Using Virtual Reality and Construction Software to Transform Jobsite Facilities

Jacqueline Badal
California Polytechnic University
San Luis Obispo, California

The objective of this project is to analyze construction jobsite facilities, specifically portable restroom facilities, and brainstorm how they can be redesigned to better suit the needs of women and individuals working on site. Portable toilets endure a great amount of weathering throughout the duration of the project and can become unsanitary and often riddled with offensive profanity. This can create an unclean and unwelcoming environment, especially for women working on the jobsite. The purpose of this project is to create a discussion around jobsite safety, starting with portable toilets. This is done using construction technology. Virtual reality was used to transform individuals into spaces showcasing unsanitary portable restrooms to incite a reaction. SketchUp was then used to model the ideal portable restroom and space for workers on site. Various SketchUp designs were created and analyzed to showcase the change that should be made to provide a better restroom experience. The overall impact of this project is to bring awareness to the issues surrounding sanitation and women’s safety on the jobsite and to inspire members of general contractors to take a stand for better facilities on site.

Key Words: Portable toilets, Virtual Reality, SketchUp, Sanitary, Construction Site

Introduction

The OSHA standard states that there must be “A minimum of one separate toilet facility…provided for each 20 employees or fraction thereof of each sex…” (Department of Industrial Relations [DIR], 2020, p 1). Portable toilets are one of the more common types of temporary restroom facilities on a construction site because they are cost-effective, easy to install and move around, and easy to maintain (Forestell, 2021). However, the tight quarters, smell, uncleanliness, and profanity written on the walls creates an unappealing space, especially for women (United States Department of Labor [USDOL], 2023). An account from female iron workers in Ontario, Canada state that in the portable toilets, it is “‘…just a big pile of feces,’ ‘No flushing, no water, no soap, no paper, no nothing. Might as well just go outside at that point.’ She said she will sometimes have to leave work to find a Tim Hortons bathroom because the toilet on the site feels unsafe” (Jones, 2023, p.1). Women who are
exposed to these unsanitary conditions are more likely to not use the on-site facilities or leave the site to find a clean restroom to use (Jones, 2023).

The sanitation of a jobsite takes a toll on the mood and health of individuals on site. In a conversation with a project engineer at an international construction company, the ways in which dirty portable toilets make women on the job site feel became apparent. She stated that through her discussions with individuals on site they feel demoralized when having to use small, dirty spaces to use the restroom. She noted that the condition of these facilities started to take a toll on the mental health of individuals on-site leading them to became angry and frustrated, which created an unproductive and unhealthy work environment. Fryer stated in the interview that how you treat your project member directly affects their mood and mental health. The few minutes they get to use the restroom, should not be in a small box that is dirty and smelly. Laborers and project members should be respected enough to be given a facility that is clean and sanitary and provides them a quiet, private location to take care of their business (E. Fryer, personal communication, April 10, 2023).

Unsanitary restrooms can also lead to various health issues, mainly seen in women. According to an article published by the United States Department of Labor, “Scientific literature indicates that holding urine in the bladder for more than one hour, after experiencing the urge to urinate, leads to a higher incidence of urinary tract infections. Thus, due to the lack of available sanitary facilities, female workers experience a higher incidence of bladder and kidney infections. Inadequate facilities can result not only in urinary tract infections but may also result in other diseases from unavoidable contact with a contaminated toilet seat” (USDOL, 2023). Many women on site are uncomfortable using the facilities due to profanity, smell, or trash. This causes them to wait to use the restroom until they can find a clean, flushable toilet (Jones, 2023). This could be many hours after work, which is unhealthy and proven to cause various health issues. It is evident that sanitary facilities affect the well-being of workers on-site.

The experience of using an unsanitary restroom is inhumane and unsafe. A hackathon is an event that brings together individuals from technical backgrounds to solve a problem or develop a new idea (Yasar, 2023). This hackathon aimed to gather construction industry workers to discuss their experiences with portable toilets, then brainstorm ways for these facilities to better suit their needs on construction sites. This paper reports on a hackathon event that was held to bring awareness to this issue, to allow individuals to share their experiences with portable toilets and allow them the opportunity to redesign this space and instigate change surrounding this norm. technology at the porta-potty hackathon that took place at Cal Poly on June 8 and 9, 2023. Specifically, this paper presents the use of virtual reality where hackathon members were exposed to various images of unclean and unkept porta potties. Then, using SketchUp, members designed their own 3-dimensional models of portable toilets, highlighting features they believe promote sanitation, safety, and employee health.

**Methodology**

The hackathon was a two-day event where industry members and construction management students were able to come together to discuss the facilities on a construction site and brainstorm the various ways these facilities can be made more sanitary for the overall safety and well-being of individuals on-site. Virtual reality and 3-D modeling technologies were used to understand these safety issues on site and how they can be resolved.
A virtual reality (VR) experience was created to transport individuals into unsanitary restroom spaces. During the beginning of this project, various jobsites were visited to take photos of the portable toilets on site. Many of them were filled with trash and were overall unclean. A few were littered with profanity and inappropriate images. Using P360, a 360-camera application for smart phones, images were captured of the porta-potty interiors. These images were downloaded on an app then connected to the VR headset. On the day of the hackathon, an area to use the VR was set off to the side. In this location, individuals could wear the VR headset and walk around the portable toilets as if they were inside the facility, allowing, individuals to be transformed inside of a portable toilet. Using this technology, participants could experience the issues with portable toilets gave them ideas on what needs to be improvised and incite emotions with participants.

Once hackathon members understood the conditions of these restrooms, they took time to reimagine the portable toilet and create a 3D model of their improved idea. They did this using the construction software SketchUp. A student who was proficient in SketchUp helped the hackathon members turn their visions into 3D models. Once each team completed their models they shared their work with the rest of the group, to showcase their design and ideas for creating better facilities on-site. This process highlighted the utility of using technology to reimagine jobsite facilities and make them safer and more sanitary.

Results and Discussion

During the two-day hackathon, participants used technology to experience porta-potty conditions (VR), develop solutions to the problems discussed by participants, and create and share 3-D models that incorporated recommended solutions (SketchUp). This section presents the results from the VR simulations and recommended improvements as identified by participants.

Virtual Reality

The VR experience was used to incite emotions and frustrations within hackathon members and start conversations about how these unsanitary spaces can be reimagined. The goal was for them to be transformed into an unsanitary space that was uncomfortable to spark ideas for how these spaces could be better constructed. After participating in the VR experience, one woman was appalled at the conditions of these unkept restrooms on-site. She noted that it would be hard to want to even use the restrooms on the jobsite if they were like the conditions viewed. She also noted it upset her that men and women alike are forced to use these facilities on site, and that the conditions are inhumane. There is a level of respect that people on site deserve, and unsanitary restrooms demoralize and disrespect a basic human right. Another individual who noted that some of the restrooms viewed were some of the worst seen. There was a level of shock incited that these are the conditions that many individuals face daily. The individual stated they would much rather go to the restroom outside then be trapped in those conditions.

In addition to the dirty conditions, other participants were shocked by the number of graffiti and profanity etched into the walls of the portable toilet. They noted that much of the profanity was directed toward women. This could make women feel uncomfortable or unsafe being on site, knowing that harsh words and emotions are being harbored towards them.
Figure 1. Participants using the VR headset to view images of portable toilets to gain inspiration on how to rework the space to better suit individuals on site.

Figure 2. Images of portable toilets shown on the VR headset, showcasing an unclean environment.
Once hackathon participants used VR to experience some of the problems with porta-potties, they brainstormed ideas for their newly imagined porta toilets and created a 3-dimensional model using SketchUp. SketchUp is a 3-dimensional modeling software that is used for drawing and design applications. This gave members the ability to showcase their creativity through designing and gave them a voice in the sanitation discussion. Each group approached this conversation from a different perspective, with some aiming to be more creative and others more practical. However, each design aimed to solve a larger issue in the safety and sanitation discussion.

**Design #1**

The first design sketched is more creative and showcases many fixes that can be made in portable toilets, including shelves, hooks, hand sanitizer, toilet seat covers, and increased ventilation. This design includes both a urinal and a toilet. Above the toilet are seat coverings. There are multiple corner shelves in the portable toilet that can be used to store any loose material while using the restroom. There are also two hooks, one designed for a hard hat the other for a safety vest. This allowed individuals using the restroom to feel more comfortable and not as weighted down. The back wall has a hand sanitizer dispenser and fans that point outward to help with the smell of the restroom. The smell of the porta-potty was a frequent complaint by all participants. To help solve this issue, this team included an air freshener dispenser that sprays out air freshener after the portable toilet is used next to the toilet.

This team focused mainly on restroom access. Some of the women on this team had experienced jobsites trying to tackle the issues with portable toilets by giving women their own facility. However, these team members noted that there were many other difficulties that arose surrounding women accessing the portable toilet since a separate key was often needed. Only the women would have a key to open the facility, but this typically became confusing. Who keeps track of the key? Do all women on-site get a key of their own, or is there one communal key? This team noted that the biggest issue with the communal keys was that everyone had access to them. If the men on site had access to the key, they would use the women’s restroom defeating the purpose of a separate restroom. The solution the team devised was a restroom door lock that can be opened using a code, which is received upon scanning a QR code and filling out a form before entering the job site. Women entering the site can fill the QR code out and get a numerical password that can be used to open the portable toilet.
Figure 3. SketchUp design #1 equipped with a urinal, toilet, paper towel holder, seat tissue holder, fans, shelves, hangers, and hand sanitizer dispenser.

Design #2

The second design is simpler but still has important features, including increased ventilation and shelving. This team included openings at the top of each wall to allow for adequate airflow within the facility. There is also a shelving system for individuals to place their personal belongings. Different from the rest of the teams, this group noted that there is no place to dispose of feminine hygiene products in a portable toilet. Portable toilets are not inclusive to all women, which presents an issue if there are many women on site. This team decided that it was necessary to provide a feminine hygiene receptacle to allow women a sanitary way to dispose of their hygiene products. This group also wanted to give the portable toilet a feminine design, so they decided to color it pink. This would allow a simple distinction to be made for women on site.
Design #3

The third design is more practical and emphasized more of a realistic version of a portable toilet, with few, simplistic modifications. This team agreed that the biggest issues were the smell and the temperature. The hackathon members in this design group were more focused on the cost of the portable toilet and believed that with an increased number of modifications the price of the portable toilet rental might also increase. From a general contractor’s perspective, an increased cost might deter companies from purchasing these specialized units. The modifications included one toilet and no urinal. This group hoped that removing the urinal would help to limit the amount of urine that is often found around the inside walls of the portable toilet unit. The main feature, which is not pictured in the SketchUp, is the battery-operated, motion sensor fan that would circulate the air in the portable toilet, helping to minimize the smell. They noticed on their job sites that portable toilet vendors are inconsistent with cleanings and do not service the spaces enough during the week. This leads to the restrooms becoming smelly and littered with trash. In the summer months especially, the restroom heats up like a greenhouse, making the smell worse and creating an uncomfortable environment. In the newly designed portable toilet, the fan is motion-activated. Another feature, not pictured in the SketchUp was a foot pedal on the floor, connected to the toilet lid that would open and close the lid. Keeping the lid closed would contain the smell of the materials being held in the holding tank. The individual using the portable toilet would press the pedal once, firmly, locking it and lifting the toilet lid into place. Tapping the foot pedal lightly again would unlock it and cause the toilet lid to fall back down. Since this system is hands free it would hopefully be consistently used. This team also installed a shelf in the portable toilet for hard hats, belt bags, and safety vest storage.
Living in a technologically advanced world, we have many different tools that can be used within the construction industry to increase productivity and revolutionize construction processes. VR “...provides a great platform for the project participants to share and exchange valuable information without any physical medium and within a second. AR [augmented reality] and VR are also used for quality and defects management in the construction project” (Ahmed, 2019). Allowing individuals in the hackathon to use VR allowed them to visualize the conditions of a portable toilet without having access to a dirty portable toilet on campus. We also were able to share the information and visuals needed in a quick and efficient manner and prompt discussion around the conditions viewed. The goal of this hackathon was to tackle issues surrounding safety and sanitation on site. The quality of the portable toilets on construction sites and the defective restroom space was visualized through virtual reality. This also gave individuals the inspiration needed to produce solutions to this dilemma.

After using virtual reality to highlight the problem, SketchUp provided an important visual for the hackathon members. It allowed them to focus on their needs and produce a design that would make them feel comfortable with the portable toilet experience. SketchUp allowed their ideas to come to life and highlighted how reasonable their requests are for sanitary and safe restrooms on site.
There were a few lessons learned after the hackathon event that should be considered for future events. For the VR portion of the event there should be a clear announcement made to hackathon members regarding how to use the headset. This might prompt more individuals to use the technology throughout the event. It also would be good to have a volunteer at the station to help with the experience, ask questions, and gather the user’s reactions and comments. Regarding the SketchUp technology, it would have been good to have more than two computers to complete the SketchUp designs. This limited the number of groups who could model their design. This caused some groups to start their modeling later in the day, producing simpler designs.

Overall, there are many issues and difficulties women face on the job site and ensuring the safety of women on site should be a priority in the industry (Jones, 2023). A lack of access to clean, sanitary restrooms on site has proven to be a safety hazard to women (USDOL, 2023). This hackathon was able to bring awareness to this issue and showcase the very realistic solutions to this problem. Solutions included increased ventilation to combat the smell, additional shelving, and hooks to hang tool bags and hard hats, and coded locks that could be accessed using QR codes. By using technology via virtual reality and SketchUp, hackathon members were able to visualize the issue and create simple solutions providing the safety and accessibility women on site desire.
References


Fryer, Elle. Personal Interview. 10 April 2023.

