mini drones, laser scanning, and 3D printing, through theory-based lectures on where/how they are used as well as hands-on practice. First, they learned the potential uses of a robot dog in a construction site, such as inspection and access to dangerous parts of a construction site. They observed how laser or 360 scanning camera attachments on these robots are used to record construction site data (Figure 5). Second, drone applications in construction projects were introduced, and the students practiced hands-with mini drones and drone flight simulators (Figure 6). Third, the students received basic training in laser scanning and practiced it by scanning the Caddell building at Georgia Tech. Finally, a lecture on potential uses of 3D printing for building on Mars was delivered to the students. After the lecture, the students designed their Mars centers using a 3D modeling software (e.g., Sketchup) and conducted 3D printing of the model.



Figure 5. Students Interacting with Robot Dog

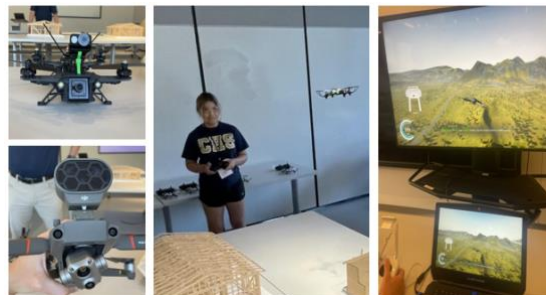


Figure 6. Hands-on Practice of Drone Operations

#### 4) Industry Interactions

Industry guest speakers, an office visit, visit to two actual construction sites, and a virtual site visit using Virtual Reality provided opportunities for the students to visualize and better understand the daily operations of a career in construction. The virtual site visit was pre-recorded by the research team using a 360 camera.

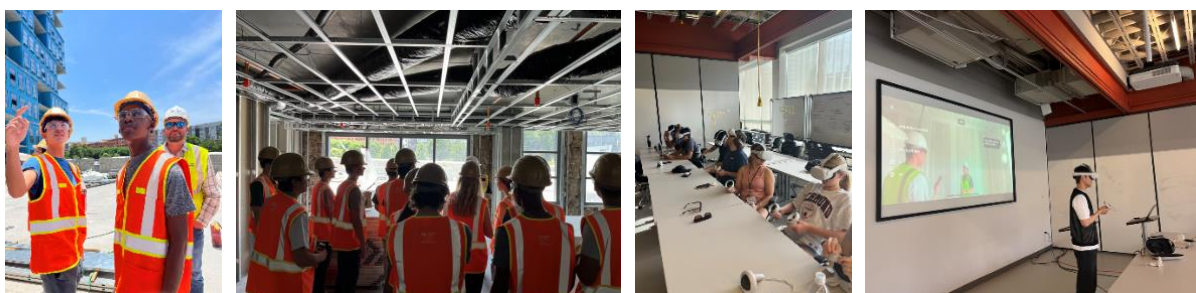


Figure 7. Left two Images: Actual Site visit, Right two images: Virtual Site Visit

#### Preliminary Findings

As part of this research program, a literature review was carried on documenting other universities' construction summer camp and other educational activities that involve technology in similar ways. The team also conducted Pre- and post- surveys for the entire camp, as well as after key innovative applications. Finally, the students were asked to give both an intermediate and final presentation, that reports their experience and reflections. During the final presentations, the students reflected on their improved understanding of what a professional career in construction really entails and that they are excited about this career choice than before. The camp was very successful in that over 90% of the students stated that they will be applying to Georgia Tech's School of Building Construction as their top college/major choice. Survey data is currently being analyzed.

#### Future Work

Throughout the remaining months of this research program, the research team will study the survey data, publish a conference article, and make improvements to the camp curriculum if needed, for the second offering of the camp in Summer 2023. Further, a focus group of high school students with disabilities will be recruited to spend one day on campus to experience an abridged and entirely AR/VR-based version of the site visits and some of the other activities.