



LAUREN MASSARI  
FALL 2011

INCLUSIVE DESIGN GRADUATE RESEARCH GROUP  
SCHOOL OF ARCHITECTURE AND PLANNING  
STATE UNIVERSITY OF NEW YORK AT BUFFALO

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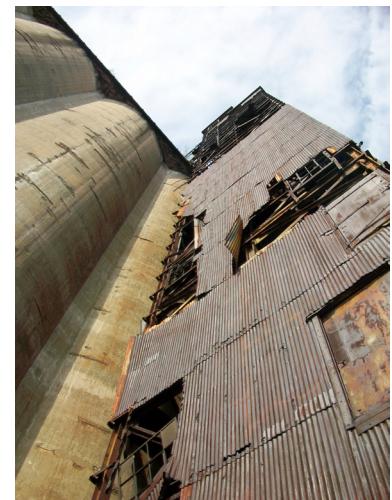
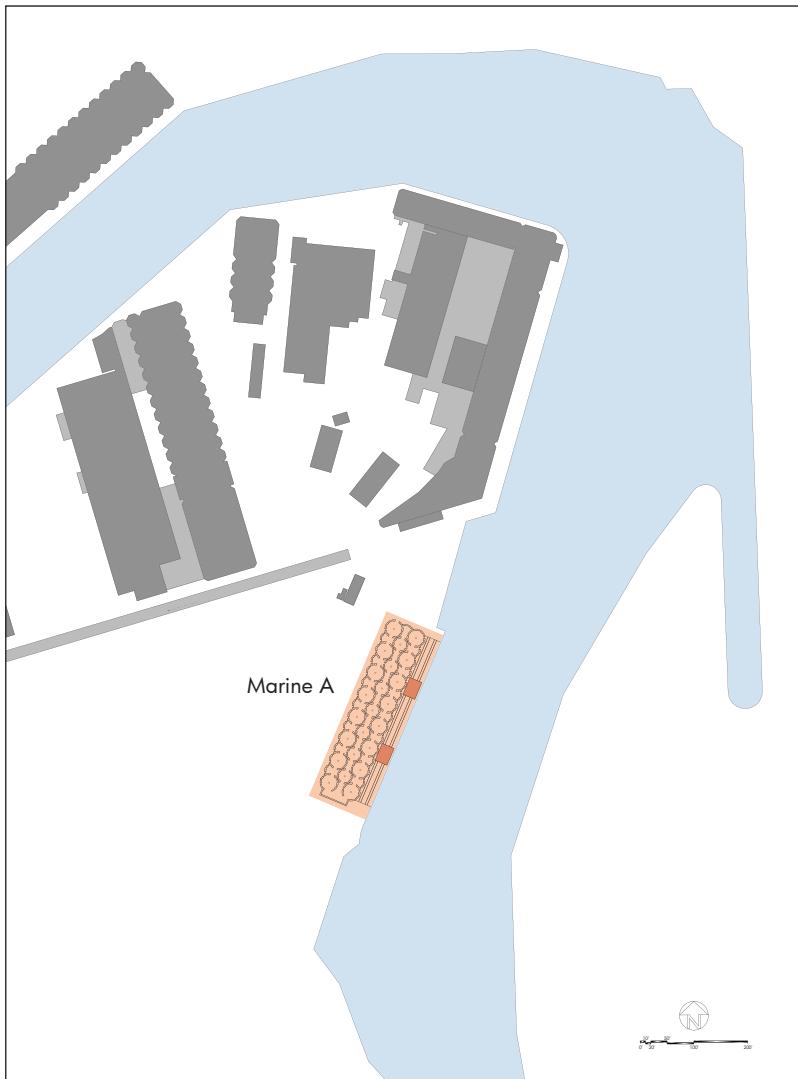
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## SITE



The Marine A grain elevator is located along the Buffalo River south of downtown Buffalo, New York. The grain elevators played a vital role in the city's industrial growth in the early 20th century, but have fallen into disuse. Marine A was chosen as the site for this semester's project for two reasons. First, the silos are monolithic concrete structures that are nearly indestructable. Second, the Marine A grain elevator is an important historical building with many unique qualities that can be celebrated and given new life as an event destination.



## **PROJECT ONE\_INTRODUCTION**

### **PORABLE DISASTER RELIEF TOILET**

The introductory project for the Inclusive Design Research Group was to design a portable toilet for disaster relief for ourselves and an imaginary client, to be located at the Marine A grain elevator south of downtown Buffalo.

The main objective was to create a specific design that addressed the varying needs of two people primarily by using ergonomic information and research into conditions that could potentially influence design. The secondary objective was to consider economy of means in regard to cost, materials, construction, and transportation.

The requirements of the design were that it was to be portable, storable, and easily constructed; that it could be assembled in under two hours by only one or two persons; that it was easy to maintain in terms of waste removal and the sanitation of both the user and the unit; and that it was to provide an enclosure appropriate to the clients' needs. Materials were to be lightweight, readily available, durable, and sustainable.

# PROJECT ONE\_CLIENT DESCRIPTION



## DELILAH

Age: 55  
Gender: Female  
Gender Identity: Female  
Race: Black  
Ethnicity: Ethiopian-American  
Religion: Christian  
Cultural Background: Grew up on a reality show  
Belongings: Nothing  
Interests + Hobbies: Reading + Writing  
Occupation: Student  
Socioeconomic Status: Middle Class  
Diet: Gluten-free  
Emotional State: Stressed  
Physical Characteristics: 4'8" tall, anorexic, brown hair and eyes  
Medical Condition: Asthma  
Intuitiveness/Ability to Learn: Has difficulty grasping new concepts  
Psychological: Low IQ and the reasoning of a child  
Physical Ability: Can pick things up with her feet  
Physical Disability: Broken right arm  
Cognitive Ability: Sound to color synesthesia  
Cognitive Disability: Anterograde amnesia (short-term memory loss)  
Sensory Ability: Expert smeller  
Sensory Disability: Near-sighted and lost her glasses



## LAUREN

Age: 24  
Gender: Female  
Gender Identity: Female  
Race: Caucasian  
Ethnicity: Puerto Rican + Irish-American  
Religion: Atheist  
Cultural Background: American  
Belongings: Nothing  
Interests + Hobbies: Reading + Art  
Occupation: Student  
Socioeconomic Status: Middle Class  
Diet: Normal  
Emotional State: Worried  
Physical Characteristics: 5'5"  
Medical Condition: Allergic to penicillin  
Intuitiveness/Ability to Learn: Fast learner  
Psychological: Normal  
Physical Ability: Strong  
Physical Disability: None  
Cognitive Ability: Intelligent  
Cognitive Disability: None  
Sensory Ability: Sensitive to smell  
Sensory Disability: Poor eyesight without vision correction

## OSTEOPOROSIS

- o an estimated 1 out of 5 American women over the age of 50 have osteoporosis; 1/2 of all women over 50 will have a fracture of the hip, wrist, or vertebra
- o other than age, eating disorders, vitamin D deficiency, low body weight, + too little calcium in the diet are risk factors that Delilah may have
- o symptoms: bone pain, neck or lower back pain, stooped posture, loss of height over time, fractures with little trauma

## ASTHMA

- o three types: exercise-induced, occupational (caused by an environmental irritant), + allergy-induced (caused by allergens such as pet dander, pollen, or mold)
- o symptoms: coughing, wheezing, shortness of breath, chest tightness or pain
- o ways to reduce chances of an attack: air conditioning to reduce allergens and maintain optimal humidity; avoiding objects that may trap allergens (fabric, carpeting, etc.); cleaning regularly

## CELIAC DISEASE

- o damaged villi do not effectively absorb proteins, carbohydrates, fats, vitamins, + minerals from food
- o left untreated, damage to the small bowel can be chronic + life-threatening
- o classic symptoms: abdominal cramping + intestinal gas, distension + bloating of the stomach, chronic diarrhea and/or constipation, steatorrhea, anemia, unexplained weight loss with large appetite or weight gain
- o other symptoms include: osteoporosis, bone or joint pain, fatigue or weakness, tingling or numbness in hands + feet, migraines

## ANOREXIA NERVOSA

- o to prevent weight gain or continue losing weight, people with anorexia may starve themselves or exercise excessively; they may also binge + purge, vomit after eating, or misuse laxatives, diuretics, or enemas
- o symptoms: fatigue, dizziness or fainting, constipation, absence of menstruation, dehydration, osteoporosis, + swelling of arms or legs
- o behavioral symptoms: lack of emotion, social withdrawal, preoccupation with food, irritability
- o complications: death, anemia, heart problems, bone loss, gastrointestinal problems (constipation, bloating, nausea), kidney problems

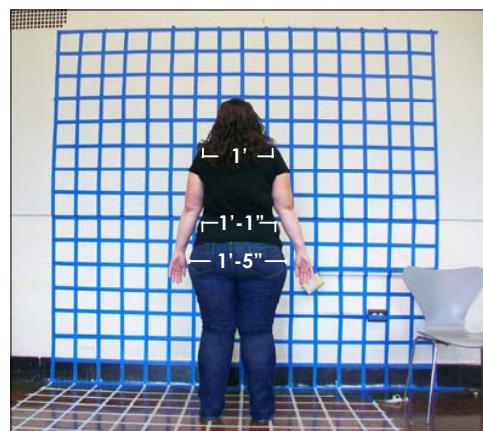
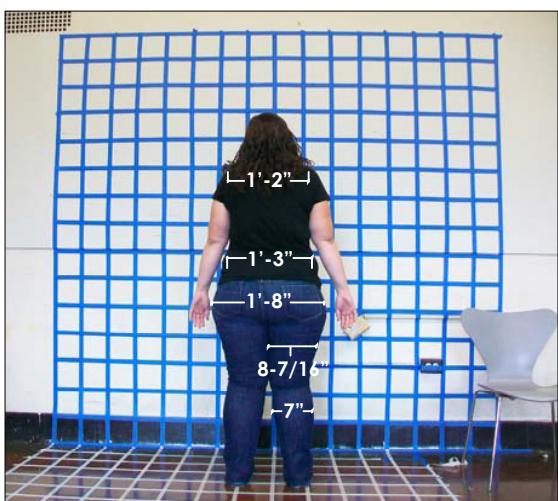
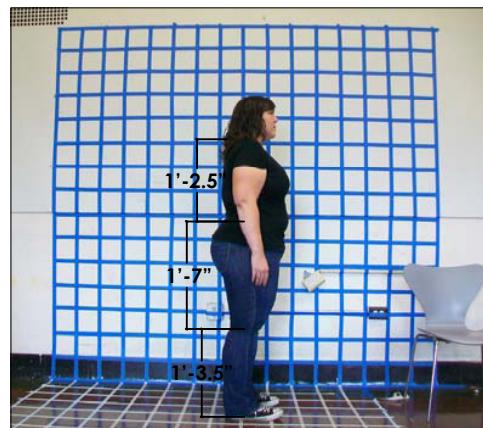
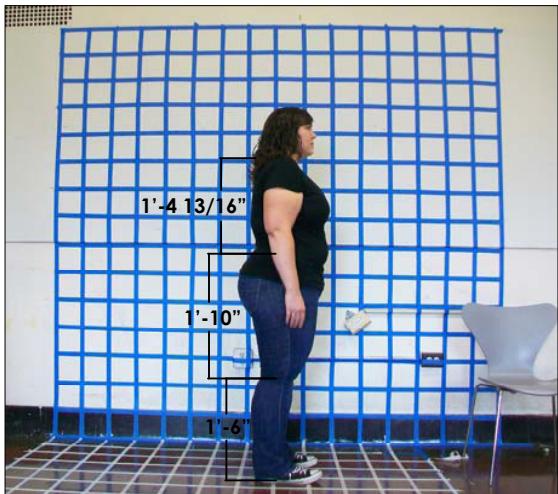
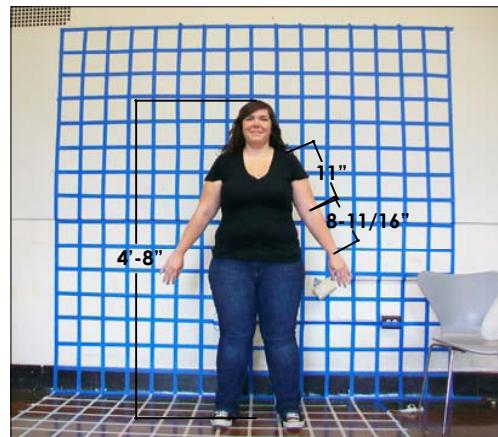
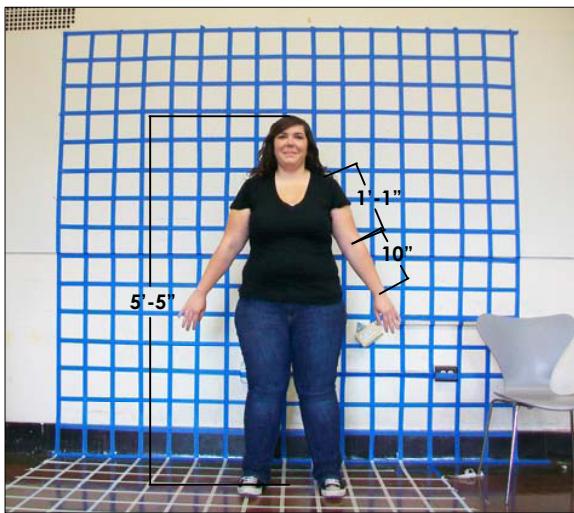
## ANTEROGRADE AMNESIA

- o the inability to form new memories after the onset of an illness or brain injury
- o short-term memory lasts about 30 seconds; with anterograde amnesia, learned information does not move from short-term to long-term memory
- o over time, a person with anterograde amnesia may learn new tasks with no recollection of doing so

## CONCLUSIONS:

- o osteoporosis and a broken arm suggest designing a toilet enclosure with ample space to minimize contact with the walls, door, and fixtures
- o diagonal grab bars would be useful for someone who can only utilize one arm well or for someone with bone or joint issues
- o lower-than-average height suggests a toilet seat at a lower level or a toilet with foot rests
- o asthma requires a well-ventilated space that is easily cleaned
- o a low IQ and anterograde amnesia suggest a toilet that is intuitive to use
- o osteoporosis and low IQ/anterograde amnesia suggest a toilet and enclosure with buttons, latches, etc. that are easy to manipulate

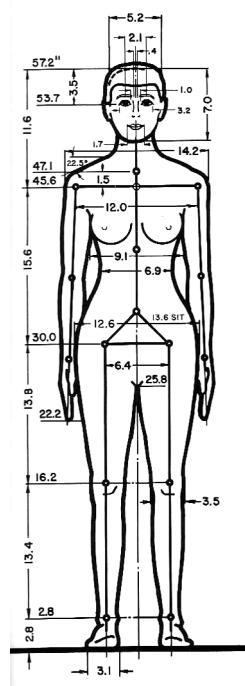
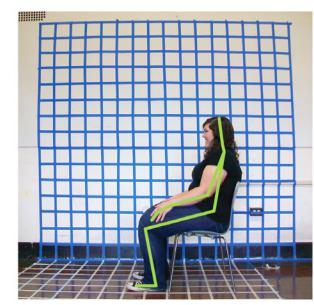
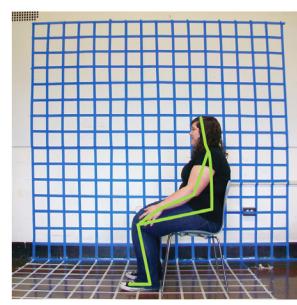
# PROJECT ONE\_BODY MEASUREMENT + MOVEMENT DOCUMENTATION



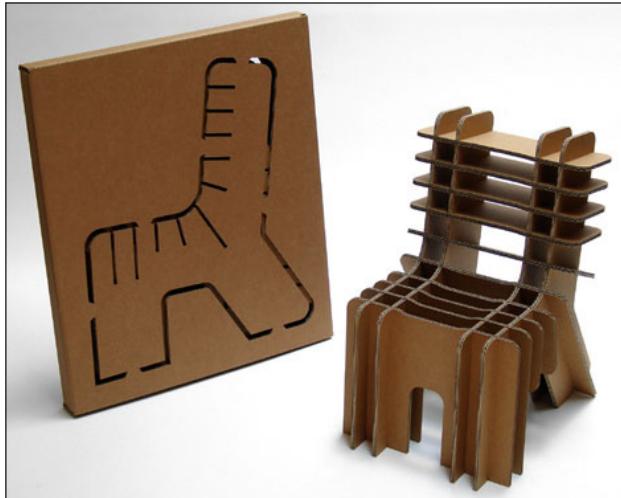
Delilah's measurements

My measurements

**Anthropomorphic Data for a Standing Adult Female, 2.5%tile**, from Henry Dreyfus' *The Measure of Man*. Roughly equivalent to Delilah's height, 4'8" (56").

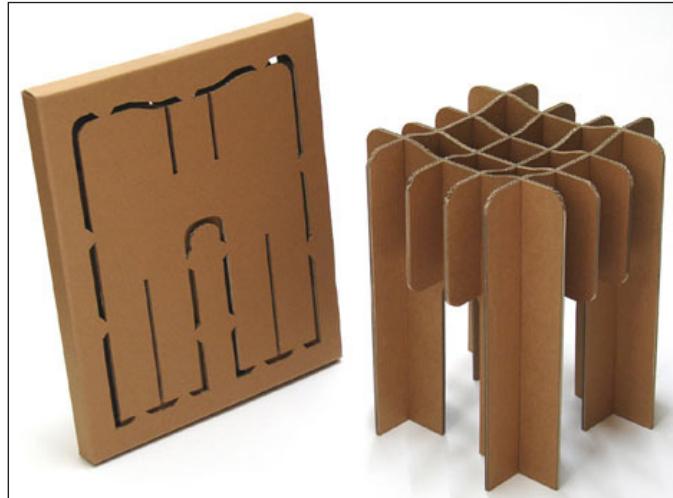


## PROJECT ONE\_PRECEDENTS



**Flat-pack Furniture Designs**

David Graas



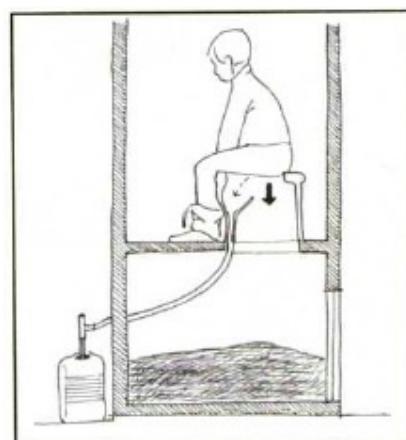
**UnBathroom**, 2003

William Hsu  
Pasadena, CA  
Cost: \$2 (prototype)



**Ecological Dry Toilet, 1980**

César Añorve  
Cuernavaca, Mexico  
Cost: \$27-54 for stand-alone toilet



### HUMANURE + COMPOSTING TOILETS

Humanure is the use of recycled human waste for composting and agricultural purposes. It is most often created through the use of a composting toilet, which typically uses an aerobic process to break down the waste and eliminate potential pathogens. A dry composting toilet uses a material such as sawdust to maintain proper liquid levels, aid the aerobic process, and reduce odor.

## PROJECT ONE\_CONCEPTS



### TOILET

The concept was to design a toilet with light-weight, readily available materials that would be economical to transport and easy to assemble on-site. The added benefits of using cardboard are that it is recyclable and structural.

Adding to the sustainability of the toilet is the use of a biodegradable bag and environmentally-friendly absorbent material that allows the bag and its contents to be composted.

The result is a simple yet functional and sustainable design.



### ENCLOSURE

The concept was to create a compact design that could be expanded and installed on-site. The full height of the enclosure is reached by sliding the upper wall out of the lower double-wall structure.

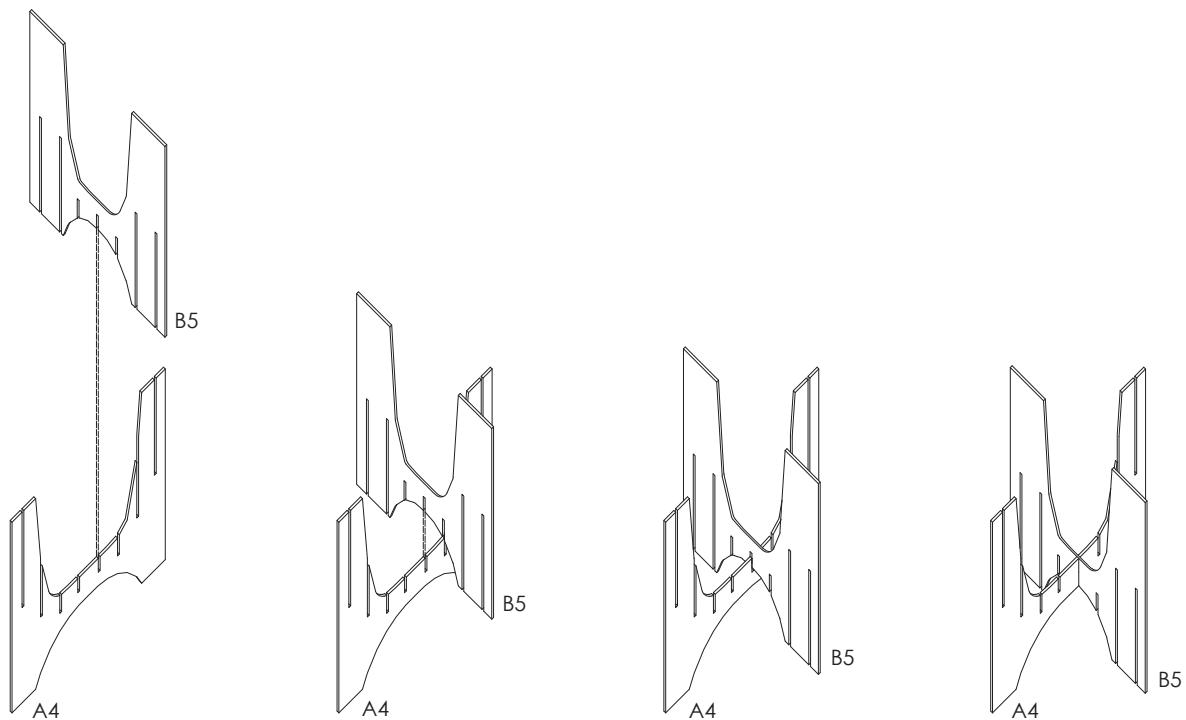
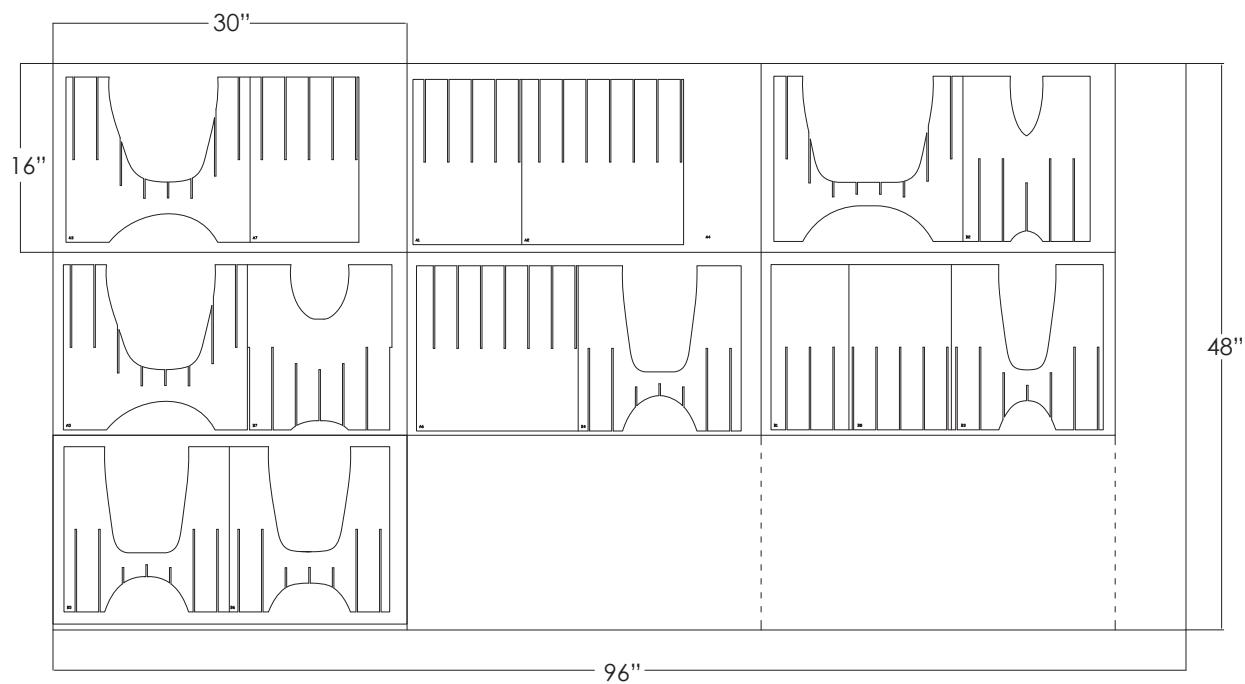
The design is a partial cardboard enclosure that uses the interior wall of the grain elevator. Instead of a door, the user is shielded from view by entering through a short corridor.

Light and air penetrate the enclosure at the top, where cardboard strips are placed in a way to make use of the voids in the corrugation of the cardboard.

The construction method is similar to that of the toilet; at the corners, the walls slot together to give the enclosure stability.



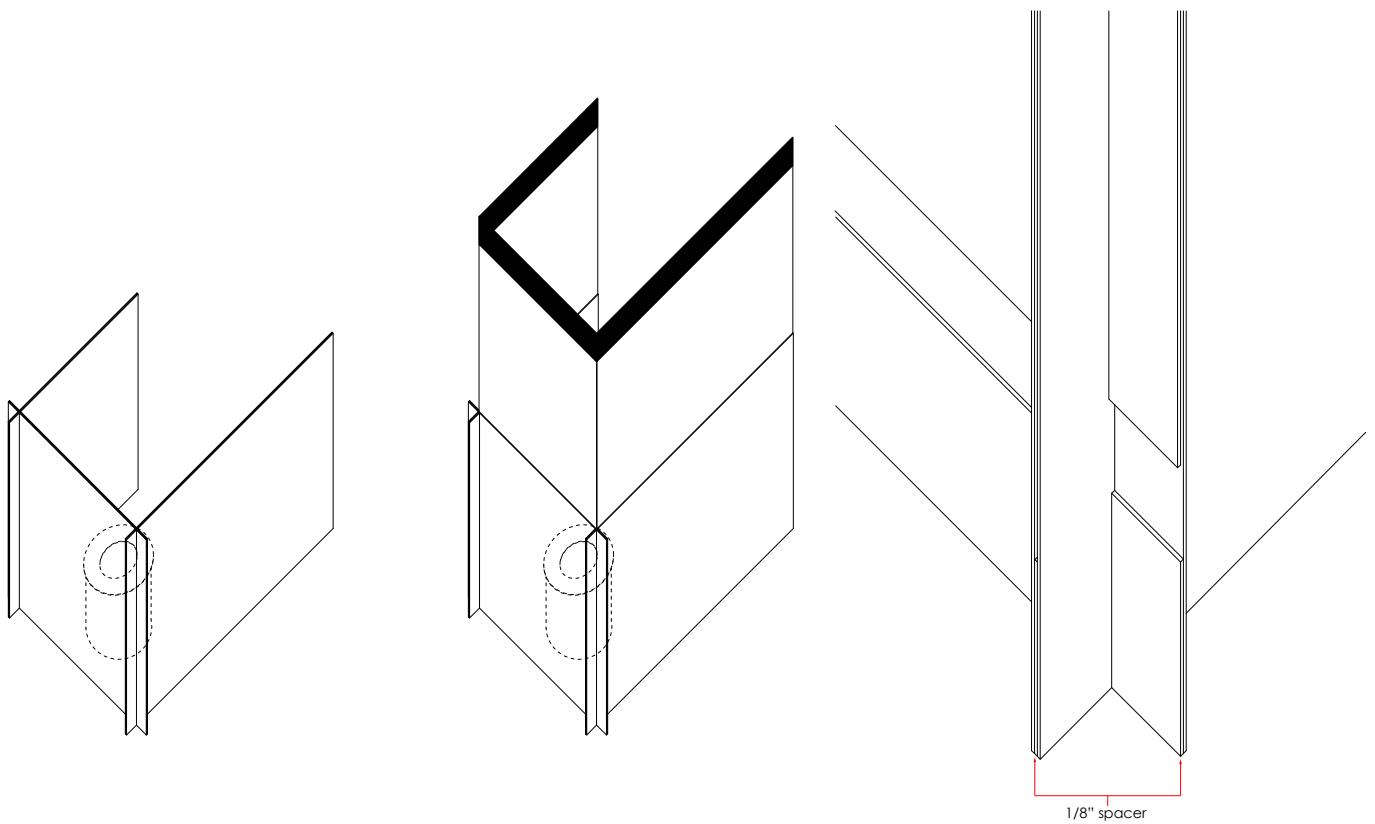
## PROJECT ONE\_ASSEMBLY + USE



One 4'x8' sheet of corrugated cardboard yields one toilet as well as several toilet seats of varying sizes. The 4'x8' sheet can be cut down to nine 16"x30" sheets, which can then be lasercut and transported to the site for assembly.

Each template is labeled for easy organization and assembly at the site. The templates from left to right are labeled A1-A7, while templates from front to back are labeled B1-B8. For stability during assembly, it is best to begin with the centermost templates and work outward.

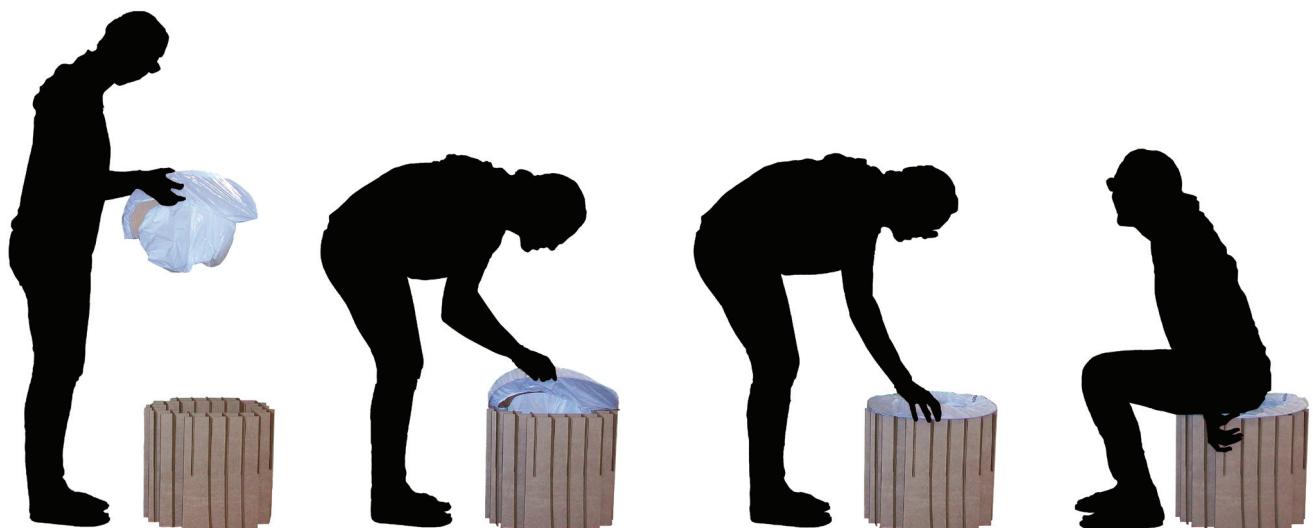
This diagram shows how two centermost templates, A4 + B5, slot together. No glue or hardware is required for assembly.



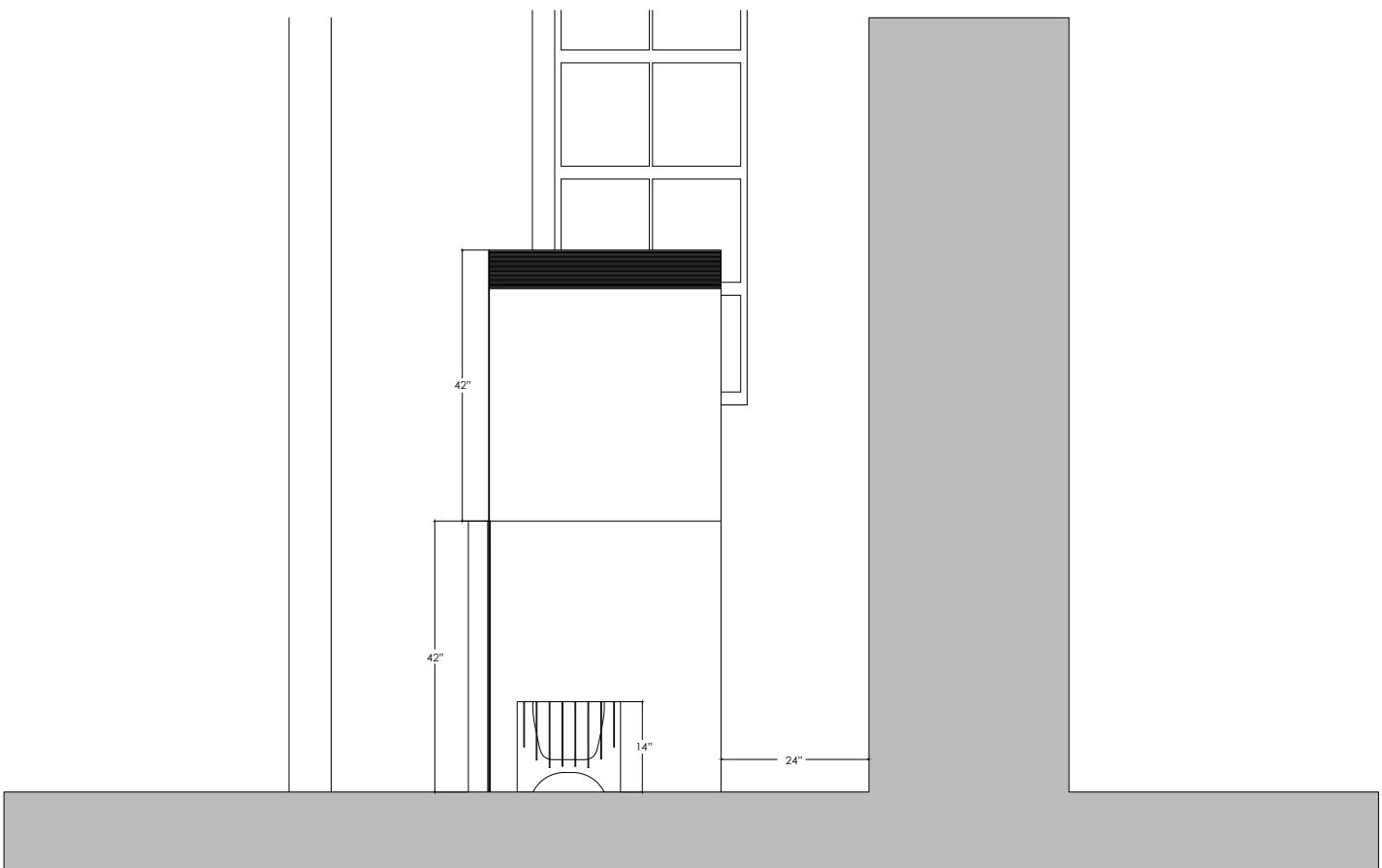
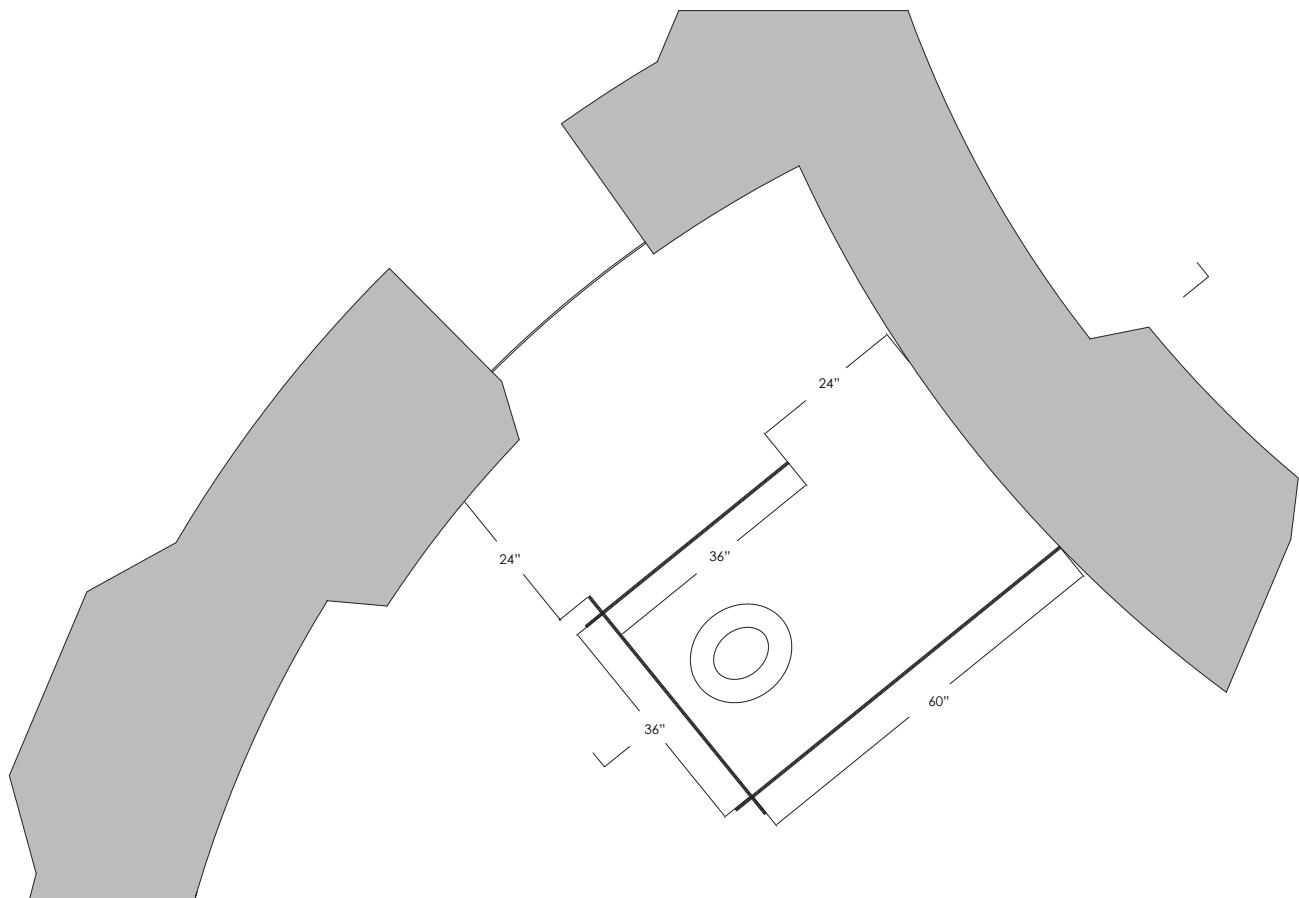
The enclosure is assembled in a similar manner to the toilet. The walls of the base consist of two layers of cardboard with a spacer at the bottom; like the toilet, the walls notch together. The structure is given stability by the overlap of cardboard at the corners. The upper walls slide up from between the layers of the lower walls and are secured to bring the enclosure to its full height.

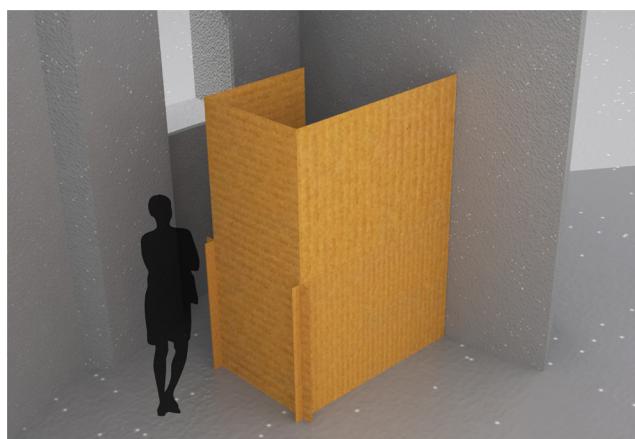
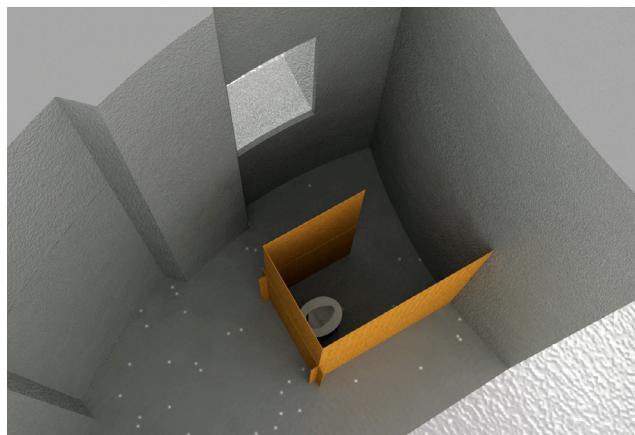
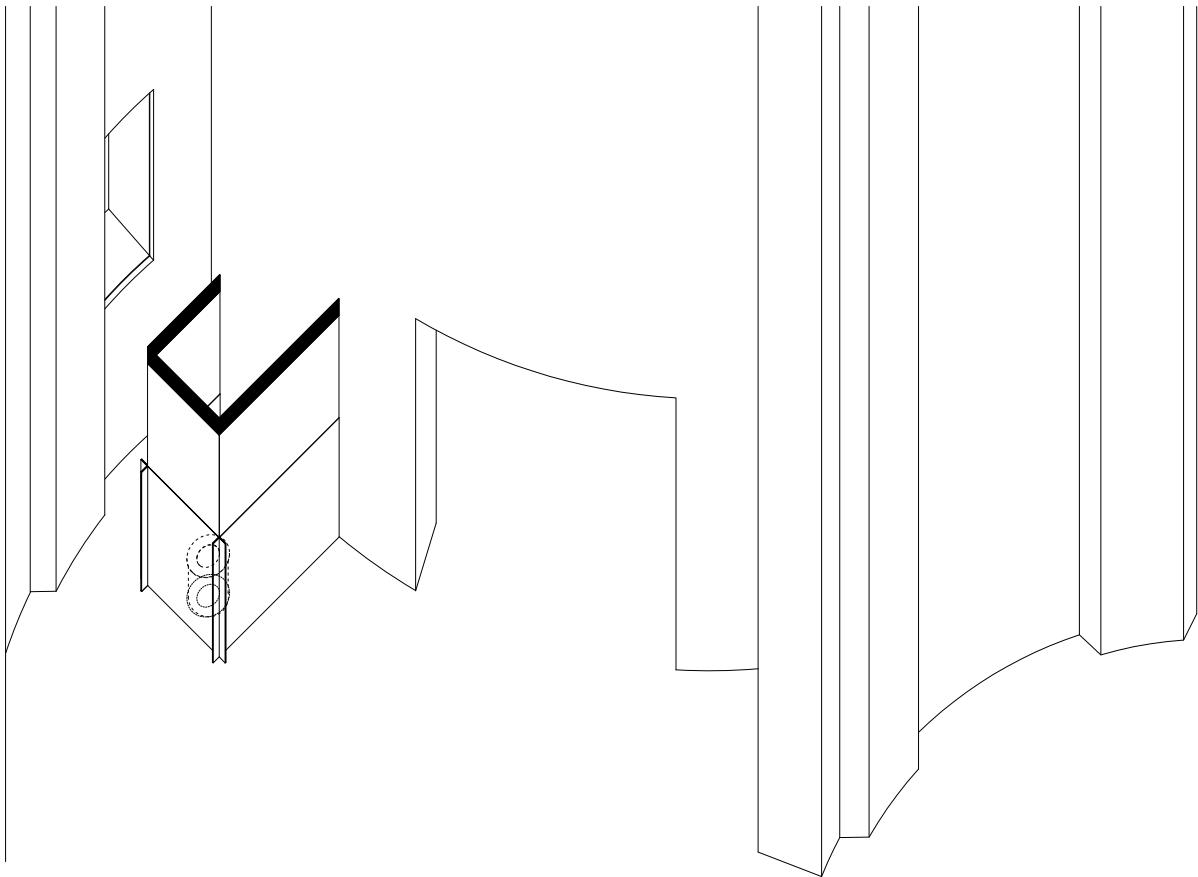
Once the toilet is assembled, users can take a toilet seat and attach a bag with an elastic band and place it over the structure. Seats can be made in varying sizes to accommodate users' needs. Bags and seats are biodegradeable; once used, the seat can be folded in half to close the bag, which can then be disposed of in a receptacle to be composted. A detachable bag allows the toilet seat to be used several times before disposal.

Once the toilet has reached the end of its life, the entire structure is easily disassembled and recycled.



## PROJECT ONE\_DRAWINGS + RENDERS





# PROJECT ONE\_CRITIQUE



The project was reviewed on September 27th, 2011 in the Marine A grain elevator. Reviewers included: Beth Tauke, studio instructor; Dr. Jean La Marche, professor and architect; Dr. Ed Steinfeld, professor, architect, and director of the IDeA Center; Dr. Despina Stratigakos, professor and architectural historian; Dr. Sue Weidemann, environmental psychologist; Dr. Andre Toth, psychoanalyst; Ken Hood, Facilities Planning & Management Officer, University at Buffalo Libraries; and Mike Anderson, architect.

## **Develop the bag and seat further, they are an important part of the concept:**

- o A hole in the seat could allow fresh bags to be hung in or near the enclosure for use
- o Put handles on the seat so it's easier to carry the bag when disposing
- o Devise a way to seal the bag after use and before disposing- adhesive, tie, twisting?
- o Could there be a machine that ties the bag and drops it into a container after it's used?

## **Material:**

- o Could less material be used to construct the toilet?
- o Could cardboard packaging be recycled into toilets, instead of using "new" cardboard?
- o There are other types of cardboard available than what is in the UB shop

## **Hygiene:**

- o The toilet is structurally stable and it will last a long time; the issue governing replacement will be the cleanliness of the cardboard
- o Could the bag go past the seat and down the sides of the toilet a few inches to make it more hygienic?
- o Should the bag be disposed of inside the enclosure so users don't have to walk around with it?

The project is simple, straightforward, and doable; it's low-tech and transportable- with refinement it could be patented.

## **Self Evaluation:**

I felt that my project was particularly successful in addressing our objective of considering economy of means. The main goal of my design was for the entire process to be biodegradable. I also feel that my design minimized cost and waste in materials, time and effort in construction, and space in transportation.

However, I think that the enclosure needed further refinement. Although I designed the toilet so it was lower to accommodate my client's stature, and it is simple to use, I think that the design of the enclosure would make it more apparent that the project was tailored to my client. I also agree with the critics that the toilet seat options (height and width options, handles, how the bag could be connected) could be explored more.

## **PROJECT TWO\_INTRODUCTION**

### **PUBLIC RESTROOMS FOR AN EVENT SPACE**

The main project for this semester's Inclusive Design studio was to design a set of permanent public restrooms for the Marine A grain elevator. Marine A provides a unique space that can accommodate many programs and activities, so the public restrooms had to provide amenities for a maximum occupancy of 1,000 people with diverse needs. These restrooms were to address the Seven Principles of Universal Design:

1. Equitable Use
2. Flexibility in Use
3. Simple and Intuitive Use
4. Perceptible Information
5. Safety and Tolerance for Error
6. Low Physical Effort
7. Size and Space for Approach and Use

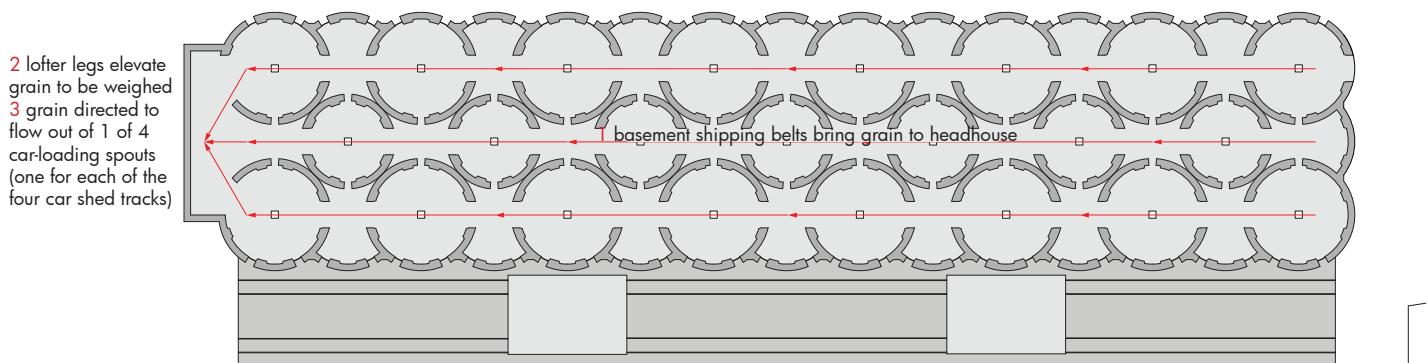
To gather information about how people feel about public restrooms, the studio held a focus group. The issues brought up that I felt were most important to address were:

1. Insufficient space in standard stalls for the average user, as well as insufficient space in accessible stalls for wheeled mobility device users
2. The majority of participants said that privacy in a public restroom was more important to them than other factors such as safety and cleanliness

Other than providing inclusive facilities for event-goers at Marine A, other major goals of this design project were to provide visitors with a unique and multisensory experience not usually associated with the public restroom, and to challenge cultural norms.

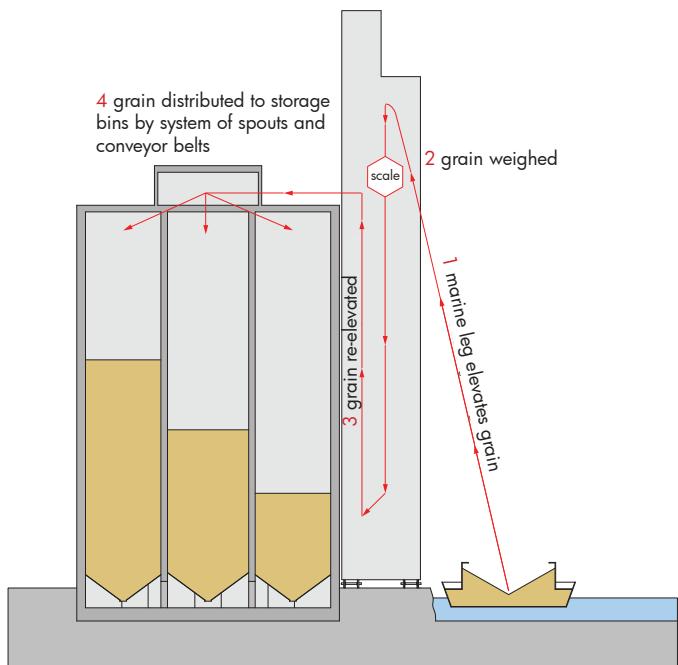
## PROJECT TWO\_CONCEPTS

### GRAIN CIRCULATION



CIRCULATION OF GRAIN WHEN SHIPPING BY RAIL

Based on written description in Historic American Engineering Record (HAER) No. NY-252



CIRCULATION OF GRAIN WHEN RECEIVED BY WATER

Adapted from diagram found in *Reconsidering Concrete Atlantis: Buffalo Grain Elevators*, Lynda H. Schneekloth, editor.

- Grain could be received and shipped by both water and rail; however, it was most often received by water and shipped by rail

### RECEIVING BY WATER

- Marine A has two movable marine towers; each marine leg was capable of elevating grain at a rate of 30,000 bushels per hour by a system of buckets attached to a loop
- Once grain reached the top of the tower it descended by gravity through a scale to be weighed before being re-elevated by an internal marine lofter consisting of buckets attached to a rubber belt
- Buckets discharged grain through a travelling spout into hoppers over the main storage bins; from here, grain was distributed directly into the bins or onto receiving belts to be transported horizontally to other bins

### SHIPPING BY RAIL

- All grain left the storage bins by way of three conveyor belts, one below each row of bins
- The eight-foot-wide openings at the base of the bins were for the conveyor belts, while the two-foot-wide openings were for personnel
- Grain was conveyed to the headhouse at the southern end of the elevator, where it was elevated by lofter legs to be re-weighed
- A turnhead below the scale directed flow of grain out of headhouse to one of four car-loading spouts, one for each of the tracks servicing Marine A
- The car-loading capacity of the elevator was 40,000 bushels per hour, or 200 cars filled in a 10-hour period

The design was influenced by the circulation of the grain through the marine towers and silos. The marine towers served as the location of the main vertical circulation of the grain and were where workers mainly interacted with the circulation process. It was the logical place to locate the vertical circulation and services for the event space to maximize the space within the silos. In my design, the silos are the location of the circulation that bridges the 12 foot gap between the floor of the silos and the floor of the marine towers. This circulation manifests itself in a largely horizontal form, a ramp with a 1:12 slope. While the ramp takes up a significant amount of space within the silos, traveling on the ramp is meant to be a different way to experience the silos.

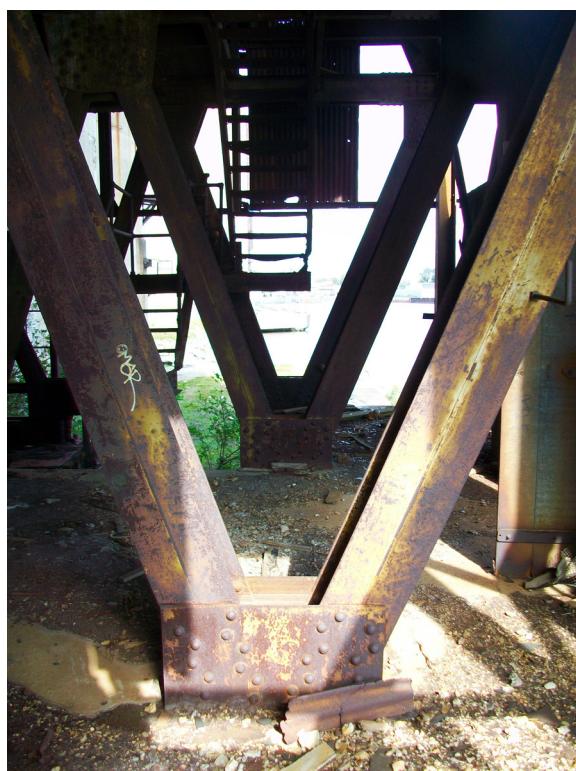
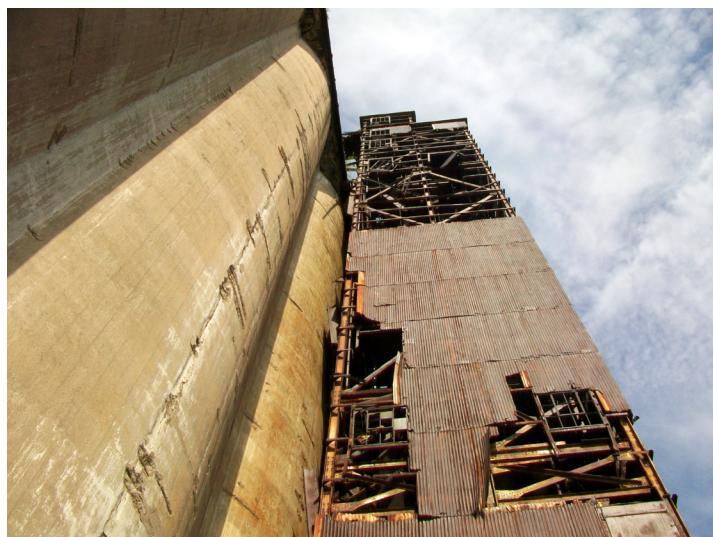
## PROJECT TWO\_CONCEPTS



REUSE

Historic American Engineering Record (HAER) No. NY-252

### MATERIALS



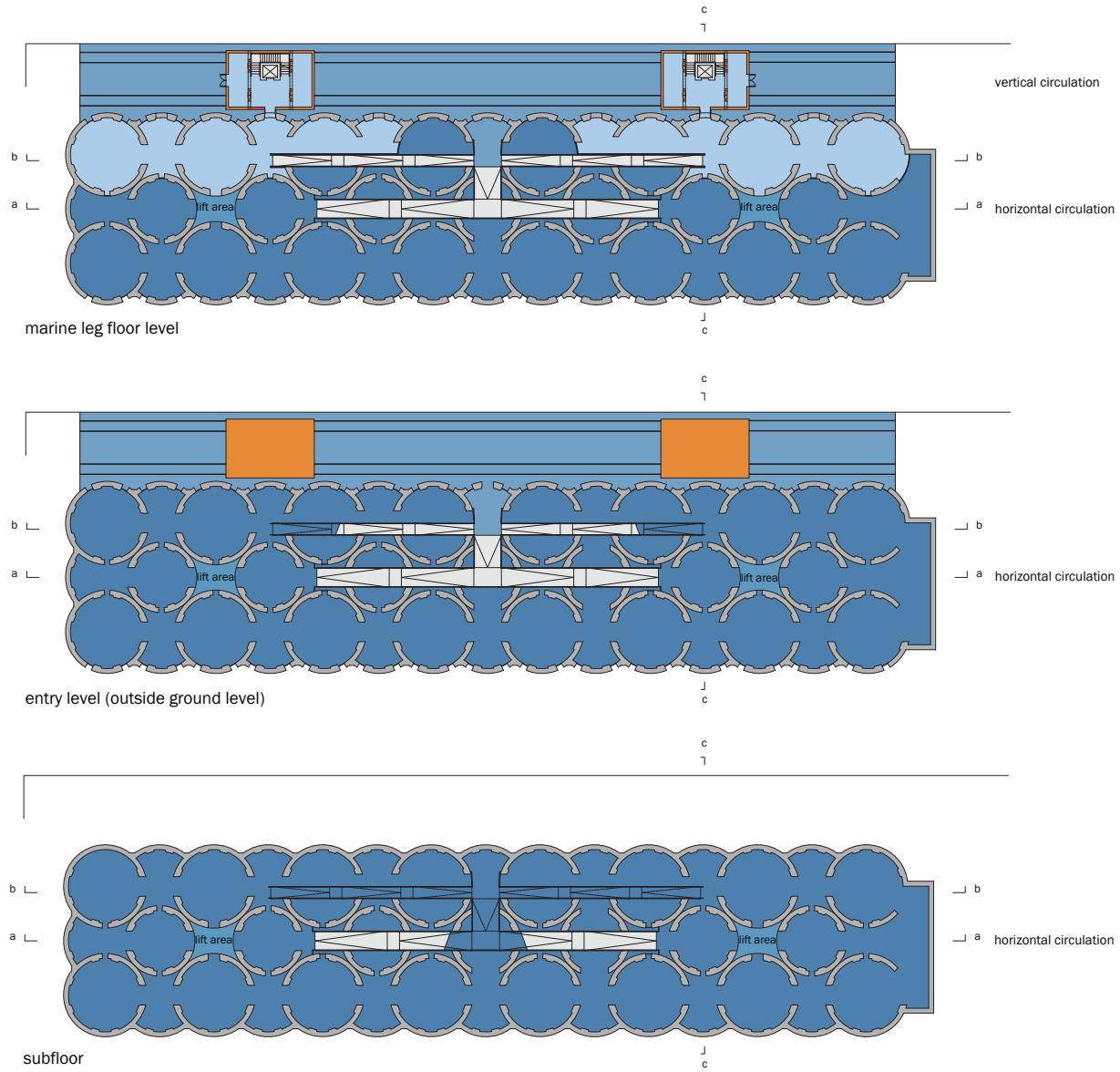
### FUNCTION

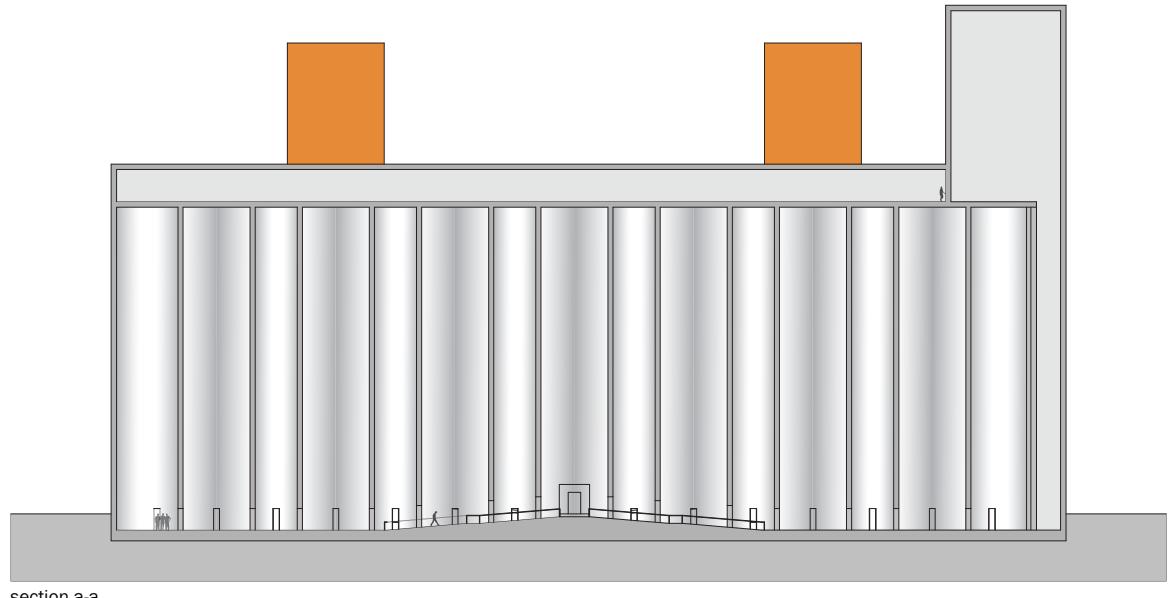


STRUCTURE

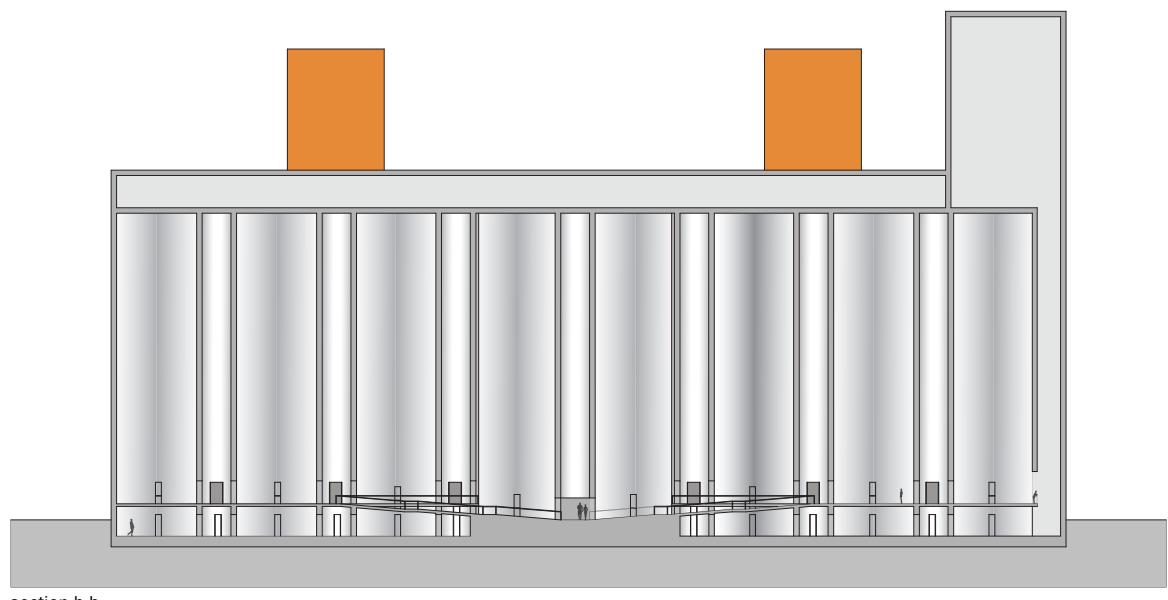
The strategy was to largely maintain the appearance of the silos and marine towers and use the existing materials and structure. I did not assign a program to my design as I imagine the space being flexible to accommodate different types of ephemeral events. The services, main vertical circulation, and bathrooms are located in the marine towers to maximize open space within the silos for these events. The layout of the bathrooms was influenced by the existing structure of the marine towers and resulted in units that could be “plugged in” to the bays. The interior of the marine tower would leave the structure relatively exposed to reflect the industrial nature of the site and its existing condition; the façade treatment is influenced by the existing corrugated steel siding, which is falling off and leaving the interior exposed.

## PROJECT TWO\_CIRCULATION

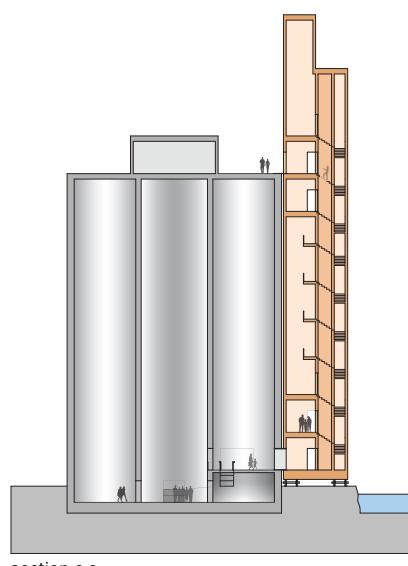




section a-a



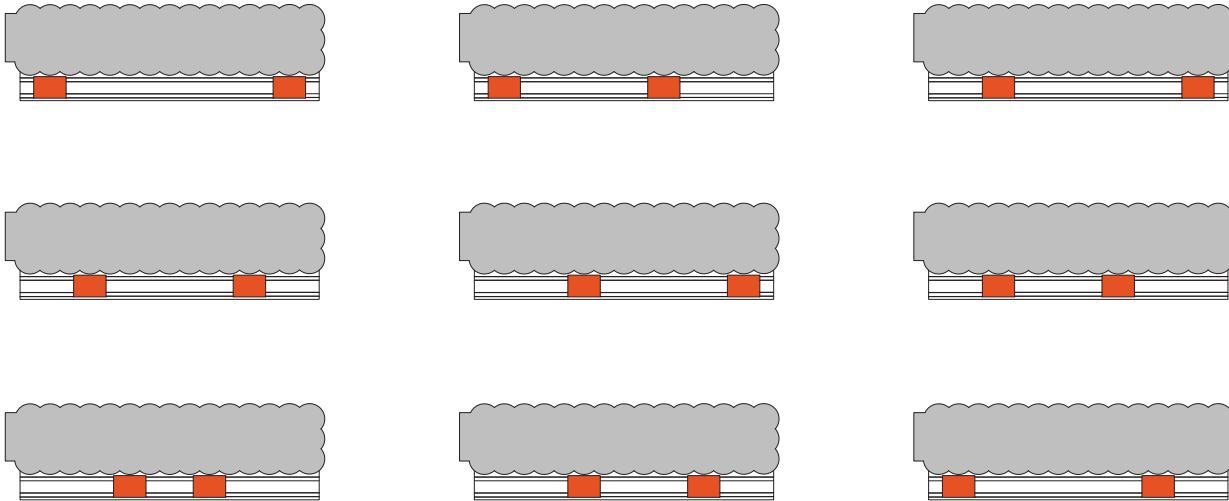
section b-b



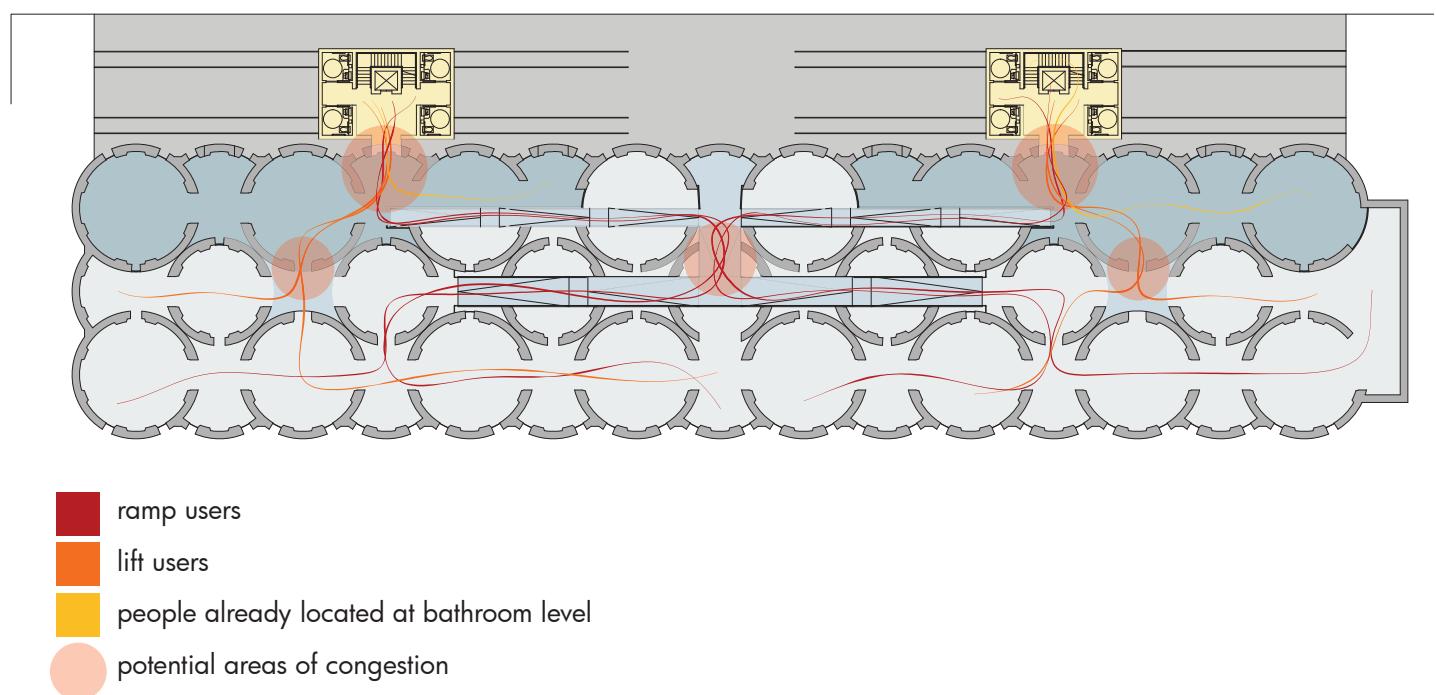
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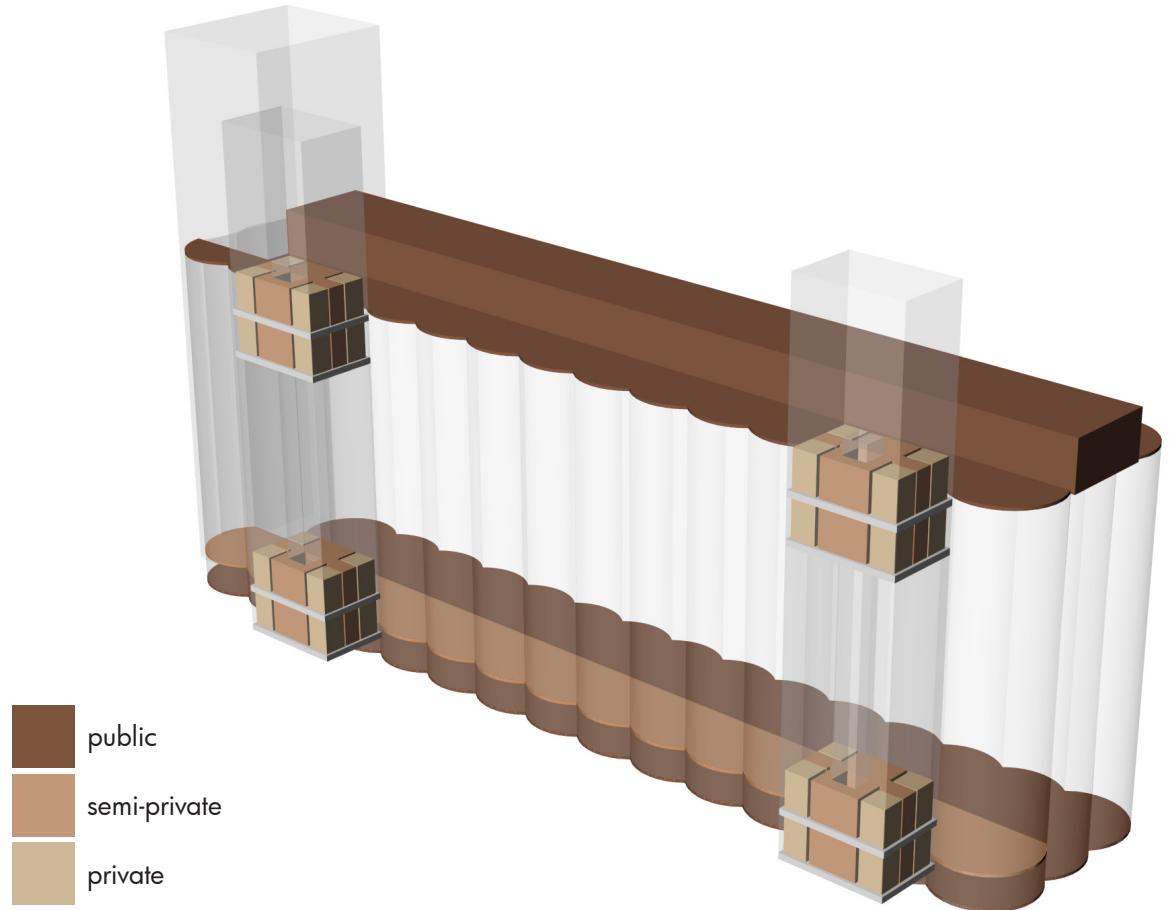
## PROJECT TWO\_CIRCULATION

### POSSIBLE CONFIGURATIONS OF MOVABLE CORES



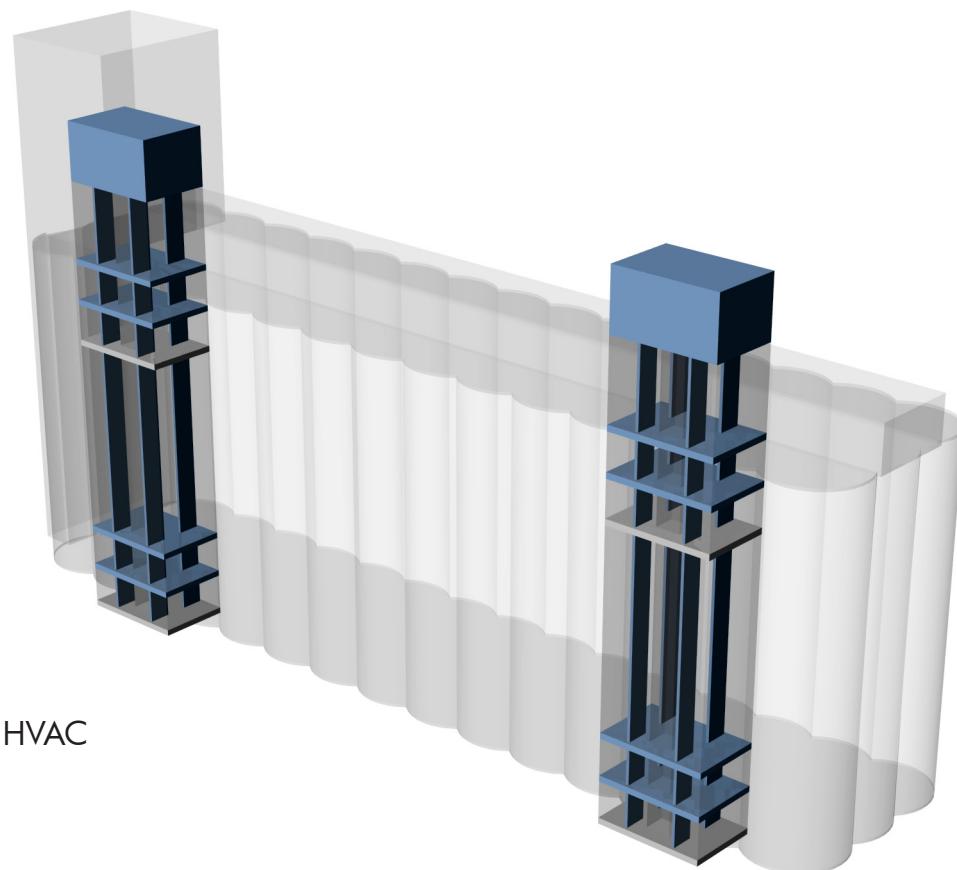
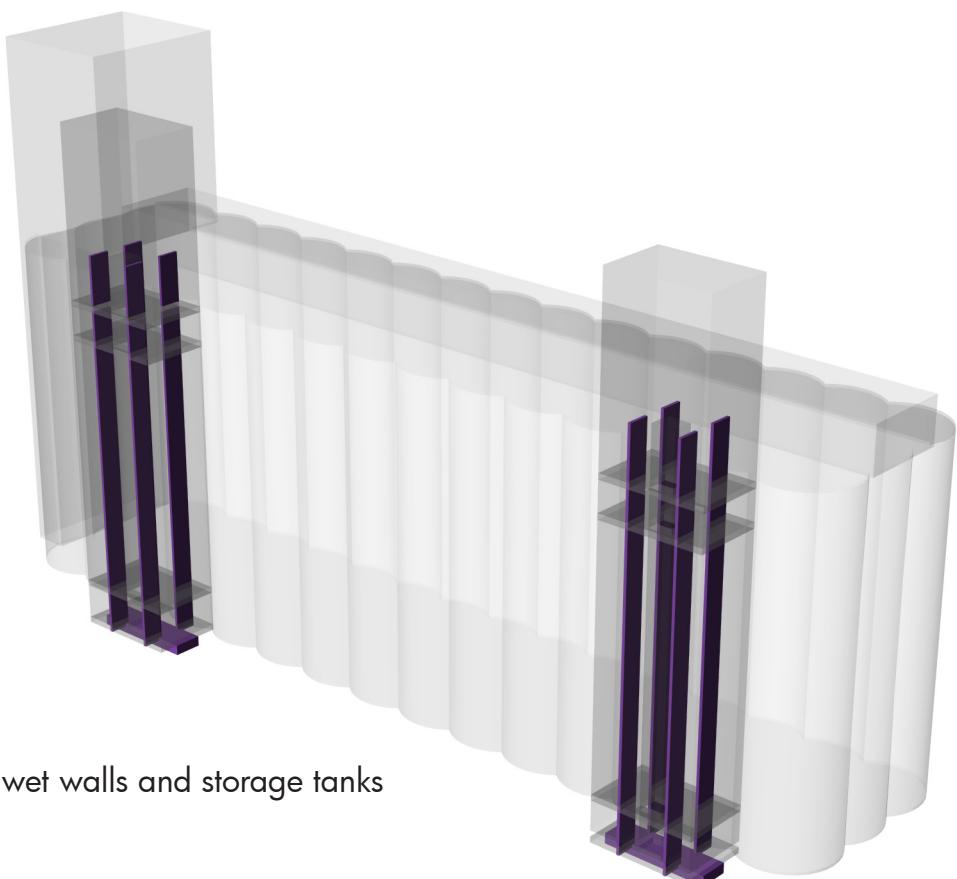
- Each marine tower moved along the dock on the east side of the elevator with 20 pairs of wheels on 4 rails
- Electric current was originally transmitted to extension arms on the towers via a 3-wire bare copper trolley system on the roof of the elevator
- A single motor located in one of the towers was rigged to move both structures
- When only one tower was to be moved, car wheel stops were left in place under the tower that was to remain stationary





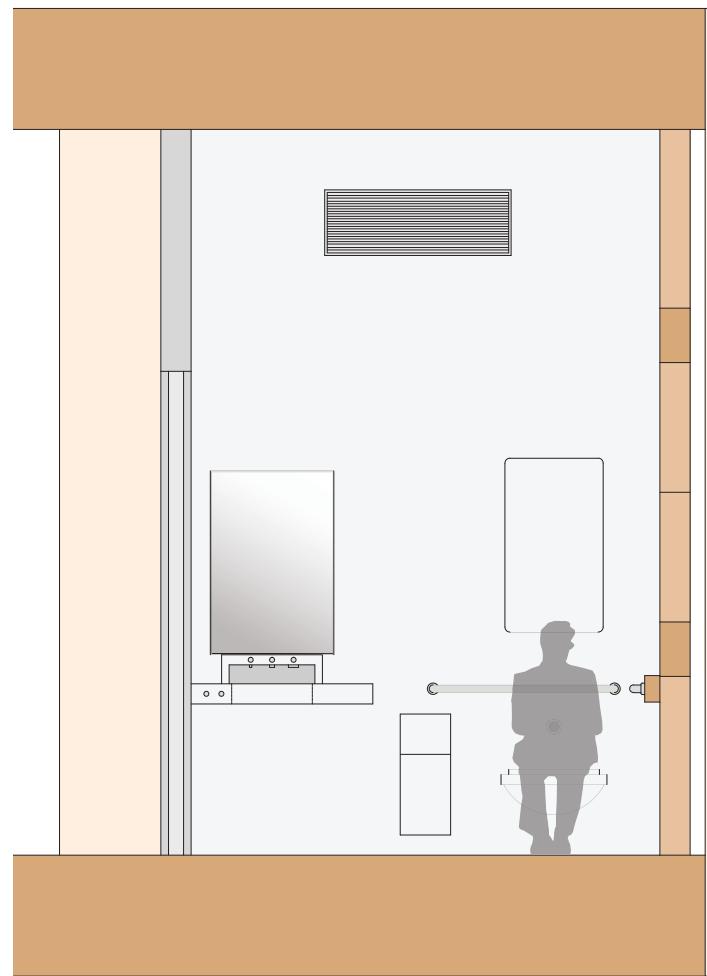
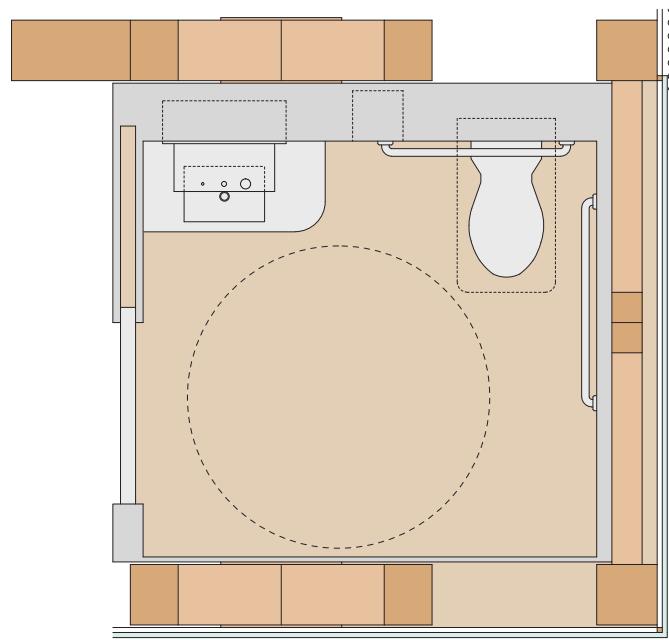
The largest and most public space, the silos themselves, is left largely untouched. A semi-private space located on the southeast part of the building is created by the waiting platform leading to the restrooms. The only times one would likely occupy this space was if they were waiting to use a bathroom or wanted a space that was slightly less occupied than the main space, but did not provide much privacy (sound reverberation, large open spaces). This area is located twelve feet above the main event space and one would not likely accidentally wander to this location. The most private spaces, the bathrooms themselves, are removed from the main event space and are located in an entirely separate structure. These spaces are destinations. The marine towers provide a more human-scaled and intimate space, while the bathroom units provide total isolation and privacy, at least from other guests located indoors.

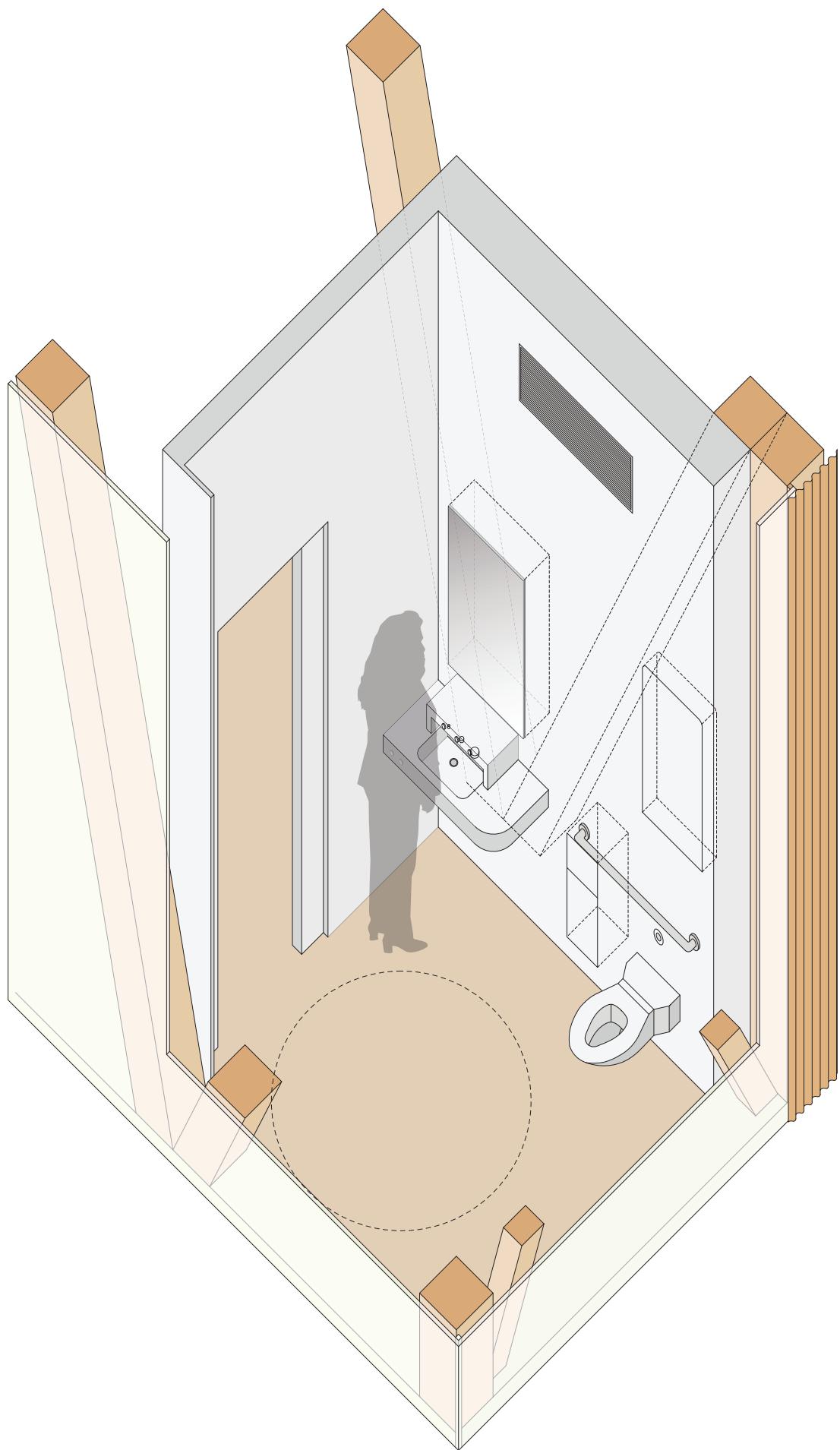
## PROJECT TWO\_SERVICE DIAGRAMS



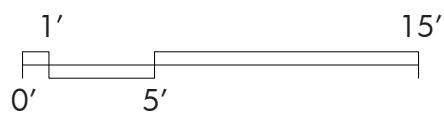
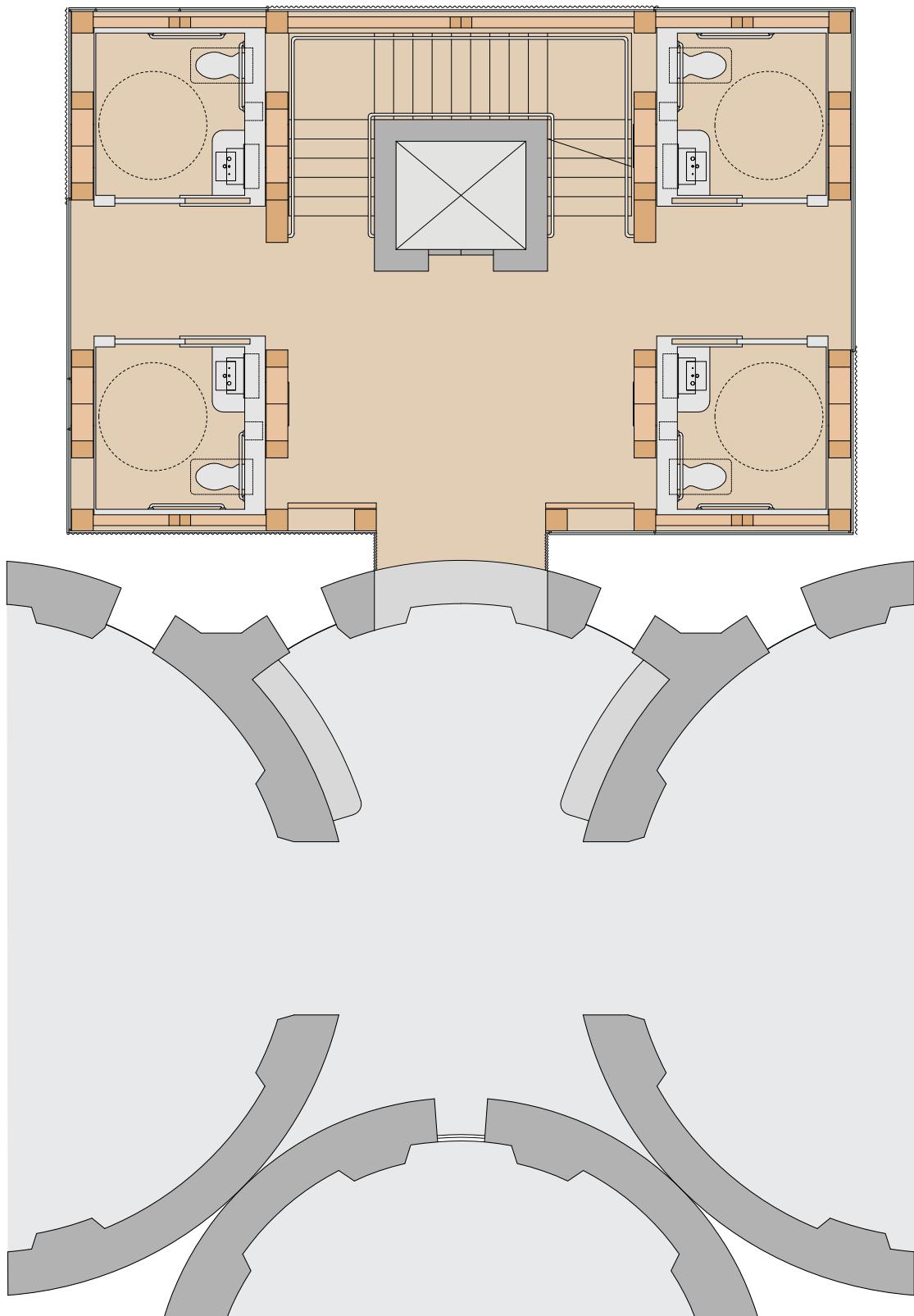
Bathrooms and services are stacked in the marine towers. All services impacting the function of the bathrooms are located in the utility walls in each bathroom, creating four walls that run the height of the towers. Because they are stacked, more bathroom units could be added relatively easily if needed. A storage tank for waste is located at the bottom of each tower between the existing wheel axles, allowing the towers to move without being attached to an underground waste system. Alternatively, the towers could be hooked up to an underground tank located under each possible position of towers, or the towers could be fixed in place and hooked up to an underground system. HVAC equipment would be located at the top of the marine tower, where the motors and mechanics for the towers were originally located. The towers run on rails and a trolley system located at the top of the grain elevator, which could be used as a way to provide electricity to the towers and the event space.

## PROJECT TWO\_DRAWINGS

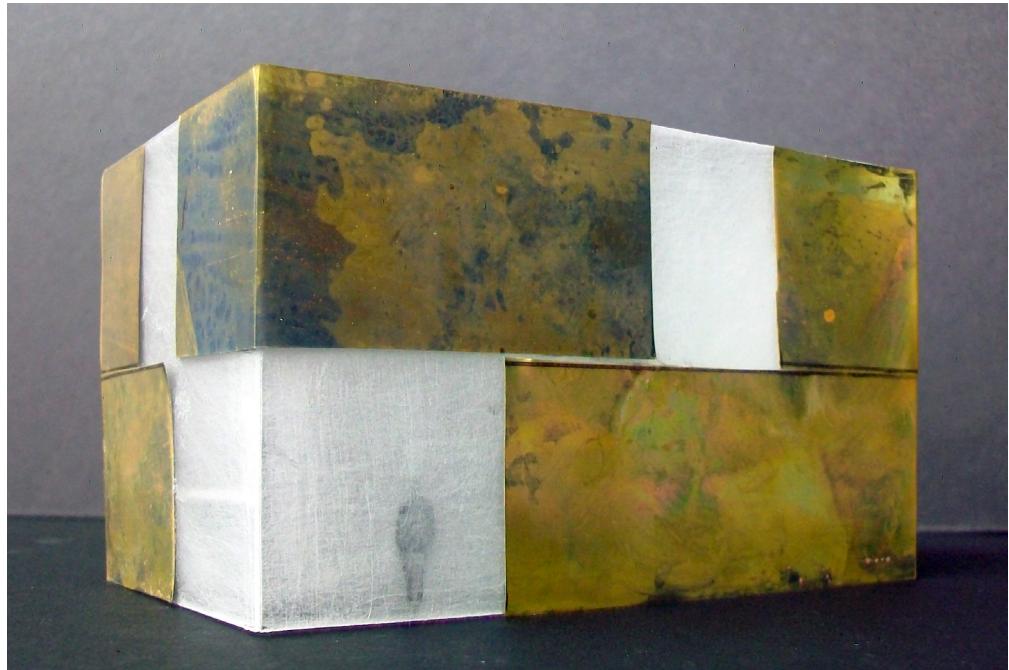




## PROJECT TWO\_DRAWINGS

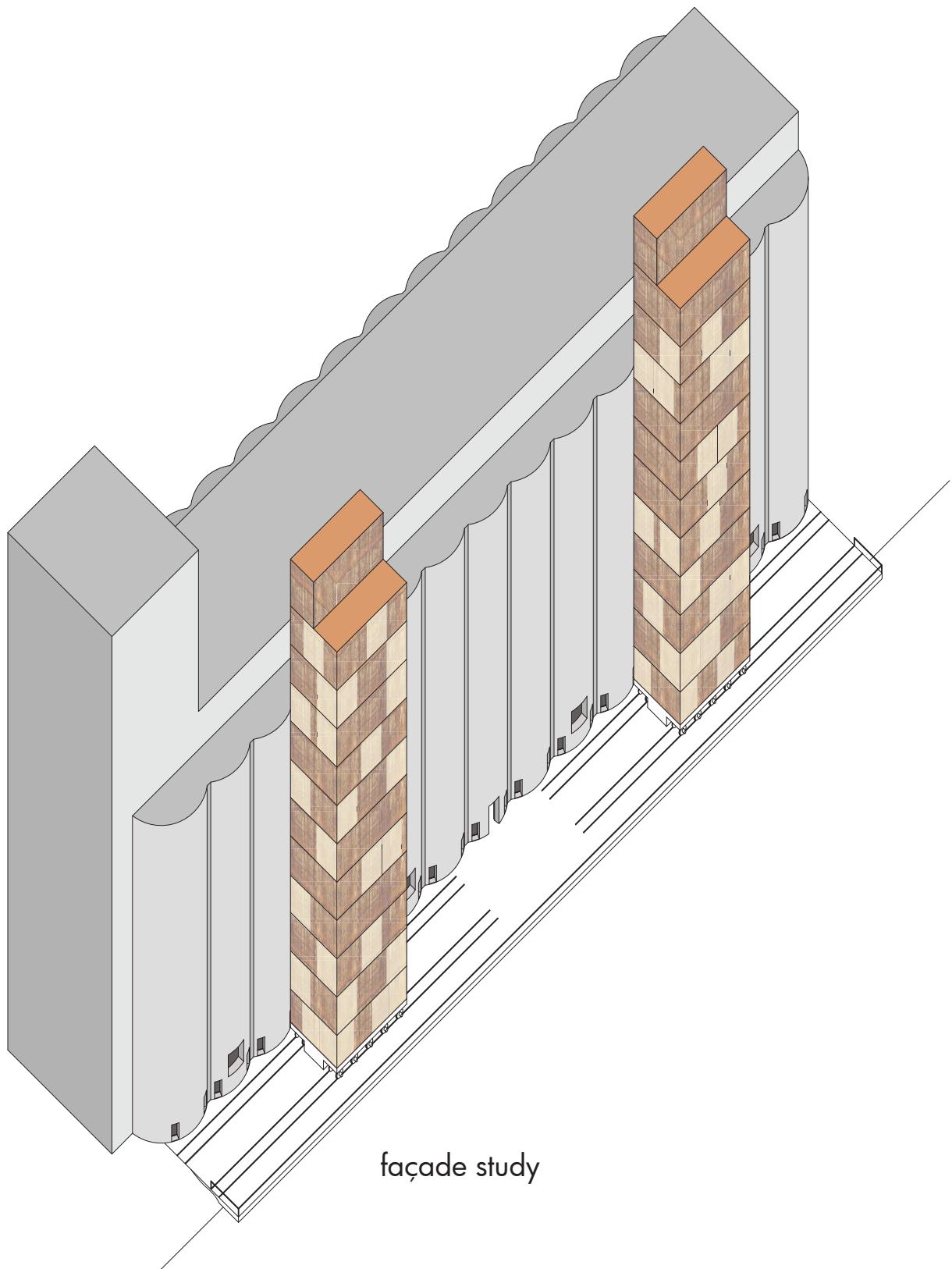


## PROJECT TWO\_MATERIAL STUDIES



translucency

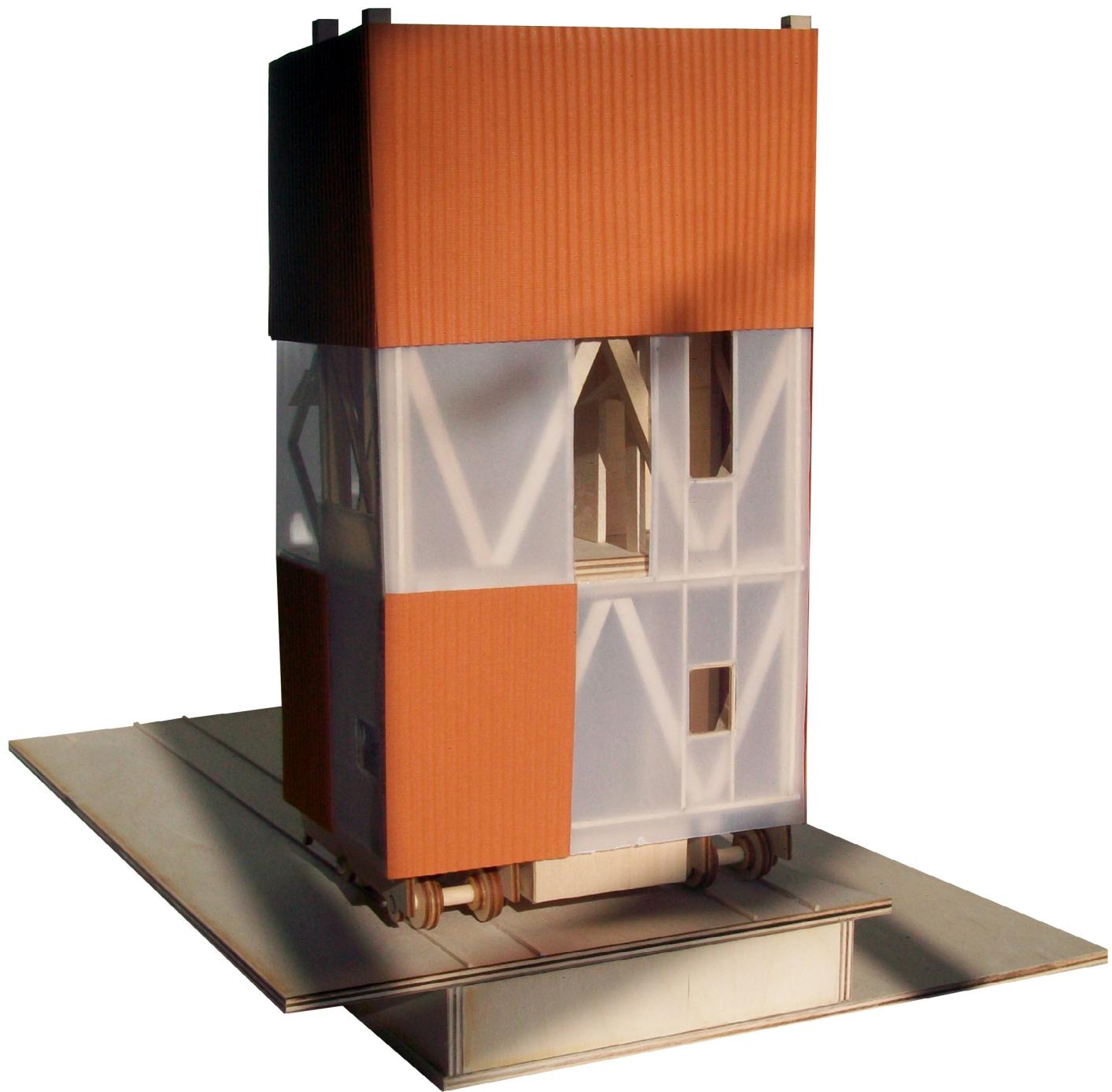
## PROJECT TWO\_MATERIAL STUDIES

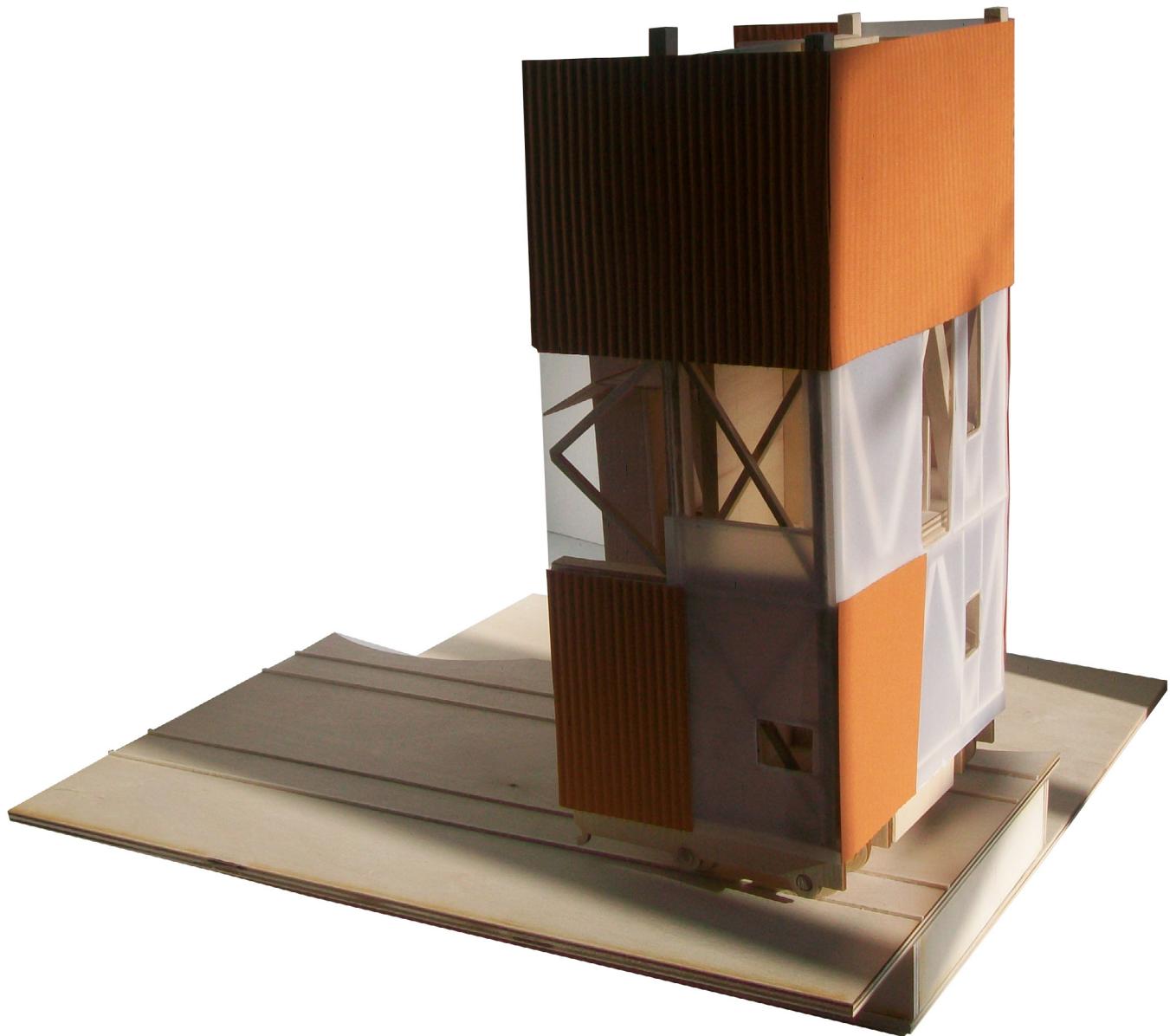


A single bathroom type is provided for all users, to equalize wait time and make the layout of the units more intuitive. The clearances provided are largely based on the ADA Accessibility Guidelines. However, based on feedback from the focus group, more space was provided than required by the guidelines to provide adequate space for larger wheeled devices. While the toilet and sink heights are fixed, ample space is provided for companions for those users who may need assistance in the bathroom (small children, frail elderly, severely disabled, etc.). The mechanical functions of the bathroom (door, toilet, sink, hand dryer, soap) would be largely automatic or require minimal effort from the user.

The treatment of the façades in my design also challenges the idea of what is expected or even acceptable in a public bathroom. Each bathroom unit has different cladding, ranging from fully enclosed by opaque material to fully exposed by (translucent) glazing. The use of translucent glazing, along with sections of transparent glazing, challenges the comfort level of a person tending to private acts in a public setting. While the person is not exposed at all to people inside the marine towers, they are partially exposed to people viewing the towers from the outside. However, they are never fully exposed- they are seen from a great distance or their silhouette or movement within the bathroom is all that is exposed.

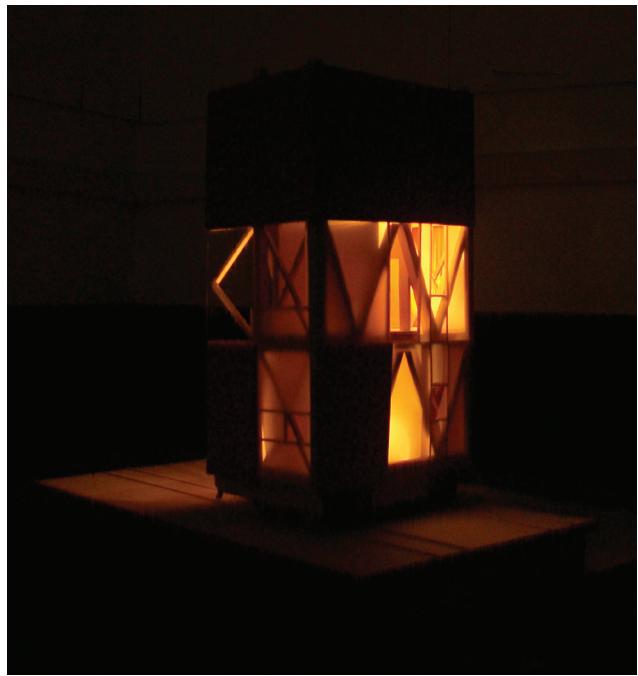
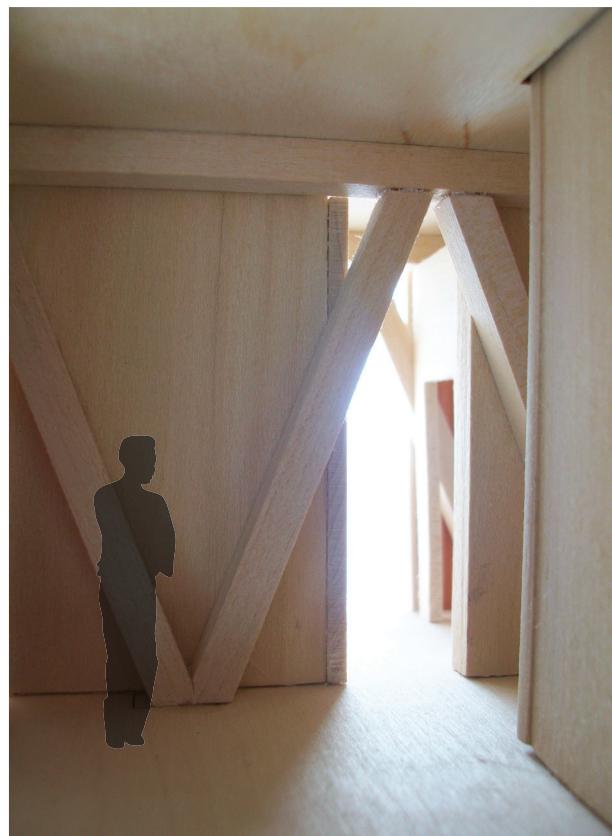
## **PROJECT TWO\_SECTION MODEL**



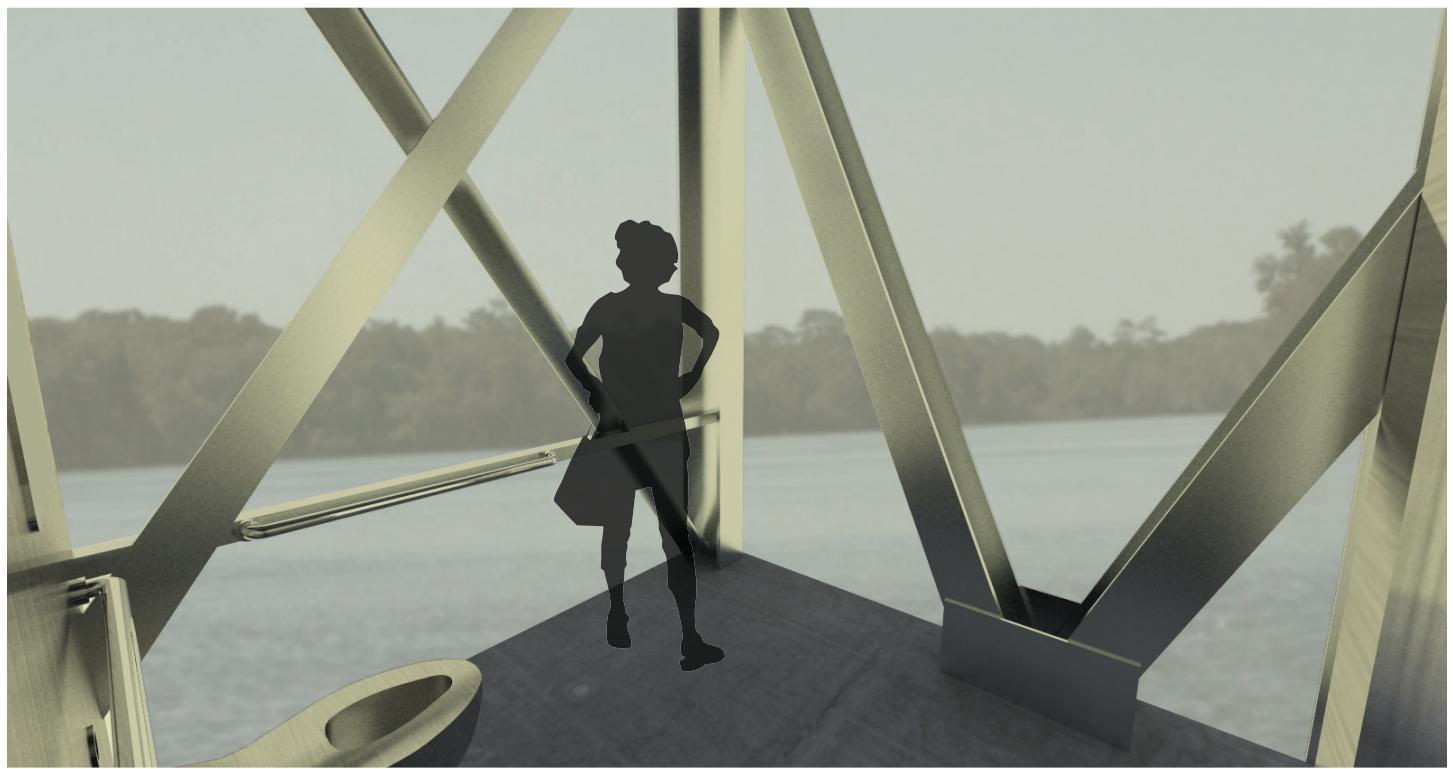
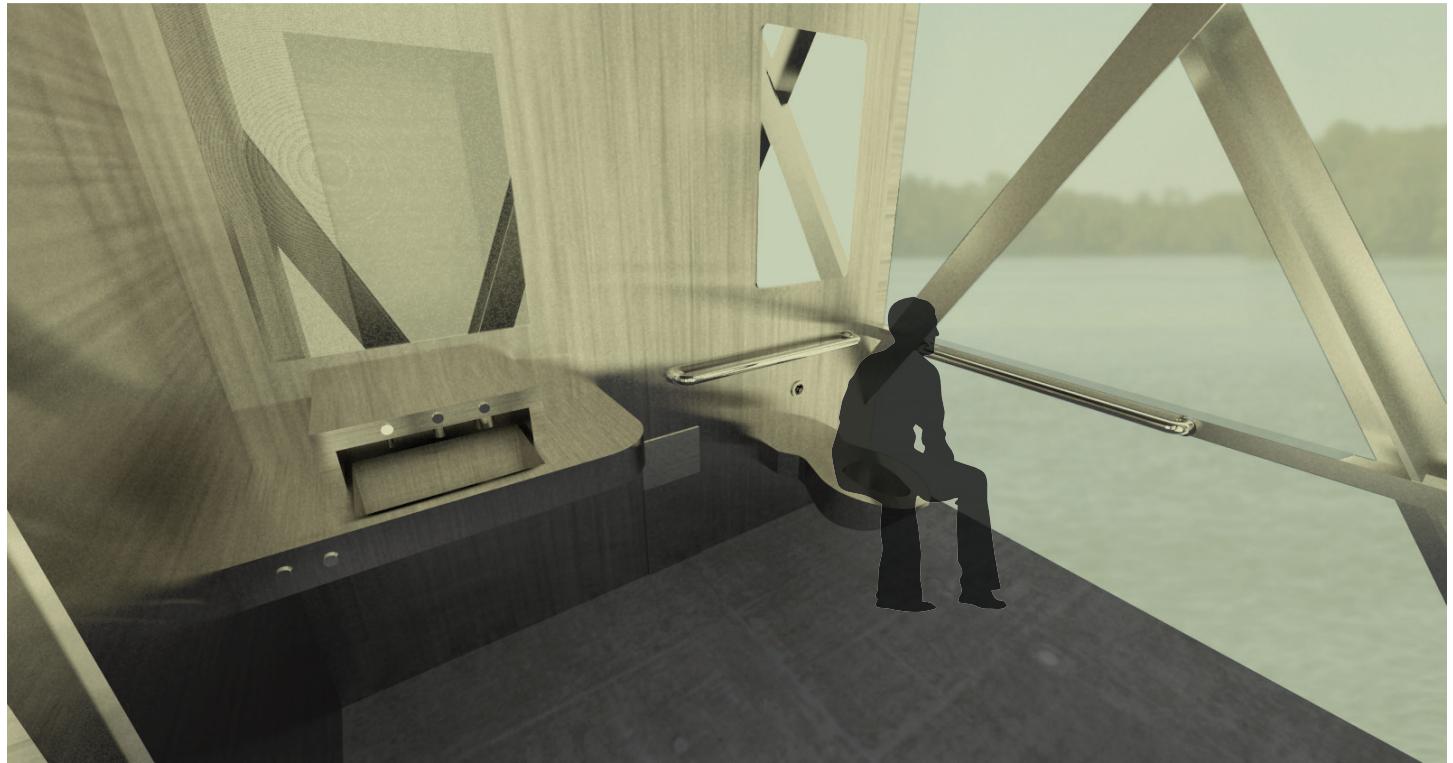


The design of the bathroom is largely visual, focusing on the industrial nature of the site and the views out from different points of the marine towers. However, I was also interested in the contrast between the silos and the marine towers. The interior of the silos is cool, dark, damp; the walls are smooth and cold. In contrast, the marine towers are warm in color and receive a lot of sunlight due to their location on the southeast side of the grain elevator. With the treatment of the façade, I imagine that each bathroom would be a different thermal and light experience, based on the glazing and position of the unit.

## PROJECT TWO\_SECTION MODEL



## PROJECT TWO \_INTERIOR PERSPECTIVES



## PROJECT TWO\_CRITIQUE



The final review for project two was held on November 22nd, 2011. Reviewers included: Beth Tauke, studio instructor; Dr. Jean La Marche, professor and architect; Dr. Ed Steinfeld, professor, architect, and director of the IDeA Center; Lynda Schneekloth, professor and landscape architect; Audrey Ross Sanders, architect; and Tammy Milello, focus group participant. Fellow Inclusive Design Graduate Research Group students were also encouraged to give peers feedback. The final presentation was held on December 8th, 2011 at the Peavey Building near Marine A.

In conversation with Audrey Ross Sanders, she said that if the marine towers move, it should be more deliberate and play a larger role. Instead of the people going to the bathroom, could the bathroom come to the people? They could stand on a platform and wait for the tower to arrive. If you spend too long in the restroom, you wind up on a different platform.

On the other hand, Lynda Schneekloth said that you have to evaluate whether what you get out is greater than what you put in. She asked me if the effort it would take to get the marine towers moving again would be worth the experience they provide. Instead, she suggested making the towers stationary and developing the outdoor space framed by them- this could be the unique experience provided at Marine A.

General comments were in agreement that the interior experience in the bathroom needed to be developed. In response to this, I created interior perspectives to show potential materials and views within one bathroom unit fully enclosed by translucent glass.

## SELF EVALUATION

Overall, I think that I represented my project well. I focused on creating bathroom units that were fully accessible and private, yet challenged users' perception of privacy. I also wanted the experience in each bathroom unit to be slightly different and to provide eventgoers with options as to how "exposed" they felt.

If I were to continue working on this design, I would concentrate on developing the interior experience of the bathrooms and explore new ways to represent that information. I would also want to develop ways to make the experience more multisensory and go into more detail, such as developing signage.