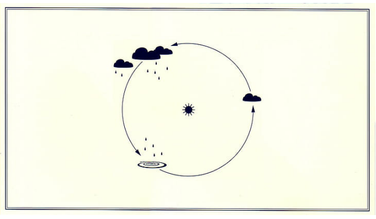
# the belt

## PROJECT BACKGROUND

Water is life: it is the most critical natural element and is necessary to sustain the life of all living things. Water is also a powerful and unpredictable force of nature having the ability to impact our environment without any warning. As such, we must pay close attention to Water Resource Management in our communities, neighborhoods and cities alike.

Being based in New York City, ACE Team 30 decided to address the Water Resource Management and Preservation issues impacting us locally. First, we analyzed global water resource management issues to understand the full breadth of the problem. Next, we applied this information to NYC and the surrounding areas to see what specific issues we could improve upon here.



## GLOBAL WATER MANAGEMENT ISSUES

There are a number of water resource management and preservation issues facing us throughout the world. A summary of the most significant issues is below:

1. WATER SCARCITY - with increasing populations and urbanization, clean and potable water sources are diminishing and, in some parts of the world, obsolete. Access to safe, clean drinking water is not available to all. This poses an issue of global health crisis, economic distress, and population displacement.


2. CLIMATE CHANGE & SEA LEVEL RISE - sea level rise is caused by factors associated with global warming: (1) rising global temperatures cause rapid ice sheet melting and (2) seawater expands at higher temperatures. As Earth's climate continues to warm, the effects of climate change are increasingly apparent.

3. INCREASING VULNERABILITY TO SEVERE WEATHER EVENTS - due to climate change, we now experience more severe storm events than in the past, resulting in greater storm surge and intense flooding. Most communities are not equipped to recover quickly from such events, thus increasing vulnerability and potential for damage to existing infrastructure and property.

4. WATER POLLUTION - local and state regulations require municipalities to treat water to meet acceptable water quality standard prior to discharging into local water bodies. In many places, wastewater treatment plant capacities are not sufficient and combined sewer systems must discharge directly into recieving waterbodies prior to treatment.

5. AGING INFRASTRUCTURE - much of the worlds' water infrastructure was built over 100 years ago - in some places, centuries ago - and has come to the end of its useful life. Pipes and tunnels are leaking, mechanical and electrical equipment is failing and our water infrastructure is suffering because of it. Aging infrastructure results in unreliable systems, loss of water and water quality concerns.

## LOCAL WATER MANAGEMENT ISSUES

After analyzing the global water management and preservation issues, the team assessed the water management issues facing NYC. The team decided to address three main water management issues for this project.

### CLIMATE CHANGE & SEA LEVEL RISE

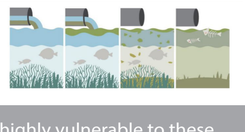
Sea level surrounding NYC is projected to rise rapidly in the next 50-100 years. This issue could displace hundreds of thousands of New Yorkers and could also have a major economical impact. In order to protect the City, this issue must be addressed.

### INCREASING VULNERABILITY TO SEVERE WEATHER EVENTS

Since NYC is surrounded by water, it is at a high risk of damage and flooding from severe weather events. NYC has experienced many devastating storm events in the past 20 years which have caused major disruptions to City operations and have put the City at risk for public safety and health concerns.

### WATER POLLUTION

About 60% of New York City is on a combined sewer system which means both stormwater runoff and sewage are carried through a single pipe. During heavy rain events, sewers are inundated with higher flows than normal. Since treatment plants do not have the capacity to handle these high flows, the combined water is discharged into nearby waterways - these events are called Combined Sewer Overflows (CSOs). CSOs have a negative effect on water quality in NYC's waterways, which are recreational bodies and habitats to thousands of species.



# EXISTING CONDITIONS

After identifying three major water management and preservation issues to address, Team 30 analyzed how these issues are impacting NYC. This analysis lead the team to conclude that Lower Manhattan is highly vulnerable to these three Water Management Issues.

## LOWER MANHATTAN

For most of New York's 400 year history, the City only existed below Chambers Street. New York's rich history began in Lower Manhattan and many of its historical monuments still exist today: Ellis Island, Bowling Green Park, City Hall (the oldest city hall in the country), the Woolworth Building, New York Stock Exchange and Trinity Church, just to name a few. This area of NYC, known as Lower Manhattan or Downtown Manhattan, has evolved into the epicenter of finance, government and world commerce.

Today, this one square mile area of Lower Manhattan continues to flourish - see below for some statistics on the area:

BUSINESS
- 300,000 public & private sector employees, making up some 70% of the areas workforce
- Private sector employment at highest level since 2001
- 90 million square feet of office space, including buildings such as 1 World Trade Center


VISITORS AND TOURISM
- 14.6 million annual tourists
- 7700 hotel rooms and 35 hotels
- 12 new hotels under construction planned to open in the 2020's

ENTERTAINMENT & RESIDENTIAL
- Nearly 600 bars and restaurants
- Approximately 700 stores & storefront services
- 337 existing residential buildings with 17 under development
- 65,000 increase in residents in 2019

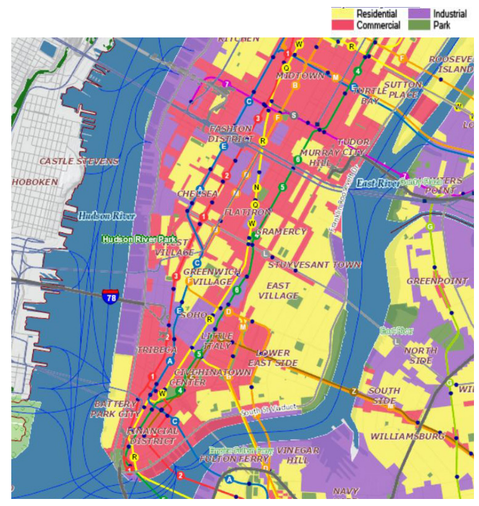
EDUCATION
- 27 K-12 public & private schools
- Total K-12 enrollment: 14,000
- 18 institutions of higher learning with total enrollment of 54,000


## EXISTING CONDITIONS MAPPING

Lower Manhattan is zoned primarily as residential and commercial districts, with smaller areas of industrial and park land along the waterfront. Industrial areas are highly concentrated along the west side near existing piers. Residential areas and parkland are concentrated along the east side in the Lower East Side and East Village neighborhoods. Many NYC housing complexes are located in these two neighborhoods, as seen indicated in yellow on the map. As discussed previously, Lower Manhattan is also a heavy business district - as such, the large majority of the area is zoned as commercial.

There is a vast public transportation network in Lower Manhattan. The area has 13 of the 27 total MTA subway lines, 30 MTA bus routes and 17 commuter ferry lines leading to outer boroughs and New Jersey. In addition, there are three major bridges to Brooklyn - the Brooklyn Bridge, Williamsburg Bridge and Mahnattan Bridge - and two tunnels to Brooklyn and New Jersey, respectively - the Brooklyn Battery Tunnel and the Holland Tunnel.

Knowing that Lower Manhattan is a major business area and also a public transit hub with many connections both inside and outside the city, it was important for the Team to take this into consideration when developing their design elements.

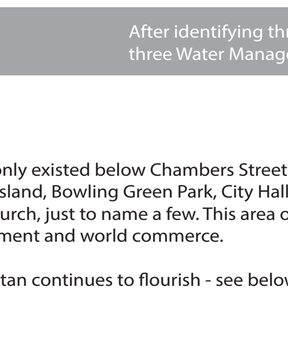



ZONING DISTRICTS, SUBWAY LINES & FERRY ROUTES

## HISTORIC FLOODING

New York City has experienced many extreme storm events in the past century. Of the most extreme, most have occured within the past 30 years - amongst them, Hurricane Irma and Hurricane Sandy. These events have caused severe flooding, property damage and loss of life.

In October 2012, Hurricane Sandy hit NYC and caused a major amount of devastation - $19 billion in damages, 250,000 people without power, 17% of total landmass flooded and 43 deaths. Power loss and flooding was most severe in low-lying areas of Manhattan, specifically Lower Manhattan below 14th Street, as seen in the New York Magazine Cover Photo on the right. It took almost two weeks to fully restore power and return utilities to full operation. Storm surge also reached a record high in the Lower Manhattan area, reaching levels of about 14 feet high in New York Harbor.




The damage from Hurricane Sandy was so severe that many NYC agencies released reports outlining how they planned to recover quickly from future storm and flooding events in order to protect the public and the City's vital infrastructure. Amongst those plans were the NYC Department of Environmental Protection's Resiliency Plan for Wastewater Facilities, NYC Mayors Office East Side Coastal Resiliency Plan, NYC Residential Flood Insurance Affordability Study and MTA's Fix &



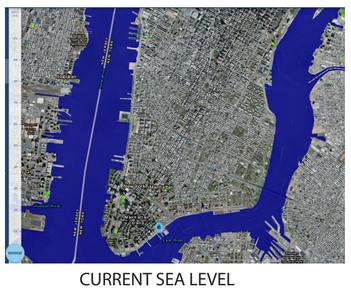
PROJECTED 100 YR & 500 YR FLOOD LEVELS

## SEA LEVEL RISE PROJECTIONS

Four of NYC's five boroughs are completely surrounded by water, making the City very vulnerable to the effects of climate change and sea level rise.

Sea levels surrounding NYC have been slowly rising for years. Studies from the past decade have shown that levels are rising more rapidly than in the past, as much as 1 inch every 8 years, and are projected to rise exponentially in the next 100 years. Due to their low elevations, areas in Lower Manhattan, Staten Island and Southeast Brooklyn have seen higher sea level rise than other areas of the City. For perspective on this issue, the sea level surrounding Battery Park in Lower Manhattan has risen 6 inches in the past 40 years. This is a sharp increase as compared to other areas of the city.

Studies project that sea levels around NYC will rise 6 feet by 2100. The maps below show Lower Manhattan's current Mean Higher High Water (MHHW) level (or sea level) and future MHHW level with the 6 feet increase expected in 2100.



CURRENT SEA LEVEL

YEAR 2100 SEA LEVEL

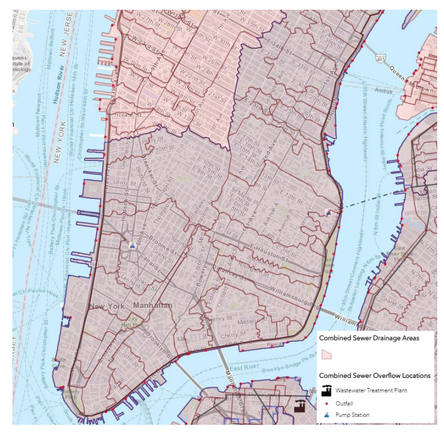
## COMBINED SEWER OVERFLOWS (CSOs)

NYC has approximately 700 CSOs along its waterfront which discharge to open waters during wet weather events. Due to limited capacity at the City's 14 wastewater treatment plants and more frequent and severe wet weather events in recent years, CSOs have been discharging an average of 20 billion gallons of combined sewer overflows into New York City waterways annually. CSOs have a negative effect on water quality by introducing bacteria and decreasing oxygen concentration in waterways. They pose a hazard to ecosystems, an increase in algae growth, and lead to increases in carbon dioxide and methane production in tidal wetlands.

The City has implemented a Long Term Control Plan (LTCP) to help reduce the number of CSOs and thus improve water quality throughout the City. The plan has recommended increasing storage capacity via tunnels and/or tanks in order to capture overflows in lieu of immediately discharging to waterways.

Although Lower Manhattan was not considered in the LTCP for CSO management, there are still a significant number of outfalls in this area.

The map on the right shows the CSO outfalls and drainage areas in Lower Manhattan. There are approximately 38 outfalls on the east and west sides of Manhattan below 14th Street. This area also covers approximately 2.2 square miles of drainage area with two pumping stations which convey flows to Newtown Creek Wastewater Treatment Plant in North Brooklyn.




# DESIGN ELEMENTS

## FLOODING AND SEA LEVEL RISE SOLUTION

After identifying the three main water management issues, the team set out to design a flood and sea level rise resistant structure. Considerations for both a seawall and a berm were analyzed. These two very different structures would both protect Manhattan, but would have much different visual impacts to the well-established coast of Manhattan.

### SEAWALL

Seawalls have been used in many coastal cities and towns around the US to protect land from storm surge. The seawall would be a vertical structure, built into the sediment and rock of the Hudson and East Rivers.

- provides excellent protection against sea level rise and flooding
- requires less space for construction and lower overall footprint

- integration into existing marine infrastructure, such as tunnels, would be challeneging and create gaps in the seawall
- visual impact of a wall around Manhattan would be non-favorable to New Yorkers who value coastal views

VS.

### BERM

Berms are raised barriers separating two areas. The berm would be a concrete-box like structure filled with soil and other earthen material. The structure would be supported by piles, drilled into bedrock of the Hudson and East Rivers.

- pile placement could be coordinated with existing infrastructure as to not interfere
- create more space for park, residential, commercial space on the coastline of Manhattan
- more opportunity for funding options (commercial spaces could draw revenue)

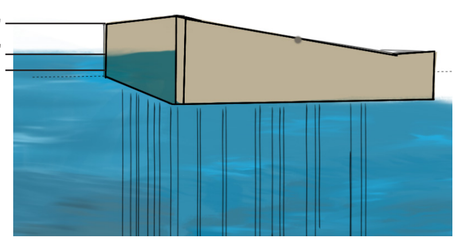
- larger footprint
- larger capital cost
- more coordination with enviromental and permitting agencies

The design flood elevation for the 500-year storm (DFE500) was calculated based on the project site's Coastal Transect Data. This transect data dictates the stillwater elevation (E500), which is 12.9 [feet NAVD88] for the project site and accounts for wave run-up (maximum vertical extent of the wave when it hits the berm). The stillwater depth (d500) was calculated using the project site's average grade elevation of 10 [feet NAVD88], as

$$d_{500} = E_{500} - Average\ Grade\ Elevation$$
$$d_{500} = 12.9 - 10.0$$
$$\boldsymbol{d_{500} = +2.9\ [feet\ NAVD88]}$$

Using the formula below, DFE500 was calculated to be +14.5 [feet NAVD88], which was used to determine the berm height by subtracting the grade elevations along the Manhattan coastline from DFE500.

$$DFE_{500}\ [\text{feet NAVD88}] = E_{500} + 0.55 \times d_{500}$$
$$DFE_{500}[\text{feet NAVD88}] = 12.9 + 0.55 \times 2.9$$
$$\boldsymbol{DFE_{500} = +14.5\ [feet\ NAVD88]}$$




The team utimetaly chose the berm, as it would be easier to integrate into the existing coastline, and marine infrastucture such as tunnels. It would also provide acres worth of new space along the coast of Manhattan, which could serve as community, residential, and commercial

## COMBINED SEWER OVERFLOWS

After choosing a berm as the sea level rise and flooding resisting strucure, the team sought to identify the CSO mitigation plan. Two types of infrastructure were analyzed, a CSO tunnel and a CSO tank. Both provide the same benefit to an overloaded combined sewer system, but are constructed very differently.

### TUNNEL

CSO tunnels are underground tunnels which hold stormwater overfall during rain events. The tunnel would be constructed utilizing a tunnel boring machine, and would connect to the exsiting CSO outfalls by gravity.

- less disruptive construction, as tunnel boring machines would construct tunnel in bedrock
- requires less space for construction and smaller overall footprint

- higher capital cost due to underground tunneling
- coordination with existing infrastructure (road tunnels, subway infrastructure, building foundations) would be necessary and critical to sucecss of tunnel
- would be independent of the berm structure

VS.

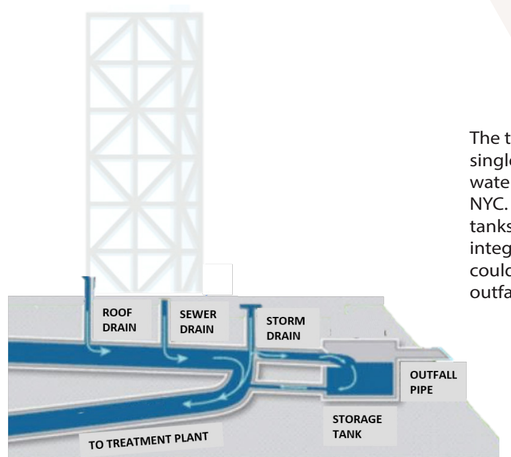
### TANK

A CSO tank would retain overflow water during rain events until the treatment system has capacity to handle in the days after a rain event.

- tanks can be constructed and installed in pre-cast concrete sections
- simpler connection to exsiting CSO outfalls
- easier access for maintenance and operation in comparison to tunnels
- can be integrated into berm structure

- may require pumping to send water back to sewer system for treatment depending on elevation
- larger in-water footprint

The diagram to the right demonstrates a CSO tank storage system. Combined sewer flows travel towards the CSO outfall during wet weather, but are diverted to the storage tank before discharging. Flow that cannot be sent directly to the treatment plant is stored in the tank until the wet weather event is over.




The team wanted to create single structure solution to the water management issues in NYC. The team decided on CSO tanks, which would become an integral part of the structure and could easily connect to existing outfalls.

# the belt

## FINAL CONCEPT

*the belt* is a sea level rise-resisting, water quality maintaining, asset securing structure, which will preserve Manhattan with the protection it needs from the force that is water. *the belt* will hold Manhattan together throughout the effects of climate change in the city, while also providing over 30 acres of new coastal greenspace and potential commercial/residential area to be developed by the city. *the belt* will be an innovative solution to the water management issues that exist in New York City.

## CSO STORAGE

Calculating the CSO storage would require the team to understand the hydrology in lower manhattan, along with existing and projected rainfall data.

-IDF CURVES: The team utilized NYSWERA IDF (intensity-duration-frequency) curves to analyze 24-hour storm events for 2, 5, 10 25, 50, and 100 year storm return periods, utilizing Manhattan rain guage data.

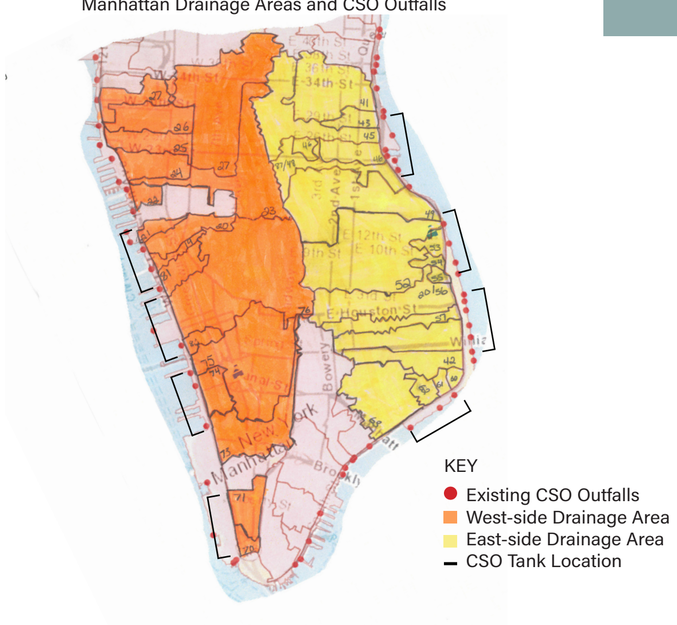
-DRAINAGE AREAS: The team then utilized Manhattan ESRI drainage area maps (below) and existing outfall locations to determine the stormwater quantities that would fall on our project site during a 24-hour rain event for the 2,5,25,50, and 100-year storms. Value enginering lead the team to plan for a 50-year storm, which would result in a 9-inch per 24-hour rainfall event.

-TANK SIZE: The team calcualted the total storage required for a 50-year storm, separating the east and west drainage areas. Four tanks along each coast will store over 70 million gallons of water per rain event, providing massive alleviation on the existing system.

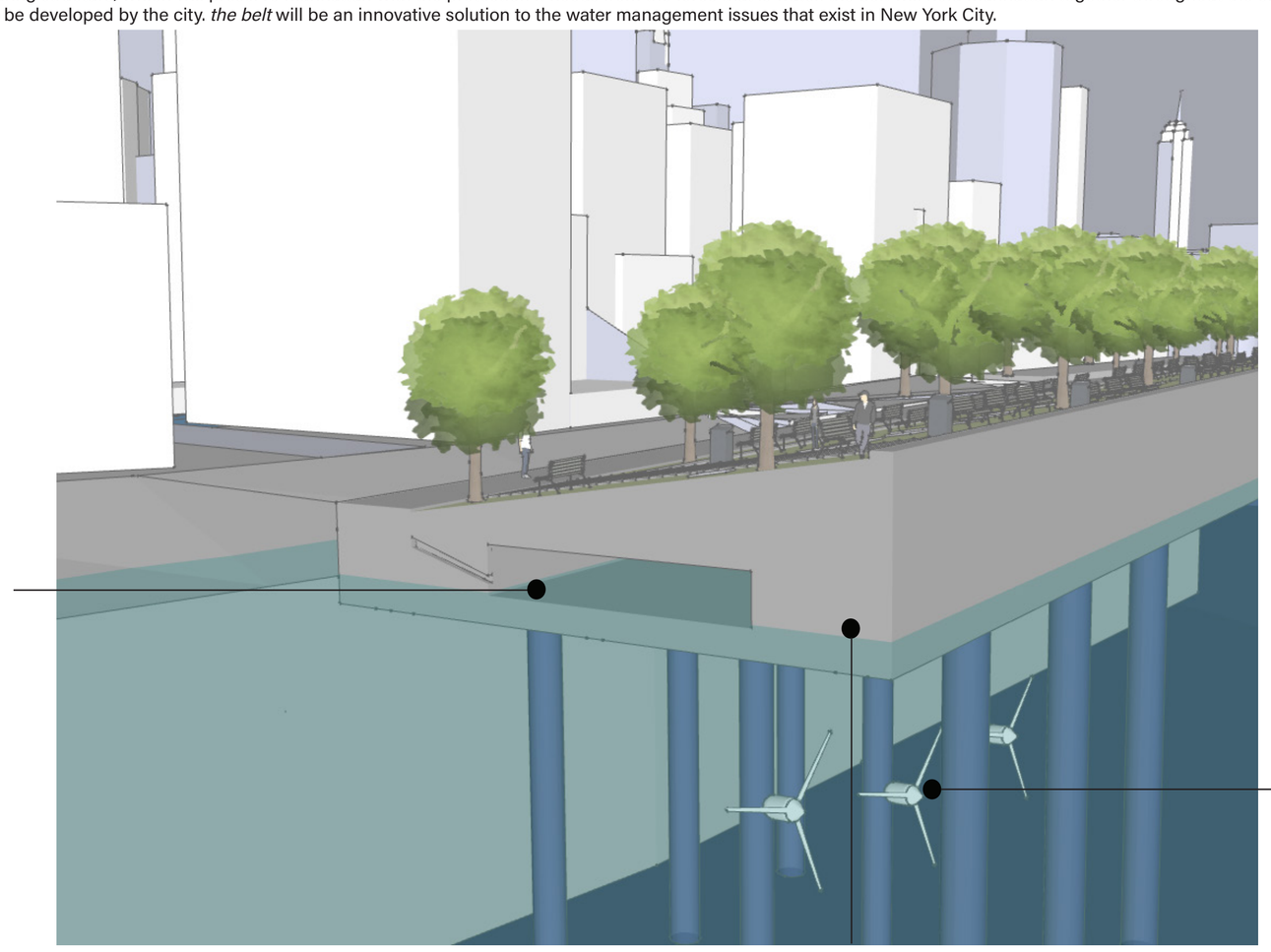
-CONNECTION TO EXISTING OUTFALL: The 8 new CSO tanks would be connected via pipes to the existing CSO outfalls.

-POST-STORM TREATMENT: After the storm event, the retained water would be fed back into the sewer system, and then conveyed to the wastewater treatment plant. The plant would treat the water to effluent standards and discharge to either the Hudson or East Rivers. Retaining storm event water and not overflowing outfalls could save NY rivers, and provide clean recreational water for long-term use.

Manhattan Drainage Areas and CSO Outfalls




| Location | Runoff Coefficient | Total Drainage Area ($mi^2$) | Storage Required (Million Gallons) | Tank Size ($ft^3$) (l x w x d) |
|---|---|---|---|---|
| East | 0.85 | 2.2 | 32.5 | 150 x 740 x 10 |
| West | 0.85 | 2.7 | 39.5 | 150 x 900 x 10 |



## TIDAL ENERGY

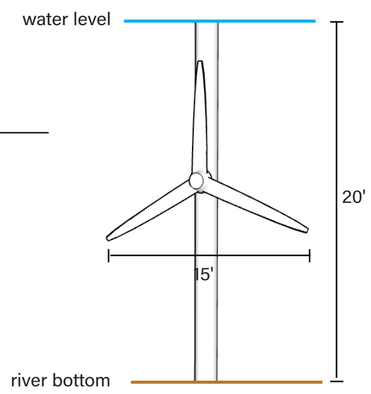
The team saw an opportunity to harness the power of water through tidal turbines, which turn with both the East and Hudson River's current. The tidal energy harnessed will be converted to electrical, and used as an energy generation source in this project.

-The turbines would be 15' in diameter, and would be placed on every other pile along the belt.

-2,500 units would be installed, and would be moved using the 8 knots water velocity of both the Hudson and East Rivers

-Each unit produces 55kW. Both Hudson River and East River flow at a rate of 8 knots, allowing the belt tidal turbines to generate 2100MW/day at a 70% efficieny.

-Electricity generated by the turbines would be collected and stored at a small powerplant on site. The belt would utilize this electricity to power all facilties along the belt. If surplus energy is generated, excess could be sold to Con Edison, the local electric utility, which conveiently has a it's largest NYC plant located at 14th Street on the east side.




## SEA LEVEL RISE AND HISTORIC FLOODING PROTECTION

*the belt* would create a perimeter around NYC, impacting existing structures such as ferry stations, loading piers, and marinas. These facilities would be relocated off the outer edge of the *belt* in order to maintain functionality.


*the belt* will span the coast of Manhattan from 14th street on the West-side to 14-street on the East-side. During Superstorm Sandy, all of Manhattan below 14th street was left flooded and without power. We've decided to protect the most vulnerable part of Manhattan within *the belt*.

To create the footprint of the belt, we measured existing elevations at the coast line, which varied from EL. 0 to EL. 10. We then used the DFE of EL 14.5' and an average slope of 4%, to find the length of the belt. Below are length dimensions:

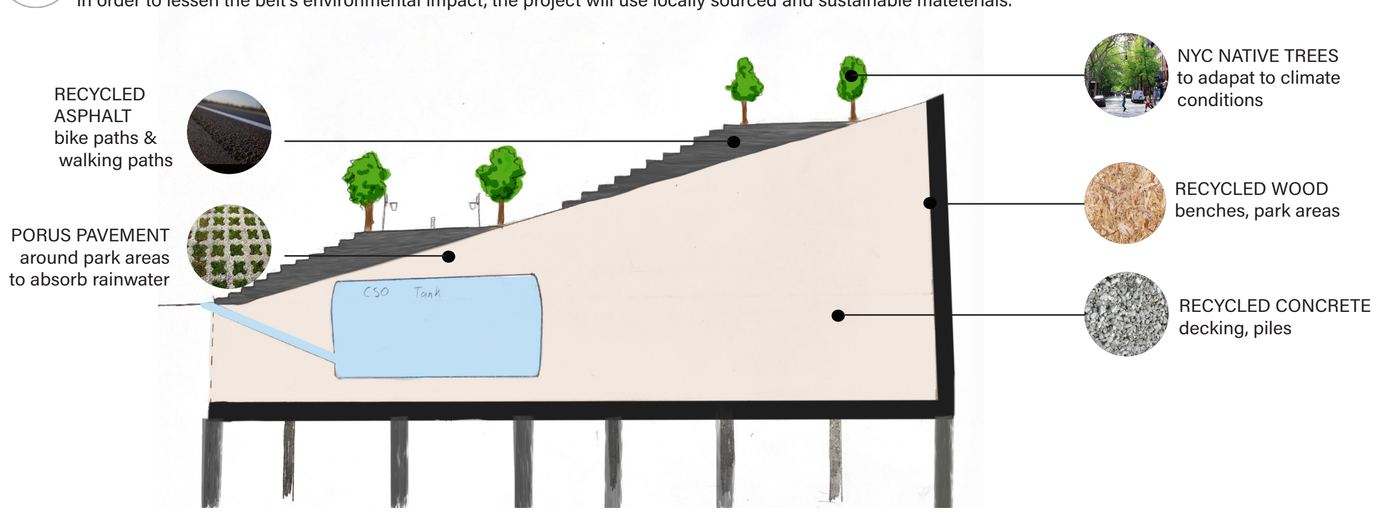
| Point ID | Location | Elevation (NAVD 88 feet) | delta (DFE-Elevation) | Berm Length (feet) |
|---|---|---|---|---|
| 1 | 14th Street-West Side | 10 | 4.5 | 112.5 |
| 2 | 10th Street-West Side | 8 | 6.5 | 162.5 |
| 3 | Pier 25 | 5 | 9.5 | 237.5 |
| 4 | Brookfield Place | 0 | 14.5 | 362.5 |
| 5 | Battery Gardens | 7 | 7.5 | 187.5 |
| 6 | Brooklyn Bridge | 9 | 5.5 | 137.5 |
| 7 | Manhattan Bridge | 7 | 7.5 | 187.5 |
| 8 | Williamsburg Bridge | 9 | 5.5 | 137.5 |

*the belt* would also utilize a permeable barrier, which would be constructed between the deck and the existing coast line, this barrier would create a waterproof seal around Manhattan, preventing any water from infiltrating into the city.

*the belt* would create a perimeter around NYC, impacting existing structures such as ferry stations, loading piers, and marinas. These facilities would be relocated off the outer edge of *the belt* in order to maintain functionality.

## SUSTAINABLE MATERIALS

In order to lessen the belt's environmental impact, the project will use locally sourced and sustainable mateterials.




## ENVIRONMENTAL IMPACT

Construction of *the belt* would impact impact water bodies which serve as a recreational space for New Yorkers and habitats for other species. An Environmental Impact Statement (EIS) would be prepared during the planning phase of the project. An EIS would analyze the impact of the project to all life (both humans, marine life, bird life, etc.) which would be impacted by the construction of *the belt*. The major state and federal agencies shown on the right would be coordinated with, along with local environmental conservation groups to ensure that habitats are protected for all species in the Hudson River, East River and surrounding land.

## SECURITY

*the belt* will be connected to the NYC Department of Environemntal Protection wastewater treatment system, which is considered critical infrastructure. Water stored in the CSO tanks will eventually reach treatment plants, which will treat and discharge the water to the Hudson and East Rivers. Limiting access to only NYC Department of Environmental Protection personnel and other personel will protect the tanks and the water treatment system from any contamination or security threats. Authorized personnel will access the tanks for maintenance through locked manholes, hatches, or other means. These security measures are in place to mitigate CSO discharge in the rivers and protect recreational users, waterways, and ecosystems.

## SCHEDULE AND CONSTRUCTABILITY

*the belt* cost will be constructed in a 5-phase approach. Each segment is estimated to take 3 years to construct. Phases 1 through 5 will all have the same construction work breakdown schedule.

Phase 1 staging area will utilize existing abandoned piers on the west side. After construction of Phase 1, Phases 2 through 5 will mobilize using the finished area from the previous segment as staging area. The piles, pile caps and grade beams will all be built using barges, and the concrete deck will also be constructed via barge, using a concrete plant stationed on the Hudson or East Rivers.

Each phase will be constructed and completed for use by the public while the other segments are being constructed.

Construction duration is estimated to be 15 years. Below is a typical construction schedule for a single phase.


Construction duration is estimated to be 15 years. Below is a typical construction schedule for a single phase.

| Activities | Duration (months) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Year 1 | | | | | | | | | | | | Year 2 | | | | | | | | | | | | Year 3 | | | | | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 |
| Mobilization | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pile Installation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Deck Installation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Landscaping | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Demobilization | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

## COST ESTIMATE

*the belt* cost estimate was developed using quantities and unit costs. The cost suggests an approximate value of $12.7B not including soft costs, such as land acquisition, permitting and environmental impact mitigation measures. The costs include labor, materials and equipment. The units that are represented are the average height and width of *the belt*.

| Item | Quantity | Units | Cost/Unit ($) | Total Cost ($) |
|---|---|---|---|---|
| *belt structure* | | | | |
| Pile (36-inch diameter drill shaft, 100 ft depth) | 18,594 | units | | |
| Tidal turbines (15-ft diameter) | 2,324 | units | | |
| Concrete pile caps and beams (3ft by 2.5ft) | 1,859,400 | VLF | 500 | 929,700,000 |
| Concrete Deck 1ft thick | 258,189 | CY | 5,000 | 1,290,945,000 |
| Concrete Retaining Wall (8ft by1ft) | 469,333 | CY | 3,000 | 1,407,999,000 |
| Berm/Backfill (average 200ft by 8ft) | 18,773 | CY | 2,500 | 46,932,500 |
| CSO Tank 150 by 800 by 40 (average size) | 8 | EA | 25,000,000 | 200,000,000 |
| | | | | |
| | | | | |
| *belt landscaping/development* | | | | |
| Total New Land Area Created | 300 | ACRES | | |
| Landscaping/Recreational Area | 90 | ACRES | 2,000,000 | 180,000,000 |
| Private Re Development | 90 | ACRES | 250,000 | 22,500,000 |
| Bike Paths and Circulation | 30 | ACRES | 2,500,000 | 75,000,000 |
| Public Facilities | 90 | ACRES | 5,555,556 | 500,000,000 |
| | | | | |
| Marine Maintenance and Protection of Traffic (2.5% of structure & landscaping) | 1 | LS | 122,000,000 | 122,000,000 |
| | | | | |
| | | | Sub-Total Direct Cost | 4,962,809,800 |
| Contingency | | | 30% | 1,488,842,940 |
| | | | Sub-Total | 6,451,652,740 |
| Contractor Overhead & Profit | | | 15% | 967,747,911 |
| | | | Sub-Total | 7,419,400,651 |
| Bonds & Insurances | | | 2% | 148,388,013 |
| | | | Sub-Total | 7,567,788,664 |
| Escalation (5 year design, 15 year construction) | 4.25% | % per Year | 68.25% | 5,164,940,085 |
| TOTAL COST | | | | 12,732,728,749 |
| | | | | |
| Cost/Square Foot (total cost/berm area) | 1,056,000 | SF | | 12,057 |

## FUNDING SOURCES

*the belt* is estimated to cost a $12.7 billon. The team understands that this is a lot for one entity to take on, and so the belt will have to be built via the fincial support of many groups. Because the belt will provide NYC with 30 new acres of land for residential, commercial, and recreational use, and also incporates critical water infrastructure, we expect agencies such as United States Department of Housing and Urban Development, NYC Department of Environmental Protection, NYC Department of Housing, NYC Department of Transportation, and private developers to provide funding. All of these groups would benefit from the building of the belt.

Grant programs within the Environmetal Facilties Corporation, such as Green Innovation Grant Program and the Water Infrastructure Improvement Act, as well as the Clear Water State Revoloving Fund, the USDA Rural Development Water and Environmental Program, and non-profit foundations such as the Jonson Foundation, Rokerfeller Foundation, and Ford Foundation could all support the construction of the belt.

## LESSONS LEARNED

The RFP challenged us to learn about a topic that was unfamiliar to most of the team. Water management and preservation is not something we think about often, however, water management systems are working all around us, 24/7, to provide clean drinking water, treat wastewater, protect us from natural disasters and, overall, keep the public safe. Throughout the project, Team 30 learned about the water infrastructure in NYC and how we could improve water management locally in order to develop our final concept: *the belt*.

TEAM 5 CHICAGO 2020

# FOOD BANK

"The gastronomic center ultimately mirrors the concept of a watering hole in the Savanna. Through food, cultural exchange, and the opportunity to learn from each other the gastronomic center brings people together to create a community of people with diverse stories and experiences. With a sustainable focus, the building provides a welcoming environment for people to engage in community and work together, with the hope that future generations can be encouraged and inspired to learn, share, and grow in the same way."

EXISTING

EXISTING

CONCEPT SKETCH

***A:*** There was interest in choosing to do the pavilion in the beginning because with the pavilion there was so much room to expand on different social issues such as LGBTQ+ and racism, which were issues that everyone was interested in tackling. The pavilion was also noted to be a great installation that the public could interact with. Texture, color, form, shape and pattern were all ways in which we could develop context towards the issues we wanted to bring into the limelight. The main argument opposing the gastronomic center was that it seemed like just another supermarket or restaurant and not something that could really help bring a community together.

However, after much debate, our group realized that a gastronomic center could be so much more than just food service. This type of center could foster community connections and bonding through food and inspire sustainable strategies behind the way we produce and consume food. Especially since Chicago has so many people of different backgrounds and different stories, the ability to create cultural exchange in such a segregated city, which was appealing to everyone. Furthermore, we thought the idea could be very versatile because of its potential to touch on many different things (sustainability, cultural exchange, food history/development, community space, new urban agricultural methods). A gastronomic center is also not a very common project that is typically developed in cities and in fact, no one could think of a built example of one in Chicago.

***B:*** Our design process started with the site. We wanted to promote sustainability through reusing or remodeling an already existing building and celebrating its historical significance. We ended up choosing an old bank building on the intersection of North Ave and W Pulaski. The bank was originally designed neoclassical style with its large white Ionic columns and stone facade. Behind the now abandoned bank building is a vacant lot with an empty graffitied shed. We realized the open lot provided room for expansion and offered more possibilities for what our gastronomic center could become. We then started thinking hard about how the building had been previously used. Next, the group thought about how the existing building could be translated into a new concept: the bank vault becomes a seed vault, development of a space for food exchange is similar to money exchange, cues from existing structure led to a modern interpretation for the new program. The program was also expanded to fit community needs by incorporating new amenities such as a greenhouse, garden and community eating area. Lastly, we did some site research by looking at the transportation, retail, residential and food availability in the area. Sun path and general orientations of the building were considered as well as a huge part of our sustainable plant-filled structure.

## SITE ANALYSIS


The site analysis displays grocery stores, restaurants, schools, and bus stops nearby the site. Few green spaces are dispersed near the site as well.

***C:*** Our project included construction challenges that required critical thinking and innovation. These challenges included the following: alley located between the existing bank and the proposed new building, consideration of neighbors to the West, and a busy road with foot traffic and bus stops to the south. We addressed these challenges thoroughly. The alley will be closed during construction phases 1 & 2. As a trade off the project will restore this alley to a brand new condition by project's end. The facade of the building will be preserved and enhanced, with additions being made to the South and East faces and new brick being applied to the North alley face. In order to keep the neighbors' operations uninterrupted cranes will be kept away from adjacent building at the North lot and deliveries will be received in this lot as well. These measures will limit obstructions and annoyances the neighbors are exposed too while leaving them a far more pleasant product at project's end.

Budgetary: every room/area/program is beneficial to public (no wasted space), provides food and education back to consumer. Kept height of building consistent and reasonable to maintain a sensible cost and maintain cohesion with neighboring buildings. The addition adds more net rentable area.
Timeline issues and other Construction Challenges: By building south to north we ran out of space. Resolved by moving field office into unused portion of finished building in order to complete landscape areas. Chose to complete renovation of administrative portions of existing building first to allow for functionality to be utilized. This granted functions such as marketing, program directors, and maintenance employees the ability to get started prior to the building be in full operation and open to public.

***D:*** We, as a group, wanted to preserve the history for the site and provide important amenities that would help the rest of the neighborhood thrive as a collective unit. We worked to reuse and reinterpret the existing structure of the bank, by adding important spaces to the community such as: cooking classrooms, volunteer spaces, lecture halls, broadcasting rooms, and collaboration spaces for established and aspiring cooks around the world. This is encompassed within the existing three floors of the original bank building with the exception of the top floor where the roof was removed and expanded.

Moving through the bank building, we come into a community gathering space with markets and eating areas. As people eat, they enjoy a magnificent view of a water cascade facilitated by a conical glass roof overhead inspired by the Singapore airport. Continuing on, the community space leads to an interactive garden. In addition to food education, service, and sale; we also explored the idea of producing the food we consume on site. Most of the food sold in the markets is grown in the garden. Through the help of the volunteers, people help cultivate crops they can eat and also pack food for nearby soup kitchens.

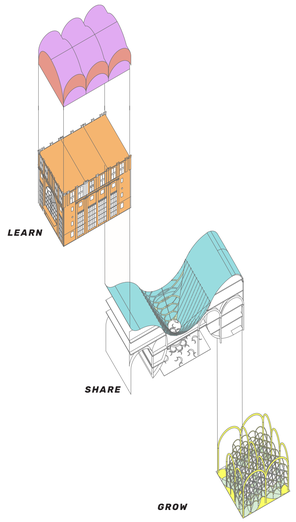
In the basement of the old building, we explored the practice of aquaponics and seed vaults. Lastly, a lot of glass is incorporated into the material of the building to maximize sunlight and minimize the need for artificial lighting.

Fresh water is a limited natural resource and buildings use it for a number of applications including drinking, mechanical processes, and landscaping. Some uses, for example, wastwater in our urinals and water closets, do not require potable fresh water to function. Our rainwater collection system provides the water these applications need, and in doing so, reduces the need for domestic water in our building.

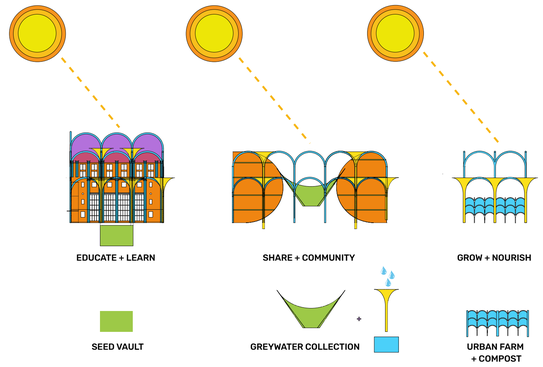
***E:*** We learned how to think about an idea, put it into words, and convey it to our peers. We assigned project roles based on our skills and interests, and resolved disagreements through compromise between groups. We demonstrated the importance of communicating between different trades and disciplines. Communication was key for the structural team because the structure takes up physical space that can conflict with both the architecture and mechanical teams, and this had to be coordinated ahead of time to allow for the optimal solution. We learned about the process of design and the importance of processes in general. Mindfully sequencing these processes is critical to the efficiency of the design. Patience is key to working with other pieces of the puzzle as we developed the design concurrently. We learned about perspective in drawings, and we learned how to render in Lumion. We learned presentation skills and how to be comfortable sharing our ideas out loud.

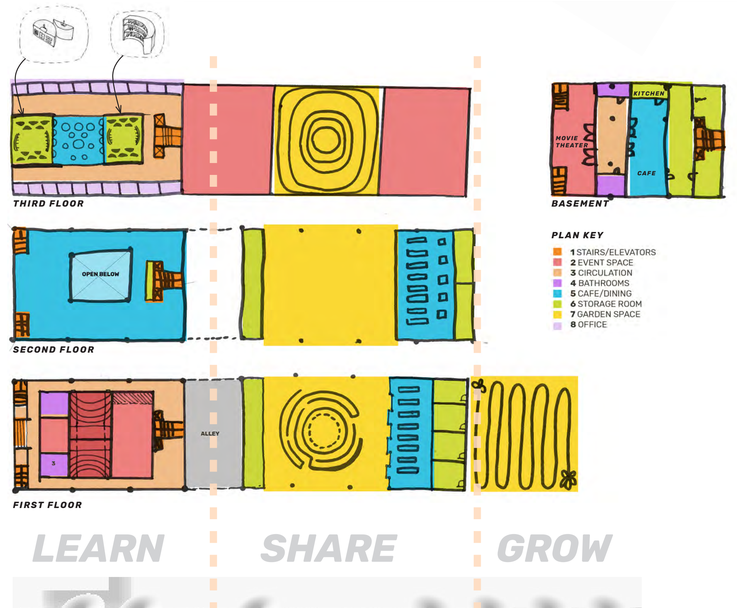
This experience has provided us with the unique opportunity to get some insight into the construction management industry. Through the creation of cost estimates and phase planning we learned more about organization and problem solving strategies to issues that are commonly faced in this career path. Through the submission of RFIs we also learned more about the importance of strong communication and collaboration on large scale projects like the ones our mentors likely work on all the time. We also learned to use a variety of different computer programs such as BlueBeam which we can later use in other areas of our academic lives.

## FORMAL ANALYSIS

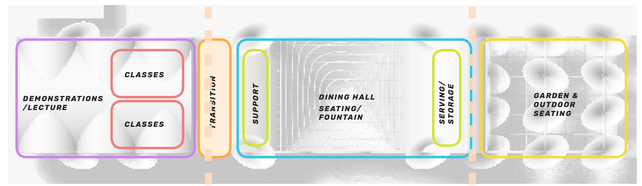



## SUSTAINABILITY




## LEARN SHARE GROW



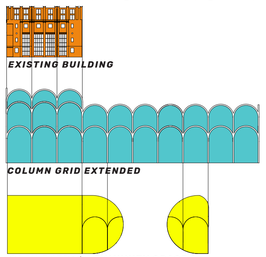



ELEVATION

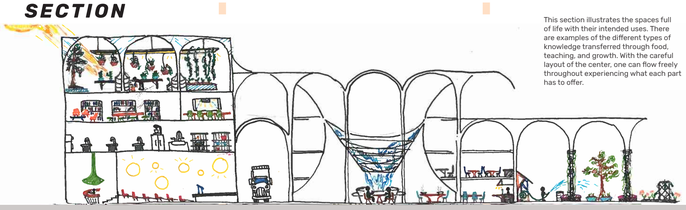


RHINO MODEL

## HISTORIC RENOVATION




## SECTION



This section illustrates the spaces full of life with their intended uses. There are examples of the different types of knowledge transferred through food, teaching, and growth. With the careful layout of the center, one can flow freely throughout experiencing what each part has to offer.

TEAM 5 CHICAGO 2020

# LEARN

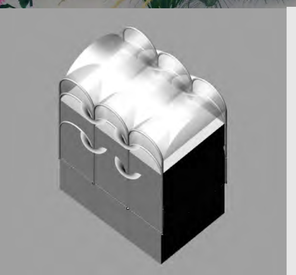
GREEN HOUSE

# SHARE

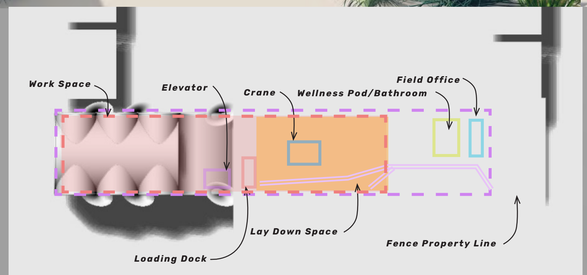
COMMUNITY DINING

# GROW

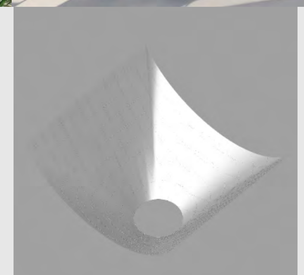
OUTDOOR GARDEN



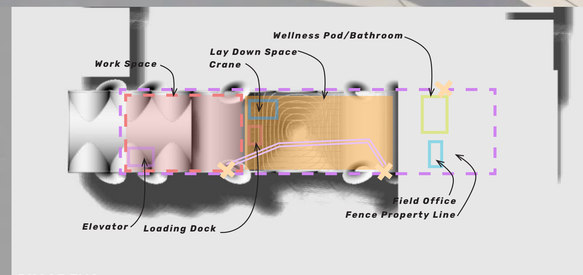
EXISTING MASONRY BUILDING




PHASE ONE

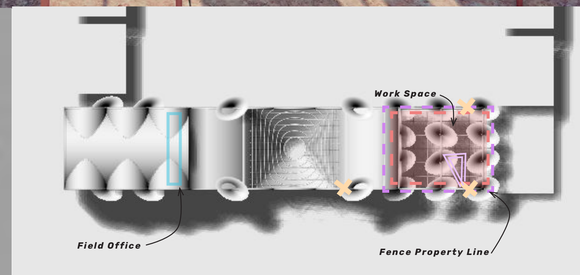


PARABOLIC STEEL FUNNEL




PHASE TWO

STEEL WATER COLLECTION COLUMNS




PHASE THREE

| Item/Description | LEARN |
|---|---|
| Demolition | $217,404 |
| Excavation | $0 |
| MEPFP & Utilities | $2,257,492 |
| Paving | $4,000 |
| Bank Fitout | $1,699,704 |
| New Building Fitout | $0 |
| Landscaping | $527,688 |
| Structural Steel | $16,950 |
| Foundation Concrete | $0 |
| Facade | $162,000 |
| Roof | $1,230,371 |
| Appliances / Furnishings | $68,750 |
| Water Collection System | $40,000 |
| ***TRADE TOTAL*** | **$6,224,359** |
| **General Requirements @ 2.5%** | $155,609 |
| **General Conditions @ 5%** | $318,998 |
| **Insurance @ 1.25%** | $76,502 |
| **Fee @ 3%** | $203,264 |
| **Contingency @ 5%** | $318,998 |
| ***TOTAL*** | **$7,297,731** |
| **$/SF** | **$147.70** |

LEARN

***CONSTRUCTION***

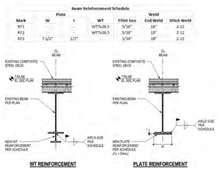
In this phase we tackled the renovation of the existing building which involved the creation of the greenhouse on the roof and the replacement of the facade on the north most wall of the building. In this phase we also renovate the interior of the building to better suit the functionality of the building. In our plan the field office and worker's amenities are located at the northernmost area of our job site. Just slightly north of our work area is where we chose to place the crane and lay down space. The road laid down for the trucks to come and unload is south of the placement of the field office space and is placed where there are openings in the curb for easy access to the site. We also made use of the existing elevator in the building to transport materials.

***STRUCTURES***

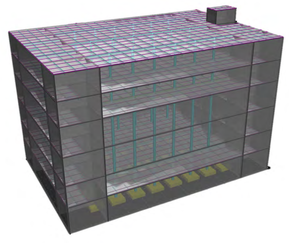
The "Learn" structure is an existing five-story building made of steel beams and columns with load-bearing concrete masonry walls and concrete floor slabs. We modeled the existing building in RAM Structural System and applied dead loads and live loads. We determined superimposed dead loads using the AISC Steel Manual for building material densities, such as flooring, MEP, glass, finishes, and saturated soil. We determined live loads using ASCE 7-10 room types provided by the architect, including offices, lobby, bathrooms, classrooms, hallways, etc. After applying the loads, we ran the model and determined there was too much demand on the beams, so we had to design reinforcement to get the demand-to-capacity ratio below 1.0. We reinforced the existing beams with steel T-sections and plates to support loads from a new roof garden. We did a quantity take-off and gave the tonnage to the construction group so they could estimate structural cost. We also coordinated with the MEP engineers to locate a mechanical shaft in the roof to accommodate ductwork for new mechanical units.

***MECHANICAL***

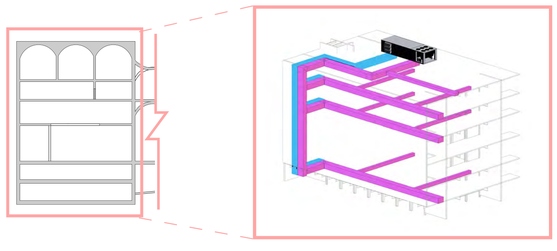
Designed a new HVAC system to account for our rooftop garden. Building dimensions and function were used to determine size of system needed. Ductwork sizes and locations coordinated with structural to allow distribution throughout the building.




***RAM STRUCTURAL MODEL: EXISTING BUILDING***



***BUILDING HVAC RISER***



| Item/Description | SHARE |
|---|---|
| Demolition | $74,669 |
| Excavation | $30,993 |
| MEPFP & Utilities | $4,104,532 |
| Paving | $21,000 |
| Bank Fitout | $0 |
| New Building Fitout | $2,971,177 |
| Landscaping | $527,688 |
| Structural Steel | $1,432,793 |
| Foundation Concrete | $503,289 |
| Facade | $1,001,049 |
| Roof | $967,613 |
| Appliances / Furnishings | $68,750 |
| Water Collection System | $40,000 |
| ***TRADE TOTAL*** | **$11,743,553** |
| **General Requirements @ 2.5%** | $293,589 |
| **General Conditions @ 5%** | $601,857 |
| **Insurance @ 1.25%** | $144,337 |
| **Fee @ 3%** | $383,500 |
| **Contingency @ 5%** | $601,857 |
| ***TOTAL*** | **$13,768,694** |
| **$/SF** | **$152.43** |

SHARE

***CONSTRUCTION***

In this phase we work on the building of the new addition which involved the bridge from the old building as well as the main fountain centerpiece. This phase also includes some vegetation surrounding the fountain. In this phase the location of the field office and worker amenities remained the same as the previous phase. The crane moved more towards the west boundary of our site to better allow for construction to occur on the new building. The loading dock is also north of its previous location. In this phase the road for trucks is the same as the previous phase. We continued to use the elevator in this phase, similar to the last phase.

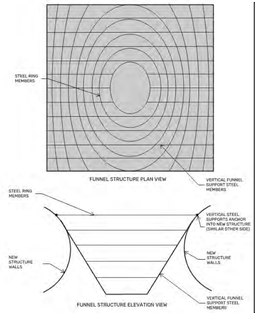
***STRUCTURES***

The new "Share" structure is composed of two semicircular-shaped buildings which support a waterfall funnel in the ceiling. The structural system that was chosen was steel with composite deck to allow for flexibility in programming. The lateral system for the "Share" structure was six steel braced frames. The braced frames were used for lateral support against wind loads. Because braced frames take up physical space, their location had to be coordinated with the architecture team. We used the Chicago Building Code (CBC) to determine the wind load by multiplying the wind pressure times the brace tributary areas. Since the building was under 200ft the wind pressure was 20psf. Similar to the existing building, we used AISC and ASCE 7-10 to determine superimposed dead loads and live loads. For the funnel we drew out a schematic structural plan to determine the load path and validate that the funnel structure was possible.

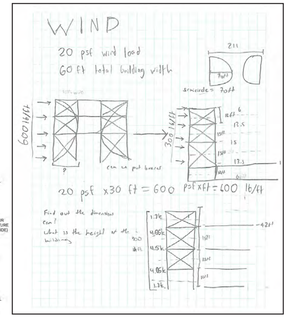
***MECHANICAL***

Plumbing riser showing distribution to building. Pumps able to draw water from city water supply and collected rainwater. Calculations estimate savings of 500,000 gallons/year.

***PLAN AND ELEVATION: FUNNEL***



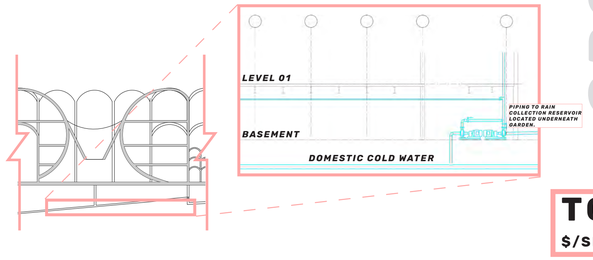

***BRACED FRAME CALCULATION***




***BUILDING HVAC RISER***



***PLUMBING RISER***




| Item/Description | GROW |
|---|---|
| Demolition | $36,778 |
| Excavation | $15,265 |
| MEPFP & Utilities | $478,862 |
| Paving | $2,000 |
| Bank Fitout | $0 |
| New Building Fitout | $0 |
| Landscaping | $703,584 |
| Structural Steel | $16,950 |
| Foundation Concrete | $55,921 |
| Facade | $0 |
| Roof | $0 |
| Appliances / Furnishings | $0 |
| Water Collection System | $120,000 |
| ***TRADE TOTAL*** | **$1,429,360** |
| **General Requirements @ 2.5%** | $35,734 |
| **General Conditions @ 5%** | $73,255 |
| **Insurance @ 1.25%** | $17,568 |
| **Fee @ 3%** | $46,677 |
| **Contingency @ 5%** | $73,255 |
| ***TOTAL*** | **$1,675,849** |
| **$/SF** | **$157.89** |

GROW

***CONSTRUCTION***

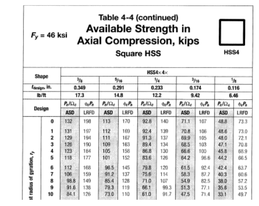
This phase is entirely plant life and the new water collection system. In this phase we faced the challenge of having to move the field office to the finished existing building to conserve space as well as costs. The road for trucks to come and unload was reduced to a much smaller turn around to conserve work space and allow landscaping to happen more easily. We no longer needed to use the elevator in the existing building in this phase.

***STRUCTURES***

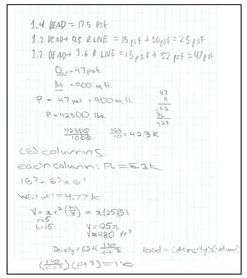
The "Grow" structure is a series of steel tube columns with cone shaped openings used to collect water. We coordinated with the architects through design iterations to determine the parameters of the structure. We calculated the weight of the water in each cone based off the volume of the cone and applied load to the top of the column. We used SAP2000 to model the column and apply the load. We ran the SAP Steel Designer to determine a column size. To verify the SAP2000 results we did a hand calculation using the AISC Steel Manual Chapter E and Table 4-4 for compression members.

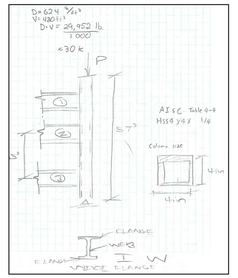
***MECHANICAL***

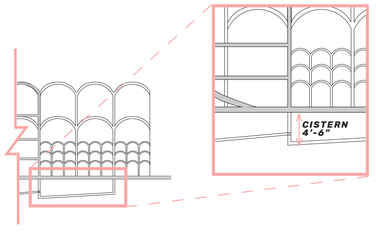
This rain water collection reservoir located underneath outdoor space to collect water through structural columns. Acts as storage basin for water which will be integrated into the existing building's plumbing system upon demand. Water is delivered through gravity fed pipe into building pumps.




***STEEL COLUMN HAND CALCULATIONS***







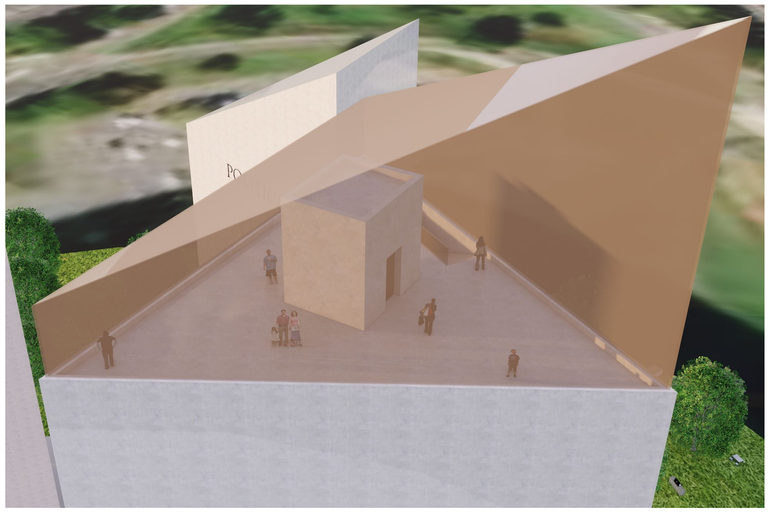

# TOTAL BUDGET

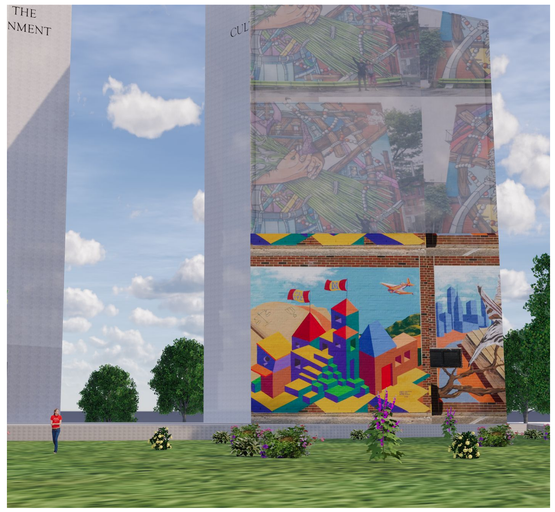
**$/SF** $22,742,273 | $151.26

# The National Star

## Guiding America's Brilliance into the Future

A collection of murals and quotes in a public gathering space that represent the United States in the 21st century displayed on the exterior walls of five monumental pillars. The triangular pillars form the five points of a bird's eye view star with internal elevator access to a rooftop glass-enclosed observation deck at the top of the tallest pillar. The angled pillar roofs allow the star motif to be seen at ground level from a distance.





## Observation Deck

The star is oriented so that the observation deck points directly East away from D.C. This allows for a scenic panorama of the Nation's Capital, looking out over the rest of the site grounds and down East Capitol Street NE towards the U.S. Capitol building. Doing so grants a view over Kingman Lake and the Anacostia River, as well as a view up East Capitol St. SE.

Located at the top of the tallest pillar, elevator access allows the deck to be reached by all.

## Exterior Murals

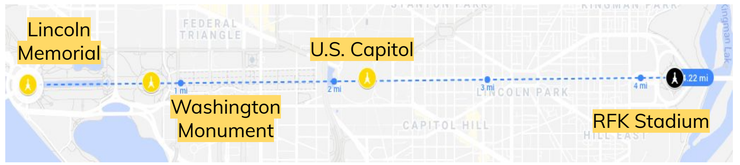
Murals encompass the ideas of SPICE analysis when examining a nation during a desired period of time. Social, political, interactions between humans and the environment, cultural, and economic themes are considered the key components to a nation's whole.

The artwork is large and simplistic in style, in order to be easily seen and interpreted from ground level.

## Site Location

The lot selected previously housed the Robert F. Kennedy Memorial Stadium in Washington, D.C. While once home to many of DC's sports teams, the Stadium is now defunct and unused. Located 2 miles east of the U.S. Capitol building, the stadium's property encompasses a number of lots along the Anacostia River. The portion of these lots developed for the purposes of this project are between C St NE, Independence Ave SE, and 22nd St NE where the stadium previously stood (pictured right). This allows for physical connection between the Nation's Capital, a critical part of America during recent centuries, and scenic views of the city from The National Star.

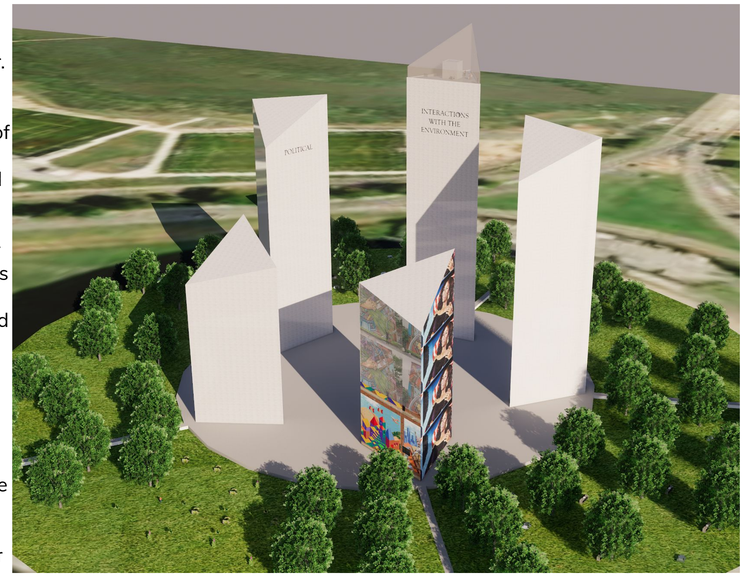
## Symbolism in Design




**Location/Orientation:** The selected location allows the orientation of The National Star to be aligned with the National Mall and the U.S. Capitol; the linear alignment with these important parts of our Nation's Capital and its past symbolize that although we are continuing to move along our perceived linear path in time, we can still choose to move in new directions throughout the rest of the 21st century, represented by the 5 points of the star.

**General Design:** The use of a star as the landmark's main icon represents two aspects of the United States: Stars are considered a symbol of the success of the United States and their use is meant not only to represent this American essence but their recognition as a symbol of what is strived for as well. The latter meaning applies to American excellence and its influences in the past (such as various democratic countries' constitutions being based after its own) and our own desire to move towards greater things in the upcoming century.

**Murals:** The symbolism of the past, present, and future of the United States is incorporated in the organization of the pillar's murals. The base of each pillar is painted by local artists with scenes from the beginning of the 21st century; the further up the sides of the pillars, the closer the mural subjects are to the present.




Each pillar represents a different category of SPICE (social, political, interactions with the environment, cultural, and economic), with corresponding images in the murals. Only the lowermost 20% of the pillars will be completed at the time of the pavilion's construction, emphasizing the fact that the present is always developing as America progresses through time. As the 21st century develops, additional murals will be commissioned.

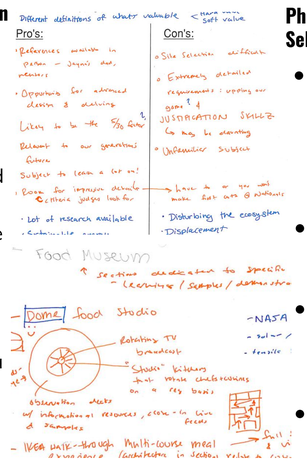
**Observation Deck:** The observation deck at the top of the tallest pillar represents the future in the vertical progression of time; the images from the past decades in the murals transition to the blank canvas that is the present, to the transparent observation deck. The people standing on the observation deck are people who will be part of the future; they serve to represent it as a diverse, living and ever-changing part of the pavilion's symbolism.

## Design Process

As fall developed, we transitioned from club recruitment to working on our response to this year's design challenge, meeting at least every other week to work and learn from project-relevant guest speakers.

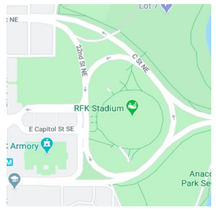
### Phase 1: Prompt Selection

- Brainstorm session to conceptualize ideas for all prompts
- Weighed pros and cons of each idea
- Used a group vote to select prompt
- Overcame challenges when trying to agree on ideas to come to a successful compromise



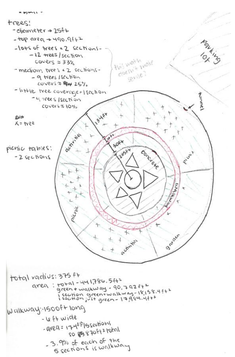

### Phase 2: Site Selection

- RFK Stadium is a large venue in the DC area not being used
- Not near any other major monuments that would take away from the impact of the National Star
- In an area of DC that does not have many major establishments creating revenue, it would boost the economy, and lead to further developments.
- In line with the Washington Monument and the US Capitol making the site significant for a monument



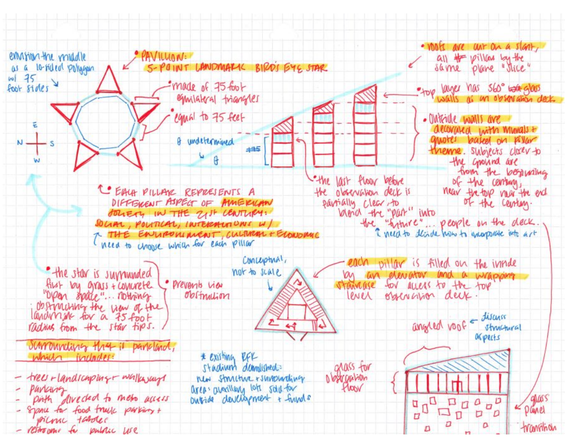

### Phase 3: Focus

- Although other ideas were considered, the ultimate focus chosen was for an open-air destination that symbolically represented the values of the prompt
- Finalized star shape as a major part of the focus of the design
- Improved collaboration skills while developing the project's focus

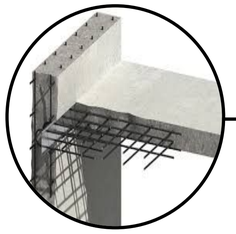


### Phase 4: Further Development

- Focused on other prompt requirements
- Developed the mural concept as Social, Political, Interactions with the Environment, Cultural, and Economic themes
- Mini-groups were formed to tackle different aspects of the project with check-ins and group discussions leading to final decisions. Summative data and visual elements were developed
- Guest speakers were invited to speak on specialized topics related to the design - cost estimation, security, landscape design, etc.



# Materials



**Reinforced Concrete**
Cast-in-place reinforced concrete to be used for the tower structure.

By adding the reinforced steel bars within the concrete the building becomes stronger in tension and more cost effective.

**Recycled Rebar**
At least 25% recycled steel used as rebar in the concrete.

Very strong and durable material used in a variety of ways to protect and ensure safety of visitors.

**Limestone**
Aesthetically pleasing flooring for the monument.

A durable and cost-effective material for its life cycle while also having a “monumental” aesthetic similar to other landmarks in D.C.

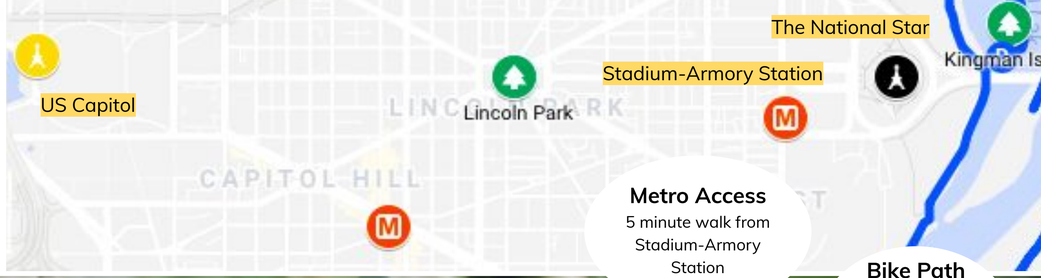
**Tempered Glass**
Durable construction glass used for the observation deck.

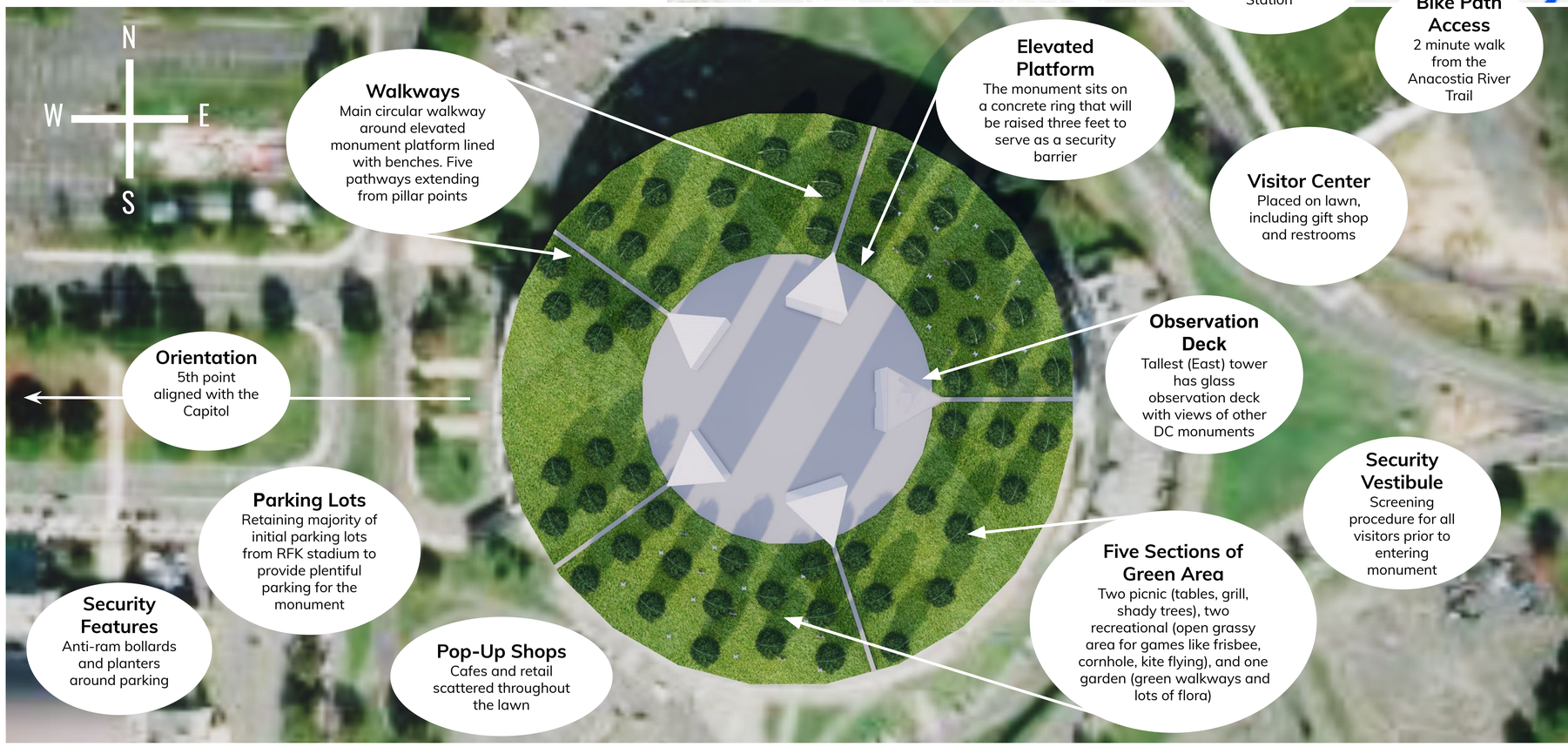
It is impact-resistant and presents a low risk to visitors in the event of failure.

# Site Plan

The National Star · Metro · Smithsonians · Parks · Monuments · Anacostia Trail

To the right is a map of the DC area showing existing landmarks located directly to the West of the project site. The Stadium-Armory Metro Station and Anacostia Bike Trail are each less than a 5 minute walk to the monument. It is expected that people will access the site by driving (and parking in one of the two existing, resurfaced parking lots), via public transit, or by biking/walking. Below is a digital rendering of the model on top of a concrete base with five pathways extending through the surrounding green area connecting visitors to transportation options.




# Construction Techniques

This monument will be a design-build project built with traditional and modern building methods using a wide variety of subcontractors. This will also be a DC First project, creating more local jobs rather than outsourcing.

# Structure & Architecture

The star-shaped monument comprises a decagon with each side being 75 feet long. Each point of the star is a reinforced concrete tower sloping 28 degrees at the top, with steel framing at the observation deck. The sloped pillars allow the star design to be visible and easily recognizable from a distance.

# Strategy for Sustainability

The monument will be constructed out of sustainable and long lasting materials, such as low-carbon emission concrete and recycled steel reinforcement. The development of the surrounding area will expand DC’s green space and promote an environmentally sustainable culture.

# Size and Scale of the Project

The pavilion will be a welcome addition to the Washington, DC skyline with the tallest pillar towering 300 feet in height. The two western pillars are 200 feet while the middle pillars stand 250 feet tall. These heights are similar to many other buildings in DC as limited by the city building code. By comparison the Washington Monument is twice the height as the tallest tower of the National Star.

# Security

To protect the people visiting the monument, basic security features such as cameras, security guards and proper lighting will be implemented throughout the site. To secure the observation deck, the monument entrance will contain a screening vestibule containing x-ray machines and metal detectors. A capacity limit will additionally be provided to prevent overcrowding. To protect both pedestrians and the structure from vehicular threats, anti-ram bollards and planters will be placed around the designated parking areas.

# Construction Timeline

| Activity Description | Duration (Mo) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul |
| Abatement | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Demolition | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Site Development/Site Concrete | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Structural/Observation Deck | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Skin/Finishes/Murals/Security | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Landscaping | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

The first star represents the completion of the first pillar and the second is for the start of the planting season

# Cost Estimate / Feasibility Study

| Categories | Cost Total |
|---|---|
| Demo of RFK Stadium | $ 9,425,000 |
| Site Development | $ 4,010,000 |
| Structure | $ 17,304,200 |
| Exterior | $ 12,625,000 |
| Building Systems | $ 5,416,500 |
| Finishes | $ 2,019,780 |
| Landscaping | $ 10,867,200 |
| **Total Construction Cost** | **$61,667,680** |
| **Total Construction Cost Per Square Foot of Site* Developed** | **$140** |
| *Total Square Footage of Site = 442,000 Sq Ft | |

During the feasibility study, access and location were strongly considered when determining the project site. Selling points for this site included existing parking lots and public transportation to ease the barrier of access for visitors. We considered built in retail space and contrasted it with pop-up shops. The cost estimate aligns with pre-existing memorials in D.C.

# GREENSPOINT REIMAGINED [HOUSTON, TEXAS]

## VIOLET VISIONARIES LLC

## OUR VISION

Abandoned-mall renovations have become prevalent in the United States as online shopping takes hold and big-name retail stores decline. With the loss of a major economic and leisure center, communities often suffer. Greenspoint mall is no exception. In 1989, it was one of the most prominent shopping malls in Houston. The now dead mall used to be bustling with activity and had major stores like Macy's and JC Penney. Our vision is to revitalize Greenspoint mall in a way that will benefit the local community and bring back economic activity.

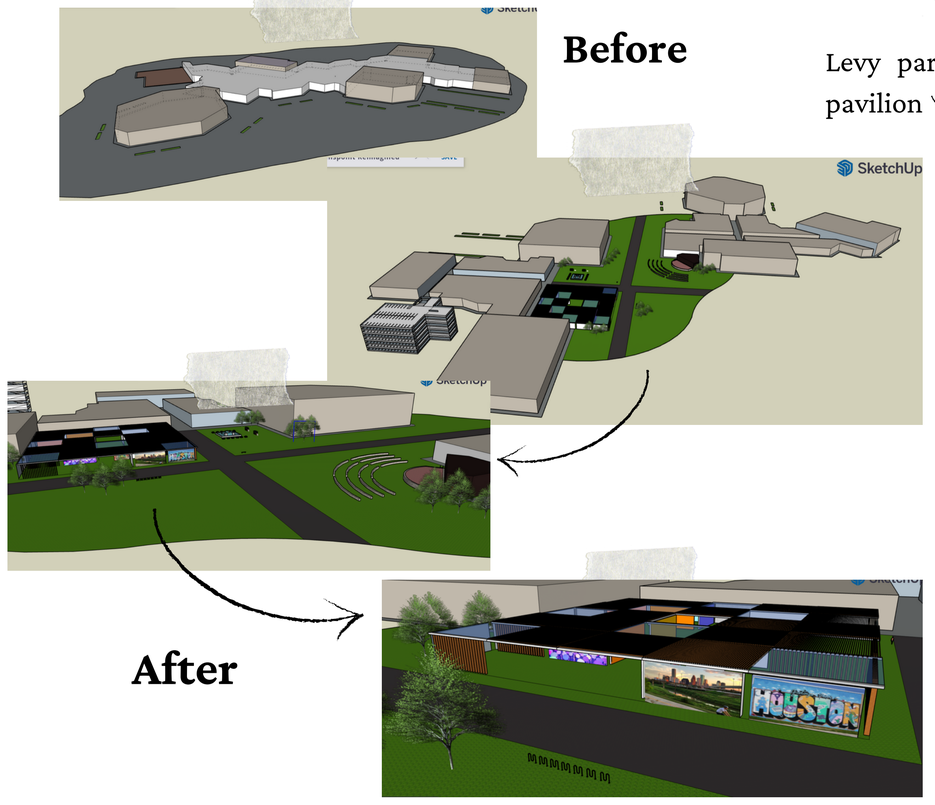
## PLAN

- Pavilion and Greenspace
  - mitigate flooding and provide an area for people to relax
- Office rental spaces
  - Aimed towards small businesses or self employed workers who need external workspaces
  - Medium Sized Companies that need a floor of workspace
- Affordable housing complexes
  - Uplift the local community by increasing local purchasing power and closing the distance to community services
- Community Center that will have community classes, outreach events, social services, and etc.
- Rooftop Community Garden
  - Combating urban heat islands, provide fresh food and reduce runoff that flood surrounding areas
- Recreation Space
  - Amphitheater-Invite local performers or music acts or enjoy community movie nights in the open area
  - Playground - Children can enjoy the playground while adults go off to shop in the retail space or exercise at the Fitness Center
- Retail
  - Renovate a portion of the mall to newer retail sites to encourage greater economic activity in the area

## SITE ANALYSIS

Greenspoint Mall is located at the intersection of beltway 8 and interstate 45 and is near Hobby airport. It is in the greater Greenspoint area which has had some flooding issues due to poor drainage. Greenspoint is also located in a low-income neighborhood. The site also contains many vacant parking lots and unused retail space.

We wanted to convert some of the space into greenspace for flood mitigation and recreational activity. We also wanted to put affordable housing complexes so many of the residents could afford the housing. Additionally, adding other features to attract more visitors.



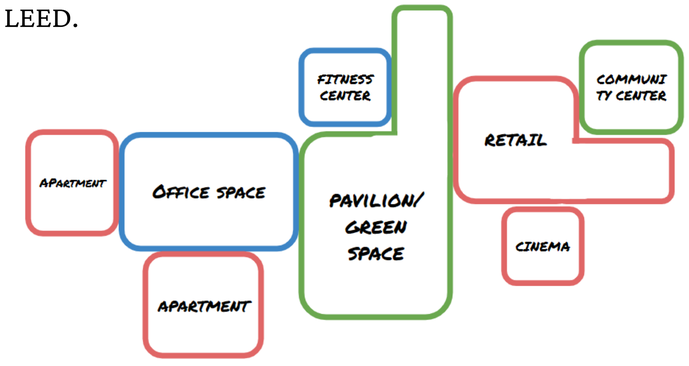

- Parking Garage
  - Constructing a new parking garage for residents in the affordable housing complexes so they do not have to compete for normal parking outside
- Bike Parking Spaces
  - Encourage more ecofriendly transportation and support people who bike to work


## SUSTAINABILITY

We aim to use materials that are locally available and also ones that may arise from our demolition of the building. Our main materials are wood, brick, and concrete. By procuring nearby resources, we will save money on transportation and fulfill a requirement for LEED.

Through renovations such as replacing HVAC equipment and switching to LED lighting, we will also increase the energy efficiency of existing buildings and making them more sustainable.

Next to our cite, the Houston Metro has the Greenspoint Transit Center stop that allows for easy accessibility. In addition to public transport, the paved center and the addition of bike racks around the cite encourage residents and visitors to use bikes, meeting the location aspect of LEED.



# GREENSPOINT REIMAGINED [HOUSTON, TEXAS]

## VIOLET VISIONARIES LLC

Concept photo of the interior of the renovated building

Picture of Greenspoint mall

## TRAFFIC IMPACTS

Located at the intersection of beltway 8 and I-45, our team knew it was important to minimize traffic disruptions. We estimated the amount of new traffic the renovations would generate and plan to keep several entrances open throughout construction so existing traffic isn't disrupted. Our aim is to maintain a service level of C or above on nearby roads through measures such as encouraging biking. We also plan on constructing a parking garage to accommodate new traffic.

| Type | Average Trips per 1000 sqft/unit on a weekday | Square feet | New trips |
|---|---|---|---|
| Office | 11 | ~100,000 | 110 |
| Retail | 35 | ~500,000 | 17,500 |
| Apartment | 1 | ~100,000 | 100,000 |
| Community Center | 35 | ~100,000 | 350 |
| Restaurants | 40 | ~75,000 | 3000 |
| total: | | | 120,960 |

## FUNDING

There are many potential sources of funding for this project. For instance many investors see a lot of potential in redeveloping Greenspoint due to it's location near the Bush International Airport, but also in the middle of the commute between Downtown Houston and The Woodlands area. The city of Houston also provide grants or help for building affordable housing and greenspaces such as the Housing Tax Credit program and the recreation grant program.

## COST ESTIMATION

The cost includes a fee for our company and accounts for any changes in material or labor prices that unexpected events can have through the contingency fee.

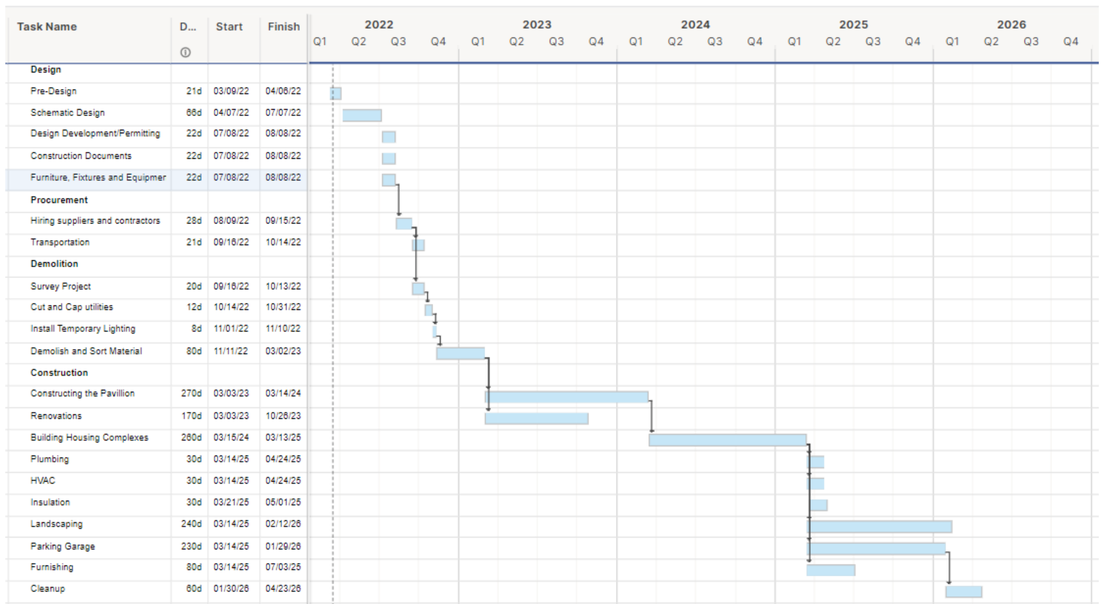
| Category | Cost |
|---|---|
| Demo | 1200000 |
| Site Redevelopment | 570000 |
| Structure | 1125000 |
| Furniture | 103414 |
| HVAC | 72000000 |
| Plumbing | 850000 |
| Landscaping | 506000 |
| Design Cost (8%) | 6108353.12 |
| Construction Cost (4%) | 3054176.56 |
| Contingency (5%) | 3817720.7 |
| Total Cost | 89334664.38 |
| **Total Sq. Footage** | **500000** |
| **Cost per sq. ft** | **178.6693288** |

## CONSTRUCTABILITY

Much of this site will be demolition work and renovation opposed to building from the ground up, but as a company, we intend to utilize prefabrication for much of the structures we will bring in, including parts of the pavilion and recreation area. By using this process, we will have more control over the finish and quality of what we introduce onto the site as well as prevent excess disruptions in our demolition process.
As we go through the demolition process, our company will be doing structural analysis to determine what walls or supports may be taken down while still maintaining the structural integrity. This will occur in our affordable housing complexes, office spaces, and community center. As for our retail area and greenspace, there will be a demolition analysis done to prevent demolished building parts from falling on the buildings we need to remain. We will work on this building in sections to prevent injury to people that still maintain use of this mall.

## SCHEDULING

The project will take about 4 years including designing and other preconstruction steps. Throughout construction, functioning retail spaces will still be open and owners can continue to generate revenue.




## LESSONS LEARNED

Constructing a multi-use area requires a lot of planning ahead of time, as each type of activity follows different building codes, laws, and etc. It is also important to consider how the building will impact the community and the resources it will take to construct and maintain it. Through our process we were able to develop sensitivity for the cost of the project but also for how a visitor would navigate our space.

# 1 October Memorial


## Maverick Design Associates

Derek Miller, Jasmine Chung, Sterling Fitzgerald, Emma Franczak

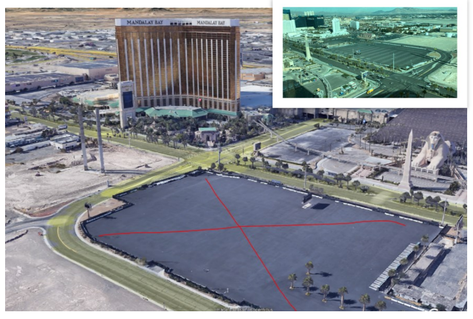
Throughout most of its history, Las Vegas has been a hub of tourism, casinos, attractions, and concert venues. The Strip has long been a top destination for friends and families alike who wish to enjoy the seemingly endless entertainment options or marvel at the fabulous lights and attractions. The "Entertainment Capital of the World" has proudly made a fond and lasting memory for billions of people over the years.

It was on the tragic evening of October 1st, 2017, that the lively city felt uncharacteristically still, and the bright lights seemed to figuratively dim in solemnity, as an individual opened fire on thousands of individuals in attendance at the Route 91 Harvest Festival. The senseless act of violence would end up taking the lives of 60 concert goers and injure over 500 people. The tragedy evoked numerous feelings within the Las Vegas community; sadness, terror, anger, confusion. For many, these feelings were soon transformed into strength, resilience, compassion, and community as Las Vegans banded together to provide the support that was needed in such a challenging time. Thus, the Vegas Strong attitude was born. Countless individuals have felt the impact of the event, many of whom will forever remember the levels of anguish it caused.

Our design for a memorial will enshrine the names of the victims, giving them the honor they deserve. The memorial will serve as a space of commemoration, reflection, and remembrance which will enshrine the identities of the victims and provide a space for anyone to reflect and remember. The memorial and its features will ensure that the memory of the victims will forever be preserved and their impact will never be forgotten. The commemoration will also be extended to the first responders and volunteers who helped attend to the damage caused by the event. There were many factors that went into consideration throughout our design process given our desire to create a space that can be enjoyed by residents and tourists alike.

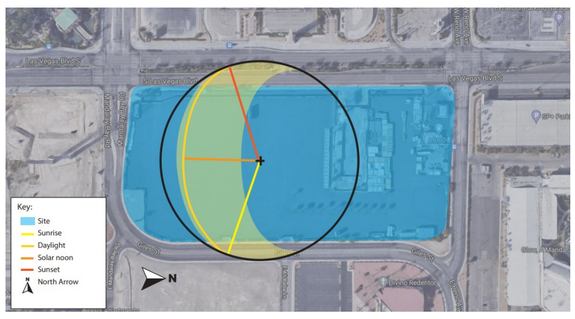
As residents of Las Vegas, the tragedy and its impact remains fresh in our minds and hearts. We felt compelled on a personal level to design a memorial for the 1 October shooting, which will reinforce the signature Vegas Strong spirit.

## Design Process



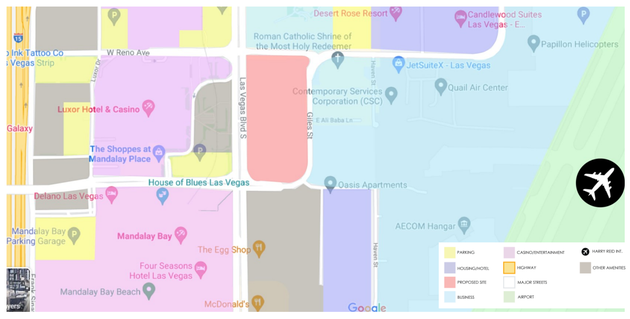

**Site:**

When starting to research available land for the memorial, we were drawn to building on the original site of the Route 91 Harvest Festival. MGM Resorts International recently donated the site in remembrance of the victims and families of the festival. Therefore, the fifteen acre festival site not only provides plenty of space to design an honorable memorial, but the location also holds prime historical significance on the Las Vegas Strip.



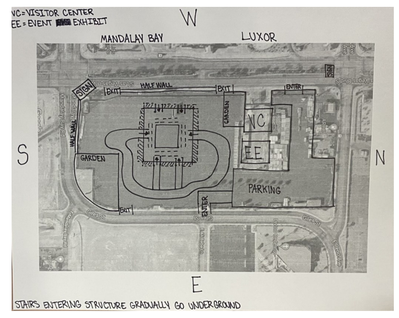

**Sun Path:**

Before planning the layout and memorial design, we conducted a sun study analysis of the site. The direction of the sun path on the Las Vegas Strip impacts the lighting, shadows, and visibility of the memorial. Thus, we oriented the memorial perpendicular to Las Vegas Boulevard for optimal natural shading, daylight, and both heating and cooling conservation.



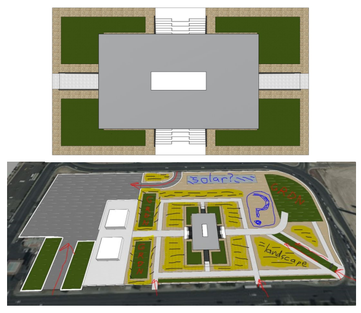

**Zoning:**

Near the site there is the Mandalay Bay, Luxor, and Excalibur. These areas are very populated with tourists as they are very popular hotels and casinos. Harry Reid International Airport is directly behind the site with housing and businesses all around. As the entrance is right off of Las Vegas Boulevard, the site is in a very busy location where people would visit the most often. With parking at the site and at all the hotels, the memorial will be a perfect walking distance from those popular areas.




**Sharpie Sketch:**

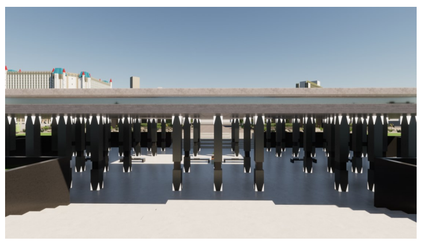
We created a series of design sketches to revise our design ideas of the memorial. We experimented with shade structures and skylights of an outdoor memorial accompanied with gardens and walking paths. In our design drafts, we also incorporated a visitors center and informational exhibit.

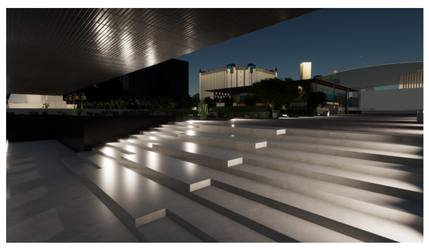


**Rough FORMIT Model:**

With our finalized design, we first created a rough conceptual model in Formit on a scaled underlay of the site. Modeling allowed us to experiment with different materials before creating our final renders in Revit and Twinmotion.

## Site Plan



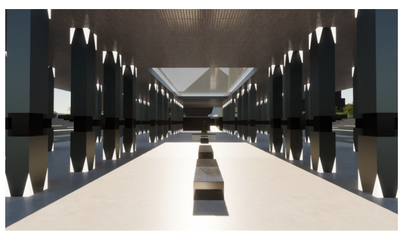


**Stairway Entrances:**

The stairways leading into the Pavilion feature a combination of both large and small steps illuminated with lined lights for evening visibility. These stairs not only provide for expansive entrances and exits but they also help mitigate crowdedness for a more open flow of incoming visitors. The larger steps centered in either stairway also provide possible seating arrangements and settings for social connections within the overcast of the memorial's shading structure.

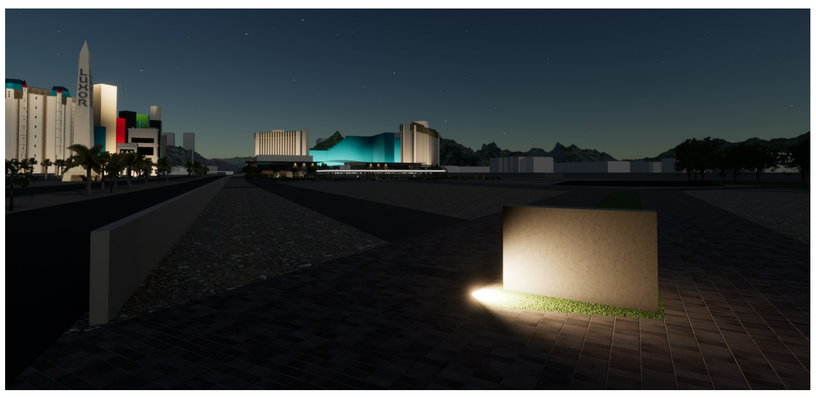
**Section View:**

In order to accommodate for the extreme seasonal temperatures in Las Vegas, the Pavilion is partially sectioned below the site's finished grade for optimal geothermal energy efficiency. Ramps and stairways are used to lead into the memorial for greater accessibility. The interior of the Pavilion is ten feet below and eight feet above the surrounding ground line. The lowered interior with the overhead misting system helps keep the outdoor memorial naturally cooler in the summer to encourage year-round visitors.



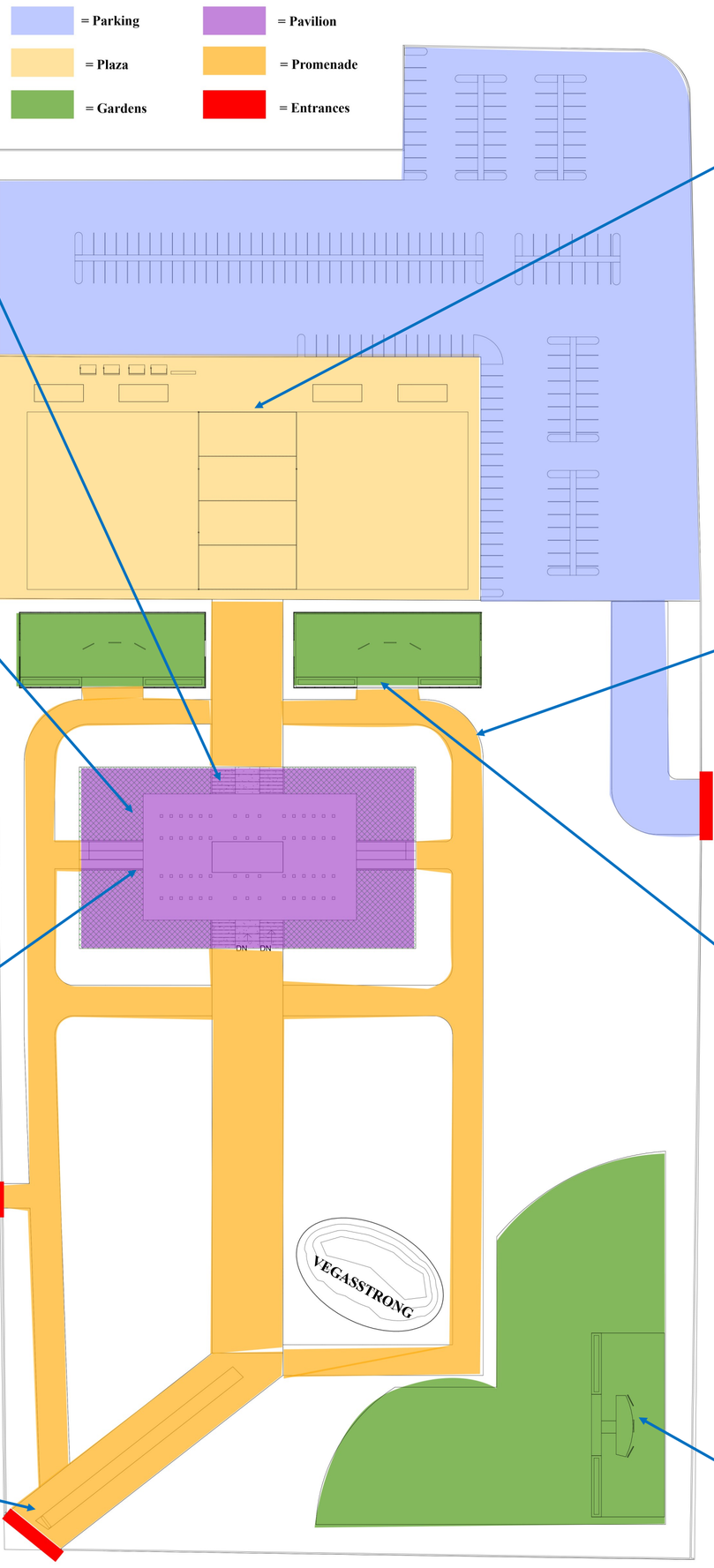
**Pavilion Interior:**

The interior of the memorial displays sixty columns commemorating the passed victims of the Route 91 Festival. Black granite lines the interior walls and sections for planters of perennial desert flowers are centered between the two main column sections. The overhead shade structure provides natural lighting throughout the day from the open sides and ETFE skylight. Retaining walls at the finished site grade level lining the Pavilion and drain components inside prevent flooding of the memorial.




**Las Vegas Sign:**

To bring awareness of the memorial to those entering Las Vegas as well as create a welcoming entrance for those on the Strip, we opted to position this main sign at the southwest corner of the site. This placement best maximizes the ability to inform incoming Las Vegas visitors about the Memorial and where it is located. To continue creating a cohesive and reflective environment, the sign would be constructed using black granite. The sign will continuously bring awareness to the memorial and will provide a unique entrance to those who may be walking across the Strip.

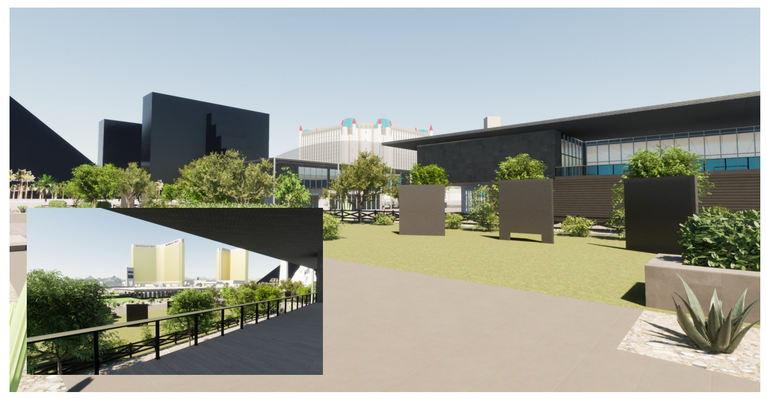



**Visitors Plaza:**

In the Plaza, the Visitors Center and Event Exhibit welcomes and leads visitors to the 1 October Memorial. The Visitors Center has restrooms, indoor seating, and public amenities as well as a flower shop for visitors to bring to the memorial site where proceeds help support families and victims of the Route 91 Festival. Balcony decks provide outdoor seating that also overlooks the memorial site from the second floor of the Visitors Center. The Event Exhibit provides informational historical context of the event, and allows a space to share the individual stories and remember the victims of the Las Vegas community.

**The Promenade:**

The Promenade walkway circles the memorial Pavilion and connects to the Visitor's Plaza and several featured memorial gardens. In the evening, embedded lighting highlights the path navigating through the memorial. Along the pathway native plants, garden features, and landscaping are displayed.



**First Responder Garden:**

This is more closed off to admire the people that came to help. In between the fenced off walkway and the signs with pictures and names is the garden/greenery. This way visitors will be able to admire the people that helped as well as the landscaping.


**Survivors and Families:**

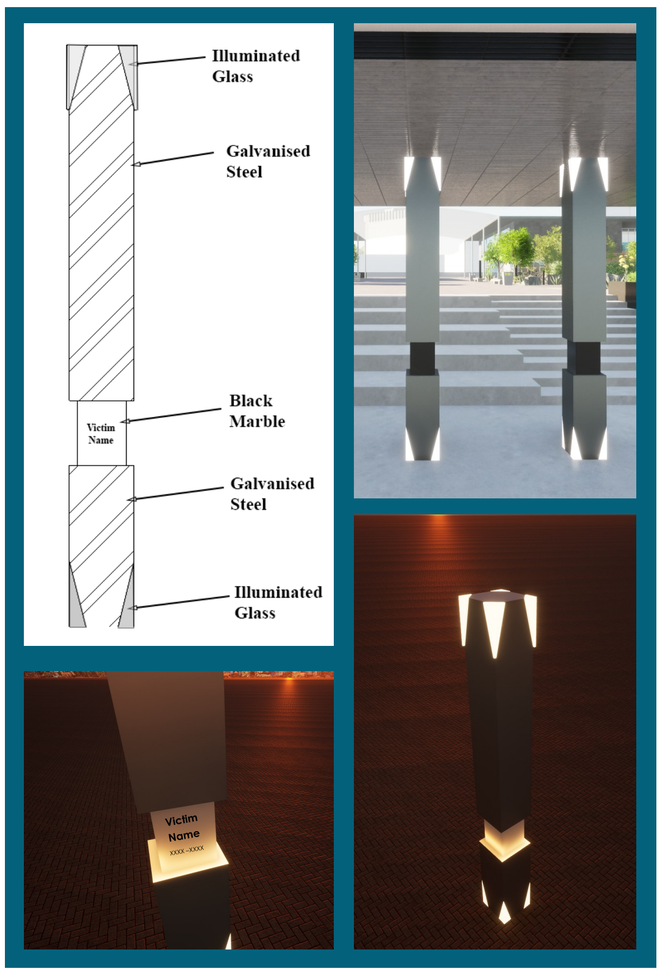
This is more open and interactive with ability for visitors, families, and survivors to place flowers, pictures and notes on the signs to commemorate the victims. There is a stone pathway leading up to the signs with garden/greenery surrounding.

# Symbolism

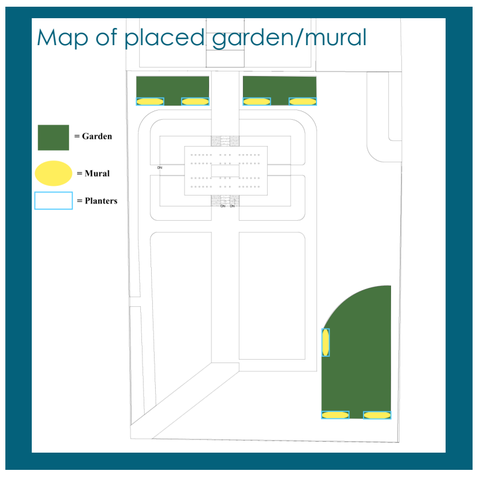
**Significance of columns:** There are 60 columns for the victims of the Route 91 Harvest Festival. Originally, 58 tragically lost their lives that night and over the years two more have perished from injuries. Highlighting those that have passed was a big significance to the purpose of the columns. For materials, galvanized steel is on the upper and lower halves of the column. It is durable against corrosion which is very important for a water misters aspects and great for outdoor use. On each column, victims names will be engraved on black polished marble, which is in the center of the column. Lastly, on all corners of the column there is glass that will be illuminated with warm tone lighting.

**Glass Accents:** The idea of rebirth is prominent in glass symbolism. From broken like glass, a new self can emerge and become stronger. October 1 was a difficult time in many people's lives so bringing light into the dark and highlighting all of those that have passed is a great representation.

**Marble:** Marble is a symbol of purity and immortality. With the victims names being showcased, friends, family members, survivors and visitors are able to pay tribute to those that lost their lives the night of October 1.








**Murals:** Vegas is home of many famous attractions and places for creative freedom. Art is all over the city done by many different artists. Incorporating this art into the memorial would bring positivity and liveliness to the space. Some representing Vegas and some mimicking a specific art style would add to the creativity uniquely represents Las Vegas.

**Image 1**: Created by *Michael Birawer.* It shows a unique drawing of The Las Vegas Strip and the different buildings and casinos around it. It shows the creativity that can come from a perspective.

**Image 2**: Created by *Eric Vozzola*. Some of his murals are already all over Vegas and they are very colorful and vibrant. When looking at them nothing makes sense which is what gives that creative touch.

**Gardens:** There are a total of three gardens. One for first responders, one for victims, and one for survivors and families to reflect on the event. Within each garden on the site there are planters of native greenery. This is where the murals and art work will be showcased throughout the site. From various styles and references, the murals will be there to bring positivity and vibrancy to the space. Visitors will be able to admire the pictures in each garden as well as the artwork.

# Materials

- **Galvanized Steel:** Galvanized steel is used for both the Pavilion shade structure and the individual memorial columns for long-lasting out door durability. The steel can withstand the harsh elements of both Las Vegas' extreme summer and winter seasons. Galvanized steel is also resistant to corrosion and can be used alongside the Pavilion water misting system to keep the site cool during the summer.

- **Black Granite:** Highly polished black granite lines the interior walls of the Pavilion and details the name plates of the memorial columns to create a sense of solemn contemplation as people can view their own reflections in the granite. The black granite helps symbolize the strength and durability that brought the Vegas Strong community together over this tragic event. For best outdoor durability, the black granite is both treated and sealed to preserve the stone's shape and color.

- **Stone Paver:** Using natural desert stones and rocks, stone paver lays out the path of the memorial Promenade. For a walkway path expected to have much public use, stone paver is very durable and efficient to maintain for level walkways.

- **ETFE Skylight:** Installing ethylene tetrafluoroethylene (ETFE) skylights transmits abundant natural lighting for plants and illuminating the interior of the Pavilion. Compared with the material polytetrafluoroethylene (PTFE), ETFE's carbon construction in more durable and sustainable as the sheets are 100% recyclable.

# Landscaping


Red Yucca


Primrose


Mesquite tree


Weber Agave


Rabbit Bush

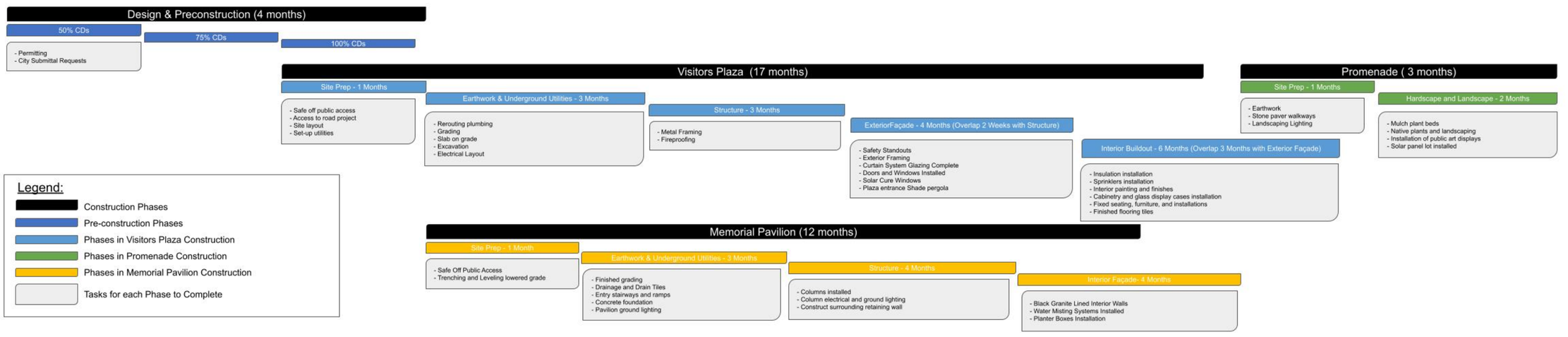

Mexican Feather Bush

To support the ecological health of Las Vegas' desert environment, the 1 October Memorial landscape features native plants such as weber agave, rabbit bush, and cacti. Mesquite trees provide natural shading for the outdoor promenade while primrose, red yucca, and desert marigold flowers highlight natural desert plants within the memorial gardens. Native plants help the memorial better integrate with the surrounding land and are less intrusive on current ecosystems. Desert plants not only reduces landscaping maintenance, but also helps build overall environmental resilience by sup-

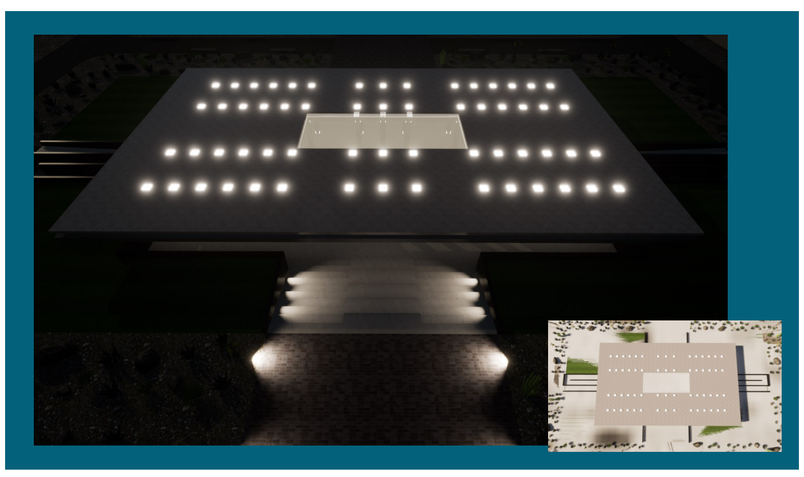
# Cost Estimate

| Visitors Plaza | | | | Promenade | | Pavillion | | | | Gardens | | TOTAL: |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Item: | Cost: | | | Item: | Cost: | Item: | Cost: | | | Item: | Cost: | |
| **Framing** | $805,427 | **HVAC** | $625,333 | **Paving** | $611,000 | **Excavation** | $280,000 | **Shade Structure** | $350,000 | **Landscaping** | $7,540,000 | |
| **Interior Buildout** | $7,123,432 | **Furnishing** | $ 731,700 | **Electrical Equipment** | $11,000,000 | **Retaining walls** | $ 17,472 | | | **Property lining walls** | $34,830 | |
| **Glass & Glazing** | $730,520 | **Insulation** | $ 54,000 | **Signage** | $20,000 | **Concrete Finishing** | $ 4,060,000 | | | **Watering Systems** | $6,500 | |
| **Utilities** | $457,897 | **Exterior Finishing** | $ 705,000 | **Benches** | $18,000 | **Columns** | $18,000,000 | | | | | |
| | | **Cost Summary:** | $11,233,309 | **Cost Summary:** | $11,649,000 | | | **Cost Summary:** | $22,707,472 | **Cost Summary:** | $7,581,330 | **$53,171,111** |

# Project Schedule




# Conclusion



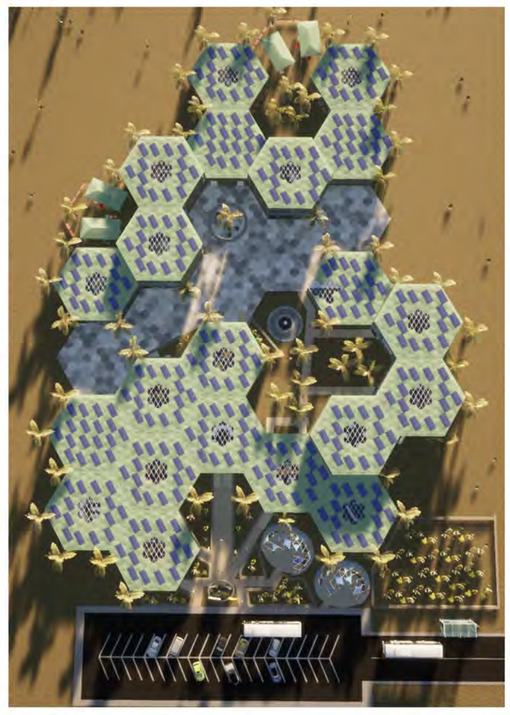
Our design proposal of the 1 October Memorial aims to properly commemorate the individuals and families affected by the Route 91 Festival and establish the spirit of Vegas Strong as a part of the iconic Las Vegas Strip. The memorial's native landscaping, geothermal cooling, and locally based materials help durably incorporate the surrounding environment and display the natural desert beauty of the Vegas Valley. With the visitors center and event exhibit, the memorial would not only bring together the Vegas community but it would also serve as a place to inform and educate visitors about such a significant event in American history.

Participating in the 2022 CIRT Competition has allowed our team to explore how creative design, symbolism, and space planning in a national memorial can honor and represent a community. We learned the significance of establishing and having a lasting connection with all those who visit Las Vegas.

# SANTA TERESA HUMANITARIAN CENTER

MAGNUM OPUS DESIGN

ISABELLA ALVAREZ, DORISMAR CALVA, JONATHAN FENTON, GAVIN WEIR, SCOTT MARTIN



## THE PROBLEM

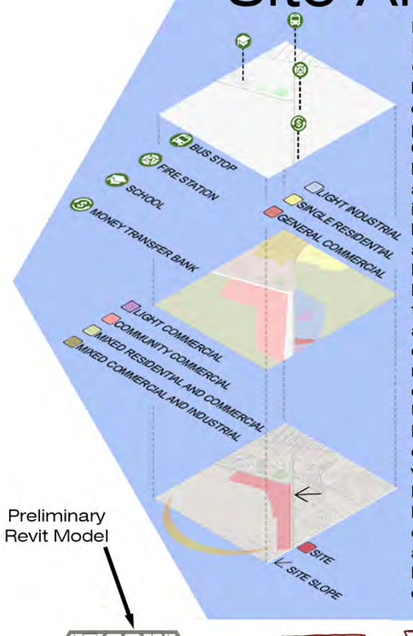
Fewer topics in American politics are as controversial as immigration. Especially on the southern border of the U.S., immigration has become an increasingly important problem that needs to be addressed. Thousands of immigrants cross the border each year without the proper resources to obtain citizenship and a stable life. The current solution, I.C.E. Detention Centers were originally designed for criminals and not families. This setup has proven to be insufficient and even dangerous. According to the non-partisan data collector TRAC Immigration, 63.2% of the current detainees in all I.C.E. centers have no criminal record, showing how there are many immigrants who should not be in these facilities. Clearly, a new and effective solution is needed; one that is affordable, repeatable, sustainable, and specifically designed for immigrant families, not dangerous prisoners.

## THE SOLUTION

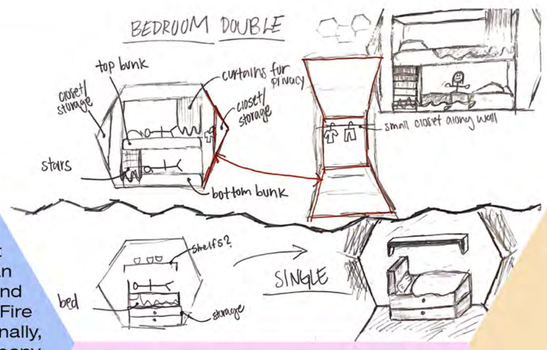
To address this need, A-TECH's Magnum Opus Design Team has developed a building that fulfills the prerequisites above. The Santa Teresa Humanitarian Center exemplifies an adaptive future for immigration centers. Made out of recyclable materials, our center is innovative and extremely functional. The center is made entirely of hexagonal modules, which are prefabricated off-site. Moreover, these modules are designed to fit inside a standard shipping container, meaning they can be shipped via train, truck, boat, or cargo plane. Once modules arrive on site, the building can be put together at unprecedented speed.

# DESIGN PROCESS

## Site Analysis



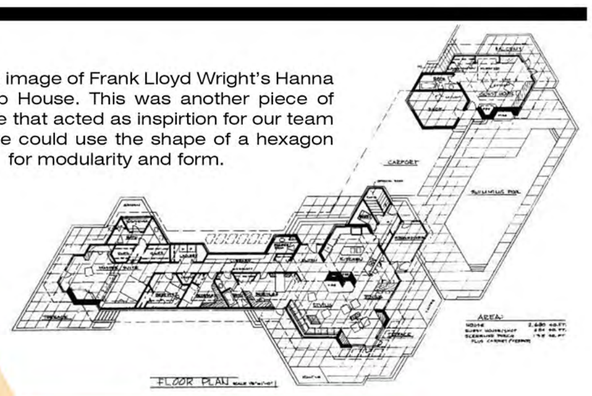

Near the hotspots of El Paso, Texas and Las Cruces, New Mexico, our humanitarian center will be crucial in aiding the immigrant population crisis in both cities. Our site is a 33.720 acre plot of land on the corner of Airport Rd and McNutt Rd. Across the street is Stampede Meat Inc. which can help supply our kitchens, and adjacent to it is Sunland Station Fire Department Station 2. Additionally, Rinker Materials is a nearby company that can supply piping for our center, and the Western Union money exchange station within a quarter mile distance can be utilized to exchange Mexican Pesos for USD. Proximity to a Union Pacific rail line allows for cost effective material transport via train, and a close by Dona Aña County airstrip lets planes bring in emergency supplies. An additional bus stop will let visitors return for continued resources.




## 3D Printed Hexagons

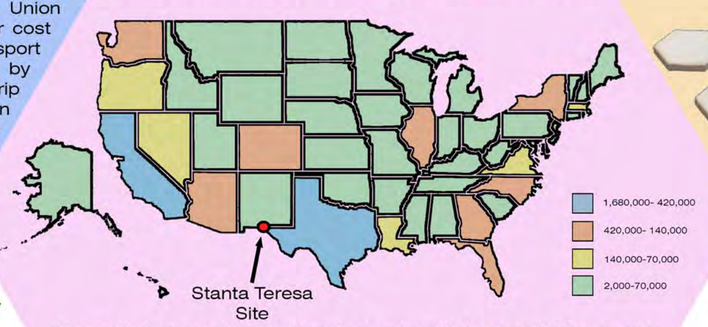
Modularity allows for designs that address specific needs. While brainstorming solutions for housing immigration populations, our movable 3D hexagons allowed us to find unique solutions. In addition, we found that modular designs can be quickly implemented, sustained and provide shelter during hurricanes, earthquakes, and refugee crises. In the case of the Santa Teresa Humanitarian Center, the 3D configuration shown became our final design.

Below is an image of Frank Lloyd Wright's Hanna Honeycomb House. This was another piece of architecture that acted as inspirtion for our team and how we could use the shape of a hexagon for modularity and form.




## Demographics

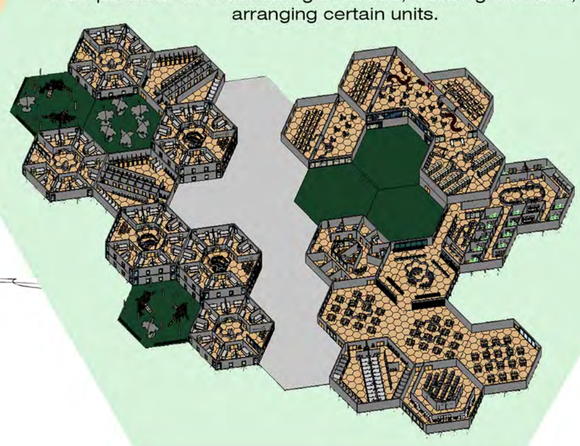
Undocumented Immigrants Per State



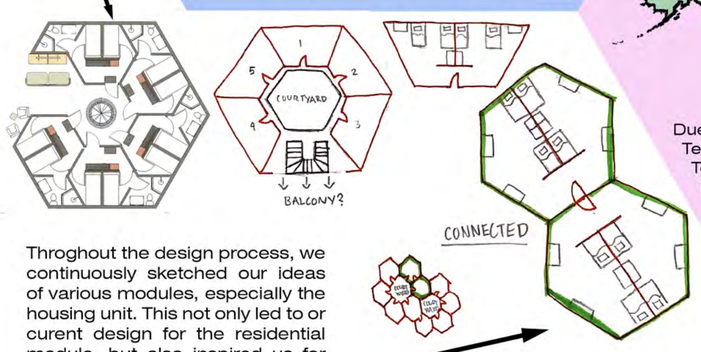

Due to their many cities abutting the border with Mexico, California and Texas possess the highest concentration of immigrants. Focusing on Texas, we chose our site to be right next to the major hot stop of El Paso. This area, known as one of the most highly used immigration routes into the U.S. and the world, creates a distinct need for a new immigration center. According to the City of El Paso, approximately 100 refugee encounters happen daily. This provides evidence of a critical need for a new center to help alleviate the overcrowding in surrounding facilities.

## Revit Model

Once all site analysis research, demographic data, sketches, and 3D conceptualization were finalized, we used Revit to complete the final model. We created a furnished and contextualized building through Revit's powerful 2D and 3D capabilities. Having our idea translated into Revit was critical in determining what was possible for connecting modules, building sections, and arranging certain units.



Preliminary Revit Model




Throghout the design process, we continuously sketched our ideas of various modules, especially the housing unit. This not only led to or curent design for the residential module, but also inspired us for our designs of the additional units.


# HUMANITARIAN CENTER LAYOUT

## PLAYGROUND

Four playgrounds are located at the back of the residential building. These playgrounds serve as an inviting space for families to socialize and relax in this often stressful process. Here, children can interact while parents and guardians sit on the provided benches. Shading is provided by shade structures and surrounding palm trees.

## BEDROOM

The residential building in the back of the center includes rooms with twelve beds each. This can accommodate many different families. Because residents are temporary, the decision to assign multiple families to one expansive room proved to be the most cost effective and realistic. These rooms are efficient and affordable while still providing appropriate safe, temporary space for families. A spiral and an egress mid-landing staircase are included for 2 floor. modules.

## LEGAL WING

Getting into the U.S. is a process that is increasingly complex and the help of legal experts is essential. To address this, a legal wing was added with multiple offices for meeting with attorneys. This service assists with necessary paperwork and guidance on navigating the immigration system. Two conference rooms sit in the center of the wing to provide needed space for large families to meet with a representative. Additionally, a seating area with a presentation screen sits in the back, which can be used by attorneys to give seminars.

## BATHROOM

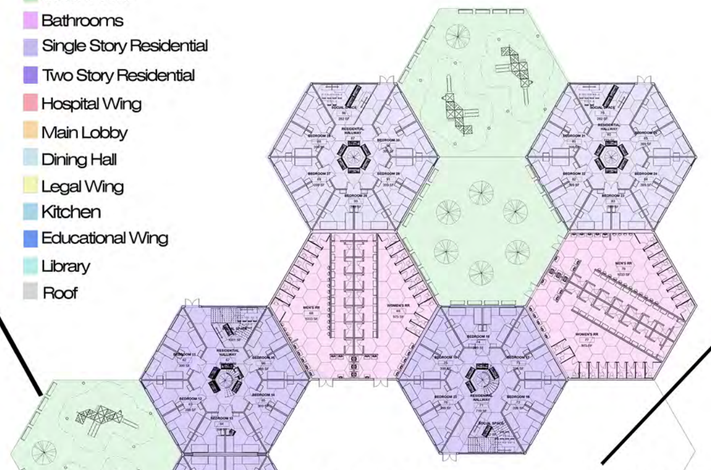
Community bathroom modules were made in order to centralize plumbing and lower cost. These modules reside in both the residential and main building. Individual, closed showers are provided for the temporary residents. These units are also ADA accessible and centralized between sections of the residential building for ease of access. The bathroom modules are efficient, affordable and simple to maintain.

## DINING HALL

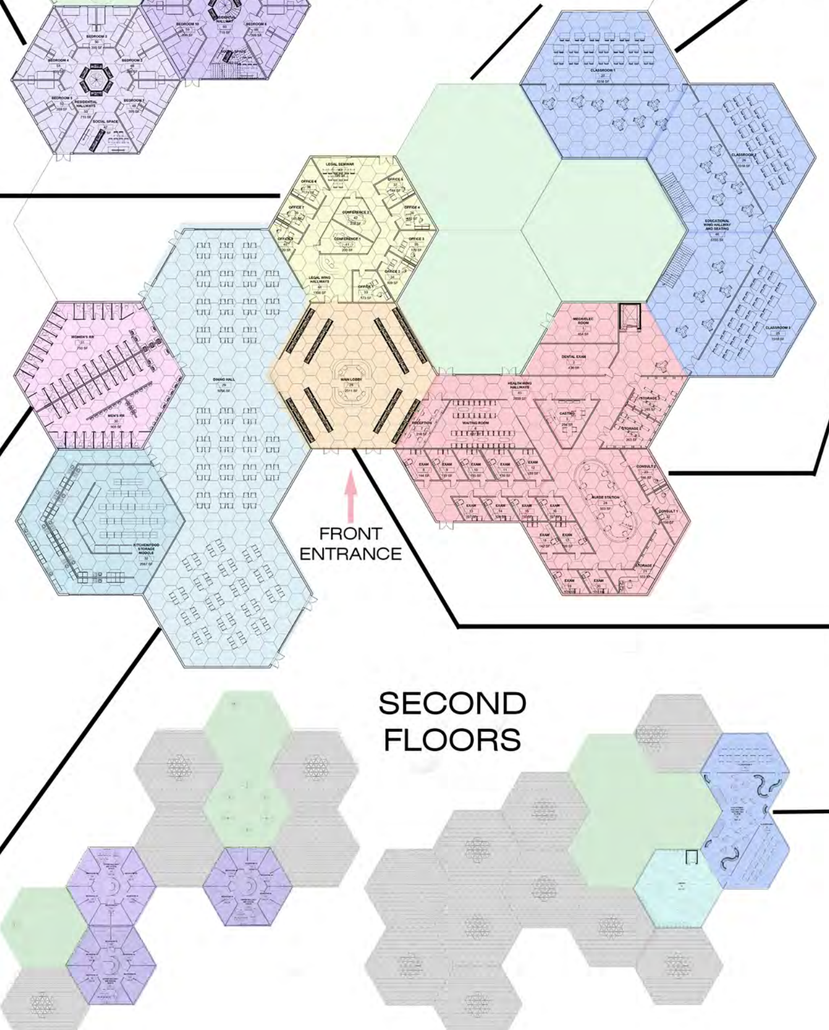
Since people will be staying here for a few nights, food is a necessity. A centrally located, expansive dining room resides in the main building. In-house kitchen and restroom modules accompany this unit. Using an open-space design, the dining area ecompasses three hexagonal modules. The kitchen module has multiple counters of kitchen space on the perimeter, with storage shelves placed in the center of the hexagon. Fresh food is made and distributed to the patrons daily.

## RESIDENTIAL BUILDING

- Green Areas
- Bathrooms
- Single Story Residential
- Two Story Residential
- Hospital Wing
- Main Lobby
- Dining Hall
- Legal Wing
- Kitchen
- Educational Wing
- Library
- Roof



## MAIN BUILDING




## SECOND FLOORS



## OUTDOOR SPACE

The main building wraps around an extensive green space. This area serves as a calming outdoor environment for visitors to relax and congregate. The community fountain acts as a focal point of social interaction and calmness. Water has been proven to be a source of stress-relief for people, and because immigrating is such a stressful process, this fountain is even more essential.

## CLASSROOM

The educational wing includes three large classrooms on the first floor, with table seating outside for study space. This wing is critical to teaching large numbers of visitors the basics of American culture, language, and laws. Immigrants can also be taught how to navigate the process of finding and applying for a job. as well as their rights to make sure they are not taken advantage of by employers once they leave the facility.

## MEDICAL WING


The main building includes a hospital wing, complete with reception, exam rooms, nursing station, consultation rooms, casting room, dental room, and comprehensive storage area for medicine and PPE. The center will house multiple, full-time nurses and doctors to treat those in need. Doctors can treat both immigrants with injuries from their journey over the border as well as diagnose long-term ailments.

## MAIN LOBBY

The main lobby serves as the central hub of the main building and is where immigrants will first enter when they arrive at the facility. Up to 8 receptionists will work to check visitors in and give out information on the layout of the building and available programs. Adjacent to the lobby is the reception area for the medical wing, and this close proximity allows for immigrants with emergency ailments to be checked in and treated immediately.

## COLLAB SPACE

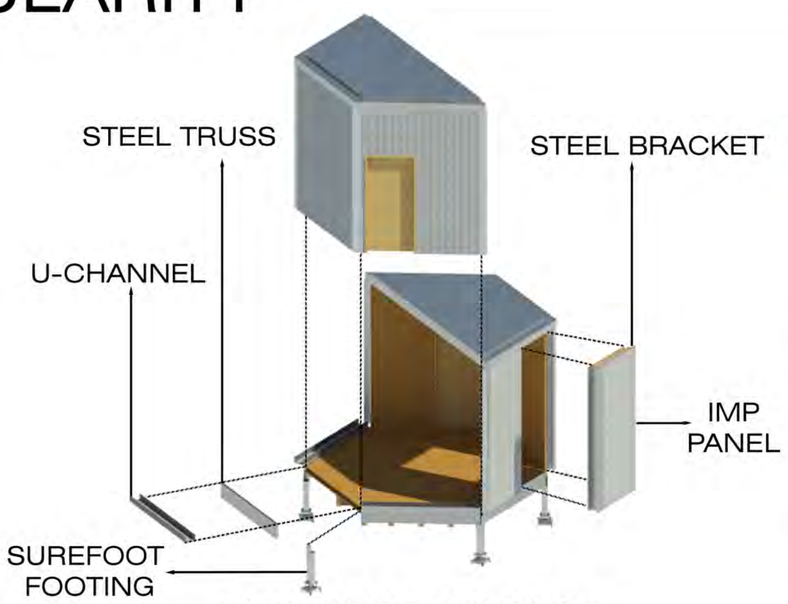
The collaborative spaces are located on both floors of the educational wing. These spaces include a large enough area for group activities. 2 additional classrooms are also on the 2nd floor adjacent to the collaborative space. In addition the second floor includes a small library to facilitate the distribution of vital information and story books that visitors can check out and keep in their rooms. Many materials will also be available in Spanish.

# MODULARITY

Our immigration center is constructed using a modular, prefabricated design in which modules are assembled on site with easily linkable floor, wall, and roof plates to decrease construction time. This allows our design to be responsive to many of the issues facing humanitarian centers around the world. First and foremost, the prefab modules allow centers to be built extraordinarily fast in response to crisis situations. Furthermore, the weather stripping and bolt based connector system allows the building to be easily dismantled and almost completely recycled or relocated once the center's usefulness expires. The modular design also allows for easy expansion on existing units which alleviates the common problem often found in traditional humanitarian centers, where additional space cannot be added on once construction is completed.

Prefab building parts also have the benefit of making the building significantly more environmentally friendly. When our centers are eventually taken down (which is incredibly common after refugee crises) the prefab parts can be easily recycled or reused in future centers. Over time, this leads to an exponential decrease of carbon emissions that otherwise would have been produced by traditional construction methods. In all, the use of a modular prefab design allows us to create a much better humanitarian center that more accurately supports refugees. When compared to current, flawed humanitarian efforts such as the present-day I.C.E. detention centers, our solution better suits the needs of modern day immigrants.

This center was specifically designed to be used all over the world. Humanitarian efforts are not isolated to the southern border of the U.S. and similarly, our design is not constrained to immigration either. Because of how quickly the building can be constructed with its modular panels, once they arrive on site, a fully functioning center with all the basic necessities can be up in a matter of days. Each center around the world can be ordered based on the needs of the situation. For example, if more classrooms are needed or if legal services are unnecessary, modules can be added or subtracted with ease. The configurations that this building can take are endless, resulting in tailored solutions for each individual humanitarian center. No matter where this center is replicated globally, it can be easily fitted to the needs of local crises and continuously adapted to changing circumstances.

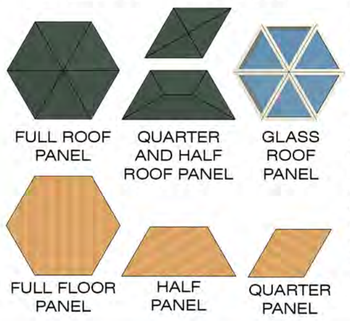



EXPLODED MODULE


## TRANSPORTATION

Modular design allows for the building to be shipped as a whole. The Magnum Opus Design Team engineered each module part to fit within standard shipping containers. According to the shipping company Western Container, standard shipping containers have an interior width of 7'-8.59" and a height of 7'-8.89" so we scaled our floor and roof panels to have a maximum diameter of 7'-8". Flooring, exterior walls, roofing, and every other construction material can be shipped inside these containers and be transported via train, plane, or boat. Once containers arrive on site, they can be quickly unloaded and snapped together in the required configuration. No matter the size requested or the location in need, our transportation system will facilitate the fastest response and construction possible.

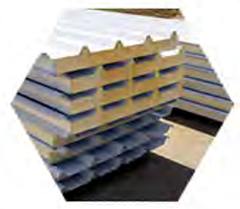
TRAIN SHIPPING CONTAINER




# MATERIALS

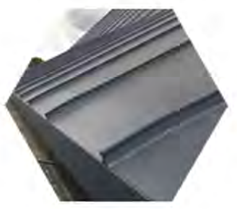
STRUCTURAL INSULATED PANEL

These were chosen for their prefabrication potential and modular capabilities. The panels consist of an insulated foam core placed between two plates of oriented strand board (OSB). The foam core allows the building to be easily temperature controlled. They can be assembled osn site quickly and can be made watertight in a matter of days, SIPs will be used for both interior and exterior walls.



THERMOPLASTIC POLYOLEFIN

Made out of polypropylene, rubber, and polyethylene, will be placed on top of the insulated metal panel roofing to seal it from water and dust. TPO can be mechanically attached and requires no torches or hot asphalt to install, making it perfect for quick construction. Sheets of TPO can be made for increased UV weathering, which will help combat the New Mexico sun.



INSULATED METAL PANEL

Being clad with metal instead of wood, Insulated Metal Panels (IMPs) are similar to SIPs. These will be used for the roof due to their decreased weight and increased ability to combat the sun. Common practice for modular design includes IMPs as a precedent, and these panels, like SIPs, can be cut into hexagonal shapes off site. With a layer of insulating foam in the middle as well, they will grant a temperature resistant overhead.

SPACE FRAME

Space structures, are truss systems that utilize metal rods and struts that are interconnected. This frame will be used for the ceiling and will support both the IMP roof and the drop ceiling below. It is strong, lightweight, and allows for large areas to be framed without columns. While they are more expensive than traditional framing, this system allows us to stay modular and have wide open units.

SUREFOOT FOOTINGS

These concrete free alternatives to screw piles are manufactured in Australia. These hybrid "all-in-one" steel footings efficiently resist gravity, wind uplifts, and heavy loads and are graded for every soil type in the United States. Using these footings will allow us to eliminate concrete foundations and minimize earthwork. As reflected in our construction timeline, this contributes to the short construction time.

SOLAR PANELS

56" - 39" solar panels will be placed on the roof to provide adequate energy for the entire building. Solar panels are placed strategically to obtain the most sunlight available. The quantity of solar panels allows minimal reliance on power grid use. Thinking broader, by relying on some energy generated on site, this contributes to our center's ability to get set up even faster without total dependence on the grid.

LUXURY VINYL TILE

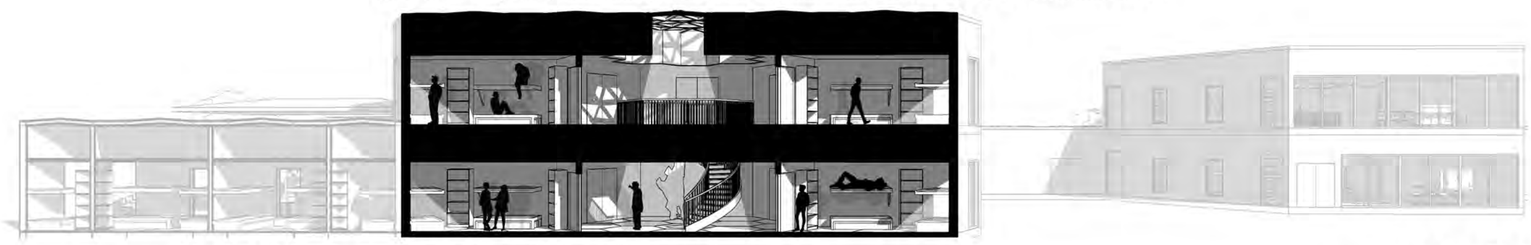
It's elegant design, high durability, and ease of maintenance. These tiles are scratch and stain resistant, have modular flexibility in their size, and can be ordered in a variety of colors. Great for commercial, high traffic environments, these tile systems simulate the look of more natural materials like wood and are easy to cut and snap together to cover our SIP flooring.

UNITIZED GLASS CURTAIN WALL SYSTEM

Made of aluminum framing will be factory assembled and shipped alongside our other module pieces to the construction site. They will run along the cafeteria, residential building, and classroom areas to supply natural light for interior spaces. These curtain systems will grant outdoor visual appeal while also making the spaces feel open and natural.

# RESIDENTIAL SECTION

Living modules consist of one and two stories with natural light provided on both. Windows in every room brighten the areas and allow sunlight in. Every living module is composed of 5 rooms and a social area. Each room consists of 6 bunk beds, allowing 12 temporary residents per room. 3 bunk beds are provided on each side of the room, and a wall is placed in the center to divide the space and grant some privacy to each side. Tall dressers accompany each bunk bed so that individuals can store any belongings they may have brought. This not only equips the room with adequate storage, but it also allows each room to achieve its principal objective; to be a secure place for refugees and their belongings. The first floor's spiral stairs, centrally located, lead to the second floor above. An egress mid-landing staircase in the social space ensure a safe exit in an emergency. A balcony-like structure is created in the center of the second floor which looks down to the first floor. In this centralized area, a skylight illuminates the hexagonal hallways of the second and first floors due to the balcony surrounding the central staircase. This natural light, coupled with simulated plant life, creates a biophilic feel throughout the center of the residential module. The fake tree sprouting from the center of the staircase on the first floor reaches up to the second floor and is the focal point of imitation biophilia, enlivening the entire space without the need for maintenance.



# PLANTLIFE

NEW MEXICO AGAVE

Native to southeastern New Mexico, this agave is one of the most popular in its family. It features sword-like leaves 6" - 18" high and a light green, cyan skin. When the plant matures to bloom, it sends up a 12' - 15' flowering spike that attracts hummingbirds.

SAGUARO CACTUS

This cactus is a tree-like columnar cacti that develops branches as it ages. They have white flowers and tree fruit when they bloom.These cacti are a staple of the western U.S. and add a natural touch of desert landscaping and will be locally sourced.

MEXICAN FAN PALM

This palm tree is native to Mexico and has naturalized into neighboring Texas. Their fans, which grow 3' - 5' long, can provide shade for our immigration center. These trees are easy to grow in full sun, and are drought and wind tolerant. As required, they can be bought locally in nearby El Paso, TX.

PEACOCK FLOWER

Also called the Pride of Barbados, this flower is an evergreen shrub originating in Mexico and the Caribbean. It has showy orange-red flowers and fern-like leaves. They grow 15' - 20' tall and equally as wide. Because of their origin in Mexico, they can also be locally sourced and are tolerant to the heat.

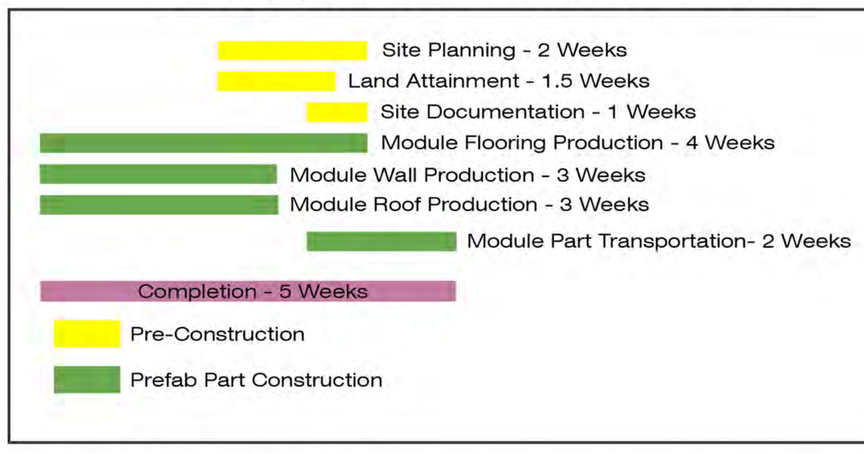
# COST ESTIMATE

After discussions with the PENTA Building Group and Stantec Engineering Company, the cost estimate below was developed. For context, according to the construction company Big Rentz, the average cost per square foot of commercial space in the US today is $490.00, and the average cost per square foot for a community center in the western US is $657.00. Our modular and sustainable design in comparison costs $491.47 per square foot, which equivocates with the average cost nationally while also being $165.53 under the western average for community centers. For total cost comparison, if a humanitarian center was built using the average community center cost above, it would cost $13,712,707.50 more. Even with these savings, the building is still environmentally friendly, reusable, and provides all the amenities immigrants need to legally assimilate into the U.S.

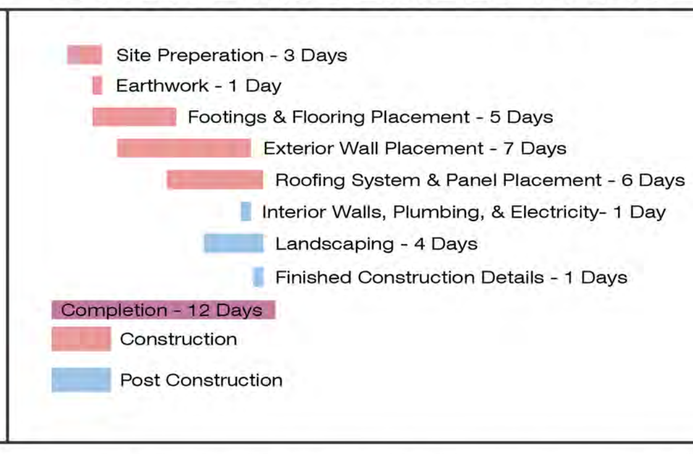
| ITEM | QUANTITY | COST/UNIT($) | UNIT | TOTAL COST |
|---|---|---|---|---|
| **SANTA TERESA CENTER MODULES** | | | | |
| FLOOR PANEL - SIP | 82,840 | $20.00 | SQ FT | $1,656,800.00 |
| WALL PANEL - IMP/SIP | 106,414 | $26.00 | SQ FT | $2,766,764.00 |
| ROOF PANEL - IMP | 70,063 | $30.00 | SQ FT | $2,101,890.00 |
| EPDM ROOF COVER | 70,063 | $22.00 | SQ FT | $1,541,386.00 |
| GLASS CURTAIN SECTION | 11,219 | $150.00 | SQ FT | $1,682,850.00 |
| SINGLE PANE WINDOW - ALUMINUM FRAME | 58 | $200.00 | EA | $11,600.00 |
| EXTERIOR DOOR | 24 | $4,500.00 | EA | $108,000.00 |
| SINGLE DOOR | 172 | $3,800.00 | EA | $653,600.00 |
| CEILING PANEL | 67,155 | $1.00 | SQ FT | $67,155.00 |
| SUREFOOT FOOTING | 422 | $124.00 | EA | $52,328.00 |
| SPACE FRAME | 67,155 | $35.00 | SQ FT | $2,350,425.00 |
| LUXURY VINYL TILE FLOOR COVERING | 67,500 | $15.00 | SQ FT | $1,012,500.00 |
| CARPET FLOORING | 15,340 | $10.00 | SQ FT | $153,400.00 |
| EPOXY FLOOR COAT | 12,272 | $14.00 | SQ FT | $171,808.00 |
| EPOXY WALL COAT | 4,200 | $12.00 | SQ FT | $50,400.00 |
| PAINT WALLS | 72,814 | $3.00 | SQ FT | $218,442.00 |
| PAINT CEILINGS | 12,272 | $4.00 | SQ FT | $49,088.00 |
| *MODULE TOTAL* | | | | **$14,648,436.00** |
| **SITE LANDSCAPING/DEVELOPMENT** | | | | |
| SITE LOT | 1 | | LS | $168,600.00 |
| SURVEY/LAYOUT | 1 | | LS | $60,000.00 |
| EARTHWORK | 382,500 | $7.00 | SQ FT | $2,677,500.00 |
| LANDSCAPING - | | | | |
| PALM TREES | 70 | $1,200.00 | EA | $84,000.00 |
| STONE PATH | 490 | $10.00 | SQ FT | $4,900.00 |
| AGAVE PLANT | 50 | $40.00 | EA | $2,000.00 |
| SAGUARO CACTUS | 20 | $400.00 | EA | $8,000.00 |
| DESERT ROCKS | 1 | | LS | $10,000.00 |
| FLAGS | 2 | $250.00 | EA | $500.00 |
| PLAYGROUND | 4 | $26,000.00 | EA | $104,000.00 |
| PLAYGROUND SHADE STRUCTURE | 4 | $10,000.00 | EA | $40,000.00 |
| PAVING (LOT AND STREET) | 23,000 | $9.00 | SQ FT | $207,000.00 |
| SIDEWALK | 4,000 | $15.00 | SQ FT | $60,000.00 |
| *LANDSCAPING/DEVELOPMENT TOTAL* | | | | **$3,426,500.00** |
| **SYSTEMS** | | | | |
| BATHROOM PLUMBING AND EQUIPMENT | 1 | | LS | $362,644.00 |
| TOILETS | 88 | $20,000.00 | EA | $1,760,000.00 |
| URINALS | 46 | $10,000.00 | EA | $460,000.00 |
| PARTITIONS | 94 | $2,500.00 | EA | $235,000.00 |
| HVAC | 82840 | $35.00 | SQ FT | $2,899,400.00 |
| SOLAR PANELS (56" x 39") | 1,239 | $250.00 | EA | $309,750.00 |
| FIRE PROTECTION/FIREPROOFING | 82,840 | $8.00 | SQ FT | $662,720.00 |
| LIGHTING | 82,840 | $40.00 | SQ FT | $3,313,600.00 |
| *MISCELLANEOUS TOTAL* | | | | **$10,003,114.00** |
| **BUILDING TOTAL COSTS** | | | | |
| BASE MODULE COST - 1 FLOOR | 1 | | LS | $842,146.00 |
| BASE MODULE COST - 2 FLOORS | 1 | | LS | $1,684,292.00 |
| SANTA TERESA CENTER TOTAL | 1 | | LS | **$28,078,050.00** |
| **SUB-COSTS** | | | | |
| TRANSPORTATION | 1 | 10% | LS | $2,807,805.00 |
| DESIGN CONTINGENCY | 1 | 8% | LS | $2,246,244.00 |
| CONSTRUCTION CONTINGENCY | 1 | 10% | LS | $2,807,805.00 |
| GENERAL CONDITIONS & REQUIREMENTS | 1 | 8% | LS | $2,246,244.00 |
| INSURANCES | 1 | 5% | LS | $1,403,902.50 |
| FEES | 1 | 4% | LS | $1,123,122.00 |
| SUB-COST TOTAL | 1 | | LS | **$12,635,122.50** |
| **TOTAL COST** | | | | |
| SANTA TERESA TOTAL | 82,840 | **$491.47** | SQ FT | **$40,713,172.50** |

# CONSTRUCTION TIMELINE

## PREFABRICATION PHASE

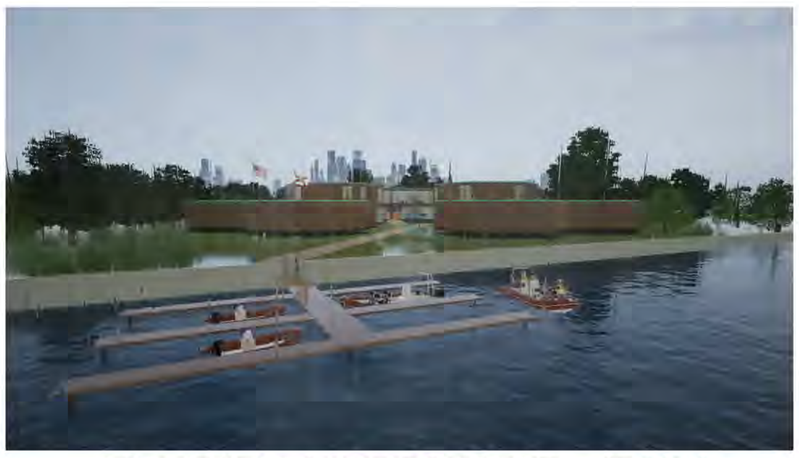



## ONSITE ASSEMBLY PHASE




Border relief is a problem that affects immigrants the moment they cross country borders, and the solutions to those problems should be available immediately as well. The construction timeline for the Santa Teresa Humanitarian Center is largely driven by its quick availability to its users. As shown above, there are two phases of construction: prefabrication and on site assembly. Ideally prefabrication is done in advance and panels are stored so that crises can be responded to as fast as possible. Once prefabbed panels arrive on site, it only takes approximately 12 days for our center to be completely built. In addition, the prefab design can be snapped together and taken apart within days, which creates an equally short duration to disassemble as it does to assemble. The miniscule timeline is only possible with the use of modular design because providing effective care should not fall on lengthy timelines.

# CLOSING



FLORIDA HURRICANE - RAIN

UKRAINIANS IN POLAND - SNOW

## ALTERNATIVE USES

The applications for this modular humanitarian center are truly endless. While immigration to the U.S. from the southern border is one of the biggest humanitarian issues facing the world today, countless other issues such as natural disasters, refugees, or war asylum seekers can also benefit from our design. Because of how easily these centers can be designed and constructed on site, they can be deployed to areas where disasters are going to occur. For example, when Hurricane Katrina famously hit Louisiana, Florida, and other states in 2005, emergency personnel were forced to house refugees in the Superdome Football Stadium, which was an inadequate facility. To the left is a render of a center potentially being used during a flooding or hurricane crisis. This center has the potential to mitigate these situations from happening again due to the short time it takes to have a facility put up.

Another use for this system would be for wartime refugees. Following the start of the Ukrainian-Russian war in 2022, thousands of Ukrainians fled to nearby states like Poland seeking asylum after their homes were decimated by the Russian war machine. As seen in the example rendered to the left, this center could also be deployed in areas like Poland to take in Ukrainians and help them find a place to stay while they wait for the fighting to end.

## CONCLUSION

The Construction Industry Round Table National Design and Construction Competition has been the most challenging, but worthwhile experience the Magnum Opus Team has faced in the field of design. Because the prompt can be tackled in so many different ways, finally settling on a modular, hexagonal structure took much trial and error. Part of this process was deciding whether we were going to design a building that was only for our site, or one that could have national and global application. Our decision to go global and modular rested on the fact that humanitarian issues are not isolated issues, and instead reflect on what we as a species value. In addition, these types of structures are less common in commercial and public architecture, making current precedent limited. However, examples of hexagonal architecture, like Frank Lloyd Wright's Hanna Honeycomb House, were influential showcases of modular and hexagonal design.

Having the opportunity to design a building solution that addresses a real-world current issue has been extraordinary for our team. We feel that because of this experience, we understand better how ordinary people can create incredible solutions to complex problems when they have a drive to succeed and benefit the world. Solving difficult issues doesn't take genius. It simply takes dedication, heart, and collaboration to bring together simple ideas that blossom into a beautiful, usable solution; one that has the potential to revolutionize current precedent for the next generation.