UTSA
Center for Cultural
Sustainability

# Case-Study Analysis

### Findings of Summary Vulnerability Assessment

of

### K'nesseth Israel Synagogue

Baytown, Texas

Presented to
**Congregation K'nesseth Israel**

October 2022

Prepared by The University of Texas at San Antonio, Center for Cultural Sustainability (UTSA-CCS)

Hurricanes Harvey, Irma, and Maria (HIM)
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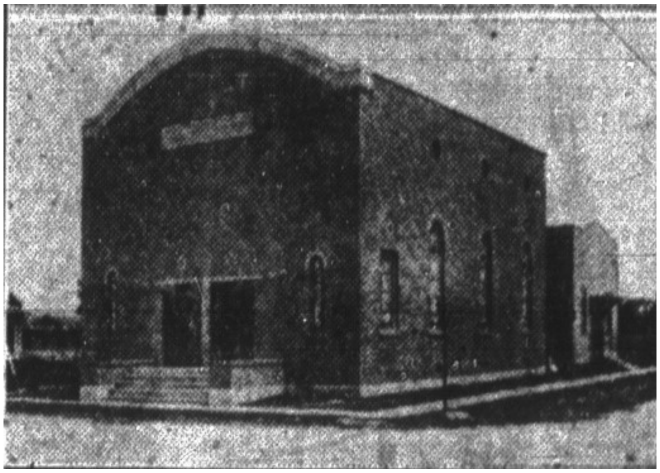
## Background

A team of researchers from The University of Texas at San Antonio, Center for Cultural Sustainability (UTSA-CCS); Eastern Michigan University; and Philadelphia-based nonprofit Partners for Sacred Places is studying the resilience of sacred places for the Texas Historical Commission (THC) as part of a sub-grant from the National Park Service's Hurricanes Harvey, Irma, and Maria (HIM) Emergency Supplemental Historic Preservation Fund (ESHPF). The project began in 2020 and concludes in 2022.

K'nesseth Israel Synagogue in Baytown is participating as 1 case-study in a broader vulnerability assessment by UTSA-CCS of sacred places along the Texas Gulf Coast. The sanctuary was built in 1930 with minimal subsequent alterations and represents a typical small masonry building that has survived multiple disasters and is expected to continue to face disasters in the future.



**Figures 5.01 and 5.02**: K'nesseth Israel Synagogue viewed from the south in 1933 and present day.

Resilience in this document refers to a congregation's "ability to prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions" (U.S. Office of the Press Secretary, 2013). Regarding congregations' buildings, resilience includes the ability to survive a disaster or recover to normal operations post-disaster (Burroughs, 2017). By studying current resilience, weaknesses and gaps can be identified and improved, providing better protection and response to future disasters.

The purpose of the case-study analyses is to determine the current level of vulnerability to damage from future weather events. The definition developed by Burton et al. (2002) is applicable to the case-study analyses.

> Vulnerability is the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including variability and extremes. Vulnerability is a function of the character, magnitude and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity.

Overall vulnerability of the case-study is the product of individual building components' vulnerability and those components' condition as observed by the research team. A congregation cannot control natural hazards, but the damaging impacts from natural hazards can be mitigated by acting to increase resilience. Higher resilience means lower vulnerability to threats from natural hazards.

The vulnerability assessments conducted by UTSA-CCS include identifying and understanding damage sustained from recent hurricanes, conducting finite element analysis (structural modeling to simulate and understand behavior under gravity, flood, and wind loads), and assessing waterborne threats. To facilitate this, UTSA-CCS developed a survey form to rapidly assess vulnerability, similar to assessment tools used by various federal agencies. Unlike the other tools, this *UTSA-CCS Survey & Vulnerability Assessment* tool utilizes a numeric point system. It is available for download from the project website [https://ceid.utsa.edu/disasterprooftexas/].

Additionally, the analyses consider prior maintenance and evaluate integrity, context, and historical significance. The project methodology is summarized in a section below and is further detailed in Appendix A.

The case-study analyses have multiple functions:

- They were used to inform discussions in sessions (also referred to as Knowledge Café Workshops) with case-study participants and emergency management professionals to obtain knowledge and wisdom from those preparing for and responding to disasters the case-studies will face. The findings from these engagement events are available on the project website and are covered in a *Resilience Roadmap* developed by UTSA-CCS.

- Each case-study analysis addresses identified vulnerabilities; investigates the capacity of case-study buildings to survive extreme weather events typical of the Texas Gulf Coast region; and provides recommendations to bring the property to a higher level of resilience.
- Together, these case-study analyses form a foundation of information to support development of other planning documents which are the primary deliverable products of the grant-funded project—a *Resilience Performance Indicators* interactive tool and a *Resilience Roadmap* for historic sacred places in the Texas Gulf Coast region, both available on the project website.

The overall goal of the analyses is to determine possible Resilience Treatments and Strategies (RTS) that may reduce the risk or mitigate the impact of future disasters and increase the resilience of the cultural resources.

Throughout the project, the research team has sought insight from national, state, and local nonprofit organizations, private professional practices, local regulatory offices and community leaders, other sacred places in the Texas Gulf Coast region, plus staff and congregation members of each case study. The Knowledge Café Workshops took place in 2021 to convey preliminary findings, receive input, and guide future planning efforts. Oversight of the project throughout was conducted by the THC.

## Context and History

### *Site Layout*

K'nesseth Israel Synagogue is located on the southeast corner of its city block, along W Sterling Avenue and N Commerce Street, with its principal south façade facing W Sterling Avenue. Its plan is simply rectangular. Its overall length along the wall area is 50'-11" and overall width is 36'-0". The interior span of the sanctuary is 33'-11" wide. A detached social hall (a.k.a. community building) is located just north of the sanctuary.

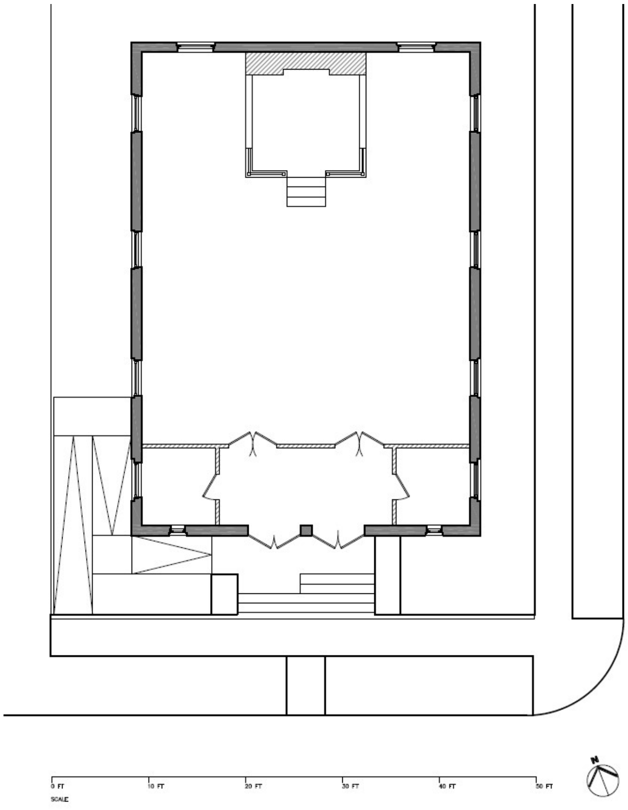


**Figure 5.03**: Floor plan of K'nesseth Israel sanctuary. Scaled drawings are provided in Appendix G.

### *Building Chronology*

A congregation of 20 incorporating members formed K'nesseth Israel Synagogue in 1928. That same year, the new congregation purchased the lot from Goose Creek developers Sterling Properties. Houston architect Leonard Gabert was hired to design the building, which was estimated to cost around $18,000. $5,000 of the requisite funds were raised, and the remaining funds were provided with a loan from the American National Insurance Company of Galveston. Mr. C.I. Fortinberry was hired as the contractor and completed the building late that year. A separate community building was also erected to the north of the synagogue at the same time or shortly after.

The building footprint of the sanctuary has remained unchanged; the only significant modification to the building's interior was the installation of air-conditioning by 1990. The adjacent community building was enlarged in 1948 and substantially remodeled in 2018.

In 1991, K'nesseth Israel Synagogue became a Recorded Texas Historic Landmark. Additionally, the U.S. Department of the Interior determined

K'nesseth Israel eligible for listing on the National Register of Historic Places in 2020. The synagogue and community building have undergone extensive repairs following Hurricane Ike in 2008 and Hurricane Harvey in 2017, as described below.

### *Historical Storms, Damages, and Repairs*

Since K'nesseth Israel was completed in 1930, it has been affected by numerous extreme weather events, particularly tropical storms (e.g., hurricanes). These include at least 24 known tropical storms, of which at least 2 are known to have caused serious damage. Strengths of the storms below are given in the current Saffir-Simpson scale to allow direct comparisons between them, which may differ from the historical classifications. Those that were at major hurricane strength (Category 3 and above) when they landed at or near Baytown are bolded, as well as lesser storms that were particularly devastating. Wind speeds given below generally refer to maximum recorded sustained wind speeds. It is typical in hurricanes for acute gusts of wind to far exceed these speeds, although only for a few seconds at a time.

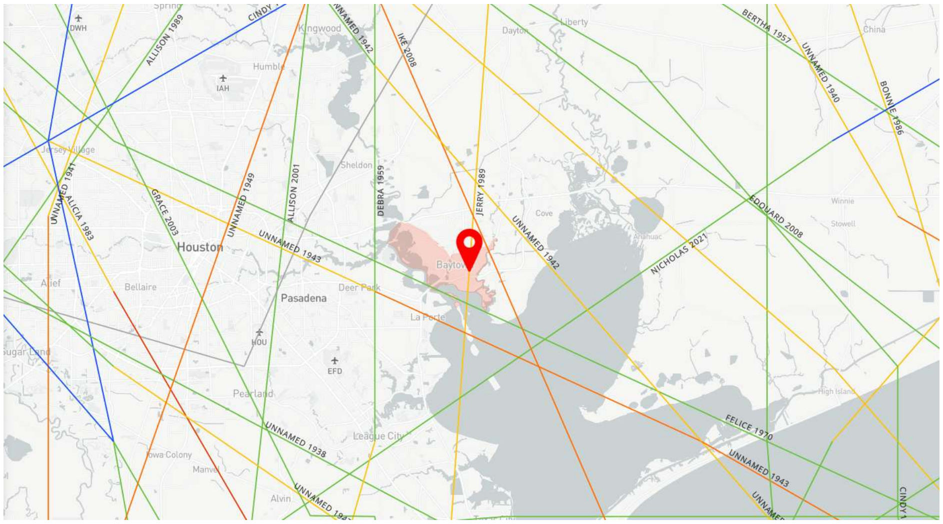


**Figure 5.04**: Paths of storms since 1930 (NOAA). The lines represent the centerline of each storm, although the effects are typically very widespread.

Early on, a series of storms impacted the area within a short span during the mid-20th century, but they caused little or no damage to the structure. The 1941 "Texas Hurricane" struck the Houston area on September 24, dropping over 5 inches of rain in a 24-hour period, although flooding was minimal in Baytown. By then it had downgraded from a Category 1 hurricane to a tropical storm, with sustained wind speeds up to 65 mph. The following season, the 1942 "Matagorda Hurricane" struck the area on August 30 as a Category 1 hurricane, with sustained wind speeds up to 80 mph. The following season, the 1943 "Surprise Hurricane" struck the area on July 28. It had also downgraded from a Category 1 hurricane to a tropical storm, with sustained wind speeds up to 65 mph. In 1945, another "Texas Hurricane" struck the area on August 27 as a Category 1 hurricane, with sustained wind speeds up to 75 mph. In 1947, Hurricane Dog-Easy struck the area on August 24. It was another tropical storm, downgraded from a Category 1 hurricane, with sustained wind speeds up to 70 mph.

The first major hurricane to strike the Houston area in K'nesseth Israel's history was the **1949 "Texas Hurricane."** It made landfall on October 4 as a Category 4 hurricane, with sustained wind speeds up to 135 mph. No historical damages were recorded, however. It would be some time before another storm struck the area, which was Hurricane Debra in 1959. It made landfall in the area on July 25 as a Category 1 hurricane, with sustained wind speeds up to 75 mph.

Another major hurricane struck in 1961. **Hurricane Carla** struck the Texas Gulf Coast farther south as a Category 5 hurricane, with sustained wind speeds up to 175 mph (see Figure 5.05). It also brought extreme rain, dropping at least 10 inches in the Houston area (more precise measurements are unavailable). Despite the extreme conditions, no damages to the structure were recorded.

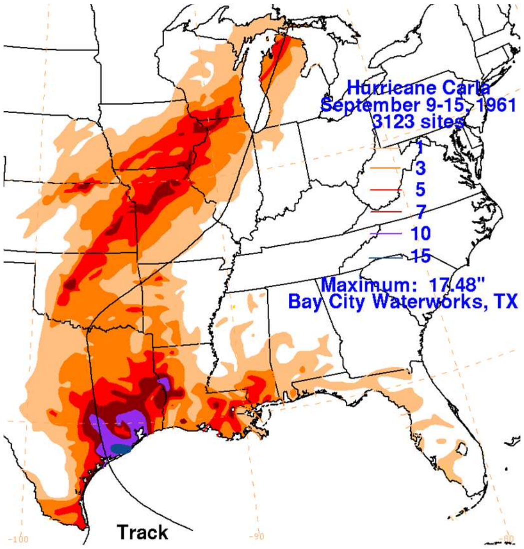


**Figure 5.05**: Path of Hurricane Carla and associated rainfall (NOAA).

Following Carla were some minor storms. Tropical Storm Claudette struck in 1979 and Tropical Depression Eight in 1981. The next hurricane was in 1983 when Hurricane Alicia made landfall in Houston on August 18 as a Category 1 hurricane, with sustained wind speeds up to 90 mph.

In 1989, 3 storms struck the Houston area. The first was Tropical Storm Allison on June 26 which only brought sustained wind speeds up to 50 mph. Hurricane Chantal then struck the area on August 1, again at that point a tropical storm and only bringing sustained wind speeds up to 60 mph. The biggest storm of the season was Hurricane Jerry, making landfall in the Houston area on October 15 as a Category 1 hurricane. Tides were recorded as high as 8 feet at the Houston Ship Channel and sustained wind speeds were up to 85 mph. No historical damages were recorded for any of these storms.

In 1998, Tropical Storm Frances struck the Houston area on September 11. Although it was only a tropical depression, it caused flooding in Houston as high as 7 feet. Similarly, Tropical Storm Allison struck the area on June 6, 2001, causing flooding as high as 7 feet a few days later. Neither flooded Baytown enough to inundate the building. Another minor event followed in 2003 with Tropical Storm Grace, landing on August 31.

The 2005 Atlantic hurricane season was exceptionally active, gaining notoriety for Hurricane Katrina's impact in Louisiana. Although not as devastating in its effects, Hurricane Rita was more powerful than Katrina and made landfall in the Houston area on September 24. Formerly a Category 5 hurricane, Rita had downgraded to a Category 1 hurricane by then, with sustained wind speeds up to 75 mph. Flooding was reported in Houston up to 3 feet, but neither wind nor flood seem to have caused serious damage to the structure. Following Rita was a small event in 2007, when Tropical Storm Erin reached the Houston area on August 16. Although wind speeds were low, floods were reported in Houston over 6 feet.

The 2008 Atlantic hurricane season was perhaps the most devastating in the history of K'nesseth Israel. An early event, Tropical Storm Edouard, struck the area on August 5 with little effect. However, this was followed by **Hurricane Ike** which directly struck the Houston area on September 13 as a Category 2 hurricane. When it hit, it brought sustained wind speeds up to 100 mph, caused about 11.5 feet of flooding in Houston, and knocked out power to 2.6 million people across Texas and Louisiana. As Ike traveled directly from Galveston Bay to the Houston Ship Channel, it landed directly over Baytown, exposing it to the brunt of the hurricane's force (see Figure 5.06). The community building was particularly damaged, with the majority deemed a total loss. The building was rebuilt following a $70,000 insurance settlement and reopened in 2009 (Howard, 2010).

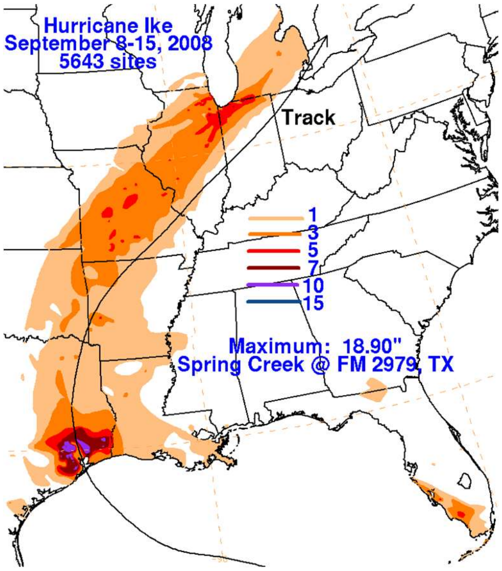


**Figure 5.06**: Path of Hurricane Ike and associated rainfall (NOAA).

After Ike was a period of several years where no tropical storms approached the Houston area, although other weather events occurred that could contribute to accelerated deterioration of building materials. A drought occurred in the early 2010s, which was exceptionally severe in the summer of 2011. A significant winter storm also occurred in February 2011. In the spring of 2015 and 2016, a series of severe flash floods struck the Houston area (the "Memorial Day" flood and "Tax Day" floods, respectively). The 2015 event was caused by rain farther inland and the effects in the Houston area were mostly flooding along waterways. The 2016 event was much more severe, with flooding of 5.5 feet recorded in Houston. While none of these events were reported to cause damage to K'nesseth Israel, they reflect the increasing frequency and intensity of extreme weather events besides hurricanes.

In 2017, the site was again struck by a severe hurricane. **Hurricane Harvey** had been classified as high as Category 4 before striking farther south along the Texas Gulf Coast on August 25. Over the next several days, Harvey passed back into the Gulf and made landfall west of Baytown. It had downgraded to tropical storm status, but dropped extreme amounts of rain with an estimated 40 inches falling on K'nesseth Israel over 4 days (see Figure 5.07). Rainfall was over 50 inches in some surrounding areas, causing severe flooding. Floodwaters over 11 feet above sea level were recorded in the Houston Ship Channel. This wind-driven rain penetrated the envelope of the sanctuary, waterlogging interior finishes and furnishings. The water damage rendered the building unsafe to occupy until it could be restored. A grant of $145,307 was approved from the National Park Service's Emergency Supplemental Historic Preservation Fund for the restoration, which began in October 2018. (THC, n.d.; Weiner, 2018; James, 2019). Some interior finishes were changed (e.g., exposed wood flooring instead of carpet) but the exterior was preserved.

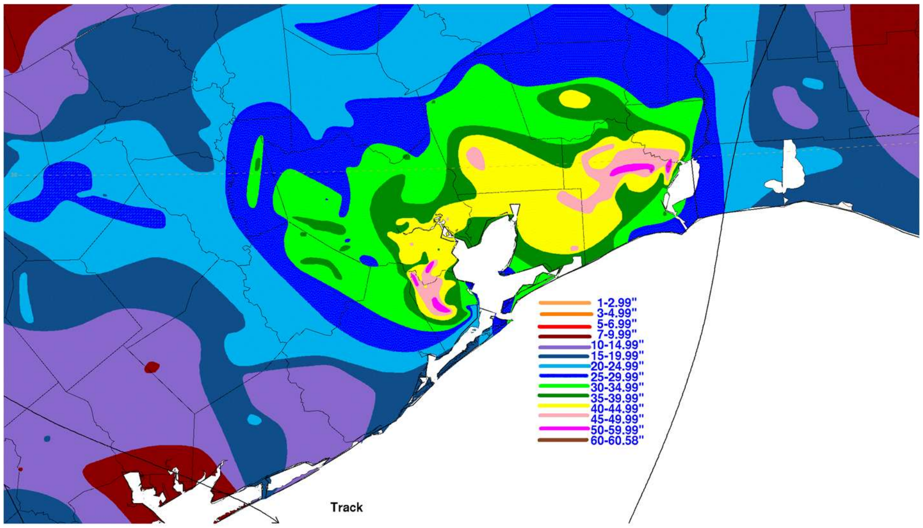


**Figure 5.07**: Path of Hurricane Harvey and associated rainfall (NOAA).

In recent years, Tropical Storm Imelda struck the Houston area on September 17, 2019. The rain caused flooding in Houston over 4 feet, but the site of K'nesseth Israel was unaffected. In February 2021, an extreme winter storm (a.k.a. "Uri") impacted much of Texas which historic buildings like K'nesseth Israel were not designed for. Uninsulated pipes froze, although they were not reported to have ruptured. Later in the year, Hurricane Nicholas made landfall farther south on the Texas Gulf Coast as a Category 1 hurricane. By the time it reached the Houston area on September 15, however, it had downgraded to a tropical storm and did not damage the structure.

## Evaluation of Significance and Integrity

### *Significance*

Congregation K'nesseth Israel was formed in 1928 by Jewish residents of the area. To accommodate the population growth that followed an oil field boom in Goose Creek, the congregation commissioned local architect Leonard Gabert to design the building and construction was completed in 1930. K'nesseth Israel Synagogue became a Recorded Texas Historic Landmark (RTHL) in 1991. The context of the history at this site also includes cultural and social intangible heritage. Additional information on architectural descriptions can be found in the THC Survey Form completed for this project, attached as Appendix F.

### *Character-Defining Features*

The character-defining features of K'nesseth Israel Synagogue include its shallow barrel vault roof with parapet, buff brick veneer façade, and round-arched stained glass casement windows. These defining features all remain intact with the synagogue.

### *Assessment of Integrity*

Based on the National Register's aspects of integrity, **K'nesseth Israel Synagogue has an overall high level of integrity**, as follows:

| | | |
|---|---|---|
| Location | K'nesseth Israel Synagogue remains at the location of its construction, at the southeast corner of present-day W Sterling Avenue and N Commerce Street. | High |
| Design | K'nesseth Israel Synagogue retains its original architectural features, proportion, and scale with minimal material alterations due to repair. | High |
| Setting | The building's setting remains intact within Baytown's Goose Creek neighborhood. | High |
| Materials | The materials of K'nesseth Israel Synagogue's character-defining features have been mostly retained with some alterations from necessary repair, including replacement bricks patching damage on the north façade and composite decking for an accessibility ramp. | Moderate |
| Workmanship | K'nesseth Israel Synagogue appears consistent with the Art Deco style of the era. | High |
| Feeling | The feeling of K'nesseth Israel Synagogue is intact as the interior and exterior remain unchanged from their original design. | High |
| Association | The association between K'nesseth Israel Synagogue and its historical uses remains evident through its religious, civic, and educational functions. | High |

## Objectives and Methods

The objectives of all case-study visits are to conduct a visual assessment of the case-study by filling out a *UTSA-CCS Survey & Vulnerability Assessment* form, gather information and documentation, and collect soil samples for analysis. A significant component of understanding resilience is assessing the current condition of the resource. Although case-study visits are limited in access and scope relative to a full condition assessment, the findings and recommendations in this report can serve as the basis of continued evaluation. Information on historical events, system performance, or hidden assemblies was provided by people facilitating the site visit, unless otherwise noted.

The *UTSA-CCS Survey & Vulnerability Assessment* is principally concerned with the threats from hurricanes. The form designed by the research team collects information regarding the physical condition of 17 categories of building assemblies, as well as 8 categories regarding the risk posed to the building by broader site-specific and environmental threats (provided in Appendix A). To achieve an overall vulnerability score for the case-study, each category is weighted to consider its importance to the structural soundness of the building; its exposure to the elements; the likelihood of damage; and the impacts of damage to that category regarding recovery efforts.

Each physical element (building assemblies and services) is assessed as “excellent,” “good,” “fair,” “poor,” or “critical” in order of best condition to least. Risk posed by site conditions is more complex to assess, but follows a similar 5-point scale as condition. Each aspect of the site is assessed as “minimal risk,” “some risk,” “moderate risk,” “high risk,” or “extreme risk.” The criteria for each condition or risk are given in Appendix A. The method for assessing risk due to environmental hazards is further detailed in Appendix D, along with findings.

2 UTSA-CCS staff visited K’nesseth Israel on Saturday morning March 20, 2021. Due to UTSA’s COVID-19 pandemic travel policies, other team members joined by videoconference for an hour during the visit. The extents of the survey include the 1930 sanctuary but not the detached social hall.

## Rapid Assessment of Building Conditions

### *Substructure*

The foundations are a reinforced concrete perimeter beam on grade. Only 1 small diagonal crack is visible in the perimeter beam in the southeast corner, but the wall above it shows no stress in the area. While the foundations of the building appear sound, site elements like the front stair and its 2 cheek-walls show ample signs of settlement or stress. Overall, **the foundations are in good condition**.

**Figure 5.08**: Cracks visible on the front stair cheek wall foundations.

A crawl space is accessible from hatches in the sanctuary. The crawl space has multiple vents in 3 exterior walls, covers the entire area of the sanctuary, and is tight, with a height of about 18" between grade and the underside of joists. The crawl space has a dirt floor with no protective membrane and the area exhibits elevated humidity, a condition which may engender future mold growth, though none was noted. **The crawl space was observed to be in good condition**.

**Figure 5.09**: Perimeter beam and floor framing visible from crawl space hatch.

### *Shell*

The first-floor finished elevation is 2'-9" above grade at the front entry on the south façade. Property managers reported that much of the floor of the sanctuary was repaired or reframed in a 2018–2019 restoration, replacing joists that had rotted down from 1½" to as thin as ½". The replacement joists seem to match historic framing, but may be vulnerable to similar water damage in the future if they are not protected by coatings. Presently, **the floor framing is in excellent condition**. A new exterior ramp was installed as part of the 2018–2019 restoration and is also in excellent condition.

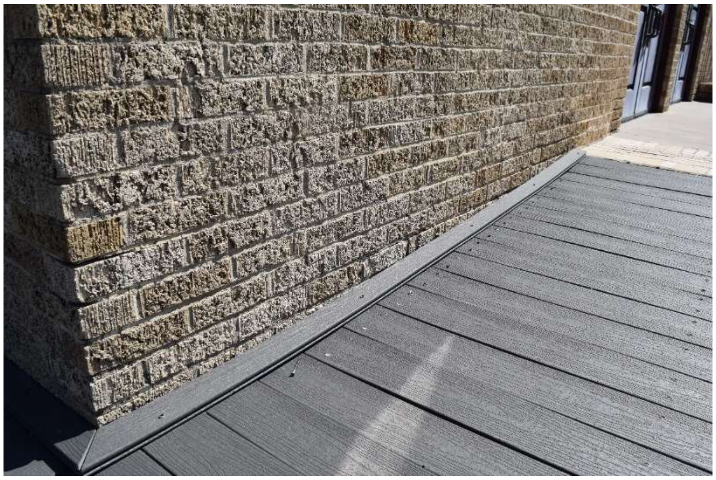
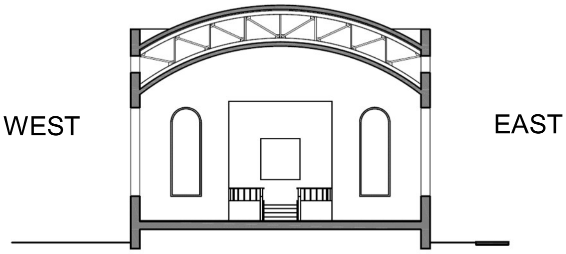
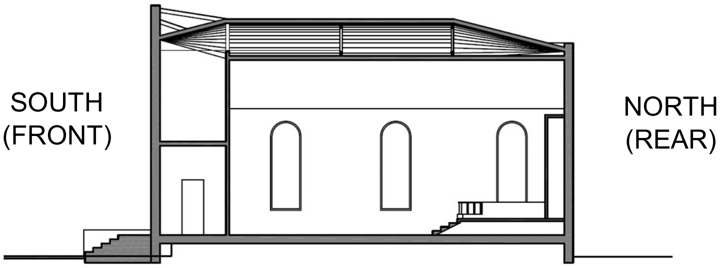


**Figure 5.10**: New exterior accessibility ramp with composite decking.

The roof is a unique shallow barrel vault shape. From the interior, it appears as a normal barrel vault along the length of the sanctuary with an inner radius (to ceiling) of about 27'-6" and an exterior radius (to top of roof) of about 32'-5". The north and south ends, however, do not terminate in an arch at the exterior but pitch down with a double curvature within the attic cavity to linear parapets. This unusual roof shape funnels water to all corners. There is no drainage at the south (front) end of the building and the east and west edges are shallowly cricketed to direct water flow northward, but not enough to prevent some standing water in each corner. Property managers reported leaks at the north corners have been a common occurrence for a very long time, indicating that the 2 drainage ports may be undersized to drain the whole roof area. The roof underlayment or flashing has evidently failed in both corners and it has leaked into the cavity, damaging the finishes on the interior at these locations and part of the masonry parapet as well. The rapid onset of this damage, apparent within a year of the roof restoration, is cause for immediate concern that should be addressed quickly to prevent further damage. The roof could not be directly observed from above or in the cavity at the area of failure to provide a more detailed diagnosis of failure. Still, **roof materials, including flashings and trim, appear to be in critical condition**. The **brick parapets are in poor condition**, displaced outward in the northwest corner. The coping is also visibly lifting off in that corner, likely exacerbating other failures in that area.





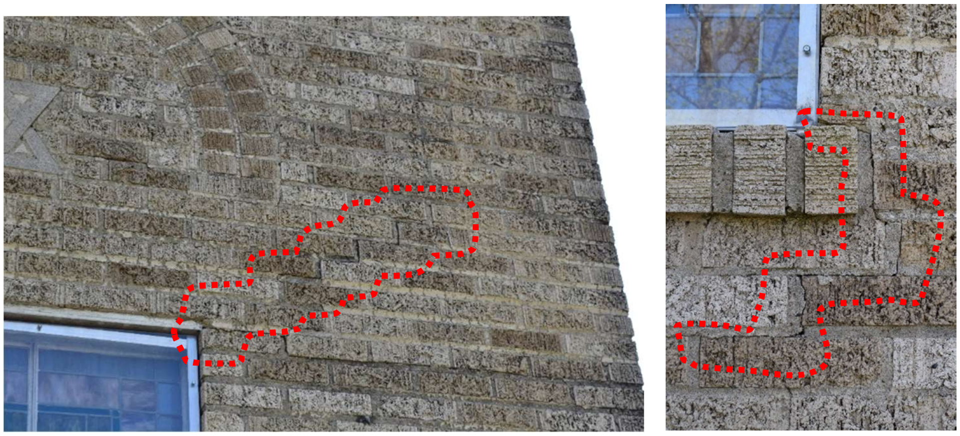
**Figures 5.11, 5.12, and 5.13**: Roof viewed from a preliminary site visit in February 2020 where standing water was observed at each corner (top). Transverse (middle) and longitudinal (bottom) drawings showing the shape of the roof.

**Figure 5.14**: Coping tiles lifting up in the northwest corner due to damaged parapet. Lifting and displacement likely caused by corrosion of metal built into wall assembly.

Roof attachments include just 2 downspouts attached to scuppers in the north side of the building. They appear to be in good condition structurally and cosmetically, although they appear to be undersized for the amount of roof area. There also appears to be no drainage overflow outlet, so if drains are overwhelmed during heavy rains, water would stack behind the parapet walls. There does not appear to be staining or any other signs of downspout failure on the exterior. Stains on the interior suggest that the failure occurs at the juncture of roof surface materials and brick parapet wall. The downspouts discharge onto a river rock bed with a subgrade French drain that daylights into the street. The downspouts are not connected directly to this drainage system, and the soil erosion around the northwest downspout suggests that much of the water is missing the drain and wetting the soil around the foundation. Also, because there are no means of directing the water away from the building, stains around the mouths of the downspouts have formed on the foundations and may eventually damage the masonry over time if left in its present state. **Although the roof attachments themselves appear to be in good condition, their installation and observed damage in their vicinity indicates the overall system performance is poor**.

**Figure 5.15**: Downspout at the northwest corner of the building discharging partially into subgrade drainage but also directly onto the soil next to the foundation.

The exterior walls are constructed of a wood frame with wood sheathing and brick veneer. Signs of structural stress are visible in many areas. Long step cracks were observed around the headers of many of the windows, the most prominent at the southwest corner, as well as smaller step cracks around some of the window sills. It is not known how new these cracks are or whether their condition is worsening. They should be monitored to determine if they are stable or indicative of structural concerns. Most of the window headers have fine cracks between some of the voussoirs. The voussoirs themselves appear to be split bricks, some of which may be weathering and depositing fine pieces of masonry over the window exteriors or interiors. A finite element analysis (FEA) was conducted by the UTSA-CCS team to reveal potential stresses affecting the walls. Findings are summarized in the FEA section below, and the full report is provided as Appendix C. Overall, **the exterior walls are in fair structural condition**.



**Figures 5.16 and 5.17**: Step cracks emanating from the upper right and lower right corners of the southernmost window on the west façade.

The exterior wall finish is exposed brick. Select areas need repointing (about 10% to 20% of the mortar area), particularly towards the base of the building and especially around the 2 projecting cheek walls at the south end of the building. There are many exterior cracks that should be repaired, after it is understood why the major cracks have formed and whether they are worsening. There are a few anchor holes on multiple façades from former objects that were pinned to the brick, such as a fence on the north side of the building. Some of the bricks towards the base of the north wall were used to repair damage on the east wall and have been replaced with modern brick. There is little to no staining, biological growth, or efflorescence and the walls do not need to be cleaned, with the exception of rust stains described in the door description further below. The overall **condition of the exterior enclosure (wall surfaces) is fair**.

**Figures 5.18 and 5.19**: New bricks at the north wall (left) and relocated bricks on the east wall (right) taken from that location on the north wall.

**Figures 5.20 and 5.21**: Deteriorated mortar in need of repointing. Anchor holes in the masonry on the west façade.

Exterior windows are all metal casement windows and appear to have once been operable. The large round-arched windows in the sanctuary are 3 lites wide and 5 lites tall, with the bottom row of lites as a hopper and the middle 2 rows as a center pivot. The shorter windows at the sides of the bathroom and storage rooms are also 3 lites wide and just 4 lites tall, with just the center pivot. The small round-arched windows in those same rooms on the south façade are crank windows that once swung outward. All these windows have been made inoperable by a thin (approximately ¼") polycarbonate panel bolted to the brick surrounding all edges, providing some protection from debris and vandalism (but not hurricane-rated protection). There are no vents in the polycarbonate panel, although the edges are not sealed which allows moisture to vent away from the windows around the sides. At 1 window, a hornets' nest has been built behind the polycarbonate panel, indicating why insect-proof vents inserted in the pane are preferable to gaps around the edges. The lites are single pane opalescent stained glass without protective membrane coatings. Windows account for about 12% of the wall area on the east and west façades, only 2% on the south façade, and about 8% on the north façade. The windows were recently repaired as part of the 2018–2019 restoration. A couple of panes are cracked, although they appear stable. Some of the window surrounds have cracked plaster around the interior header and some, especially the eastern window on the north wall, have fine debris on the sill, possibly from insects or bats (several were observed inside) or from damaged panes that allow dust inside. The metal frames appear to be in good condition structurally, and their paint is generally sound, with slight wear and imperfections typical for early-20th century casements. The inoperability of the windows could hamper efforts to air out (ventilate or dry) the building in a post-disaster recovery phase. Still, despite some compromised resiliency, **the condition of windows in general is good**.

**Figures 5.22 and 5.23**: A typical sanctuary window with protective polycarbonate panel bolted to the masonry. Concentration of loose debris on window sill of the eastern window on the north wall.

There are 2 sets of exterior doors on the south façade. Both are large solid wood double doors, serving as the main entrance. Although building code analysis is beyond the scope of this assessment and code compliance may be balanced with preserving historic integrity, the quantity and location of the egress may be insufficient depending on the number of people allowed in the assembly space. The wood door frames and slabs are presently in good condition, although their finishes have been almost entirely lost on the exterior and they are vulnerable to weathering. Some cracks are already starting to form, and the condition will likely worsen soon without refinishing. The weather tightness is fair. However, the interior has a lower finished floor elevation than the exterior, creating a possibility for water infiltration and ponding, especially from wind-driven rain. The steel lintels above the doors are also causing structural issues in the wall. Although they are mostly embedded within the masonry and not available to observe directly, it appears that the steel is oxidizing, jacking up the cast stone lintels they support and putting stress on the masonry above, manifesting in cracks radiating from the doorway and bricks shifting out of plumb. This also seems to be causing some localized red staining around the doorways. Although the doors themselves are in fair condition, their vulnerabilities and the deterioration of the lintel indicates that **the overall condition of the exterior door openings is poor**.

**Figures 5.24 and 5.25**: Cracked panels on the front door with no protective coating. Oxidizing steel lintel above the front doors jacking the masonry above upwards and outwards.

There is only 1 set of stairs which is at the exterior, leading to the entrance. These cast-in-place concrete stairs show many hairline cracks, causes undetermined, likely due to uneven settlement, minimal foundations, and/or a lack of expansion joints. Half of the staircase has been converted to a landing for a new (installed 2018–2019) accessibility ramp. Overall, **the condition of the stairs is fair**.

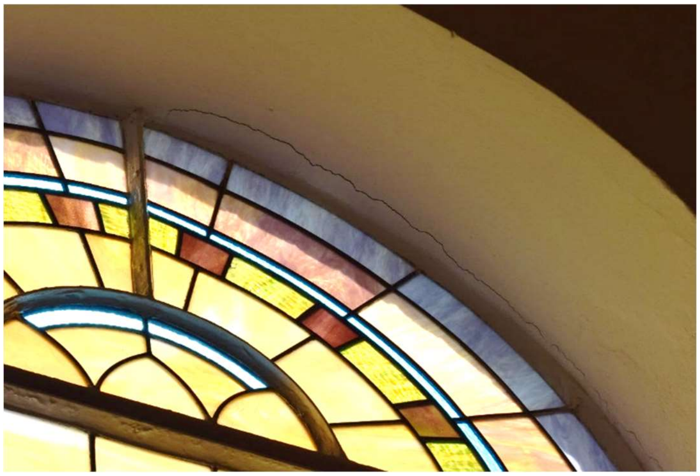
### *Interiors*

Only the interior wall between the entry vestibule and the sanctuary space is structural. Its framing extends up to, and supports, the roof. 2 steel trusses support the roof over the sanctuary space. Metal tie-rods run longitudinally (north-south), connecting these transverse structural elements together. No issues were observed, although only the area around the attic hatch could be directly observed. Property managers expressed concern that bolts connecting the trusses to the exterior wall may be loose or have come undone in the northwest corner near the damaged parapet. This area could not be accessed to confirm that condition. Without more detailed observation, all **interior structural components appeared to be performing in good condition**.

**Figure 5.26**: Steel truss and ceiling framing in good condition where observed, viewed from the southeast corner.

The interior finishes are painted plaster walls and painted wood trim. Some of the crown molding is no longer in contact with the ceiling. Future analysis should determine the cause of separations between ceiling and crown molding before repairs are made, as it is possible the ceiling is lifted up in connection with the deforming parapet. The main floor and the bimah are wood floors which are mostly in excellent shape, the exception being stains from water damage at the entrance threshold and the north corners. The walls are also stained in these corners. As mentioned above in the window description, small cracks have formed along the inside of some of the round window headers. Overall, **the interior finishes are generally in good condition** and would be excellent if not for recent water damage. Those isolated areas are in fair to poor condition.

**Figure 5.27**: Water damage to ceiling and walls in northwest corner (northeast corner exhibiting similar damage).



**Figures 5.28 and 5.29**: Weathered floor near the entrance threshold. Cracked plaster near a window header on the east wall.

### *Services*

The building is 1 story and has no need for elevators. No issues were observed with the interior plumbing, although the exterior faucet was faulty and may have sustained damage from the recent Winter Storm Uri. The HVAC system was not on at the time of our visit. Property managers did not report any issues with it. There is no fire suppression system installed, leaving the combustible materials vulnerable to fire. There is also no means of generating emergency light or power besides emergency exit signs, limiting the potential for the building to be occupied or quickly repaired in the aftermath of a disaster. The overall **assessment of the services in general is that they pose moderate risk to the structure**, as the lack of critical systems leave the structure vulnerable to multiple disaster events.

## Site and Environment Conditions

### *Ancillary Buildings*

The site has a detached hall about 12 feet to the north of the sanctuary which seems to have once been a manufactured structure, now substantially modified and wood clad. Although it is very close to the sanctuary, the risk of it causing fire or water damage to the main structure is slight. Other surrounding buildings are sufficiently distanced to pose no obvious risk to the sanctuary in a disaster event. The total **assessment of the site buildings is that they generate some risk to the sanctuary**. Specifically, the sanctuary has some vulnerability to fire due to the proximity and materials of the detached hall.

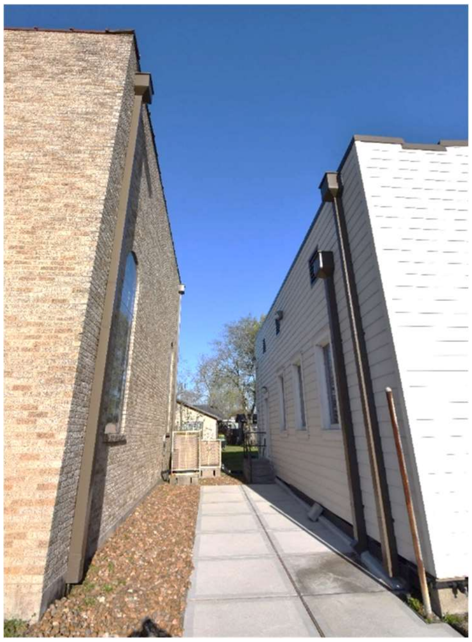


**Figure 5.30**: Area between the north end of the sanctuary and the detached hall. This area is also visible at the right of Figure 5.11.

### *Soil*

3 soil samples were analyzed by UTSA-CCS. The full report is provided as Appendix B. Findings include a moderate moisture content, high clay content (the classification being clayey sand), and low strength. In general, this soil is stable and its potential for swelling is low, but prolonged soaking can cause the strength to further weaken and **the soil may pose moderate risk to the structure**. Specifically, the sanctuary is vulnerable to uneven settlement of the foundation if the soil's moisture content becomes elevated for a prolonged period. The risk is greatest where the ground surface lacks cover of vegetation or paving, because then soil is exposed to the elements and may saturate faster. The ground around K'nesseth Israel is covered by sidewalks and healthy turf vegetation, with good thatch. There is no visible evidence of soil strength problems.

**Figure 5.31**: Soil sample collected from the east side of the sanctuary.

### *Flood Risk*

The site does not fall within any FEMA (Federal Emergency Management Agency) Special Flood Hazard Areas or NOAA (National Oceanic and Atmospheric Administration) Storm Surge categories. The current FEMA Flood Insurance Rate Map (FIRM) and NOAA National Storm Surge Hazard Maps, which all project that the site is not vulnerable to hurricane-based flooding, are included in Appendix D. The topography of the site and its environs is relatively flat, only slightly varying between about 25 and 30 feet above mean sea level (MSL). The site and surrounding blocks are among the highest points in Baytown. The finished floor elevation is about 30 feet above MSL. The **vulnerability of the site to flooding is minimal risk**.

### *Stormwater Control Systems*

There are no inlets to a municipal stormwater drainage system in the immediate vicinity of K'nesseth Israel. Property managers reported no past problems resulting from inadequate stormwater drainage at the building site. Surface water from past storms has evidently been sufficiently conveyed away from the site by the local topography.

### *Environment*

There are multiple environmental hazards nearby that could lead to contamination or damage of the structure in a disaster. These include a large oil refinery nearby (about 1.6 miles away) and several others in the area; several power stations within a 50 mile radius (closest about 2.7 miles away); a freight rail line (only about 95 feet away); a couple freight rail yards in the area; and 10 current sites on the Environmental Protection Agency (EPA) Superfund National Priorities List (NPL) within 25 miles of the structure. A detailed analysis, listing and mapping these threats, is provided in Appendix D. The vulnerability **assessment is that neighborhood-level hazardous sites pose extreme risk to the structure**.

## Assessment of Space Use

***Capacity***

Currently, the sanctuary encloses about 1,653 square feet of interior, climate-controlled space. Within this area, the sanctuary comprises about 1,341 square feet of floor area (excluding the Torah ark) and about 1,209 square feet if excluding the bimah (or about 939 square feet of the area in front of the bimah). Pews are typically used in this space for the congregation, although they were damaged by Hurricane Harvey and in the process of restoration at the time of our visit, temporarily replaced with foldable chairs (with capacity for about 50 persons). The only circulatory space is the entry vestibule at about 142 square feet. Other spaces include the bathroom and storage room (each about 61 square feet).

Historically, the space uses have not changed.

Based on the space available (floor area in front of the bimah), occupancy of the assembly space (sanctuary) in a concentrated scenario (e.g., for refuge during or following a storm, calculated at 7 net square feet per person given in the International Building Code) should not exceed 134 persons. This is based on the use of foldable seating. When the pews are returned, this capacity will decrease. Note that this figure is hypothetical for planning purposes only, actual occupancy loads should be determined by local authorities and adhered to. As mentioned above regarding entrances, it is also important to note that there is not a secondary means of egress so there is a safety concern with loading the building near its hypothetical maximum capacity.

Although it was not principally studied, the detached social hall (enclosing about 2,205 square feet of climate-controlled space) provides about 1,895 square feet of assembly space. This would have a hypothetical maximum capacity of 270 persons in a similar concentrated scenario, although the current furniture (large tables) in that area makes this impractical.

## Community Services

***Method***

In 2021, Partners for Sacred Places applied a modified version of its *Economic Halo Effect of Historic Sacred Places* tool to Congregation K'nesseth Israel to assess its individual impact and evaluate the need for public investment in the maintenance and preservation of its historic structures. More information on how the *Economic Halo Effect of Historic Sacred Places* tool was developed and is applied is provided in Appendix A.

The findings below are based on a series of surveys conducted in November and December 2021 with key leadership and staff. The interviewer focused on the last 5 years of congregational life and community-serving programs. Congregation K'nesseth Israel is a small congregation (with less than 75 active members). Still, it contributes about 170 volunteer hours of labor annually to regular community-serving efforts, and so illustrates the outsized impact a house of worship can have in its community.

### *Resource Distribution*

One of the primary roles that congregations play is that of resource distribution to community members in need. By serving as hubs for donations and coordinating the delivery of donations, congregations are able to supplement social safety net programs. Congregations often hold "drives" for specific resources around a specific need, usually in conjunction with significant dates or seasons in the congregation's life. Drives may also be triggered by local disasters or crises, responding to an immediate need within the community. Drives are a popular community-serving activity because they rely on a small number of individuals to coordinate donations; partnerships with local social service organizations decrease the labor of distribution. This means that congregations with low membership numbers can still participate in and serve their community in meaningful ways.

Congregation K'nesseth Israel coordinates annual food drives that coincide with fasting periods within the Jewish liturgical year. Congregation members contribute grocery bags full of nonperishable food items, which are then given to a local feeding program for distribution. The congregation also hosts an annual holiday drive for the local homeless shelter, complete with a Santa to distribute donated gifts to the residents. Combined, these efforts translate into $1,300 worth of resources that are donated/distributed annually.

### *Crisis and Disaster Response*

Congregations and houses of worship play vital roles in the response and recovery efforts after a natural disaster or local crisis. They are often the place their communities know they can go for help, and so often become emergency distribution centers, shelters, and clinics in the immediate aftermath of a natural disaster. These efforts may or may not be coordinated with larger efforts led by local emergency management, but nevertheless are key contributions to the response effort. All the congregations in this survey participated in some sort of emergency response in the wake of recent weather events (e.g., Hurricane Harvey, Winter Storm Uri) and the COVID-19 pandemic.

Efforts include organizing emergency supply drives in response to a local disaster, coordinating the donations and distributions of food, clothing, diapers, and hygiene products. Congregations also reported informal "wellness checks" that members participate in after disasters and crises, providing a crucial touchpoint for elderly members who may have less access to supports during and after these events.

### *Mutual Aid and Internal Support*

Although internal congregation efforts to assist and support their own members are rarely reported on or counted as valuable services, houses of worship are crucial to the social safety net by creating a network of resources and support around their own members who are part of vulnerable, marginalized, and/or underserved populations. By providing mutual aid, congregations are able to meet the immediate material, emotional, and social needs of their members and members' families. These efforts should be interpreted as part of our larger public health, social service, and disaster response efforts.

Congregation K'nesseth Israel's reported mutual aid efforts were centered around disaster response, ensuring that member families had access to potable water, cleaning materials, clothing, and food in the wake of Hurricane Harvey and Winter Storm Uri. Again, these efforts should be seen and interpreted as key activities in a larger emergency response system. These informal wellness checks and resource distribution initiatives ensure the safety and security of Baytown residents who happen to be members of K'nesseth Israel, supplementing the more formal efforts coordinated by local emergency management.

### *Local Culture and Heritage*

Historic houses of worship serve as anchors for local heritage and culture. They are sites for arts and culture programming and events, stewards of musical and oral traditions, and physical touchpoints for historic events and commemorations. They often play vital roles in cultural education and promotion through partnerships with other cultural institutions and participation in local heritage events. All the congregations in this survey see this role as a steward of heritage as a priority of the congregation and as an important function of the facilities themselves.

Congregation K'nesseth Israel works to promote and educate the local community about Judaism as a religion and the experience of Jews in Texas. Before the COVID-19 pandemic, the congregation would regularly host tours for youth members of the local Catholic church, the local middle school, and students from Lee College. These tours would introduce participants to Jewish folklore, rituals, and symbols, providing an opportunity to learn about key characteristics of theology and practice for the Jewish faith. For many of the youth and students, this was their first experience of being inside a synagogue and hearing about the practice of the Jewish faith and the lived experience of their Jewish neighbors. This kind of interreligious dialogue and cultural exposure is a significant factor for increasing religious tolerance and cultural literacy; its value is immeasurable. The synagogue is also the only Kosher building in Baytown, which provides a venue and space for observant Jewish residents to host celebrations and events. The congregation has also lent out its own religious artifacts, including Torah scrolls, to newly planted synagogues—this allows these synagogues to practice their faith while they are building their own capacity to commission and acquire needed artifacts for religious observances and liturgy.

### *Capacity Building and Partnership*

Congregations serve as capacity builders for local community-serving and charitable organizations, lending their volunteer labor, material resources, and their space for activities that benefit the wider community. These local partnerships amplify important community initiatives and increase the impact of these organizations. All the congregations in this survey participate in larger fundraising and community-serving efforts that are organized and coordinated by partner organizations, thus making a major contribution to those organizations' impact. Each of the congregations surveyed have longstanding relationships with local community-serving organizations that enhance each other's capacity to fulfill their mission and impact their communities in positive ways. The volunteer labor that congregations contribute to this effort is especially valuable, saving these charitable organizations $26.43 per every hour worked.

Congregation K'nesseth Israel organizes an annual fundraiser that supports Hadassah International, an international nonprofit dedicated to supporting the Hadassah Medical Center in Jerusalem. This fundraiser regularly collects over $5,000 for Hadassah International and is made possible by Congregation K'nesseth Israel contributing over 120 hours (valued at $3,171.60) to this effort.

### *Recommendations for Use of Data*

Congregation K'nesseth Israel contributes immense economic and civic value to Baytown and the broader community. The activities, programs, and partnerships described above are made possible by the physical structure of the house of worship itself, which serves as a flexible space for meetings, performances, lectures, logistics work, donation sites, and—perhaps most importantly—as an anchor for the faith community that provides the material resources, physical and mental labor, and intangible motivation for community service.

Congregation K'nesseth Israel can use this data to articulate cases for support in their local communities, both for the programs that they provide and for the facilities that make community-serving activities possible. The loss of a sacred place like K'nesseth Israel would create or expand holes in the social safety net, decrease access to health care among marginalized and vulnerable populations, and significantly affect local and regional capacity to respond to and recover from future natural disasters.

Congregation K’nesseth Israel can use this information to enhance annual and special fundraising campaigns for the maintenance of its buildings and other improvements that will enhance the buildings’ resilience in the face of future disasters. Sharing this data with community partners and civic leaders can open up conversation about the public value of these houses of worship, uncovering opportunities for greater partnership and external support for the congregations’ missions. Also, the congregation and affiliated denominational bodies and judicatories can use this data to engage foundations, preservation organizations, and other entities that could potentially help fund structural improvements that would sustain and increase the congregation’s impact in its community. This could ensure that the congregation will continue to play a valuable part in the larger disaster response and recovery infrastructure.

## Finite Element Analysis

### *Structural Modeling and Analysis*

Structural simulation and investigation are conducted via finite element analysis (FEA). Through finite element modeling (FEM), historical buildings are modeled using SAP2000 FE Software. Models are created using meshed elements. Geometric and material properties are defined according to the structural system. The structural system is then analyzed under predefined boundary conditions and assigned joints. The joints are connected with each other to provide continuity. Further details on methodology and results are provided in Appendix C.

As seen in Figure 5.32, K’nesseth Israel was modeled in the SAP2000 FE software considering all its structural elements. In the superstructure, truss and stud elements were individually modeled to represent the roof and wall systems, respectively. Due to findings in the soil analysis, it was determined the soil properties do not significantly affect the superstructure. Thus, the vertical structural members (walls) were modeled as fixed support to the ground at the points where they are in connection with the ground.

Once the modeling is completed, the FE structural model is loaded under different conditions. First is calculating dead loads (the building’s own weight plus furniture, excluding occupants or external natural forces). Wind and flood loads were also calculated using assumed severe and extreme scenarios. Combined loading cases are then considered. Full details and figures for those are provided in Appendix C.

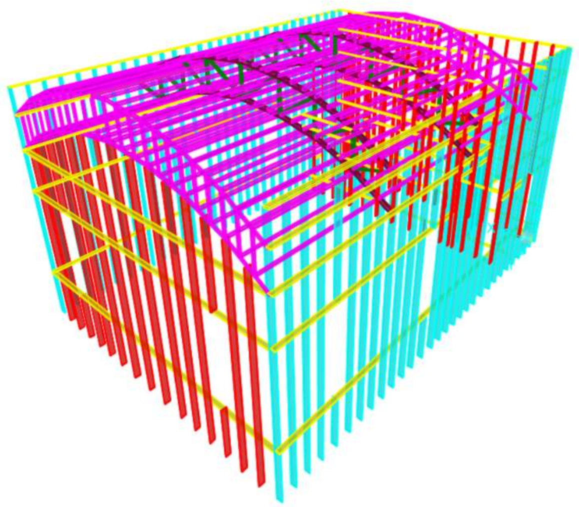
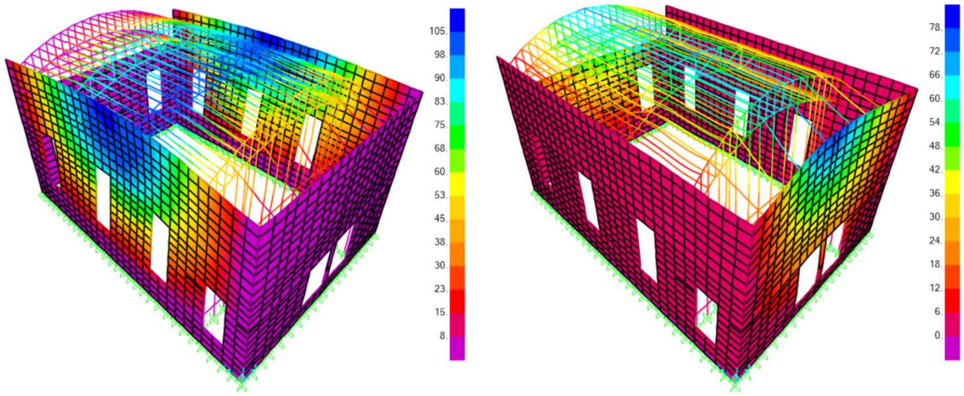


**Figure 5.32**: Finite element model of K'nesseth Israel.

### *Summary of Structural Assessment and Evaluation*

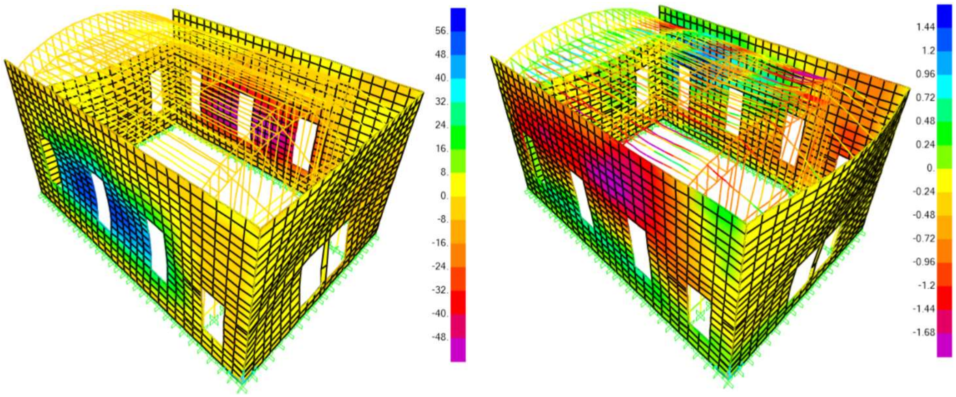
Findings from the dead load analysis conclude that the structure satisfies code regulations for vertical control parameters. However, **the lateral rigidity of the structure appears to be insufficient**, displacing laterally in extreme conditions beyond allowed values. This is due to the slender cross section of the vertical framing members and limited blocking and bracing between them.

Findings from the wind load analysis conclude that under severe hurricane conditions, the structure would displace at the upper part of any wall (effect observed in blue in Figures 5.33 and 5.34 in plane of striking wind force) beyond the allowable displacement. **This lack of stiffness does not meet design requirements for high-wind scenarios**.



**Figures 5.33 and 5.34**: Deformed shape under dead and wind loads (in mm) for X direction (left) and Y direction (right).

Findings from the flood load analysis show that **the structure would perform well in a severe flood** (water levels up to 6 feet, shown in Figure 5.35). The modeling showed that the structure would severely displace walls under an extreme flooding scenario (water levels up to the top of the windows, shown in Figure 5.35). However, considering the local topography and simulated flood levels, this scenario is extremely unlikely.



**Figures 5.35 and 5.36**: Deformed shape under extreme (left) and severe (right) flood loads (in mm).

Considering all the loading conditions the building can be expected to be subjected to, **stress values for wood and steel members were found to be below the allowable stress limits**.

A full list of findings with calculated displacements under each loading condition is provided in Appendix C.

## Recommendations

### *Treatments and Strategies for Enhancing Resilience*

This assessment finds 24 conditions or practices impacting vulnerability identified across all the surveyed categories. These concerns vary substantially in the immediacy of threat they pose to the building, the categories that are affected by the condition or practice, the potential range of costs or technical experience necessary to remedy the concern, and the degree to which resilience is enhanced by implementing the recommended Resilience Treatment or Strategy (RTS). A summary of each issue and an RTS recommendation, organized by relative urgency, is provided here. A matrix with further details is also provided in Appendix E.

When implementing each RTS, all parties involved should be familiar with the *Secretary of the Interior's Standards for the Treatment of Historic Properties* [https://www.nps.gov/tps/standards.htm] and adhere to them to the greatest extent possible. Because the structure is an RTHL, any action pertaining to the exterior must consult the THC per the Texas Government Code:

> *A person may not change the historical or architectural integrity of a building or structure the commission has designated as a RTHL without*

> *notifying the commission in writing at least 60 days before the date on which the action causing the change is to begin.*

5 conditions and practices were observed that compromise their respective building assembly category and can be considered **highly urgent** needs. These concerns generally include significant building components that were in poor or critical condition or were absent entirely. Remedying these issues should be scheduled as soon as possible. Addressing these items will enhance resilience and lower vulnerability to natural hazards such as hurricanes.

Highly urgent needs for existing conditions:

| | *Condition or practice* | *RTS recommendation* |
|---|---|---|
| 1. | Lack of disaster response and recovery plan. | Write a disaster response and recovery plan, working with county officials and referencing publications freely available from multiple organizations. Consider consulting professionals to assist the process, but author the plan yourself to ensure all aspects of cultural heritage are properly considered. |
| 2. | Drainage ports (scuppers) handling water shedding off of the roof are undersized and lack overflow drainage outlets. | Consult a licensed professional to determine appropriate modifications to current roof drainage system. |
| 3. | Downspouts not directly attached to subgrade drainage and are eroding/washing out surrounding soil and staining adjacent masonry. | Modify downspouts to properly direct water away from the building or else into the subgrade drainage system if it is designed to accommodate anticipated volume. Coordinate these efforts with a licensed professional in conjunction with redesign of roof drainage system. |
| 4. | Potential damage to anchor bolts connecting roof structure to exterior walls. | *Concern was reported after the site visit and was not directly observed.* In lieu of further information, investigate concern; consider consulting engineer. |

Highly urgent need, betterment/upgrade:

| | | |
|---|---|---|
| 5. | Lack of fire suppression system. | Consult licensed professionals to determine appropriate system and scope; install system. This is a standard recommendation for all places of public assembly and highly values cultural resources. |

7 conditions were observed to be adversely impacting other systems or may be worsening, but not to the degree that would compromise the entire building assembly category. They can be considered **moderately urgent** needs. These concerns generally include building components observed to be in fair or poor condition. Plans to understand and remedy the condition should be made.

Moderately urgent needs for existing conditions:

| | | |
|---|---|---|
| 6. | Walls are stressed and unevenly settling, causing cracks on all façades, confirmed by results of the finite element analysis. | Consult engineer regarding options for structural improvement and their benefits. Delay patching cosmetic defects until structural conditions are better understood. |
| 7. | Windows unprotected from hurricane forces. | Install new protective polycarbonate panels over windows that are hurricane-rated for impact and wind resistance. |
| 8. | Floor framing untreated and exposed to high moisture levels, providing conditions in crawl space for wood damage by insects and fungal growth. | Consult architect about feasible options to reduce moisture levels in crawlspace or to protect wood from moisture absorption. Options may include installing a vapor barrier on dirt floor, applying waterproof coating on interior walls of crawl space, treating wood framing with insecticides/fungicides, and applying protective coatings to floor joists. |
| 9. | Deteriorated exterior door finishes. | Refinish door. |

| | | |
|---|---|---|
| 10. | Interior floor level is lower than exterior entry deck. | Improve weather-stripping (strong door sweep and ensure that threshold is securely installed). |
| 11. | Steel door lintel is oxidizing, causing structural and cosmetic damage to surrounding masonry. | Consult architect; disassemble and repair as needed. |

Moderately urgent need, betterment/upgrade:

| | | |
|---|---|---|
| 12. | Lack of emergency power. | Install emergency generator sufficiently sized to power essential building systems (for a permanent system) or meet disaster response needs (a portable generator may suffice). |

7 conditions were observed to have some effect on other building assemblies or systems. These conditions may be slowly worsening, but are generally minor, isolated, or have limited effects. The urgency to address these concerns can be considered low, although maintenance should be kept up to prevent them from elevating to more significant threats:

| | | |
|---|---|---|
| 13. | Uneven settling or movement of soil below front stair and near the building foundations may be causing hairline cracks. | Consult engineer if deemed structurally necessary. Delay patching cosmetic defects until structural conditions are better understood. |
| 14. | Portions of masonry heavily weathered and need repointing. | Repoint mortar joints with new mortar where losses are substantial or pointing is loose. New mortar must match historic mortar’s composition, physical properties, texture and color. |
| 15. | Plumbing may have sustained damages from recent winter storm. | Test plumbing to confirm possible damage; consult plumber if necessary. |
| 16. | Voussoirs of window arches are split bricks, which appear to be depositing fine masonry debris below. | Investigate carefully to determine cause; consolidate unstable bricks with appropriate coatings and repoint loose mortar in manner that will not alter appearance. |

| | | |
|---|---|---|
| 17. | Cracked window lites. | Replace the affected lites with in-kind lites. |
| 18. | Inoperable windows. | Restore operability. |
| 19. | Pest intrusion (bats, insects at interior and hornet nests on exterior). | Treat active pest intrusion. Investigate method of entry (possibly vents in attic cavity or damaged roof parapet). Seal/repair entry and establish a plan/schedule for regular pest treatment. |

5 conditions were observed that are generally cosmetic and can be considered to have a minimal impact on the building's resilience. These concerns may be symptoms of more significant structural issues noted above, and may also affect the historic character of the building:

| | | |
|---|---|---|
| 20. | Masonry repair does not match historic brick. | Remove recent repair and replace with brick to match existing masonry (if such in-kind brick can be located). |
| 21. | Unpatched anchor holes in masonry. | Patch or replace brick (if in-kind brick can be located) to match existing masonry. |
| 22. | Floor heavily weathered at entry and in north corners, both likely from water intrusion and possible ponding. | Refinish where worn/water damaged (after addressing conditions 2 and 10, otherwise this condition may return). |
| 23. | Crown molding detaching from wall-ceiling joint. | Repair (after addressing conditions 2 and 4, otherwise this condition may return). |
| 24. | Stained plaster and hairline cracks. | Repair and repaint plaster (after addressing conditions 2 and 4, otherwise this condition may return). |

## References

Burroughs, S. (2017). Development of a tool for assessing commercial building resilience. *Procedia Engineering, 180*, 1034–1043. https://doi.org/10.1016/j.proeng.2017.04.263

Burton, I., Huq, S., Lim, B., Pilifosova, O., & Schipper, E. L. (2002). From impacts assessment to adaptation priorities: The shaping of adaptation policy. *Climate Policy, 2*, 145–159.

Churches and Pastors in Tri-Cities Area. (1933, July 28). *The Tri-Cities Sun*.

Federal Emergency Management Agency (Cartographer). (2017). Flood insurance rate map, Harris County, Texas and incorporated areas, panel 955 of 1150 [map]. Retrieved from https://map1.msc.fema.gov/firm?id=48201C0955M

Goldring/Woldenberg Institute of Southern Jewish Life. (n.d.). *Encyclopedia of Southern Jewish communities - Baytown, Texas*. https://www.isjl.org/texas-baytown-encyclopedia.html

Howard, A. (2010, July 1). Baytown's K'Nesseth Israel: the little congregation that could. *Jewish Herald Voice*. https://jhvonline.com/baytowns-knesseth-israel-the-little-congregation-that-could-p9299-90.htm

Independent Sector. (n.d.). The Value of Volunteer Time/State and Historical Data. Retrieved from https://independentsector.org/resource/vovt_state_2021/

International Code Council. (2014). *2015 International Building Code* (4th printing). https://codes.iccsafe.org/content/IBC2015P4

James, C. (2019, April 18). Baytown synagogue celebrates 90 years, return after Harvey. *Jewish Herald Voice*. https://jhvonline.com/baytown-synagogue-celebrates-years-return-after-harvey-p25858-90.htm

National Oceanic and Atmospheric Administration (NOAA). (2022). Historical Hurricane Tracks. Retrieved from https://coast.noaa.gov/hurricanes/

National Oceanic and Atmospheric Administration (NOAA). (n.d.). National Storm Surge Hazard Maps. Retrieved from https://noaa.maps.arcgis.com/apps/MapSeries/index.html?appid=d9ed7904dbec441a9c4dd7b277935fad&entry=1

National Oceanic and Atmospheric Administration (NOAA). Weather Prediction Center. (n.d.). Hurricane Carla – September 9-15, 1961. Retrieved from https://www.wpc.ncep.noaa.gov/tropical/rain/carla1961.html

National Oceanic and Atmospheric Administration (NOAA). Weather Prediction Center. (n.d.). Hurricane Harvey – August 25-September 4, 2017. Retrieved from https://www.wpc.ncep.noaa.gov/tropical/rain/harvey2017.html

National Oceanic and Atmospheric Administration (NOAA). Weather Prediction Center. (n.d.). Hurricane Ike – September 8-15, 2008. Retrieved from https://www.wpc.ncep.noaa.gov/tropical/rain/ike2008.html

Roth, D. (2010). *Texas Hurricane History*. National Weather Service. https://www.wpc.ncep.noaa.gov/research/txhur.pdf

Tetra Tech. (2020). *Harris County multi-hazard mitigation action plan* (Volume 1). Harris County Office of Homeland Security and Emergency Management. https://www.readyharris.org/Portals/60/documents/Mitigation-Planning/Upcoming%20Events/HarrisCounty-Vol1_Area_Wide_Elements.pdf

Texas General Land Office (TxGLO). (2020, October 8). *Hurricane Harvey state action plan: Based on amendment 7*. https://recovery.texas.gov/documents/action-plans/2017-hurricane-harvey/harvey-state-action-plan-overview.pdf

Texas Historical Commission (THC). (n.d.). Hurricane Harvey Disaster Assistance. Retrieved from https://www.thc.texas.gov/preserve/projects-and-programs/hurricane-harvey-disaster-assistance

U.S. Office of the Press Secretary. (2013, February 12). *Presidential policy directive – Critical infrastructure security and resilience*. Retrieved from https://obamawhitehouse.archives.gov/the-press-office/2013/02/12/presidential-policy-directive-critical-infrastructure-security-and-resil/

Weiner, H. (2018, January 25). Baytown's historic synagogue needs financial help after Harvey. *Jewish Herald Voice*. https://jhvonline.com/baytowns-historic-synagogue-needs-financial-help-after-harvey-p23808-90.htm

# Appendix A

## Project Methodology

***Relationship Between Vulnerability, Risk, and Resilience***

In general, vulnerability refers to susceptibility to damage from, and inability to adapt to, stresses or shocks posed by broader environmental or social systems (Burton et al., 2002; Adger, 2006). In the context of this study of historic buildings in the Texas Gulf Coast region, vulnerability is more narrowly defined as the building's natural weakness to threats, which is offset by the resilience of the physical building assemblies or services as well as occupant practices.

Vulnerability is a component of risk. In general, risk is the chance of an event occurring that will negatively impact a particular site or property (Pedersoli et al., 2016). It has been more specifically defined by the United Nations Office for Disaster Risk Reduction, the American Institute of Architects, and the academic community as a product of 3 factors: Risk = Hazard × Exposure × Vulnerability (Kron, 2002; AIA, 2021).

Because it is difficult or impossible to mitigate hazardous event occurrences and exposure to them at the building scale, reducing vulnerabilities is the best method for reducing risk. Risk is inversely related to resilience.

Resilience broadly refers to the ability to absorb change (Holling, 1973). In this study, building and congregation resilience focuses on disaster preparation, the ability to withstand disasters, and rapid recovery from disasters (Burroughs, 2017).

***Assessing Vulnerability***

The *UTSA-CCS Survey & Vulnerability Assessment* assesses vulnerabilities and risks, principally concerned with the threats from hurricanes typical of the Texas Gulf Coast region. The form designed by the research team collects information regarding the physical conditions of 17 categories of building assemblies, as well as 8 categories regarding the risk posed to the building by building services and broader site-specific and environmental threats.

To achieve an overall vulnerability score for the case-study, each category is weighted to consider its vulnerability structurally (its integrity to the structural soundness of the building as well as its ability to affect other categories), its exposure to the elements (particularly precipitation and wind), the likelihood of damage, and the impacts of damage to that category regarding recovery efforts. The parameters and category weighting are reflected in the *UTSA-CCS Survey & Vulnerability Assessment* form and summary.

| *Categories Assessing Physical Condition* |
|---|
| Foundation |
| Basement |
| Superstructure (Floor) |
| Superstructure (Roof) |
| Superstructure (Attachments) |
| Exterior Enclosure (Wall Assemblies) |
| Exterior Enclosure (Wall Surface) |
| Exterior Enclosure (Other) |
| Exterior Enclosure (Windows) |
| Exterior Enclosure (Doors) |
| Exterior Vertical Elements |
| Stairs |
| Interior Structural Components (Walls) |
| Interior Finishes (Walls) |
| Interior Finishes (Floor) |
| Interior Structural Components (Roof) |
| Interior Structural Components (Ceiling) |

| *Categories Assessing Risk* |
|---|
| Services |
| Ancillary Buildings |
| Soil Conditions |
| Site Flood Risk |
| Stormwater Control System |
| Site Attachments |
| Site Environmental Risk |
| Additional Threats |

Condition of each physical element is assessed on a scale from "excellent" to "critical" and the criteria for each are as follows:

| | |
|---|---|
| Excellent | Perfectly maintained in a condition where all is performing at or near peak capacity. No improvement work is needed. |
| Good | Well-maintained with little evidence of deferred maintenance. All is functioning as designed without any defects disabling performance. |
| Fair | Maintenance has been deferred. Functionality is limited or compromised. Routine repairs and upgrades are needed. |

| | |
|---|---|
| Poor | Some components broken, damaged, or missing. Impaired functionality, operability, or partial failure. Repair possible with professional expertise. |
| Critical | Obviously broken, damaged, or missing components. Seriously dysfunctional, inoperable, or failing. Beyond repair by normal maintenance methods. |

Note: Chart above developed by UTSA-CCS based on staff experience

Risk posed by site conditions is more complex to assess and is determined holistically. The assessment criteria are tailored to each category, but follow a similar 5-point scale as condition. Each site category is assessed as "minimal risk," "some risk," "moderate risk," "high risk," or "extreme risk."

Considerations and specific risks are described in each section, but generally include the amount, distance, and fire-rating or construction type of nearby buildings, floodplain locations or the presence of nearby water, soil conditions, quantity and distance of trees or notable site attachments, and the vicinity of potential environmental hazards (detailed in Appendix D).

### *Assessing Community Impact*

The methodology for the community impact survey is based on previous studies created by Partners for Sacred Places. In 1996, with the support of Lilly Endowment, Inc. and other funders, Partners for Sacred Places conducted the first scientific study quantifying the value of space and other resources that congregations provide to outreach programs housed in their historic and older buildings. Conducted in partnership with Dr. Ram Cnaan and the University of Pennsylvania's School of Social Policy & Practice, this study, *Sacred Places at Risk*, found that an average urban congregation generates over $140,000 per year in value by providing space and other resources to outreach programs, including volunteer time; building space rented at less than market rates; and cash and in-kind donations to support community-serving programs. The study also found that 4 out of 5 individuals who are served by programs hosted by a sacred place come from outside the congregation. *Sacred Places at Risk* established a new methodology for documenting a portion of the public value of congregations.

In 2010, Partners was funded by the William Penn Foundation to test the concept of an expanded methodology. Partners again collaborated with Dr. Cnaan and the University of Pennsylvania's School of Social Policy & Practice to craft a comprehensive approach to quantifying the public value of congregations. Based on an extensive review of available, academically-vetted methodologies, the team identified nearly 2 dozen quantifiable measures of economic impact relevant to congregations stewarding historic and older sacred places and assembled a singular methodology to pilot in Philadelphia. The results of this pilot were published in 2013 in the scholarly, peer-reviewed *Journal of*

*Management, Spirituality, and Religion*. With funding from Lilly Endowment, Inc., the McCormick Foundation and others, Partners built upon the pilot by undertaking a larger study with congregations selected at random from 3 large cities (Chicago, Philadelphia, and Fort Worth). The results were published in November 2016. Partners found that that the average historic sacred place in an urban environment generates over $1.7 million annually in economic impact.

As part of the current research project, Partners for Sacred Places offered a modified version of the *Economic Halo Effect of Historic Sacred Places* tool to each case-study congregation so that they could identify their individual impact and make the case for public investment in the maintenance and preservation of their historic structures.

## References

Adger, W. N. (2006). Vulnerability. *Global Environmental Change, 16*, 268-281.

American Institute of Architects (AIA). (2021). *Disaster assistance handbook* (4th ed.). https://content.aia.org/sites/default/files/2021-09/AIA_Disaster_Assistance_Handbook_4th_Edition_2021-0927.pdf

Burroughs, S. (2017). Development of a tool for assessing commercial building resilience. *Procedia Engineering, 180*, 1034-1043. https://doi.org/10.1016/j.proeng.2017.04.263

Burton, I., Huq, S., Lim, B., Pilifosova, O., & Schipper, E. L. (2002). From impacts assessment to adaptation priorities: The shaping of adaptation policy. *Climate Policy, 2*, 145-159.

Cnaan, R. A., Forrest, T., Carlsmith, J., & Karsh, K. (2013). If you do not count it, it does not count: A pilot study of valuing urban congregations. *Journal of Management, Spirituality & Religion, 10*(1), 1-34. http://dx.doi.org/10.1080/14766086.2012.758046

Cutter, S. L. (2015). The landscape of disaster resilience indicators in the USA. *Natural Hazards, 80*(2), 741-758. https://doi.org/10.1007/s11069-015-1993-2

Holling, C. S. (1973). Resilience and stability of ecological systems. *Annual Review of Ecology and Systematics 4*(1), 1-23. https://doi.org/10.1146/annurev.es.04.110173.000245

Pedersoli, J. L., Antomarchi, C., & Michalski, S. (2016). *A guide to risk management of cultural heritage*. International Centre for the Study of the Preservation and Restoration of Cultural Property (ICCROM). https://www.iccrom.org/wp-content/uploads/Guide-to-Risk-Managment_English.pdf

Kron, W. (2002). Keynote lecture: Flood risk = hazard × exposure × vulnerability. In B. Wu (Ed.), *Flood Defence '2002* (pp. 82-97). Science Press.

# Appendix B

## Soil Analysis: Full Report

### *Regional Soil Conditions*

The soil condition in the Texas Gulf Coast region is rather complicated as it consists of clay, silt, sand, and weathered limestones. Among these soils, clay is the most abundant in this region, which is usually characterized with high expansion potential as shown in Figure 5.B.01. Such soil often has a plasticity index (PI) higher than 30 and can be as high as 70. For example, the Houston black clay with a PI ranging from 40 to 70 occurs on about 1.5 million acres in the Blackland Prairie, which extends from north of Dallas south to San Antonio. Because of its high expansion nature, Houston Black clay has been recognized throughout the world. The Houston black clay has wide appearance in this region from Austin, San Antonio, Dallas to Louisiana.

Close to the shoreline, there is considerable distribution of alluvial soil, primarily composed of fine, loose sand and elastic silt. This soil typically is limited to a few striped areas in Houston, Galveston and Corpus Christi. Highly weathered limestone can be found at different depths in Texas Gulf Coast region. In general, the limestone layer is buried deeper in Houston and Corpus Christi due to the thicker cover of clay and alluvial soil.

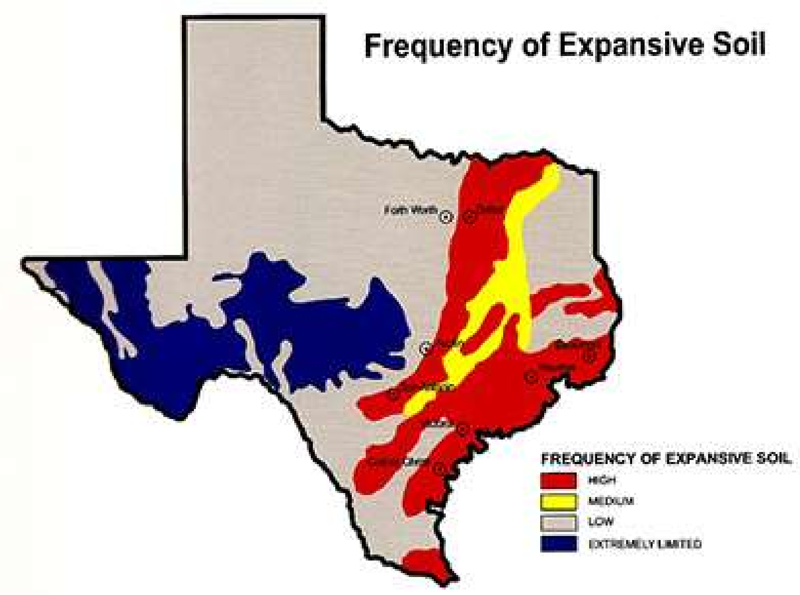


**Figure 5.B.01**: Texas expansive soil map (TxDOT).

In addition to the soil versatility, the existence of sulfate in soil makes the situation even more complicated. The clay with high sulfate content in the forms of calcium sulfate, sodium sulfate, and magnesium sulfate is usually called sulfate-rich soil that is more difficult to deal with than regular soil because it may cause significant volume increase under certain chemical reactions. The Texas Gulf Coast region is one of the few areas in the nation has considerable distribution of such soil as shown in Figure 5.B.02. The Texas Department of Transportation (TxDOT) has battled with sulfate-rich soil for decades as it could lead to severe damage to infrastructure if not appropriately addressed (TxDOT, 2005). Loose sand can be problematic to buildings under saturated conditions in seismic regions. Since Texas is considered a non-seismic zone, liquefaction is not a concern.

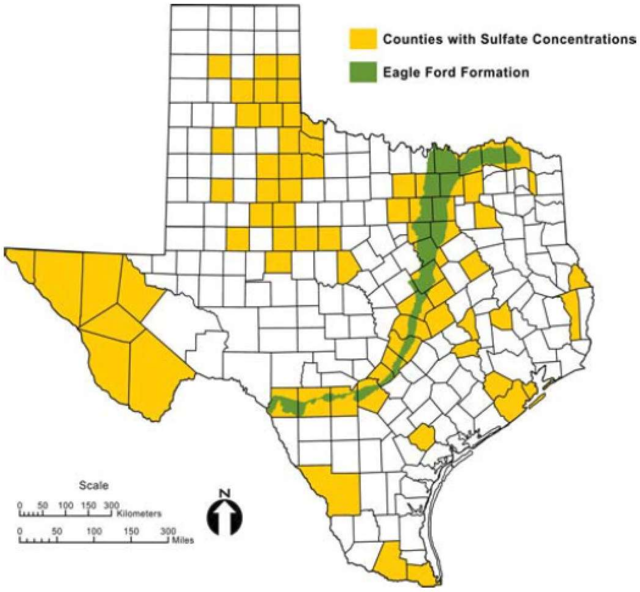


**Figure 5.B.02**: Texas sulfate soil distribution (TxDOT, 2005).

### *Site Soil Conditions*

3 soil samples were taken in March 2021 at K'nesseth Israel (at locations shown in Figure 5.B.03) and sent to the soil's lab at The University of Texas at San Antonio for various testing. All the soil samples were preserved in Ziploc bags during the transport and before testing as shown in Figure 5.B.04. The soil appeared in light gray color with moderate moisture content. No excessive organic content was observed, and no odd odor was detected.

**Figure 5.B.03**: Map of soil sample locations.

DATE: 20 March 2021
CONTENTS: BAYTOWN TX
K'nesseth Israel
Soil East Side

**Figure 5.B.04**: Soil sample from K'nesseth Israel.

The soil was tested for moisture content, particle size distribution, and shear strength. The moisture content of the soil is listed in Table 5.B.01. The particle size distribution of the 3 soil samples is shown in Figure 5.B.05. The consistency of moisture content and soil particle distribution indicated a uniform soil condition at the site. On average, the fine content (i.e., silt and clay) is approximately 26% and sand content is approximately 74%. According to the Unified Soil Classification System, the soil shall be named clayey sand with a group symbol of SC. Even though the soil contained some fine content, the direct shear test showed that the soil had negligible cohesion as shown in Figure 5.B.06. The friction angle of 21º is considered low for such soil but is within the possible range of such soil. Due to the relatively high fine content, Atterberg limits test were performed for the portion of the soil passing a No. 40 sieve. The results are present in Figure 5.B.07 and Table 5.B.02. According to the results, the liquid and plastic limits of the soil were 31 and 14, respectively, which led to a

Plasticity Index (PI) of 17. For the soil with such a PI value, the swelling potential is considered low.

***Table 5.B.01: Summary of Soil Moisture Content***

| | Sample #1 | Sample #2 | Sample #3 |
|---|---|---|---|
| Moisture content (%) | 23.5 | 23.7 | 22.3 |

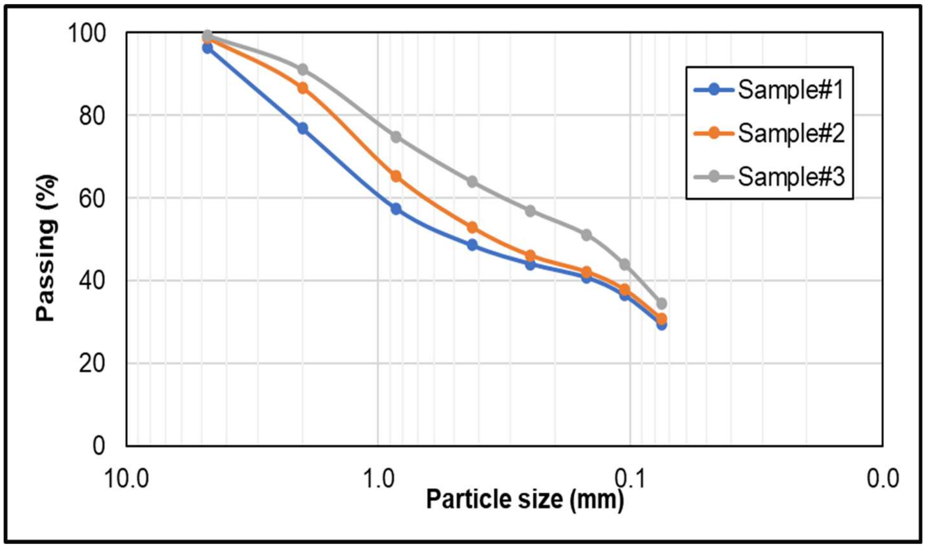


**Figure 5.B.05**: Particle size distribution of K'nesseth Israel.

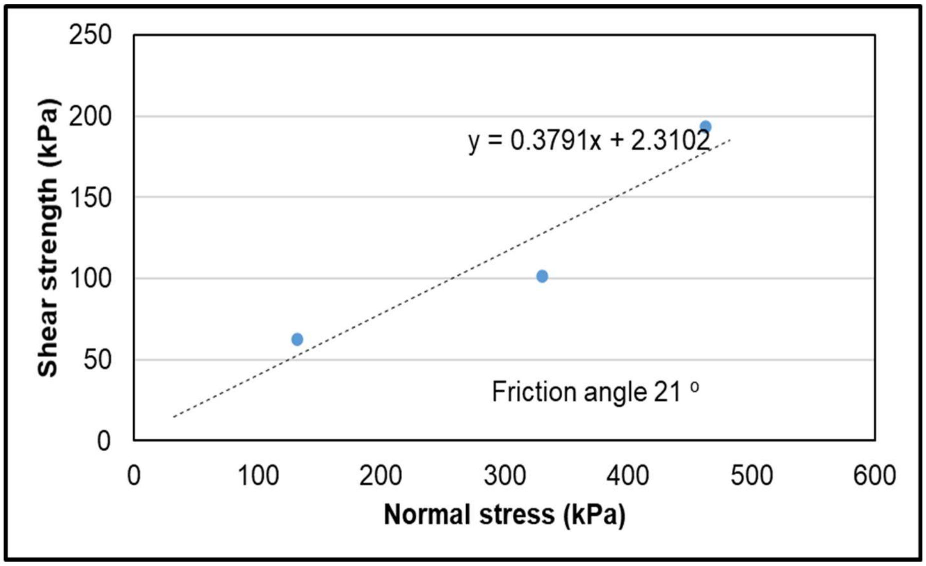


**Figure 5.B.06**: Shear strength of soil at K'nesseth Israel.

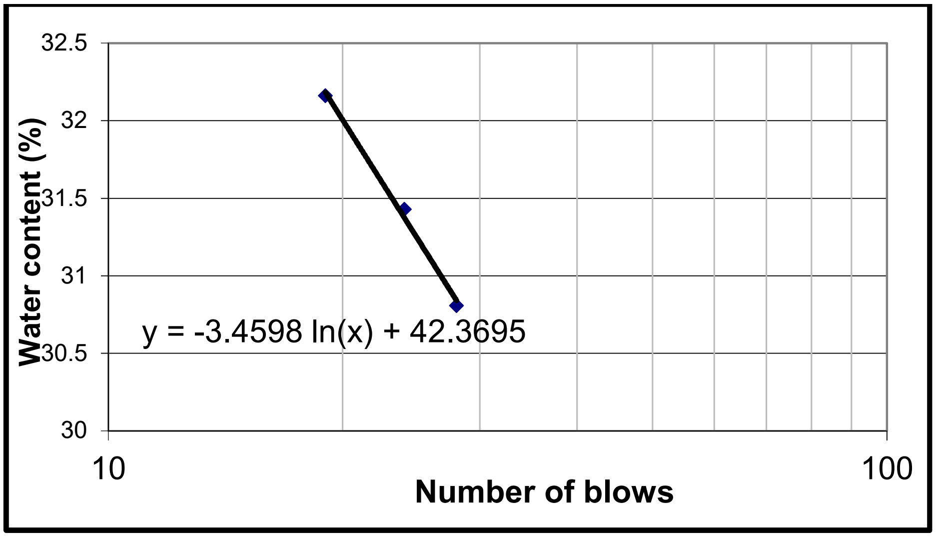


**Figure 5.B.07**: Liquid limit test results (Liquid limit = 31).

***Table 5.B.02: Atterberg Limit Summary***

| Liquid Limit | Plastic Limit | Plasticity Index | *Remarks* |
|---|---|---|---|
| 31 | 14 | 17 | Low expansion potential |

***Conclusions***

The soil at K'nesseth Israel is clayey sand with more than 25% fine content. Further testing on Atterberg limits disclosed a PI value of 17. Considering the soil composition and Atterberg limits, the soil in general is stable and has a low potential for swelling. However, the strength can become very low if soaked in water for very long. Therefore, it is very important to provide surface protection such as vegetation or paving if prolonged flooding is possible.

## References

Texas Department of Transportation (TxDOT). (2005). *Guidelines for treatment of sulfate-rich soils and bases in pavement structures*. Construction Division. Materials & Pavements Section. Geotechnical, Soils & Aggregates Branch. https://ftp.dot.state.tx.us/pub/txdot-info/cmd/tech/sulfates.pdf

# Appendix C

## Finite Element Analysis: Full Report

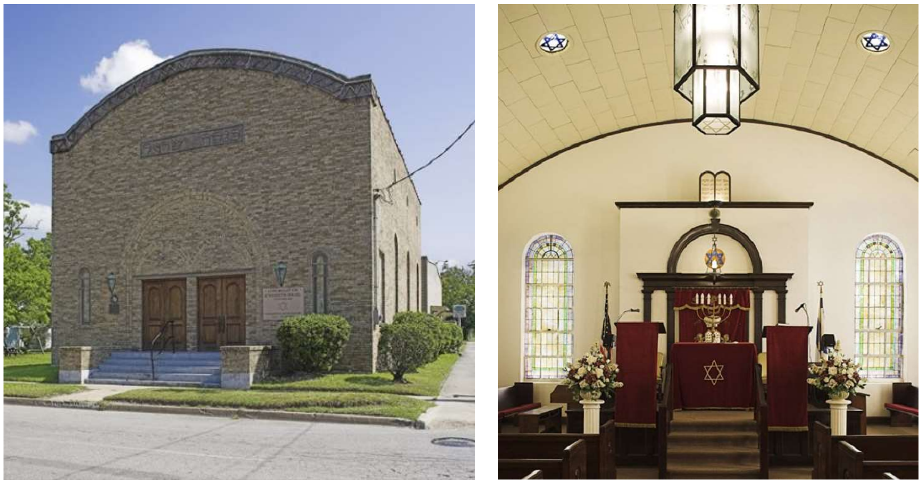
### *Introduction*

This report presents the finite element (FE) model, load cases, and the finite element analysis results of K'nesseth Israel Synagogue in Baytown, TX. Horizontal and vertical loads, material properties, and combinations were selected according to the relevant codes and standards. Assumptions and regulations are detailed in the following parts of the report.

Computer analyses were conducted using the SAP2000 software (Wilson and Habibullah, 2003), which was developed by Computers & Structures, Inc. The software is capable of performing FE analysis and has commonly been used in structural assessment. The 3D computer model of the structure was analyzed under defined loads and internal forces; and stresses and resultant displacement values were calculated. Computer model input data and all results are presented in this document for various loading combinations.

### *Architectural Properties*

The building was completed in 1930. A barrel vault roof, round-headed stained glass windows, and arched brickwork entry are the most outstanding architectural features of the structure as seen in Figure 5.C.01a. The structure has a vaulted roof of wood and steel members (HMDB, 2006).



**Figures 5.C.01a and 5.C.01b**: Exterior (left) and interior (right) view of K'nesseth Israel Synagogue.

### *Structural Properties*

Structural members of K'nesseth Israel Synagogue are made of wood. Vertical stud members have rectangular cross-sections. The roof trusses are composed of steel members, and are connected by wood spanning members in the transverse direction. The vaulted roof can be seen in Figures 5.C.01a and 5.C.01b.

### *Soil Properties*

According to the soil report prepared for the project at UTSA (see Appendix B), the soil is granular, namely, sandy soil. There is little to no potential for swelling or shrinking due to moisture fluctuation. Even under prolonged flooding, the soil shall not result in concern on the stability of the foundation. With sufficient surface cover, erosion and scouring shall not be a concern either. In summary, the soil is high quality and should not impact the structure's resilience.

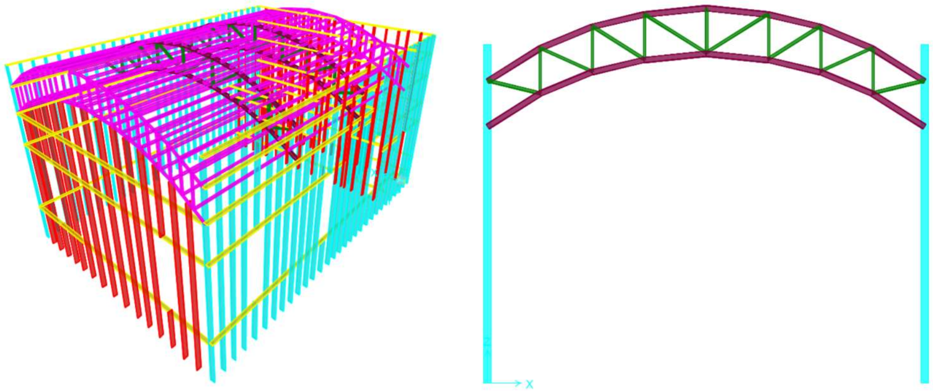
Consequently, it is understood that the soil properties do not significantly affect the superstructure. Therefore, the structural members such as walls and studs will be modeled as fixed support to the ground at the points where they are in connection with the ground.

## Finite Element Model

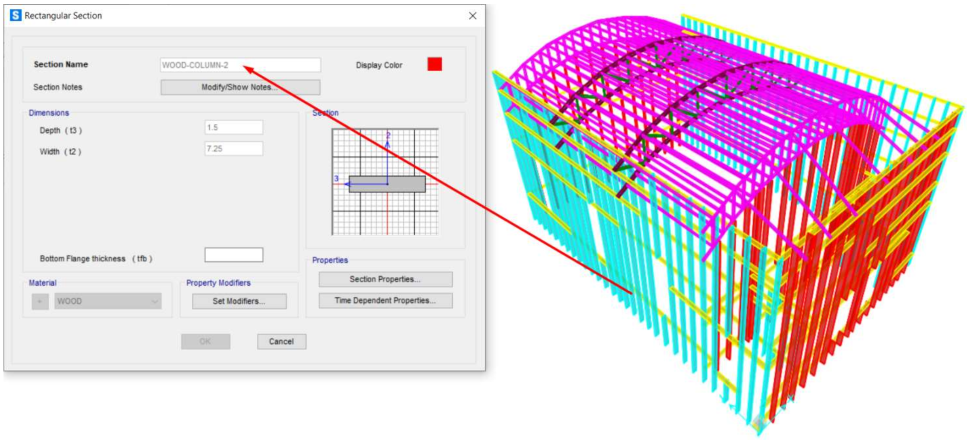
### *Finite Element Methodology*

Structural assessment is essential in defining structural behavior of historical buildings under various and extreme loadings. An accurate structural analysis gives us a better understanding of the condition of the building in question. The Finite Element Method (FEM) is an efficient and accurate analysis tool for structural assessment of both simple and complex structures. 3-dimensional analyses have also become possible in the recent decades due to advances in computer software technology. With the use of appropriate software, it is possible to create an accurate model of the structure and analyze it under realistic load combinations and scenarios. FEM can be used for both linear and nonlinear analyses. The method requires discretization of the problem into a finite number of elements and defining equations for each of them. Structural members are divided into meshes, which are analyzed individually. Once the process on each member has been completed, the members are brought together to define the overall structural characterization of the entire structure. The elements are assembled regarding the restraining factors and equations in the matrix form. The unknowns such as stresses and displacements are identified by analyzing the equation sets. The finite numbers of elements are connected to each other by finite number of meshes. The number of unknowns for each mesh is equal to its degree of freedom. The behavior of the element is defined by the equations that involve these unknown degrees of freedom. The mathematical model of the structure is obtained by ensuring the continuity conditions on meshes. The structure is converted into a model with degrees of freedom. In FEM, the elements are classified according to their geometries such as triangle, diamond, or rectangular; number of unknowns; and the characteristics of the continuum problem. They can also be categorized according to mathematical modeling due to the acquisition of the basic element matrices. The accuracy of the structural model depends on the assumption of the elements and the number of the meshes, which also increases parallel to the accuracy of the analyses results.

K'nesseth Israel Synagogue was modeled in 3D using SAP2000 software. The 3D model and an elevation of a steel truss are given in Figure 5.C.02. The details of the FE model are presented in Figures 5.C.03, 5.C.04, and 5.C.05. Stud and truss members were modeled using frame elements defining appropriate section properties as seen in Figure 5.C.03 and Figure 5.C.04, respectively.

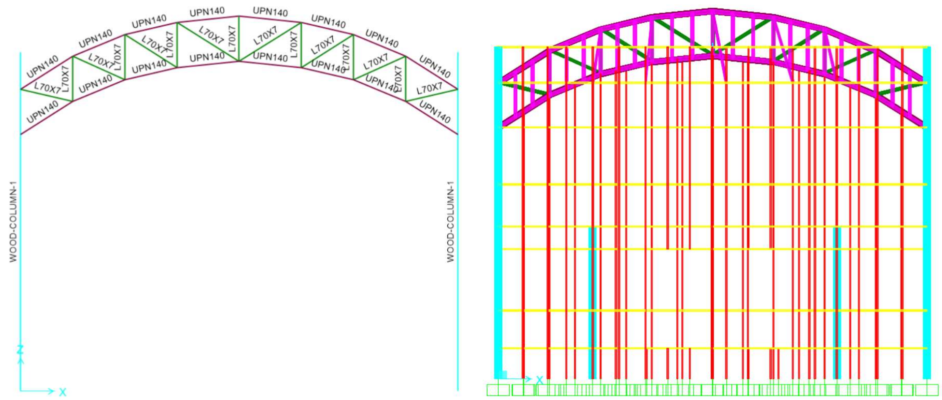


**Figures 5.C.02a and 5.C.02b**: 3D view (left) and truss profile (right).



Section Name: WOOD-COLUMN-2
Depth ( t3 ): 1.5
Width ( t2 ): 7.25
Material: WOOD

**Figure 5.C.03**: Sample stud section definition.

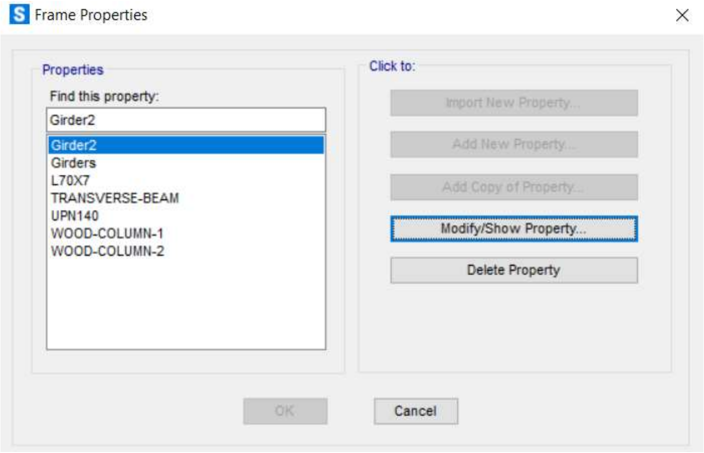


**Figures 5.C.04a and 5.C.04b**: Section of truss members (left) and restrain conditions (right).

## Section and Material Properties

### *Section Properties*

Dimensions of wood studs are 1.25 x 7.25 inches (31.75 x 184.2 mm). Truss members are composed of steel. Girders are composed of wood beams with 1.5 x 3.5 inches (38.1 x 88.9 mm) dimensions. The frame sections are given in Figures 5.C.05 through 5.C.09.

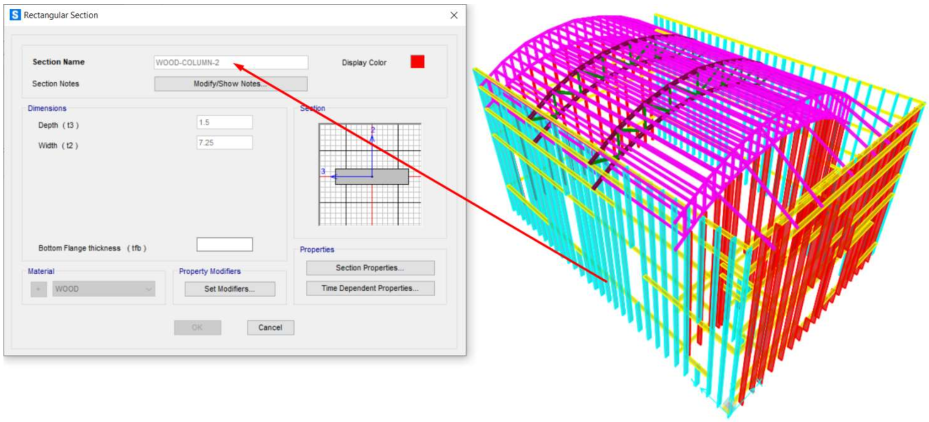


Properties

Find this property: Girder2

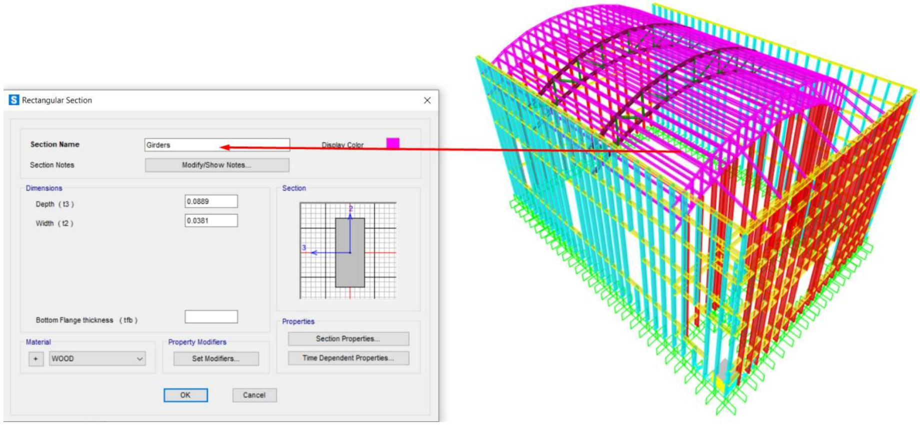
Girder2
Girders
L70X7
TRANSVERSE-BEAM
UPN140
WOOD-COLUMN-1
WOOD-COLUMN-2

**Figure 5.C.05**: Frame section properties.



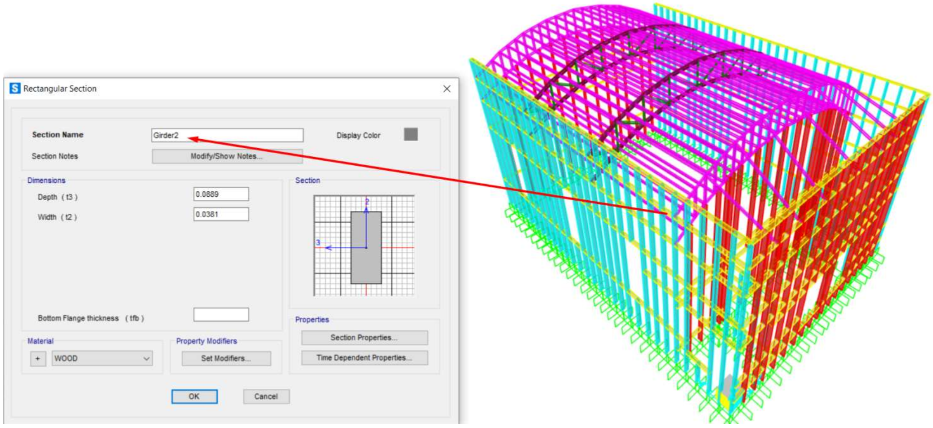
Section Name: WOOD-COLUMN-2
Display Color: 🟥
Dimensions
Depth (t3): 1.5
Width (t2): 7.25
Bottom Flange thickness (tfb):
Material: WOOD

**Figure 5.C.06**: Stud member sections.



Section Name: Girders
Display Color: 🟪
Dimensions
Depth (t3): 0.0889
Width (t2): 0.0381
Bottom Flange thickness (tfb):
Material: WOOD

**Figure 5.C.07**: Girder sections for roof.



Section Name: Girder2
Display Color: ⬛
Dimensions
Depth (t3): 0.0889
Width (t2): 0.0381
Bottom Flange thickness (tfb):
Material: WOOD

**Figure 5.C.08**: Girder sections for walls.

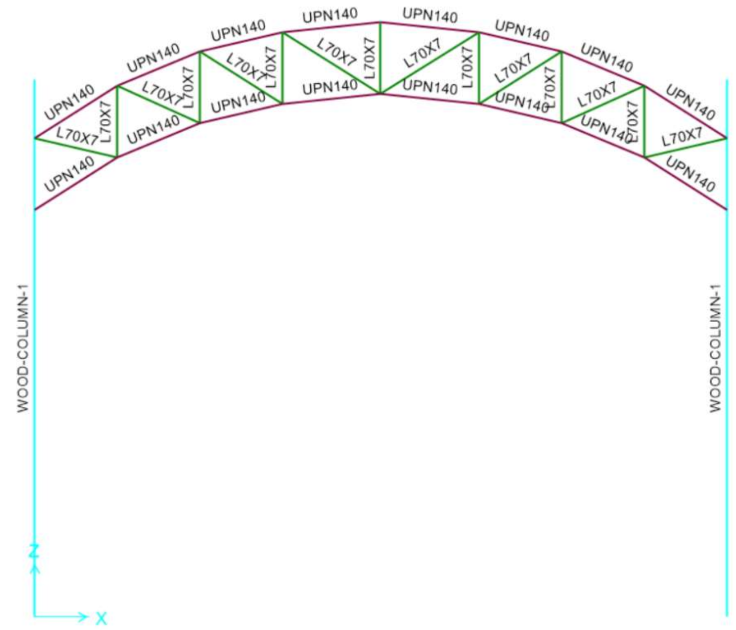


**Figure 5.C.09**: Truss member sections.

***Material Properties***

2 types of materials have been used in K'nesseth Israel Synagogue, wood and steel. Materials and their structural properties are explained below in detail.

*Wood*:

Physical and mechanical properties of wood are given below according to "Wood handbook—Wood as an Engineering Material" (Forest Products Laboratory, 1999). Softwood properties were taken for the wood members. Assumptions were made conservatively selecting the weaker material properties compared to the moderate ones. Weight per unit volume, modulus of elasticity, and Poisson ratio values are listed at the tables below. Specific gravity of wood is defined as the ratio between oven dry weight of the wood and the weight of an equal volume of water.

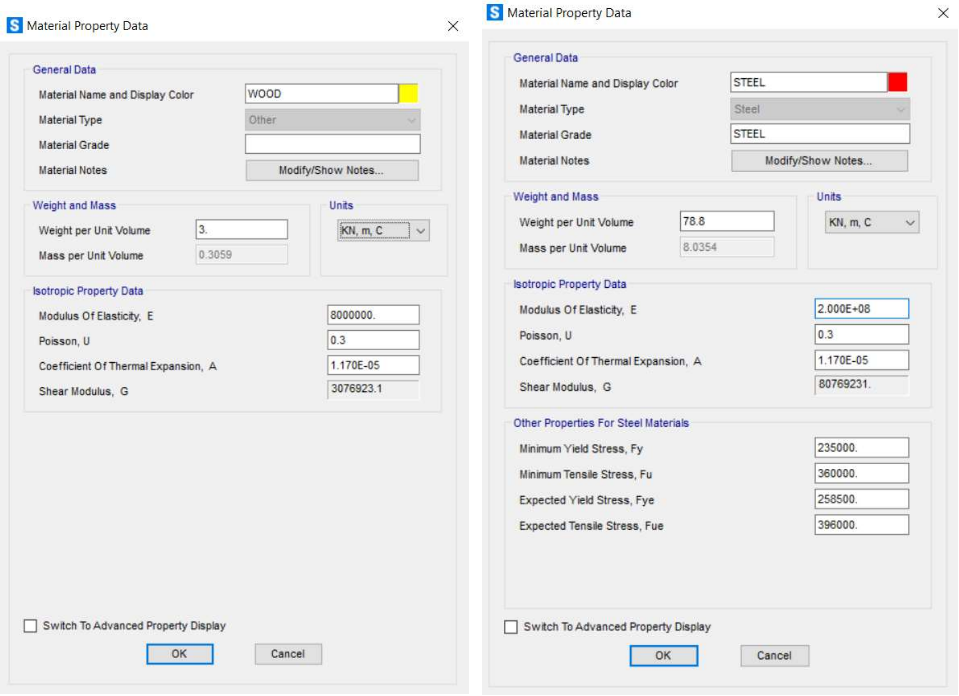
When a member is loaded axially, the deformation perpendicular to the direction of the load is proportional to the deformation parallel to the direction of the load. The ratio of the transverse to axial strain is called Poisson's ratio. The Poisson's ratios are denoted by $\mu LR$, $\mu RL$, $\mu LT$, $\mu TL$, $\mu RT$, and $\mu TR$. The first letter of the subscript refers to direction of applied stress and the second letter to direction of lateral deformation. For example, $\mu LR$ is the Poisson's ratio for deformation along the radial axis caused by stress along the longitudinal axis (Forest Products Laboratory, 1999).

*Steel*:
The American Institute of Steel Construction (AISC) recommends the modulus of elasticity for steel members as 29,000,000 psi (200,000 MPa). Unit weight of the steel is assumed as 490 lb/ft$^3$ (76.97 kN/m$^3$).

Material properties as used in the FE analysis are summarized in Table 5.C.01. Also, related material definitions in the FE model is presented in Figure 5.C.10.

***Table 5.C.01: Material Properties***

| Materials | Weight per Unit Volume | | Modulus of Elasticity | | Poisson Ratio |
|---|---|---|---|---|---|
| | (lb/ft$^3$) | (kN/m$^3$) | (psi) | (MPa) | |
| Wood | 19.1 | 3 | 1,160,501.1 | 8,000 | 0.35 |
| Steel | 490 | 76.97 | 29,000,000 | 200,000 | 0.3 |



General Data
Material Name and Display Color: WOOD
Material Type: Other
Material Grade:
Weight and Mass
Weight per Unit Volume: 3.
Mass per Unit Volume: 0.3059
Units: KN, m, C
Isotropic Property Data
Modulus Of Elasticity, E: 8000000.
Poisson, U: 0.3
Coefficient Of Thermal Expansion, A: 1.170E-05
Shear Modulus, G: 3076923.1
☐ Switch To Advanced Property Display

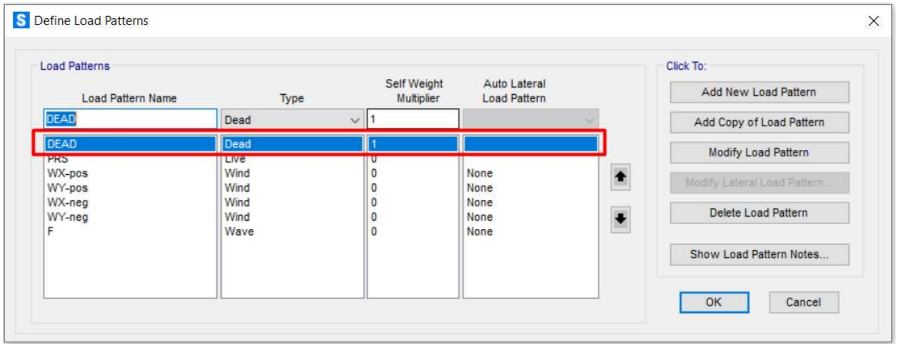
General Data
Material Name and Display Color: STEEL
Material Type: Steel
Material Grade: STEEL
Weight and Mass
Weight per Unit Volume: 78.8
Mass per Unit Volume: 8.0354
Units: KN, m, C
Isotropic Property Data
Modulus Of Elasticity, E: 2.000E+08
Poisson, U: 0.3
Coefficient Of Thermal Expansion, A: 1.170E-05
Shear Modulus, G: 80769231.
Other Properties For Steel Materials
Minimum Yield Stress, Fy: 235000.
Minimum Tensile Stress, Fu: 360000.
Expected Yield Stress, Fye: 258500.
Expected Tensile Stress, Fue: 396000.
☐ Switch To Advanced Property Display

**Figures 5.C.10a and 5.C.10b**: SAP2000 definitions for wood (left) and steel (right).

## Loads and Combinations

### *Dead Loads*

Dead loads of the members in the finite element model are automatically calculated by SAP2000 based on the unit weight of the materials, as shown in Figure 5.C.11.



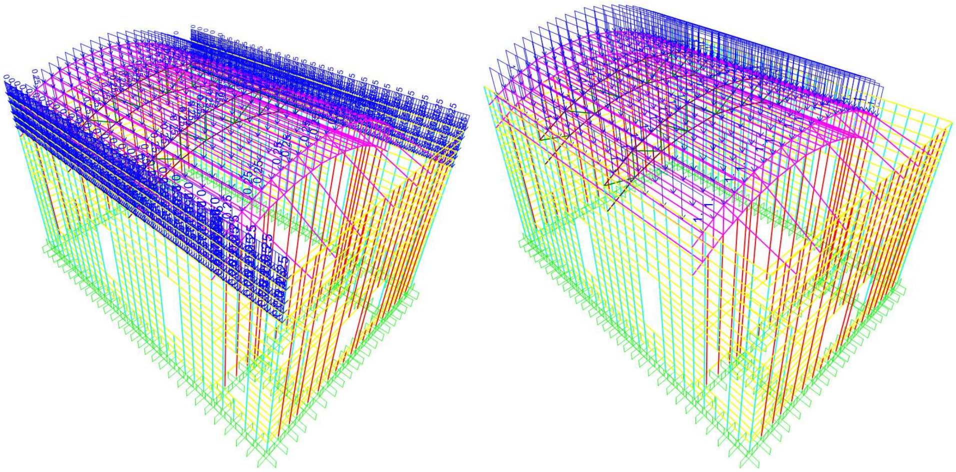
| Load Pattern Name | Type | Self Weight Multiplier | Auto Lateral Load Pattern |
|---|---|---|---|
| DEAD | Dead | 1 | |
| DEAD | Dead | 1 | |
| PRS | Live | 0 | |
| WX-pos | Wind | 0 | None |
| WY-pos | Wind | 0 | None |
| WX-neg | Wind | 0 | None |
| WY-neg | Wind | 0 | None |
| F | Wave | 0 | None |

**Figure 5.C.11**: Dead load distribution in SAP2000.

### *Superimposed Dead and Live Loads*

A dead load was applied to the girders located between the trusses as 10 lb/ft$^2$ (0.5 kN/m$^2$) to represent the roof cover load, as shown in Figure 5.C.12a.

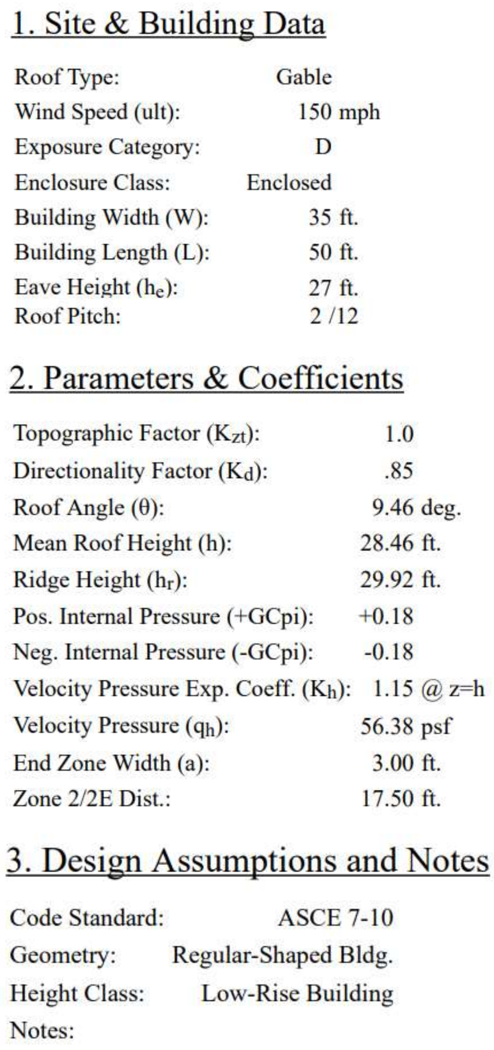
Additionally, a live load of 41.8 lb/ft$^2$ (2 kN/m$^2$) was assigned to the girders, as shown in Figure 5.C.12b. This load is half the typical specified loads per meter, because the load is shared between 2 adjacent girders in a span.



**Figures 5.C.12a and 5.C.12b**: Superimposed dead (left) and live (right) load distribution in SAP2000.

### *Wind Loads*

Wind loads are calculated based on ASCE regulations (ASCE, 2017). The modeled wind speed was 150 mph and "Category D" was selected as the exposure category.



## 1. Site & Building Data

| | |
|---|---|
| Roof Type: | Gable |
| Wind Speed (ult): | 150 mph |
| Exposure Category: | D |
| Enclosure Class: | Enclosed |
| Building Width (W): | 35 ft. |
| Building Length (L): | 50 ft. |
| Eave Height ($h_e$): | 27 ft. |
| Roof Pitch: | 2 /12 |

## 2. Parameters & Coefficients

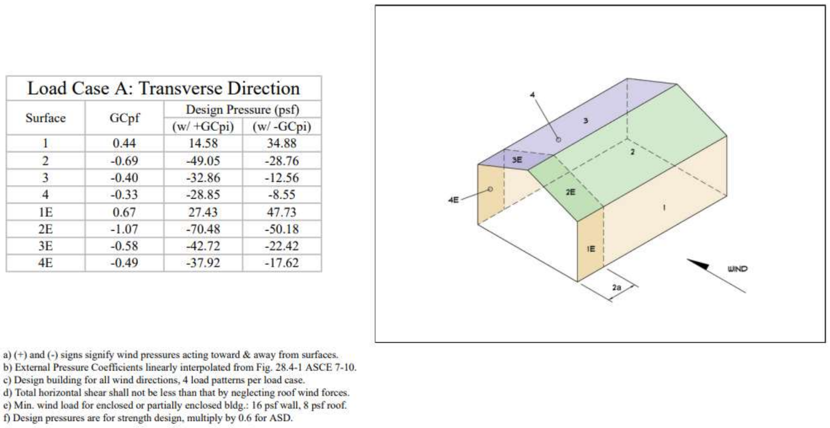
| | |
|---|---|
| Topographic Factor ($K_{zt}$): | 1.0 |
| Directionality Factor ($K_d$): | .85 |
| Roof Angle ($\theta$): | 9.46 deg. |
| Mean Roof Height (h): | 28.46 ft. |
| Ridge Height ($h_r$): | 29.92 ft. |
| Pos. Internal Pressure (+GCpi): | +0.18 |
| Neg. Internal Pressure (-GCpi): | -0.18 |
| Velocity Pressure Exp. Coeff. ($K_h$): | 1.15 @ z=h |
| Velocity Pressure ($q_h$): | 56.38 psf |
| End Zone Width (a): | 3.00 ft. |
| Zone 2/2E Dist.: | 17.50 ft. |

## 3. Design Assumptions and Notes

| | |
|---|---|
| Code Standard: | ASCE 7-10 |
| Geometry: | Regular-Shaped Bldg. |
| Height Class: | Low-Rise Building |
| Notes: | |

Detailed information about the wind loads are presented in Figures 5.C.13 and 5.C.14. Also, wind load distribution in the FE model is presented in Figures 5.C.15 and 5.C.16.

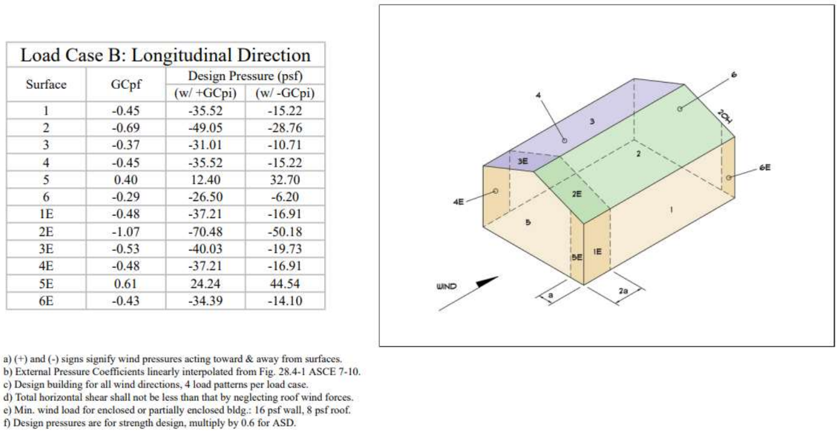
## 4. Design Wind Pressures:



| Load Case A: Transverse Direction | | | |
|---|---|---|---|
| Surface | GCpf | Design Pressure (psf) | |
| | | (w/ +GCpi) | (w/ -GCpi) |
| 1 | 0.44 | 14.58 | 34.88 |
| 2 | -0.69 | -49.05 | -28.76 |
| 3 | -0.40 | -32.86 | -12.56 |
| 4 | -0.33 | -28.85 | -8.55 |
| 1E | 0.67 | 27.43 | 47.73 |
| 2E | -1.07 | -70.48 | -50.18 |
| 3E | -0.58 | -42.72 | -22.42 |
| 4E | -0.49 | -37.92 | -17.62 |

a) (+) and (-) signs signify wind pressures acting toward & away from surfaces.
b) External Pressure Coefficients linearly interpolated from Fig. 28.4-1 ASCE 7-10.
c) Design building for all wind directions, 4 load patterns per load case.
d) Total horizontal shear shall not be less than that by neglecting roof wind forces.
e) Min. wind load for enclosed or partially enclosed bldg.: 16 psf wall, 8 psf roof.
f) Design pressures are for strength design, multiply by 0.6 for ASD.

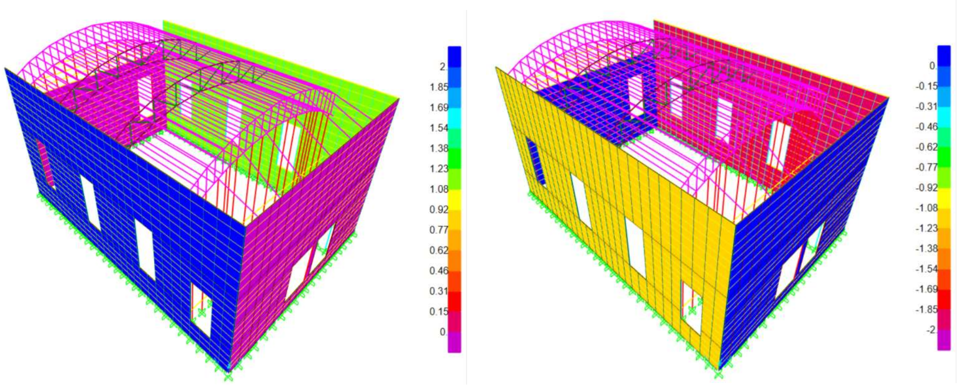
**Figure 5.C.13**: Wind load calculation for X direction (Medeek Design, 2022).



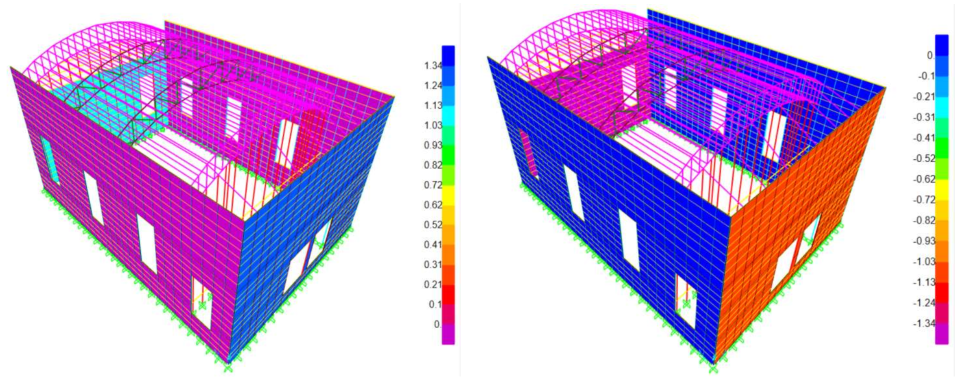
| Load Case B: Longitudinal Direction | | | |
|---|---|---|---|
| Surface | GCpf | Design Pressure (psf) | |
| | | (w/ +GCpi) | (w/ -GCpi) |
| 1 | -0.45 | -35.52 | -15.22 |
| 2 | -0.69 | -49.05 | -28.76 |
| 3 | -0.37 | -31.01 | -10.71 |
| 4 | -0.45 | -35.52 | -15.22 |
| 5 | 0.40 | 12.40 | 32.70 |
| 6 | -0.29 | -26.50 | -6.20 |
| 1E | -0.48 | -37.21 | -16.91 |
| 2E | -1.07 | -70.48 | -50.18 |
| 3E | -0.53 | -40.03 | -19.73 |
| 4E | -0.48 | -37.21 | -16.91 |
| 5E | 0.61 | 24.24 | 44.54 |
| 6E | -0.43 | -34.39 | -14.10 |

a) (+) and (-) signs signify wind pressures acting toward & away from surfaces.
b) External Pressure Coefficients linearly interpolated from Fig. 28.4-1 ASCE 7-10.
c) Design building for all wind directions, 4 load patterns per load case.
d) Total horizontal shear shall not be less than that by neglecting roof wind forces.
e) Min. wind load for enclosed or partially enclosed bldg.: 16 psf wall, 8 psf roof.
f) Design pressures are for strength design, multiply by 0.6 for ASD.

**Figure 5.C.14**: Wind load calculation for Y direction (Medeek Design, 2022).



**Figures 5.C.15a and 5.C.15b**: Wind loads on positive X (left) and negative X (right) directions.

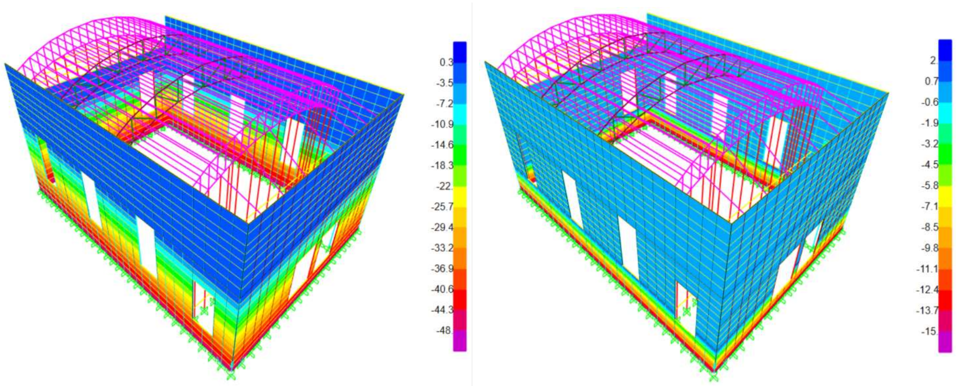


**Figures 5.C.16a and 5.C.16b**: Wind loads on positive Y (left) and negative Y (right) directions.

### *Flood Loads*

Flood loads are calculated based on FEMA regulations (FEMA, 2011). 2 different flood loads are considered in the analysis representing the extreme and severe cases, as shown in Figure 5.C.17.

For the severe flood load case, the height of the flood is assumed as 59 inches (1.5 m). For extreme loading, it was assumed that the water level rises up to the level of the window headers, almost 189 inches (4.8 m). Flood loads are shown as a triangular load distributed on vertical members. The maximum flood loads at bottom of the studs are 1,002.5 lb/ft$^2$ (48 kN/m$^2$) and 313 lb/ft$^2$ (15 kN/m$^2$) for the extreme and severe flood load cases, respectively.



**Figures 5.C.17a and 5.C.17b**: Extreme (left) and severe (right) flood loads.

Load combinations were obtained from ASCE 7-16 Chapter 2.3 (ASCE, 2017). Load and Resistance Factor Design (LRFD) provisions were followed for the analysis. Load combinations presented in the ASCE 7-16 are presented below:

1. $1.4D$
2. $1.2D + 1.6L + 0.5\ (Lr \text{ or } S \text{ or } R)$
3. $1.2D + 1.6\ (Lr \text{ or } S \text{ or } R) + (L \text{ or } 0.5W)$
4. $1.2D + 1.0W + L + 0.5\ (Lr \text{ or } S \text{ or } R)$
5. $0.9D + 1.0W$

where:
$D$: Dead load
$L$: Live load
$Lr$: Roof live load
$S$: Snow load
$R$: Rain load
$W$: Wind load

When a structure is located in a flood zone, the following load combinations shall be considered:

1. 0.5 ($Lr$ or $S$ or $R$) in combination 2 shall be replaced by $0.2D_i + 0.5S$.
2. $1.0W + 0.5$ ($Lr$ or $S$ or $R$) in combination 4 shall be replaced by $D_i + W_i + 0.5S$.
3. $1.0W$ in combination 5 shall be replaced by $D_i + W_i$.
4. $1.0W + L + 0.5$ ($Lr$ or $S$ or $R$) in combination 4 shall be replaced by $D_i$.

## Results

### *Deformed Shapes*

Deformed shapes based on service load combinations are presented below. The vertical displacement of the members due to dead loads can be seen in Figure 5.C.18.

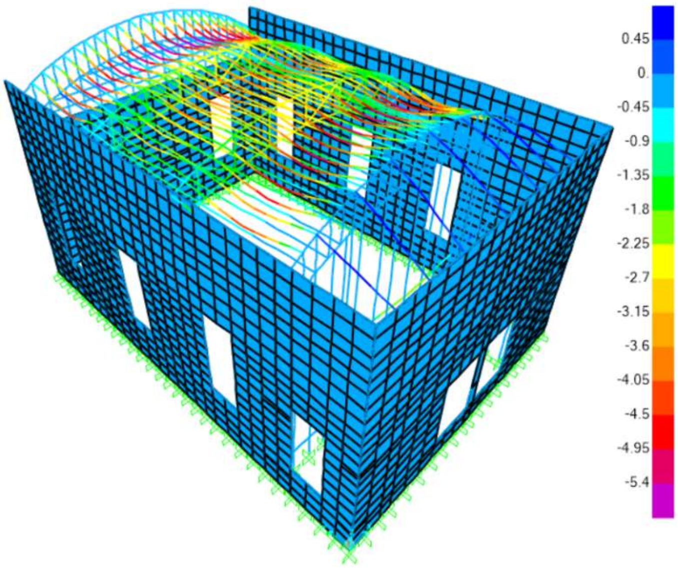
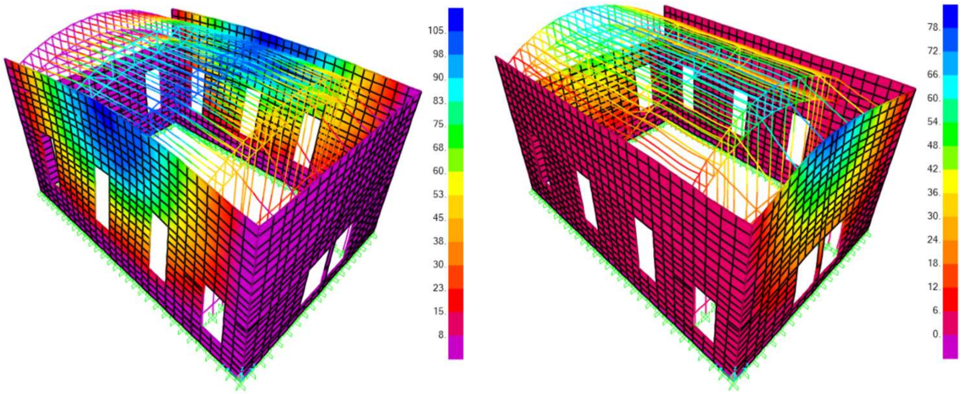


**Figure 5.C.18**: Deformed shape under dead loads.

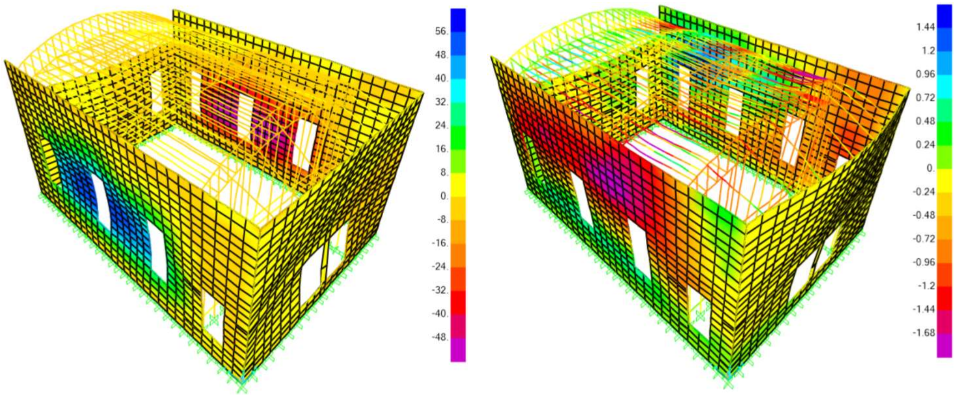
Vertical displacement of the roof girders **barely meets the general displacement requirement**. The recommended vertical displacement limit for the roof members is $L/300$ ($L$ being the span of the roof).

0.22 inches (5.6 mm) > 164 inches / 300 = 0.55 inches (14 mm)

The lateral displacement of the members due to wind loads and flood loads can be seen in Figures 5.C.19 and 5.C.20, respectively. The maximum displacement requirement of the structure for X and Y directions is presented in related figures.



**Figures 5.C.19a and 5.C.19b**: Deformed shape under dead and wind loads (in mm) for X direction (left) and Y direction (right).



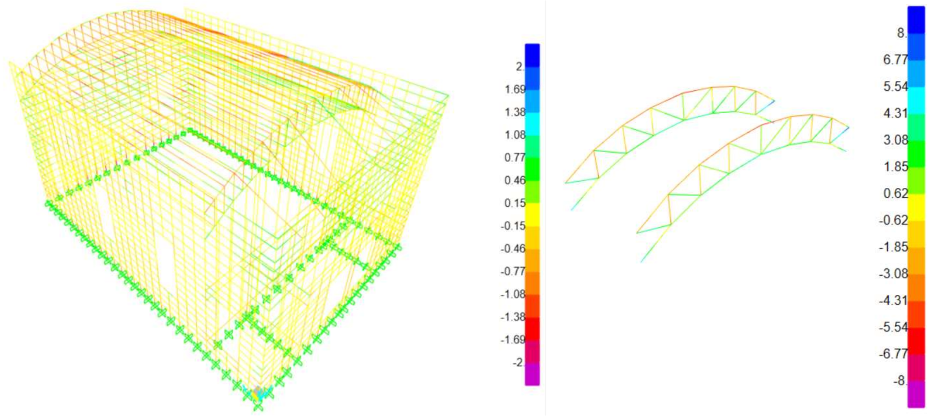
**Figures 5.C.20a and 5.C.20b**: Deformed shape under extreme (left) and severe (right) flood loads (in mm).

Horizontal displacement of the vertical members **do not meet the general displacement requirements**. The recommended lateral displacement limit for the roof members is *L*/300. The large displacement is attributed to slenderness of the wood studs.

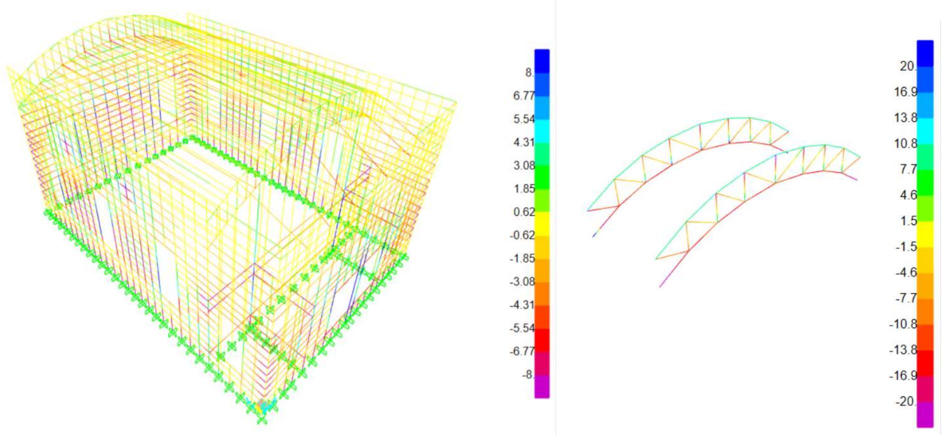
4.2 inches (106 mm) > 324.5 inches / 300 = 1.08 inches (27.4 mm)

***Internal Forces***

The internal force distribution of the members was also obtained. Figures 5.C.21 and 5.C.22 indicate the force distribution of the structure for the envelope load combination. *S11* stress distribution represents the in-plane axial stress in the members.



**Figures 5.C.21a and 5.C.21b**: Wood members *S11* distribution (left) and steel members *S11* distribution (right) for severe flood loads.



**Figures 5.C.22a and 5.C.22b**: Wood members *S11* distribution (left) and steel members *S11* distribution (right) for extreme flood loads.

## Findings and Suggestions

The geometrical, material, and loading properties, as well as the FE modeling criteria, and analysis results of K'nesseth Israel Synagogue are presented in the scope of this report. For the FE analysis, dead, wind, and flood loads were considered for the analysis. The current design codes in the U.S. were followed through the entire process. Dead loads were determined based on the architectural properties regarding the span of each horizontal member. Wind loads were applied to the FE model according to ASCE regulations (ASCE, 2017). Lastly, flood loads were taken as severe and extreme load cases, with the water height as 59 inches (1.5 m) and until the level of the window headers, respectively.

Based on the FE analysis, the findings are:

- Based on the dead load analysis, structure meets the recent code regulations for the vertical control parameters. Girders have adequate vertical stiffness.
- The lateral rigidity of the system is directly related to lateral stiffness of the wood studs. Based on the wind and extreme flood analysis results, **lateral displacement of the structure is higher than the maximum allowed values**. The deformed shape of the structure can be seen in Figures 5.C.19 and 5.C.20. The large displacements are due to the relatively small cross-sectional dimensions of the stud members.
- **For the wind loads**, the most critical parts of the horizontal spanning members are at their mid-spans. The blue contour is the most displaced part of the structure as seen in Figures 5.C.19a and 5.C.19b, in X and Y directions. For this type of structure, the allowable displacement is determined by $H/300$. **The structure does not meet the requirements**.
- The extreme flood loads are calculated based on the water level at the top of the windows. The maximum load at the bottom of the walls are 1,002.5 lb/ft$^2$ (48 kN/m$^2$). **The displacement values of the structure under extreme flood loads do not meet the requirements**. In Figure 5.C.20a, the largest displacement values can be observed where the color turns to blue.
- Under the severe flood loads, the structure performs well in terms of displacement. The deformed shape of the structure can be seen in Figure 5.C.20b. In this figure, the largest displacement can be observed at the blue region.
- **Stress values for wood and steel members are below the allowable stress limits**. It can be seen in Figures 5.C.21 and 5.C.22 that axial stress of the structural members is below the material strength.

## References

American Society of Civil Engineers (ASCE). (2017). *ASCE Standard ASCE/SEI 7-16, Minimum design loads for buildings and other structures*.

FEMA. (2011). *FEMA P-55 Coastal Construction Manual, Principles and Practices of Planning, Siting, Designing, Constructing, and Maintaining Residential Buildings in Coastal Areas* (Fourth Edition).

Forest Products Laboratory. (1999). *Wood handbook—Wood as an engineering material*.

The Historical Marker Database (HMDB). (2006). K'Nesseth Israel Synagogue. Retrieved from https://www.hmdb.org/m.asp?m=53608

Medeek Design. (n.d.). Medeek Wind Load Calculator. Retrieved from http://www.medeek.com/resources/wind/wind_calculator.pl

Wilson, E. L., & Habibullah, A. (2003). *Structural Analysis Program SAP2000. User's manual*. Computers & Structures, Inc., Berkeley, CA

# Appendix D

## Environmental Hazard Analysis: Full Report

### *Introduction*

Relatively local industrial operations that serve as potential threats to a structure's condition as well as occupant health and safety are known as environmental hazards. Although the term is similar to natural hazards, environmental hazards are distinctly manmade. These threats reduce resilience because they compound the effects created by natural hazards (e.g., the 2011 Fukushima accident in Japan). In some cases, they become disasters in their own right (e.g., the 2005 Texas City Refinery explosion and the 2013 West, TX fertilizer plant explosion). These are known as industrial disasters, although industrial disaster risk was not analyzed as part of this study.

Environmental hazards can present a variety of threats, including fire risk, contamination of air and water, explosions (which generate shockwaves and projectiles that may shatter windows or cause other damage), electrification of waters, creating obstacles (e.g., downed power lines), and disruption of communications. They can threaten all phases of the disaster cycle, but primarily hamper the response phase. In the case of contamination, they can particularly complicate the recovery cycle by necessitating specialty cleanup procedures. Even outside of natural disaster events, effects from environmental hazards can cause cumulative damage (e.g., from acid rain or soot deposits) and health issues (the degree to which varies substantially based on numerous variables).

Assessment of environmental risks is especially important in the Houston–Sugar Land–Baytown Metropolitan Statistical Area (commonly known as the Greater Houston MSA) because it represents 1/4 of the nation's oil refining capacity and has a history of hazardous materials being released into the environment (Chakraborty et al., 2014). K'nesseth Israel is located only about 2 miles away from the Houston Ship Channel where hazardous materials are produced and transported *en masse*, as documented in figures reported to the Environmental Protection Agency (EPA) and detailed below.

### *Method of Assessing Risk*

The potential for an environmental hazard to cause damage to the structure or harm to its occupants is complex to assess. The most significant variables are the type of hazard, its distance from the structure, and the capacity or scale of the environmental hazard.

The most important variable is often distance between the structure and the environmental hazard (Chakraborty et al., 2011). A simple distance decay function was established to generate a hazard score for each type of environmental hazard. Using an inverse square, the farther away a structure is, the quicker its hazard score approaches zero (and in some cases, effectively becomes zero if the capacity or scale of the industrial operation is small enough):

$$\frac{H}{(D+1)^2} \times M = S$$

where:
*H*: Hazard type (weights for different types of hazards given below)
*D*: Distance in miles
*M*: Multiplier for capacity (units vary per type of hazard, given below)
*S*: Hazard score

The weighting of hazard types was set following a literature review for the level of threat to health and safety posed by different types of environmental hazards. Categorical weighting was primarily based on the *Environmental Hazard Point System* developed by Diane Sicotte at Drexel University. The multipliers for capacity were calibrated following analysis of all 9 case studies as well as control examples to ensure consistency and to determine the scale for the overall threat level.

The 2 most dangerous environmental hazards that are easily measurable in scope are power stations and U.S. EPA Superfund sites listed on the National Priority List (NPL). The hazard type variable (*H*) for both of these was set to 25. Based on a literature review of the range at which effects travel from industrial disasters occurring at power stations, a radius of 50 miles was established within which all power stations were assessed. This does not consider air contamination via plumes, which can travel 75 miles or more. Prevailing winds and topography were not considered in this analysis, which could slightly increase or decrease the threat posed by the power stations. Power generation was considered, and the multiplier variable (*M*) was set to the plant's capacity in $10^8$ watts (MWs/100 or GWs×10). All U.S. EPA Superfund NPL sites within 25 miles of the structure were assessed. Because the level of cleanup varies from site to site, only active or recently delisted sites were considered, and the multiplier variable (*M*) was set to the EPA's hazard score divided by 10.

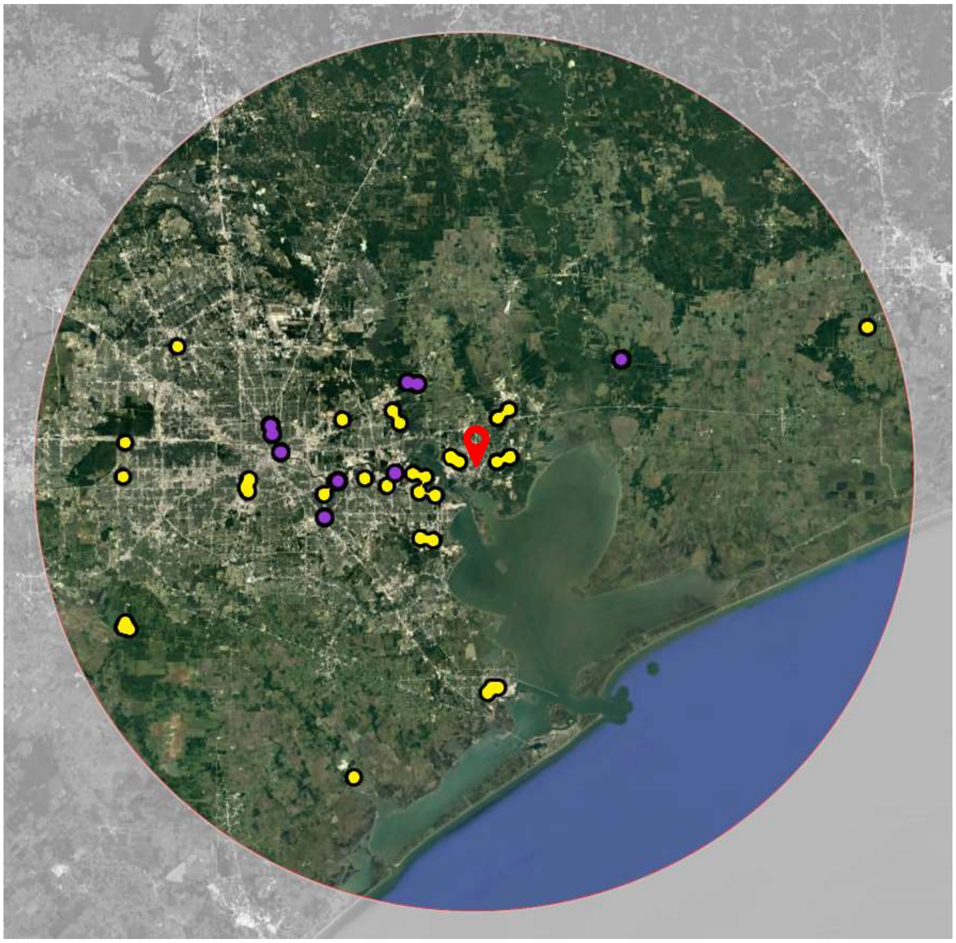


**Figure 5.D.01**: Map of environmental hazards at a regional scale. Yellow dots denote power stations (within 50 miles) and purple dots denote EPA Superfund sites on the NPL (within 25 miles).

Incinerators are slightly less dangerous than the aforementioned environmental hazards, but still pose a high fire risk. All incinerators within a 20-mile radius of the structure were assessed. The hazard type variable (*H*) was set to 20. No multiplier was applied (*M* = 1) because it is difficult to obtain reliable data that conveys the scale of different incinerator operations.

There are several types of environmental hazards that can be moderately dangerous, but typically not over great distances. These include U.S. EPA Superfund sites that are not listed on the NPL, industrial facilities participating in the Toxic Release Inventory (TRI) program (which generally include chemical plants and storage facilities, refineries, and similar facilities), commercial hazardous waste facilities (for treatment, storage, or disposal), landfills and similar such facilities (e.g., trash transfer stations, waste tire piles), large sewage treatment plants or sludge management facilities, freight rail lines and yards, and any other hazardous site designated by the Texas Commission on Environmental Quality (TCEQ). All of these types of hazards within 5 miles of the structure were assessed, and the hazard type variable (*H*) was set to 5. A multiplier was set for TRI industrial facilities to reflect the scale of their operations using hazardous materials. The multiplier variable (*M*) was set to the total release (defined by the EPA as "spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, dumping, or disposing into the environment") of chemicals (in pounds) for that site in a given year (2019) as reported to the EPA (divided by 10,000). (EPA, 2022). This poses some limitations as the data is self-reported by the industries, it treats all hazardous materials equally by weight, many releases are done within environmental regulations, it does not represent chemicals transferred ("for the purposes of recycling, energy recovery, treatment, or disposal") off-site, and 1 year is not wholly representative of the facility's operations over time. However, with the intent of merely conveying the scale of hazardous operations, it was found suitable for weighting large industrial plants and refineries higher than small warehouses and stores. A multiplier was also set for freight rail lines and yards because they potentially carry extremely hazardous materials. The multiplier variable (*M*) was set to the number of parallel tracks. Due to their linear nature, the closest point of a rail line was used for the distance measurement.

**Figure 5.D.02**: Map of environmental hazards at a neighborhood scale (within 5 miles of K'nesseth Israel). Cyan dots denote TRI industrial facilities, pink dots denote landfills, and orange lines denotes the freight rail network. Dots are located at the center of the hazard—actual boundaries may be larger or smaller than represented.

Much smaller, local threats include power substations, high-voltage transmission lines, and gas stations. All of these environmental hazards were assessed within only a quarter-mile radius of the structure and their hazard type variable (*H*) was set to 1 (except for power substations, which was set to 2). Because the scale of these facilities tends to be similar, no multiplier was applied (*M* = 1).

Hazard scores are converted to an approximation of risk due to environmental vulnerability as follows:

| *Range* | *Vulnerability* |
|---|---|
| 0.0 – 19.99 | Minimal risk |
| 20.0 – 39.99 | Some risk |
| 40.0 – 59.99 | Moderate risk |
| 60.0 – 79.99 | High risk |
| 80.0 and above | Extreme risk |

The list of each environmental hazard assessed for K'nesseth Israel is given in Table 5.D.01. To convey an overview of what types and quantities of chemicals are being released in the vicinity of the K'nesseth Israel, more information is provided in Table 5.D.02 (listed by compound, aggregating figures from all TRI facilities within 5 miles of the structure).

***Table 5.D.01: Environmental Hazards***

| Type (H) | Hazard | Distance (D, in mi) | Capacity/scale (M, see above) | Score (S) |
|---|---|---|---|---|
| EPA Superfund NPL sites | Highlands Acid Pit | 8.63 | EPA hazard score: 37.77 | 1.02 |
| | Patrick Bayou | 8.80 | EPA hazard score: 47.83 | 1.25 |
| | French, Ltd. | 11.87 | EPA hazard score: 63.33 | 0.96 |
| | Sikes Disposal Pits | 12.42 | EPA hazard score: 61.62 | 0.86 |
| | US Oil Recovery | 15.28 | EPA hazard score: 50.00 | 0.47 |
| | Geneva Industries/Fuhrmann Energy | 17.70 | EPA hazard score: 59.46 | 0.43 |
| | Petro-Chemical Systems, Inc. (Turtle Bayou) | 21.14 | EPA hazard score: 29.94 | 0.15 |
| | Many Diversified Interests, Inc. | 21.98 | EPA hazard score: 32.07 | 0.15 |
| | South Cavalcade Street | 23.24 | EPA hazard score: 38.69 | 0.16 |
| | North Cavalcade Street | 23.44 | EPA hazard score: 37.08 | 0.16 |
| Power stations | NRG/Cedar Bayou 4 | 2.66 | 535.5 MW | 9.99 |
| | ExxonMobil/Baytown Turbine + Refinery | 2.73 | 559.1 MW | 10.05 |
| | Calpine Central/Baytown Energy Center | 3.82 | 914.6 MW | 9.84 |
| | NRG/San Jacinto Steam Electric Station | 5.01 | 176.4 MW | 1.22 |
| | NRG/Sam Bertron | 5.45 | 842.5 MW | 5.06 |
| | Enterprise Products Operating | 6.50 | 25.7 MW | 0.02 |
| | Exelon/LaPorte Generating Station | 6.56 | 236.0 MW | 0.10 |
| | Oxy Vinyls LP/Houston Chemical Complex Battleground | 6.92 | 380.7 MW | 1.52 |
| | Mont Belvieu Cogeneration Unit | 8.01 | 15.0 MW | 0.04 |
| | Clear Lake Cogeneration Unit | 9.28 | 453.2 MW | 1.07 |
| | Air Liquide/Bayou Cogen Plant | 9.75 | 304.6 MW | 0.66 |

| | | | | |
|---|---|---|---|---|
| | Altura CoGen LLC | 10.02 | 643.6 MW | 1.32 |
| | Deer Park Energy Center | 10.04 | 1,176.0 MW | 2.41 |
| | Reliant Energy/Channelview Cogeneration Plant | 11.56 | 918.3 MW | 1.46 |
| | Calpine Corp/Pasadena Cogeneration | 12.48 | 815.0 MW | 1.12 |
| | Calpine Corp/Channel Energy Center | 15.82 | 923.8 MW | 0.82 |
| | NRG/Greens Bayou | 16.05 | 878.4 MW | 0.76 |
| | BP/Cinergy/Duke Energy/Green Power 2 + Power Station 4 | 24.54 | 1,502.1 MW | 0.58 |
| | Rice University | 25.70 | 3.8 MW | 0.00 |
| | TECO CHP-1 | 25.95 | 48.0 MW | 0.02 |
| | The Methodist Hospital | 26.04 | 5.0 MW | 0.00 |
| | T.H. Wharton | 36.84 | 1,189.9 MW | 0.21 |
| | Chocolate Bayou | 37.34 | 41.0 MW | 0.01 |
| | Helios Plaza CHP Plant | 40.12 | 4.3 MW | 0.00 |
| | Westhollow Technology Center | 40.28 | 3.7 MW | 0.00 |
| | W.A. Parish + Brazos Valley Generating Facility | 43.78 | 4,786.7 MW | 0.60 |
| | Goodyear Beaumont Chemical Plant | 48.05 | 34.8 MW | 0.00 |
| TRI industrial facilities | Eco Services Operations Corp. | 2.34 | 6,372.34 lbs released | 0.02 |
| | ExxonMobil Refining & Supply Baytown Refinery | 2.37 | 2,441,531.75 lbs released | 10.75 |
| | ExxonMobil Chemical Co. Baytown Olefins Plant | 3.00 | 674,996.70 lbs released | 2.11 |
| | ExxonMobil Baytown Chemical Plant | 3.29 | 894,665.20 lbs released | 2.43 |
| | Monument Chemical Baytown LLC | 3.84 | 1,691.10 lbs released | 0.00 |
| | Granite Inliner LLC - Baytown | 3.89 | 547.50 lbs released | 0.00 |
| | SI Group Baytown | 3.96 | 1,800.19 lbs released | 0.00 |
| | LCY Elastomers LP | 4.06 | 22,590.38 lbs released | 0.04 |
| | Campbell RMC Baytown | 4.56 | 0.01 lbs released | 0.00 |
| | The Chemours Co. | 4.62 | 5,644.00 lbs released | 0.01 |
| | Kuraray America Inc. | 4.64 | 1,457,116.00 lbs released | 2.29 |
| | The Lycra Co. LaPorte Plant | 4.64 | 70,879.16 lbs released | 0.11 |

| | | | | |
|---|---|---|---|---|
| | DuPont LaPorte Plant | 4.74 | 4,185.25 lbs released | 0.01 |
| | Foremark Performance Chemicals | 4.87 | 2,547.00 lbs released | 0.00 |
| | Noltex LLC | 4.99 | 2,694,814.00 lbs released | 3.76 |
| | Gas Innovations | 4.99 | 1,150.00 lbs released | 0.00 |
| Landfills & waste sites | Sanifill of Texas, Baytown | 4.57 | - | 0.16 |
| Freight rail lines and yards | Union Pacific track | 0.02 | 1 track | 4.81 |
| | Union Pacific yard | 4.81 | 14 tracks | 2.07 |
| | Union Pacific yard | 4.82 | 57 tracks | 8.41 |
| **Total** | | | | **91.49** |

***Table 5.D.02: Chemical Releases within 5 Miles Reported to EPA, 2019***

| Chemical Substance | Amount (in lbs unless noted otherwise) | Classified as Carcinogen |
|---|---|---|
| 1,2,4-Trimethylbenzene | 233.00 | |
| 1,3-Butadiene | 90,401.89 | Yes |
| Acetaldehyde | 61,567.00 | Yes |
| Acrolein | 1.00 | |
| Ammonia | 306,172.61 | |
| Anthracene | 21.00 | |
| Benzene | 106,706.00 | Yes |
| Benzo[g,h,i]perylene | 8.35 | |
| Carbon disulfide | 1,043.00 | |
| Carbonyl sulfide | 90,780.00 | |
| Chlorine | 1,211.25 | |
| Chlorodifluoromethane (HCFC-22) | 11,194.00 | |
| Chloromethane | 58,837.00 | |
| Copper and copper compounds | 19,156.40 | |
| Cumene | 2,376.00 | Yes |
| Cyclohexane | 28,494.44 | |
| Dibutyl phthalate | 120.00 | |
| Dicyclopentadiene | 1,079.00 | |
| Dioxin and dioxin-like compounds | 0.000693 grams | Yes |
| Ethylbenzene | 31,242.00 | Yes |
| Ethylene | 411,828.00 | |
| Formaldehyde | 48,430.00 | Yes |
| Hydrochloric acid (aerosols) | 32,732.30 | |
| Hydrogen cyanide | 130,847.00 | |
| Hydrogen fluoride | 2,284.00 | |
| Hydrogen sulfide | 52,186.10 | |
| Hydroquinone | 52,992.00 | |

| | | |
|---|---:|:---:|
| Isoprene | 6,240.23 | Yes |
| Lead | 0.01 | Yes |
| Lead and lead compounds | 2,573.90 | |
| Mercury and mercury compounds | 316.60 | |
| Methanol | 3,994,413.00 | |
| Methyl acrylate | 61.00 | |
| Methyl isobutyl ketone | 1,224.00 | |
| Methyl methacrylate | 296.00 | |
| Naphthalene | 28663.10 | Yes |
| n-Butyl alcohol | 7,100.00 | |
| n-Hexane | 218,425.49 | |
| Nickel and nickel compounds | 12,187.76 | Yes |
| Nitrate compounds (in aqueous solution) | 788,600.00 | |
| N-Methyl-2-pyrrolidone | 7,800.00 | |
| Phenanthrene | 9,663.00 | |
| Phenol | 28,259.00 | |
| Polycyclic aromatic compounds | 2,014.30 | Yes |
| Propylene | 562,629.85 | |
| Styrene | 4,730.17 | Yes |
| Sulfuric acid (aerosols) | 226,301.33 | |
| tert-Butyl alcohol | 17,311.00 | |
| Tetrachloroethylene | 2,901.00 | Yes |
| Toluene | 375,153.50 | |
| Trimethylbenzene | 1,330.00 | |
| Vinyl acetate | 174,888.00 | Yes |
| Xylene (mixed isomers) | 265,475.00 | |
| **Total** | **8,280,500.59** | |

### *Flood Risk, Storm Surge and Sea Level Rise*

Flood risk as determined by FEMA refers to designation of areas that are predicted to be inundated based on various criteria or simulated modeling. The site for K’nesseth Israel is represented in FEMA’s flood insurance rate map (FIRM) for Harris County, TX, Panel 955 of 1150 (map number 48201C0955M). According to FEMA, the site is not in any special flood hazard areas (subject to inundation by the 1% annual chance flood, also known as the 100-year flood) or in other flood areas (subject to inundation by the 0.2% annual chance flood, also known as the 500-year flood).

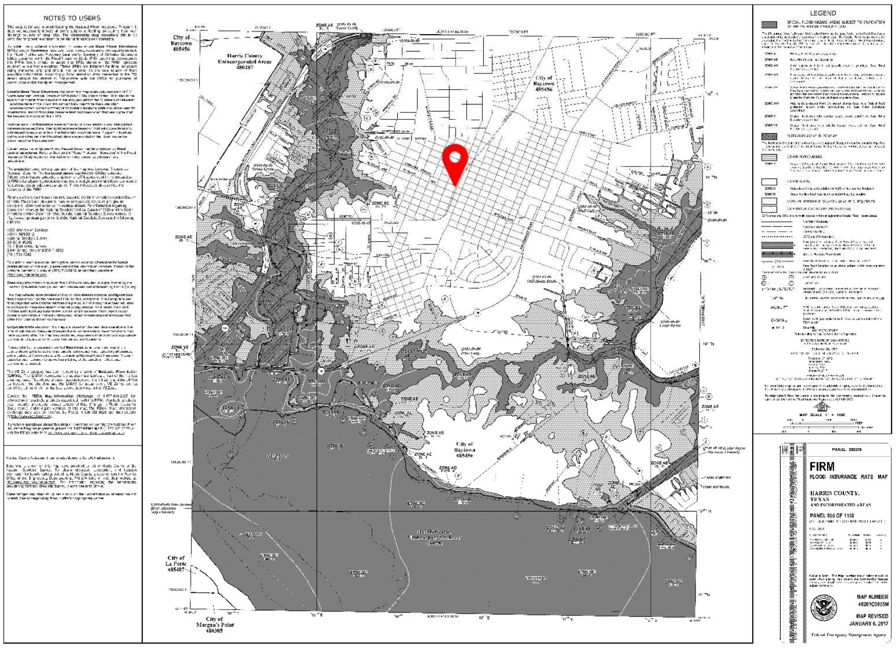
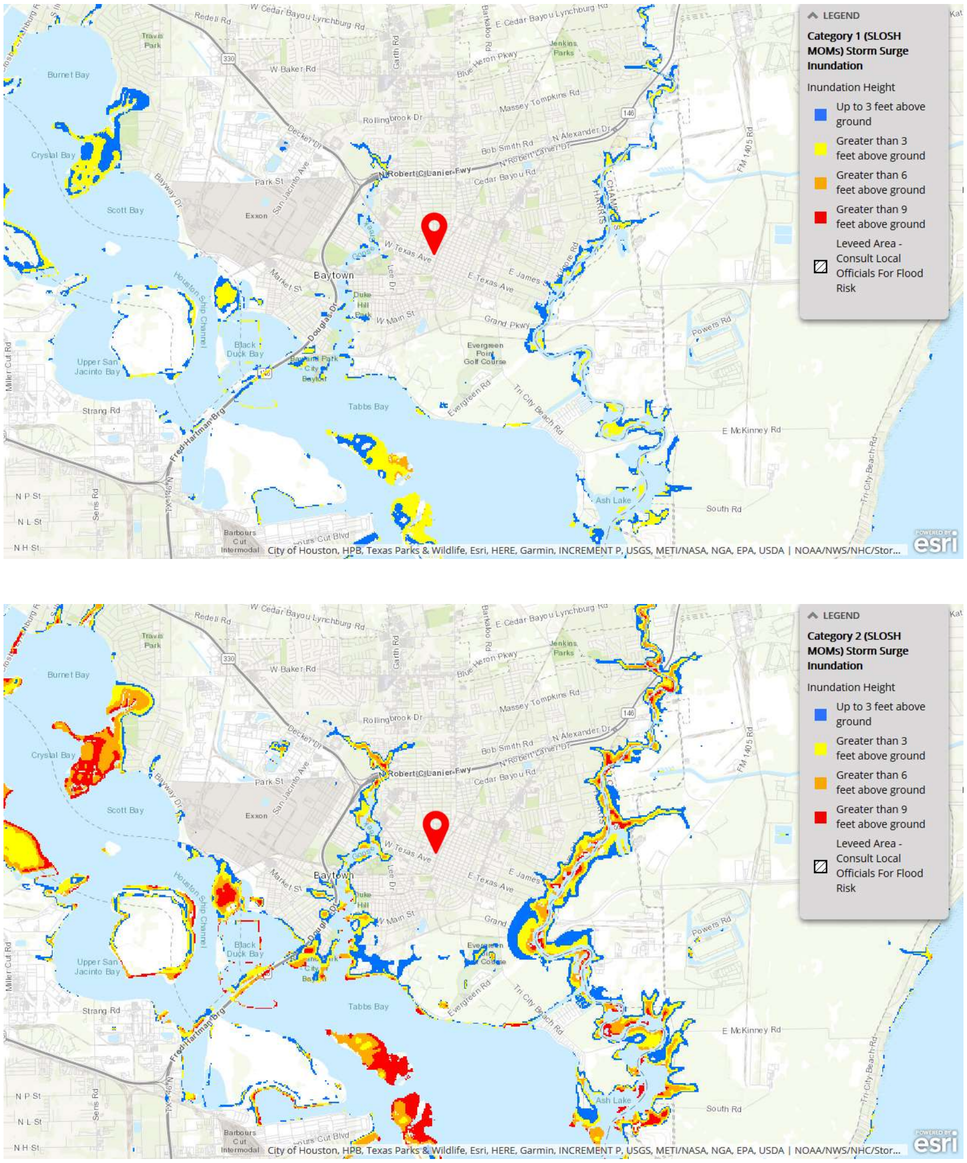


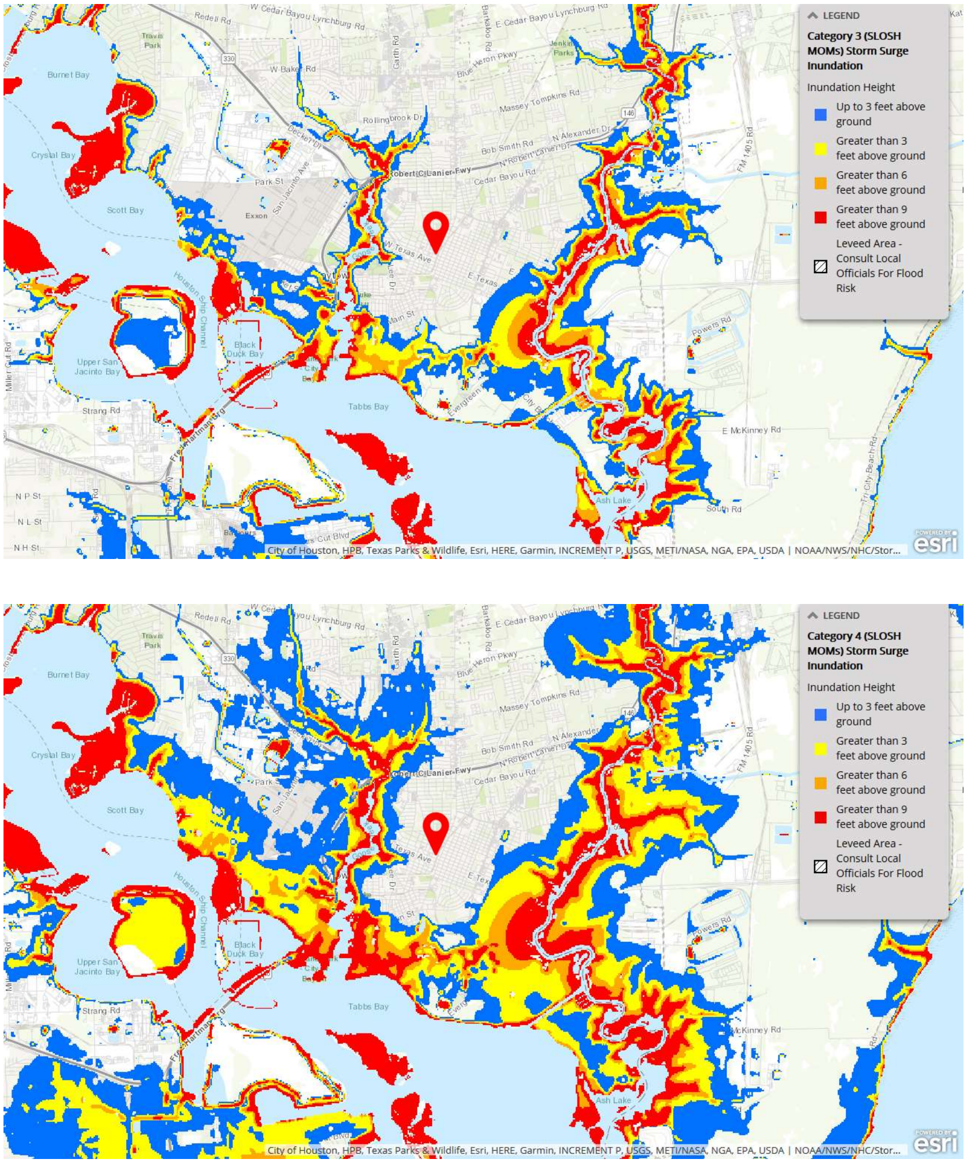
**Figure 5.D.03**: FEMA FIRM map number 48201C0955M with site location annotated.

That does not necessarily mean the site is safe from flash flooding due to extraordinarily high rainfall events, however. These are always possible and have occurred historically around the Baytown area. Due to changing climate patterns, the frequency and intensity of these events may shift.

The site is also not expected to be inundated by coastal storm surge from any classification of hurricane as calculated by NOAA's Sea, Lake, and Overland Surges from Hurricanes (SLOSH) model (seen in Figures 5.D.04–5.D.08). This can be attributed to the site's relatively high elevation (first floor finished elevation is about 30 feet above sea level) compared to the rest of Baytown. However, these maps are reasonable scenarios rather than worst-case scenarios. NOAA estimates that sites outside of the areas shown below (as is the case for K'nesseth Israel) have a "1-in-10 chance that the storm surge flooding at any particular location could be higher than the values shown" (NOAA, n.d.).



**Figures 5.D.04 and 5.D.05**: NOAA's projected storm surge in a Category 1 hurricane (above) and Category 2 hurricane (below).



**Figures 5.D.06 and 5.D.07**: NOAA's projected storm surge in a Category 3 hurricane (above) and Category 4 hurricane (below).

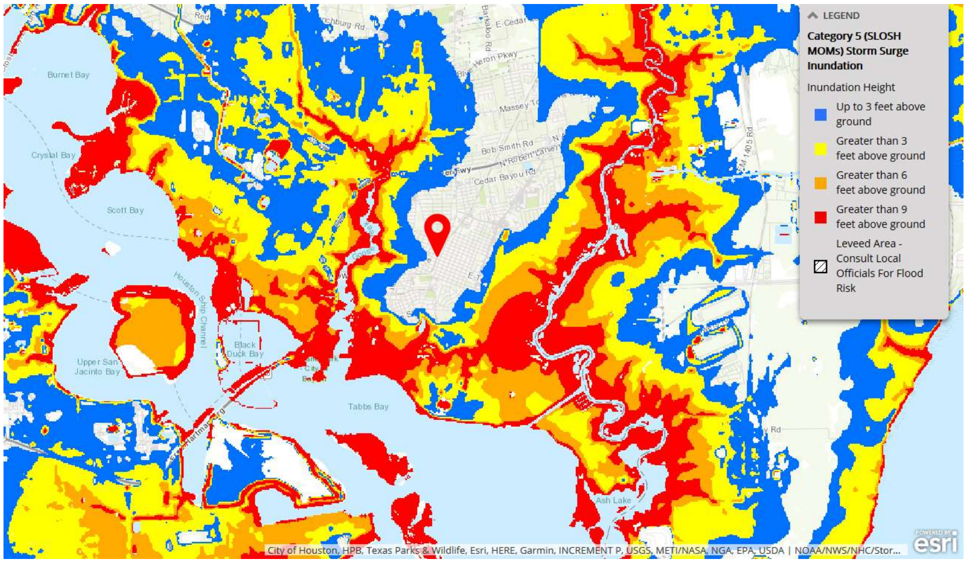


**Figure 5.D.08**: NOAA's projected storm surge in a Category 5 hurricane.

Because the site is still generally close to the current sea level, future rising sea levels may affect the site. Although NOAA's Sea Level Rise Viewer does not project the site falling under realistic future sea levels (even as high as 10 feet), higher sea levels would increase its risk of being affected by storm surge or other flooding events.

### *Findings and Conclusions*

Among the most significant threats to K'nesseth Israel is the large refinery operated by ExxonMobil (the distance for which in the table above is between central points, the actual perimeter of the facility is only about 1.6 miles away). Combined, all of ExxonMobil's facilities released over 4 million pounds of toxic substances into the environment in 2019 (almost half of the total 8.8 million pounds released in the area) and its power plant has a high power-generation capacity of over 550 MW. The amount of flammable and combustible material in such a close proximity poses a fire risk. Reflecting the industrial nature of the area, there is an unusually high concentration of power stations within a 50-mile radius. The combined generation capacity of these power stations is 17.86 GW (representing about 20% of Texas's total power generation capacity). Also of note is the presence of freight rail in the vicinity. 1 freight rail line operated by Union Pacific is very close to the structure (only about 95 feet away), and there are also 2 large freight rail yards within 5 miles. The other hazards are all much less threatening to the structure, either due to their distance or their small size, as seen in the table above. In conclusion, **the structure is at extreme risk from neighborhood-level environmental hazards** due to the predominantly heavy industrial nature and concentration of facilities in the immediate environs.

## References

Chakraborty, J., Maantay, J. A., & Brender, J. D. (2011). Disproportionate proximity to environmental health hazards: Methods, models, and measurement. *American Journal of Public Health, 101*(1). https://doi.org/10.2105/ajph.2010.300109

Chakraborty, J., Collins, T. W., Grineski, S. E., Montgomery, M. C., & Hernandez, M. (2014). Comparing disproportionate exposure to acute and chronic pollution risks: A case study in Houston, Texas. *Risk Analysis, 34*(11). https://doi.org/10.1111/risa.12224

Energy Justice Network. (n.d.). National Map. Retrieved from http://www.energyjustice.net/map/searchobject.php?gsTable=facility&gsSearchtype=nationalmap

Environmental Protection Agency (EPA). (2021). Data downloads. Retrieved from https://www.epa.gov/enviro/data-downloads

Environmental Protection Agency (EPA). (n.d.). Search for Superfund Sites Where You Live. Retrieved from https://www.epa.gov/superfund/search-superfund-sites-where-you-live#map

Federal Emergency Management Agency (FEMA) (Cartographer). (2017). Flood insurance rate map, Harris County, Texas and incorporated areas, panel 955 of 1150 [map]. Retrieved from https://map1.msc.fema.gov/firm?id=48201C0955M

National Oceanic and Atmospheric Administration (NOAA). (n.d.). National Storm Surge Hazard Maps. Retrieved from https://noaa.maps.arcgis.com/apps/MapSeries/index.html?appid=d9ed7904dbec441a9c4dd7b277935fad&entry=1

National Oceanic and Atmospheric Administration (NOAA). (n.d.). Sea Level Rise Viewer. Retrieved from https://coast.noaa.gov/slr/

Sicotte, D. (2010). Some more polluted than others: Unequal cumulative industrial hazard burdens in the Philadelphia MSA, USA. *Local Environment, 15*(8). https://doi.org/10.1080/13549839.2010.509384

# Appendix E

## Resilience Treatments & Strategy Details

***Key***

This matrix provides the same recommended Resilience Treatments and Strategies (RTSs) given in the report, with additional details that may help prioritize implementing the RTS recommendation. It is also sorted by urgency, using the following scale:

| | |
|---|---|
| **Severe** | Condition or practice poses a risk to health or safety and **should be remedied immediately**. |
| **High** | Condition or practice compromises the building assembly category, which may be marked poor or critical. **Schedule repair/address need as soon as possible**. |
| Moderate | Condition or practice actively adversely impacting other systems or may be worsening. The condition of the category may be marked moderate or poor. Make plans to remedy the condition or change the practice. |
| Low | Condition or practice may affect other systems or may be worsening, but is minor, isolated, or has limited effects. Maintenance may have been deferred, but continued deferral is discouraged. |
| Minimal | Condition or practice only concerns appearance, does not adversely affect the resilience of the building, and is generally stable. Maintenance may be deferred. |

The degree to which the RTS will enhance resilience is based on the points available in the *UTSA-CCS Survey & Vulnerability Assessment* form. The estimated effect of implementing the RTS on the score approximately follows this scale:

| | |
|---|---|
| Significant | Likely to reduce weighted vulnerability score of affected categories by 6 points or more. |
| Substantial | Likely to reduce weighted vulnerability score of affected categories by 4 or 5 points. |
| Moderate | Likely to reduce weighted vulnerability score of affected categories by 2 or 3 points. |
| Slight | Likely to reduce weighted vulnerability score of affected categories by 1 or 2 points, particularly if in conjunction with other improvements to that category. |
| Negligible | No change to vulnerability; recommendations are for aesthetic improvements only, possibly preserving character-defining features that may affect the historic integrity of the resource. |

An estimate is also provided whether the RTS can be implemented "in-house" or whether professional services (e.g., licensed architects or engineers) or specialized technical expertise (e.g., art conservators, skilled masons, stained glass technicians) will be necessary. In-house means the work can be performed by typical maintenance personnel or common trade laborers, as long as all parties are familiar with the *Secretary of the Interior's Standards for the Treatment of Historic Properties* and make every attempt to follow them. Of course, the familiarity and capacity to perform this work varies from organization to organization, so consult an architect or other skilled professional familiar with the building and type of work to be performed to obtain estimates. These recommendations are for planning purposes only. In terms of costs, typically work performed by licensed or specialized professionals costs much more than work that can be or is performed without their expertise, however, the cost is worth it to minimize future work and in many cases will be necessary.

***Table 5.E.01: Physical Conditions or Practices Affecting Vulnerability***

| *Condition or Practice* | *Affecting Category* | *Urgency* | *RTS Recommendations* | *Expertise Necessary* | *Improvements to Resilience* |
|---|---|---|---|---|---|
| Lack of disaster response and recovery plan. | All categories | **High** | Write a disaster response and recovery plan, working with county officials and referencing publications freely available from multiple organizations. Consider consulting professionals to assist the process, but author the plan yourself to ensure all aspects of cultural heritage are properly considered. | In-house/trade | **Substantial** |
| Drainage ports (scuppers) handling water shedding off of the roof are undersized and lack overflow drainage outlets. | Roof structure, roof attachments, interior finishes, ceiling structure | **High** | Consult a licensed professional to determine appropriate modifications to current roof drainage system. | Professional | **Substantial** |
| Downspouts not directly attached to subgrade drainage and are eroding/washing out surrounding soil and | Roof attachments, exterior finishes | **High** | Modify downspouts to properly direct water away from the building or else into the subgrade drainage system if it is designed to accommodate anticipated volume. Coordinate these efforts with a | Professional | **Substantial** |

| | | | | | |
|---|---|---|---|---|---|
| staining adjacent masonry. | | | licensed professional in conjunction with redesign of roof drainage system. | | |
| Potential damage to anchor bolts connecting roof structure to exterior walls. | Roof, exterior wall structure, interior wall structure | **High*** | **Concern was reported after the site visit and was not directly observed*. In lieu of further information, investigate concern; consider consulting engineer. | Likely professional | N/A |
| Lack of fire suppression system. | Services | **High** | Consult licensed professionals to determine appropriate system and scope; install system. This is a standard recommendation for all places of public assembly and highly values cultural resources. | Professional | **Substantial** |
| Walls are stressed and unevenly settling, causing cracks on all façades, confirmed by results of the Finite Element Analysis. | Exterior wall structure, exterior wall finishes, interior wall finishes | Moderate | Consult engineer regarding options for structural improvement and their benefits. Delay patching cosmetic defects until structural conditions are better understood. | Possibly professional, in-house/trade if found purely cosmetic | **Substantial** |
| Windows unprotected from hurricane forces. | Windows | Moderate | Install new protective polycarbonate panels over windows that are hurricane-rated for impact and wind resistance. | In-house/trade | **Substantial** |
| Floor framing untreated and exposed to high moisture levels, providing conditions in crawl space for wood damage by insects and fungal growth. | Foundation, basement, floor | Moderate | Consult architect about feasible options to reduce moisture levels in crawlspace or to protect wood from moisture absorption. Options may include installing a vapor barrier on dirt floor, applying waterproof coating on interior walls of crawl space, treating wood framing with insecticides/fungicides, and | Professional | Moderate |

| | | | | | |
|---|---|---|---|---|---|
| | | | applying protective coatings to floor joists. | | |
| Deteriorated exterior door finishes. | Doors | Moderate | Refinish door. | In-house/trade | Moderate |
| Interior floor level is lower than exterior entry deck. | Doors, interior finishes | Moderate | Improve weather-stripping (strong door sweep and ensure that threshold is securely installed). | In-house/trade | Moderate |
| Steel door lintel is oxidizing, causing structural and cosmetic damage to surrounding masonry. | Exterior wall structure, exterior wall finishes, doors | Moderate | Consult architect; disassemble and repair as needed. | Professional | Moderate |
| Lack of emergency power. | Services | Moderate | Install emergency generator sufficiently sized to power essential building systems (for a permanent system) or meet disaster response needs (a portable generator may suffice). | In-house/trade | **Substantial** |
| Uneven settling or movement of soil below front stair and near the building foundations may be causing hairline cracks. | Foundation, site stairs | Low | Consult engineer if deemed structurally necessary. Delay patching cosmetic defects until structural conditions are better understood. | Possibly professional, in-house/trade if found purely cosmetic | **Substantial** |
| Portions of masonry heavily weathered and need repointing. | Exterior wall finishes | Low | Repoint mortar joints with new mortar where losses are substantial or pointing is loose. New mortar must match historic mortar's composition, physical properties, texture and color. | In-house/trade | Slight |
| Plumbing may have sustained damages | Services | Low | Test plumbing to confirm possible damage; consult plumber if necessary. | In-house/trade | Slight |

| | | | | | |
|---|---|---|---|---|---|
| from recent winter storm. | | | | | |
| Voussoirs of window arches are split bricks, which appear to be depositing fine masonry debris below. | Exterior wall finishes, windows | Low | Investigate carefully to determine cause; consolidate unstable bricks with appropriate coatings and repoint loose mortar in manner that will not alter appearance. | In-house/trade | Negligible |
| Cracked window lites. | Windows | Low | Replace the affected lites with in-kind lites. | In-house/trade | Negligible |
| Inoperable windows. | Windows | Low | Restore operability. | In-house/trade | Slight |
| Pest intrusion (bats, insects at interior and hornet nests on exterior). | Windows | Low | Treat active pest intrusion. Investigate method of entry (possibly vents in attic cavity or damaged roof parapet). Seal/repair entry and establish a plan/schedule for regular pest treatment. | Professional | Negligible |
| Masonry repair does not match historic brick. | Exterior wall finishes | Minimal | Remove recent repair and replace with brick to match existing masonry (if such in-kind brick can be located). | In-house/trade | Negligible |
| Unpatched anchor holes in masonry. | Exterior wall finishes | Minimal | Patch or replace brick (if in-kind brick can be located) to match existing masonry. | In-house/trade | Negligible |
| Floor heavily weathered at entry and in north corners, both likely from water intrusion and possible ponding. | Interior finishes | Minimal | Refinish where worn/water damaged (after addressing both the roof condition and the door weather-stripping, otherwise this condition may return). | In-house/trade | Negligible |
| Crown molding detaching from wall-ceiling joint. | Interior finishes | Minimal | Repair (after addressing roof condition, otherwise this condition may return). | In-house/trade | Negligible |

| | | | | | |
|---|---|---|---|---|---|
| Stained plaster and hairline cracks. | Interior finishes | Minimal | Repair and repaint plaster (after addressing roof condition, otherwise this condition may return). | In-house/trade | Negligible |

**TEXAS HISTORICAL COMMISSION**

## HISTORIC RESOURCES SURVEY FORM

PROJECT # FAIN: P19AP00014
Local ID Click here to enter text.
County Harris
City Baytown
Address 100 W Sterling Ave

## SECTION 1

### Basic Inventory

Current Name K'nesseth Israel Synagogue
Historic Name K'nesseth Israel Synagogue

Owner Information:
Name Congregation K'nesseth Israel
Status Click here to enter text.
Address PO Box 702
City Baytown
State Texas
Zip 77522

**Geographic Location:** Latitude: 29.737140 Longitude: -94.979120
Legal Description (Lot/Block) Lot 1, 2, 21, 22, 23 & 24; Block 7
Addition/Subdivision Goose Creek Year Click here to enter text.

**Property Type:** ☒Building ☐Structure ☐Object ☐Site ☐District

**Current Designations:**
☐NR District (Is property contributing? ☐Yes ☐No)
☐NHL ☐NR ☒RTHL ☐OTHM ☐HTC ☐SAL ☐Local ☐OtherClick here to enter text.

**Architect:** Leonard Gabert **Builder:** Click here to enter text.

**Construction Date:** 1928-1930 ☒Actual ☐Estimated Source: RTHL Historical Marker

### Function

**Current Use:** ☐Agriculture ☐Commerce/trade ☐Defense ☐Domestic ☐Educational
☐Government ☐Healthcare ☐Industry/Processing ☐Recreation/Culture ☒Religious ☐Social
☐Vacant ☐Other: Click here to enter text.

**Historic Use:** ☐Agriculture ☐Commerce/trade ☐Defense ☐Domestic ☐Educational
☐Government ☐Healthcare ☐Industry/Processing ☐Recreation/Culture ☒Religious ☐Social
☐Vacant ☐Other: Click here to enter text.

### Image Information

Recorded by: UTSA-CCS
Date Recorded: 03/20/2021
Photo Data: ID# Click here to enter text. To: Click here to enter text.
Primary Image ID: TX-HR-Baytown-Sterling-Ave-W-100-02

## TEXAS HISTORICAL COMMISSION

## HISTORIC RESOURCES SURVEY FORM

PROJECT # FAIN: P19AP00014 Local ID Click here to enter text.
County Harris City Baytown
Address 100 W Sterling Ave

### SECTION 2

### Architectural Description

**General Architectural Description:** 1-story rectangular plan Art Deco style structure with barrel vault roof, round-headed stained glass windows, arched brickwork entry over two sets of wooden double doors, and wood frame with brick cladding.

☐Additions, modifications, specify dates:
☐Relocated, specify date, former location and information of interest: Click here to enter text.

**Stylistic Influence(s)**
☐Log traditional ☐Shingle ☐Gothic Revival ☐Pueblo Revival ☐International
☐Greek Revival ☐Romanesque Revival ☐Tudor Revival ☐Spanish Colonial ☐Post-war Modern
☐Italianate ☐Folk Victorian ☐Neo-Classical ☐Prairie ☐Ranch
☐Second Empire ☐Colonial Revival ☐Beaux Arts ☐Craftsman ☐Commercial Style
☐Eastlake ☐Renaissance Revival ☐Mission ☒Art Deco ☐No Style
☐Queen Anne ☐Exotic Revival ☐Monterey ☐Moderne ☐Other

### Structural Details

**Roof Form**
☐Gable ☐Hipped ☐Gambrel ☐Shed ☐Flat w/ parapet ☐Mansard ☐Pyramidal
Other: Barrel vault with parapet

**Roof Materials**
☐Wood shingles ☐Tile ☐Composition Shingles ☐Metal ☒Other: TPO

**Wall Materials**
☒Brick ☐Stucco ☐Stone ☐Wood shingles ☐Log ☐Terra Cotta ☐Concrete
☐Metal: ☐Wood Siding ☐Siding: Other Click here to enter text. ☐Glass ☐Asbestos ☐Vinyl
☒Other: Wood frame

**Windows**
☐Fixed ☐Double Hung ☐Wood Sash ☐Metal Sash ☒Casement
☐Sliding ☐Decorative Screenwork Other: round-headed and rectangular stained glass

**Doors (Primary Entrance)**
☐Single door ☒Double door ☐With transom ☐With sidelights ☒Other: two sets of double doors

**Plan**
☐L-plan ☐T-plan ☐Modified L-plan ☐2-room ☐Open ☐Center Passage ☐Bungalow ☐Shotgun
☐Irregular ☐Four Square ☒Rectangular ☐OtherClick here to enter text.

# of Stories: 1 Basement: ☒None ☐Partial ☐Full

**Chimneys**
Specify #Click here to enter text. ☐Interior ☐Exterior
☐Brick ☐Stone ☐Stucco ☐Corbelled Caps ☐Other: Click here to enter text.

**PORCHES/CANOPIES**

**Form:** ☐Shed Roof ☐Flat Roof ☐Hipped Roof ☐Gable Roof ☐Inset ☐Other: Click here to enter text.

**Support:** ☐Wood posts (plain) ☐Wood posts (turned) ☐Masonry pier ☐Fabricated metal
☐Box columns ☐Classical columns ☐Tapered box supports ☐Suspension cables
☐Suspension rods ☐Spindlework ☐Jigsawn trim ☐Other: Click here to enter text.

**Materials:** ☐Metal ☐Wood ☐Fabric ☐OtherClick here to enter text.

**Ancillary Buildings (specify # and type)**
Garage Click here to enter text. Barn Click here to enter text. Shed Click here to enter text. Other: 1 Social Hall Building

**Landscape/Site Features**
☒Sidewalks ☐Terracing ☐Drives ☐Well/cistern ☐Gardens ☐Other: Click here to enter text.
☐Stone ☐Wood ☐Concrete ☒Brick ☐Other materials: Click here to enter text.

Landscape Notes: Click here to enter text.

## TEXAS HISTORICAL COMMISSION

### HISTORIC RESOURCES SURVEY FORM

PROJECT # FAIN: P19AP00014

Local ID Click here to enter text.

County Harris

City Baytown

Address 100 W Sterling Ave

## SECTION 3

### Historical Information

**Associated Historical Context:** ☐Agriculture ☒Architecture ☐Arts ☐Commerce
☐Communication ☐Education ☐Exploration ☐Health ☐Immigration/Settlement
☐Law/Government ☐Military ☐Natural Resources ☐Planning/Development ☒Religion/Spirituality
☐Science/Technology ☒Social/Cultural ☐Transportation ☐Other: Click here to enter text.

**Applicable National Register (NR) Criteria:**

☐A Associated with events that have made a significant contribution to the broad pattern of our history
☐B Associated with the lives of persons significant in our past
☒C Embodies the distinctive characteristics of a type, period or method of construction or represents the work of a master, or possesses high artistic value, or represents a significant and distinguishable entity whose components lack individual distinctions
☐D Has yielded, or is likely to yield, information important in prehistory of history

**Areas of Significance:** Constructed for Jewish residents in response to the area's growing population following the early 20th century oil field boom. Architect Leonard Gabert was one of the earliest Jewish architects in Texas and this is the first of many synagogues he designed. Original architectural details remain intact.

Click here to enter text.

**Period(s) of Significance:** 1928-1935

**Level of Significance:** ☐National ☐State ☒Local

**Integrity:** ☒Location ☒Design ☒Materials ☒Workmanship
☒Setting ☒Feeling ☒Association

**Integrity notes:** Overall, K'nesseth Israel has a high level of integrity in all categories, but diminished integrity in materials due to some requisite repairs and material replacements.

**Individually Eligible?** ☒Yes ☐No ☐Undetermined

**Within Potential NR District?** ☐Yes ☐No ☒Undetermined

**Is Property Contributing?** ☐Yes ☐No ☒Undetermined

**Priority:**
(see manual for definitions) ☐High ☒Medium ☐Low Explain: Click here to enter text.

### Other Information

**Is prior documentation available for this resource?** ☒Yes ☐No ☐Unknown **Type:** ☐HABS ☐Survey ☒Other

Documentation details RTHL Designation

**Questions?**
Contact Survey Coordinator
History Programs Division, Texas Historical Commission
512/463-5853
history@thc.state.tx.us
version 3/2013

TEXAS HISTORICAL COMMISSION
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# Appendix G

## Drawings

### *Sheet Index*

| | |
|---|---|
| A-10 | Site Plan |
| A-11 | Floor Plan |
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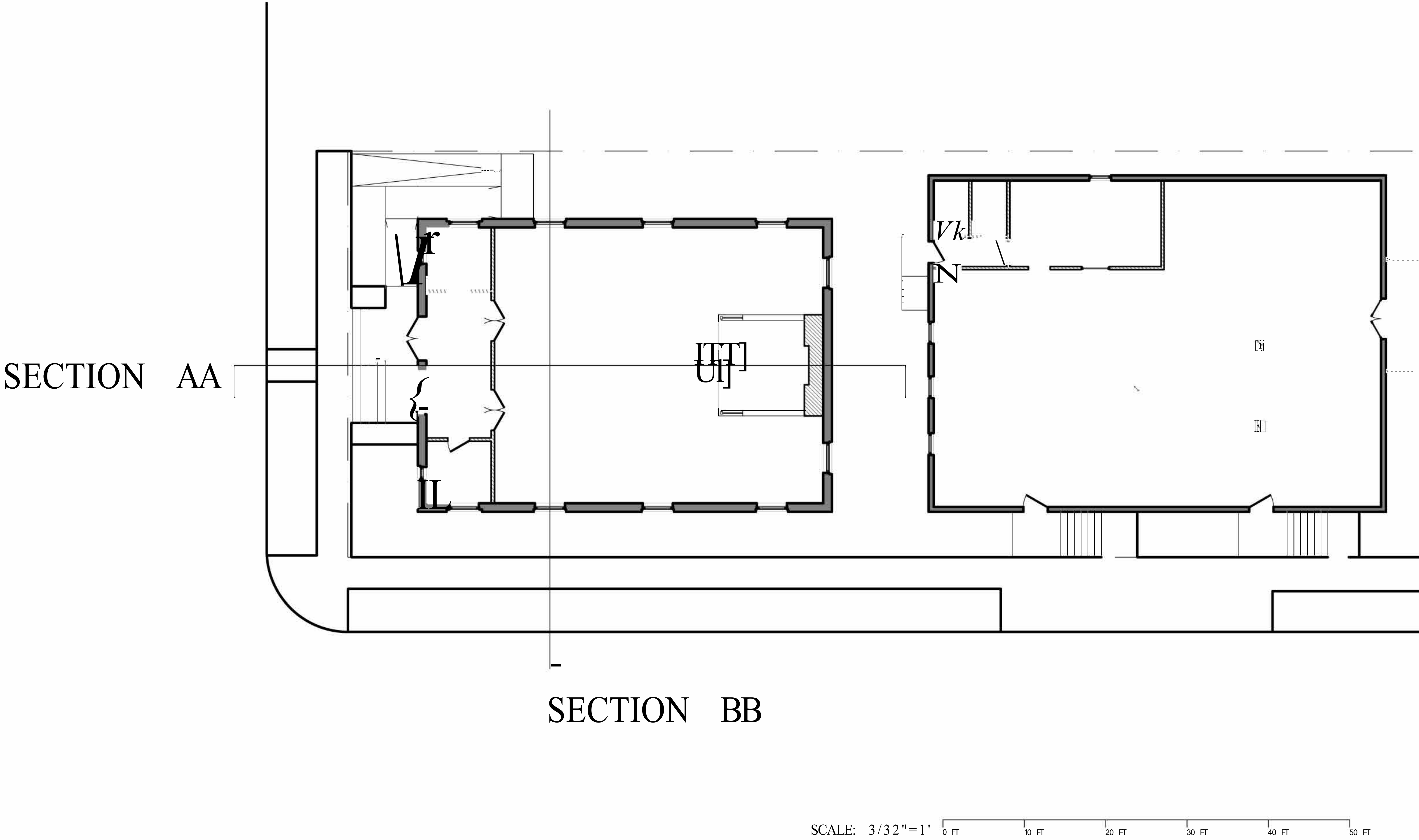
| A-13 | East Elevation |
| A-14 | North Elevation |
| A-15 | West Elevation |
| A-16 | Longitudinal Section AA |
| A-17 | Transverse Section BB |

### *Methodology & Disclaimer*

Existing architectural drawings were provided by Robert Davis, Architect. The pdf drawings were imported into AutoCAD and scaled. A new AutoCAD drawing was created with revised geometry based on measurements in the field and photographs. The purpose of these drawings was to provide reference plans, elevations, and sections for the field survey and finite element analysis. These are not as-built drawings; some dimensions may be estimates.

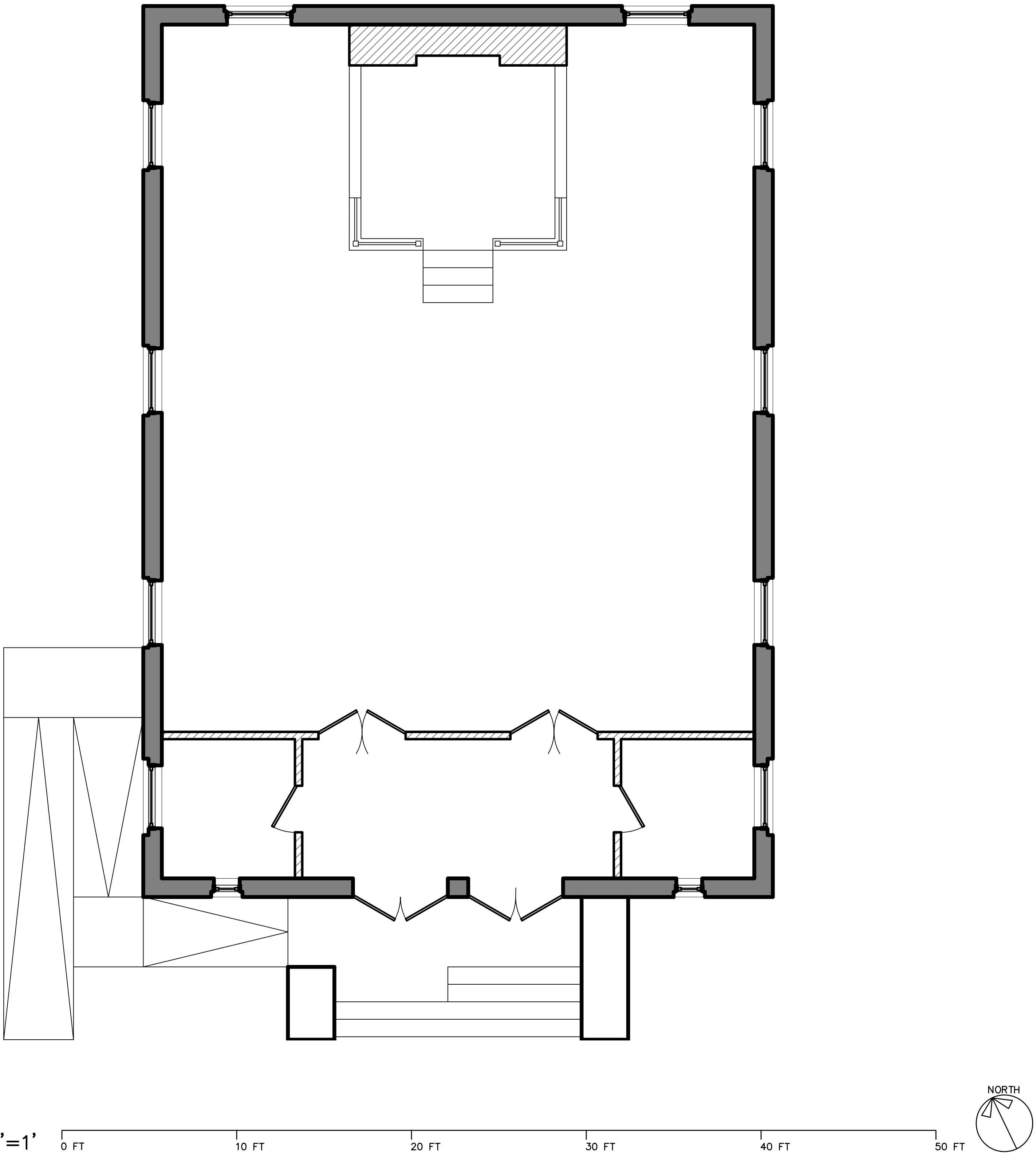


A-10
SITE PLAN

DATE: MARCH 20, 2021

APPENDIX G - DRAWINGS
K'NESSETH ISRAEL SYNAGOGUE
100 W. STERLING AVE.
BAYTOWN, TX 77520

UTSA
Center for Cultural
Sustainability



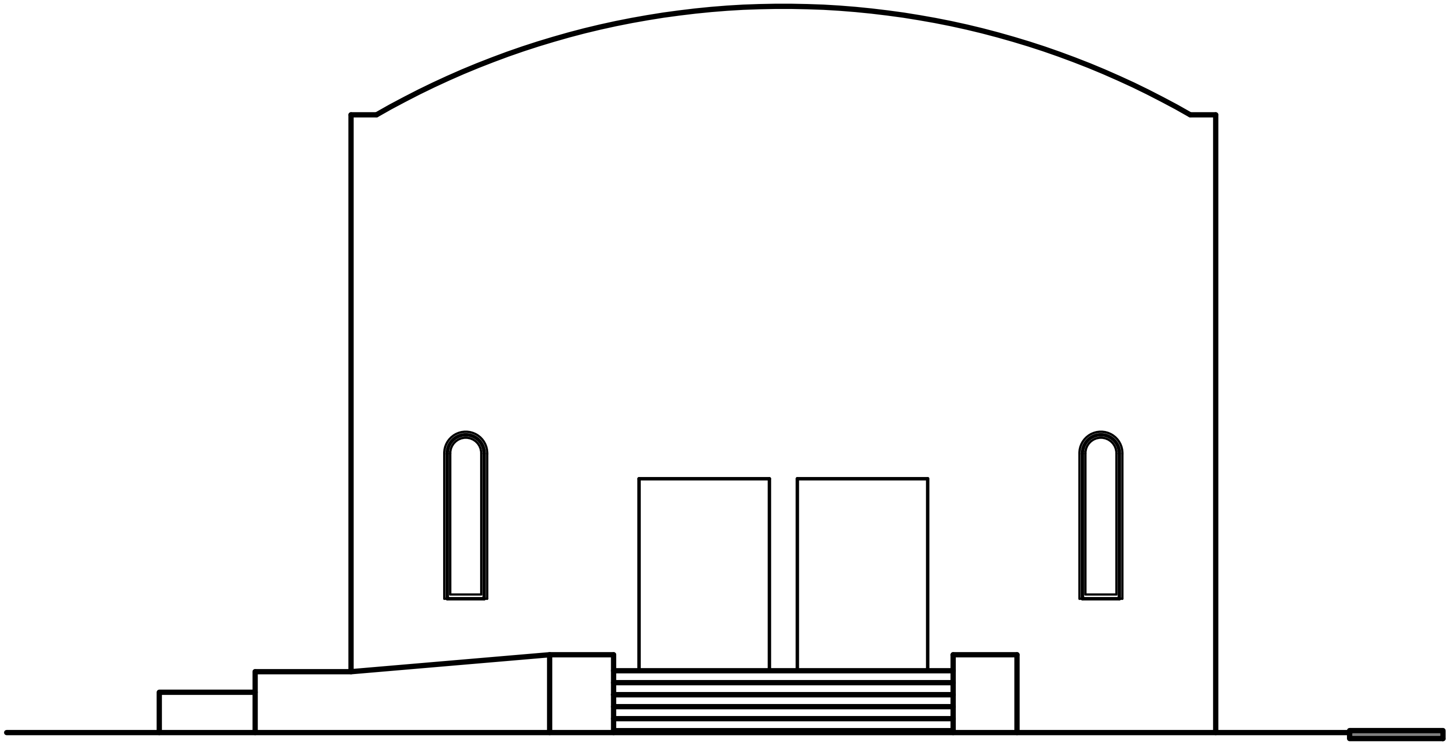
SCALE: 1/8"=1'

A–11
FLOOR PLAN

DATE: MARCH 20, 2021

APPENDIX G – DRAWINGS
K'NESSETH ISRAEL SYNAGOGUE
100 W. STERLING AVE.
BAYTOWN, TX 77520

UTSA
Center for Cultural
Sustainability



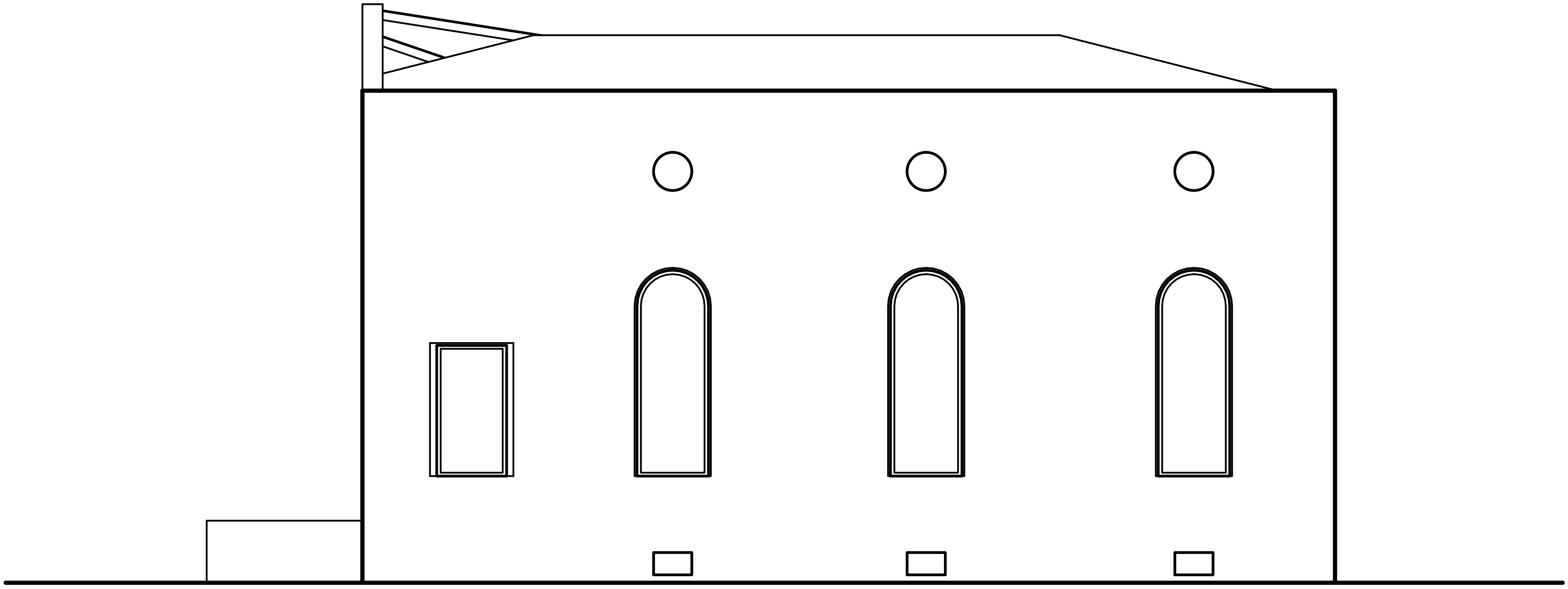
SCALE: 1/8"=1'

A–12
SOUTH ELEVATION

DATE: MARCH 20, 2021

APPENDIX G – DRAWINGS
K'NESSETH ISRAEL SYNAGOGUE
100 W. STERLING AVE.
BAYTOWN, TX 77520

UTSA
Center for Cultural Sustainability



SCALE: 1/8"=1'

A–13
EAST ELEVATION

DATE: MARCH 20, 2021

APPENDIX G – DRAWINGS
K'NESSETH ISRAEL SYNAGOGUE
100 W. STERLING AVE.
BAYTOWN, TX 77520

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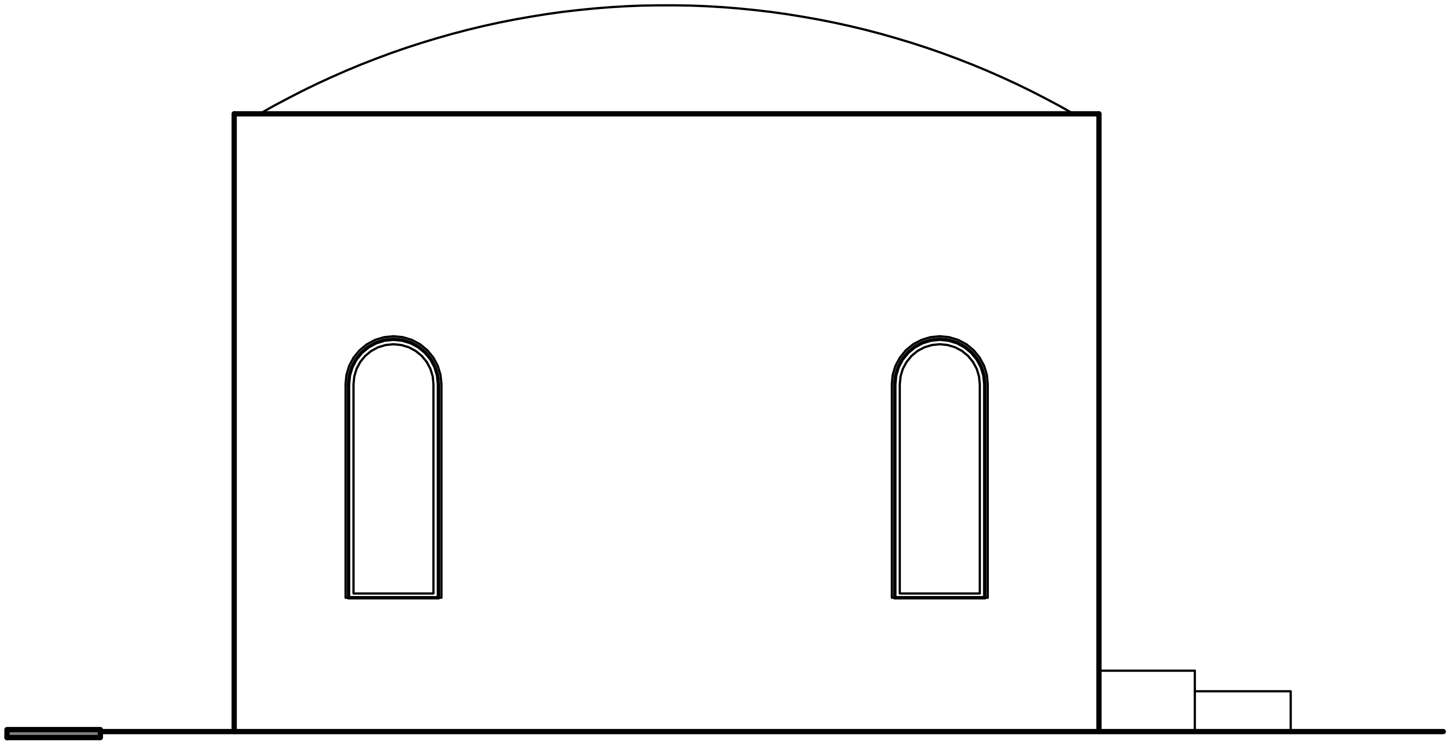

SCALE: 1/8"=1'

A–14
NORTH ELEVATION

DATE: MARCH 20, 2021

APPENDIX G – DRAWINGS
K'NESSETH ISRAEL SYNAGOGUE
100 W. STERLING AVE.
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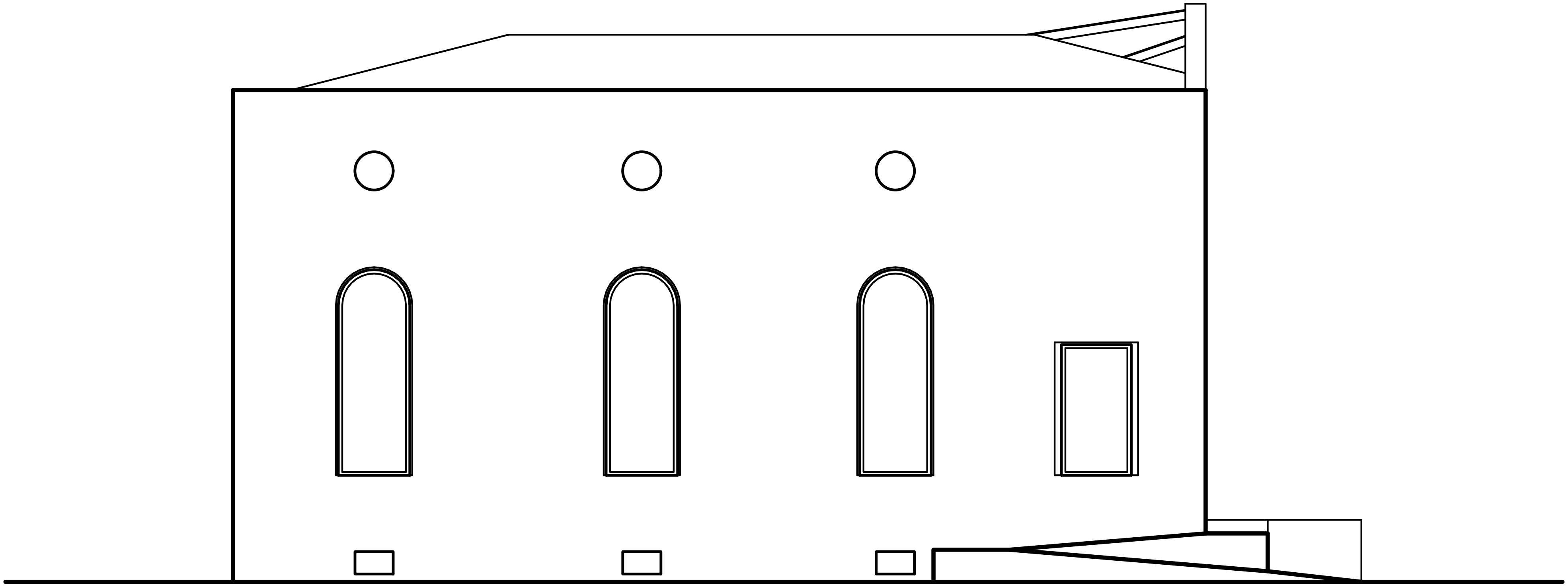

SCALE: 1/8"=1'

A-15
WEST ELEVATION

DATE: MARCH 20, 2021

APPENDIX G – DRAWINGS
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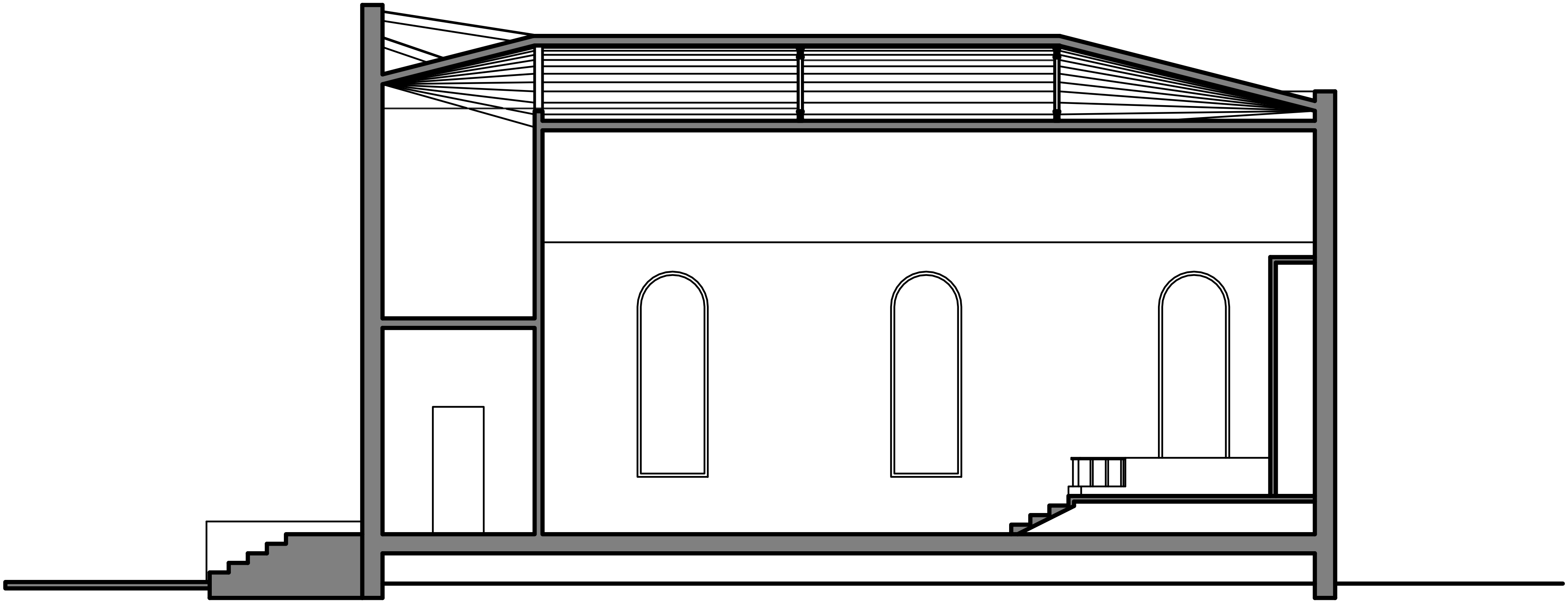

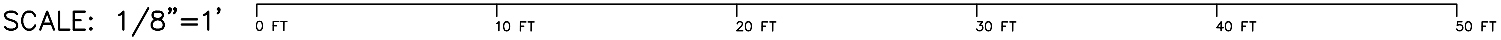

A–16
SECTION AA

DATE: MARCH 20, 2021

APPENDIX G – DRAWINGS
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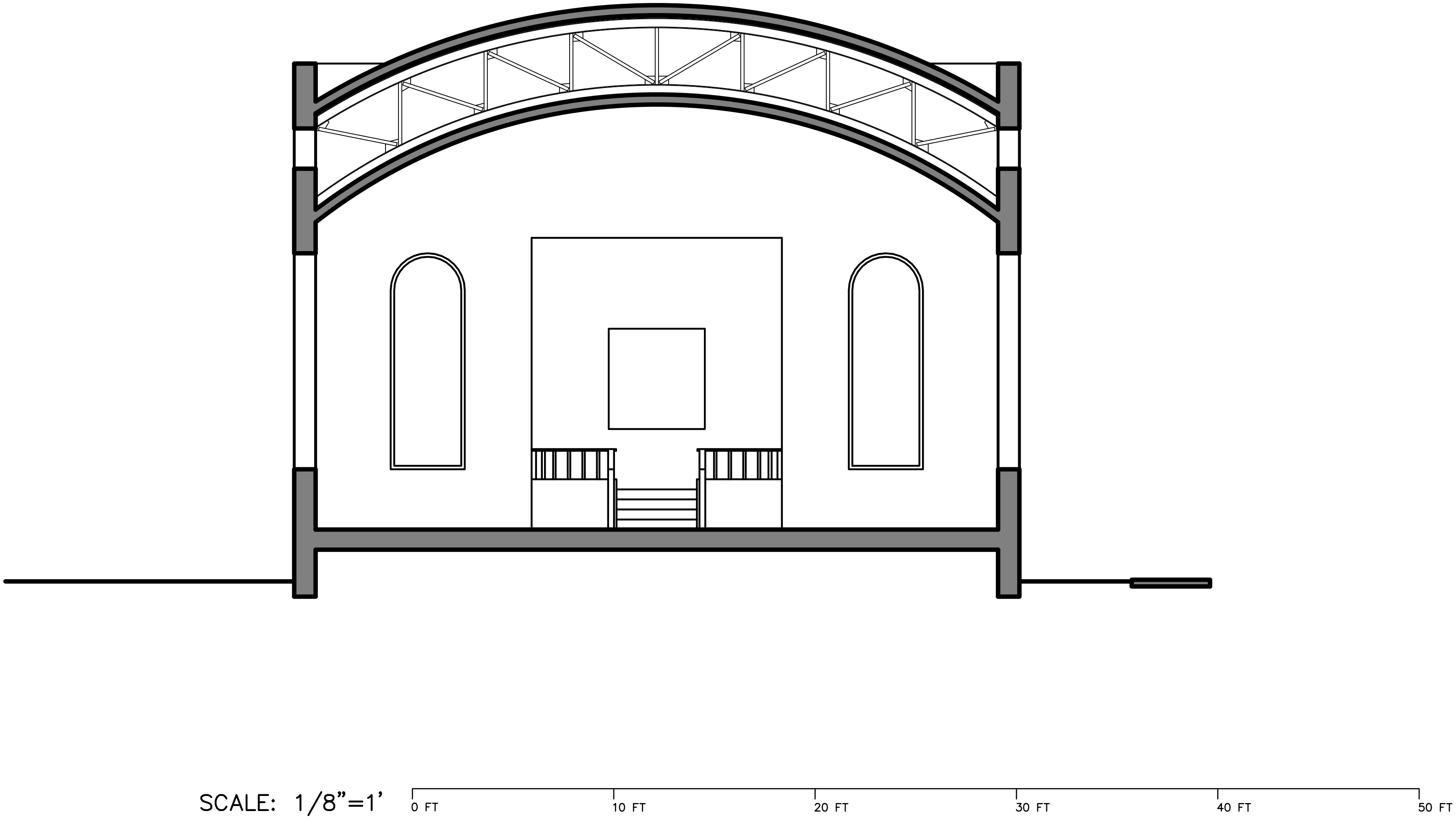

SCALE: 1/8"=1'

A–17
SECTION BB

DATE: MARCH 20, 2021

APPENDIX G – DRAWINGS
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