The University of Iowa | Office of Outreach and Engagement

FINAL DELIVERABLE

Title	Webster City Elks Club Building Restoration
Completed By	Joe Ranard, Paul Hansen, Yuyan Chen
Date Completed	May 2019
UI Department	Civil and Environmental Engineering
Course Name	CEE:4850:0001 Project Design & Management Civil Engineering
Instructor	Christopher Stoakes
Community Partners	City of Webster City

This project was supported by the Provost's Office of Outreach and Engagement at the University of Iowa. The Office of Outreach and Engagement partners with rural and urban communities across the state to develop projects that university students and faculty complete through research and coursework. Through supporting these projects, the Office of Outreach and Engagement pursues a dual mission of enhancing quality of life in Iowa while transforming teaching and learning at the University of Iowa.

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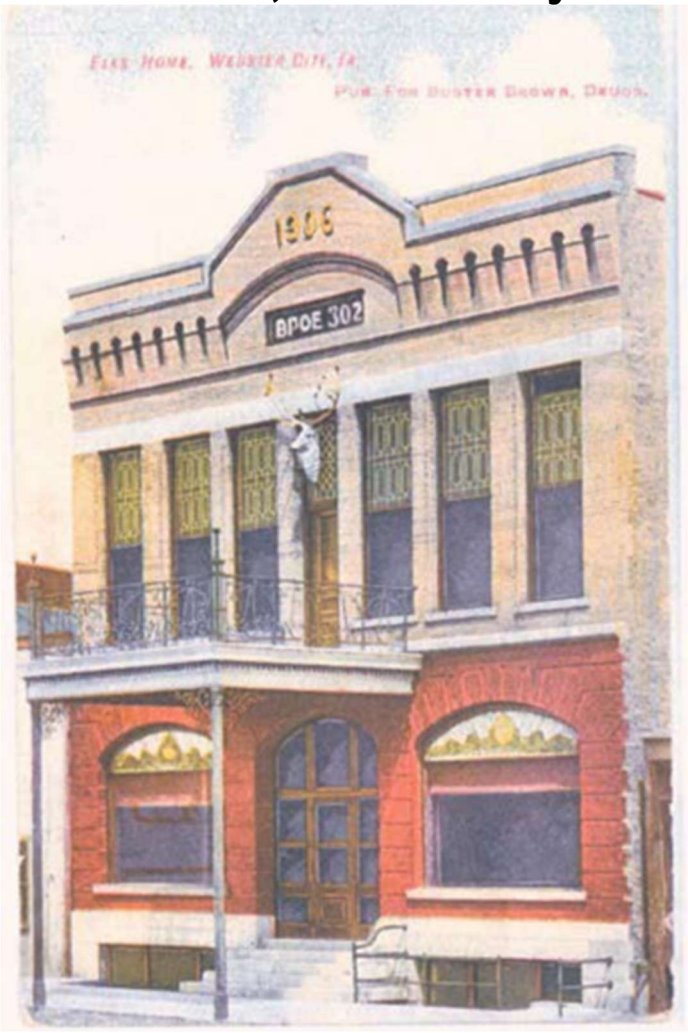
Webster City Elks Club Restoration

217 2nd Street, Webster City IA



Project Manager:	**Joe Ranard**
Editor:	**Paul Hansen**
Tech Support:	**Yuyan Chen**

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I. Executive Summary

Our team at JPY Engineering was tasked with doing a historical rehabilitation of the old Elk's Club in Webster City, IA. Our team consisted of Joe Ranard, Project Manager, Paul Hansen, Editor, and Yuyan Chen, Technical Support. Each team member focused on different areas of the project and collaborated for the final design. Joe focused on the 3D rendering of the project, elevator design and solar panel addition. Paul focused on the structural analysis of the building and the site design. Yuyan focused on the architectural design and making sure the new additions were ADA compliant. The scope of the project included a structural analysis to be completed, and exterior restoration, an interior restoration, to utilize the roof in some capacity, we chose to add a solar panel array, update the building for ADA regulations, this was supplemented by an elevator design and entrance, all this needed to be done while maintaining historical site eligibility.

While working on the project we had several constraints to adhere to. Most important was time, our team had a timeline of about three months, April through May, to complete this project. No budget was given to us for the project, so we needed to provide the optimal design for the lowest possible cost. Our team was also allowed to use only the design programs provided by the University of Iowa. Our challenges were many for this project. First of due to the old nature of the building we had no pre-existing building plans and had to measure the dimensions ourselves. Our team also needed to find suitable materials to replace the damaged parts of the building that would keep in line the historical guidelines. Our team also faced the challenge of the elevator placement and utilizing the roof in some capacity. Our final challenge was that we could not see the structural members of the building and had to assume that they were in good condition. As for the impact for the surrounding area our team projects that this will have positive impact. Which could be seen as more people in the area having a fun place to go. This could also attract more people from the surrounding areas bringing in more business for the city of Webster City.

For design alternatives our team discussed many different options. The elevator placement was between being at the front, middle or back of the west wall of the building. We ultimately decided to place the elevator in the middle of the wall. Our team also discussed the possibility of adding a balcony extending out from the banquet hall on the second floor. This proposed addition went against the historical guidelines, so we decided to not move forward with this option. Our team also needed to decide whether to move the bathrooms in the building. We ended up deciding only moving the bathrooms only the second floor to open more space on that floor. Our team had several different options to utilize the roof space. This included a green roof, patio space or a solar panel array. Our team decided on a solar panel array as the best option as it had the least amount of weight added. For access to the roof we could either have the elevator go up to the roof or have a drop-down stair that land on the second floor. We went with the drop-down stairs as the roof only need to access for maintenance.

For our final design details, we had five major elements. Our first element was the elevator design. In this process we used KONE as a resource for our design. Included in the design were also openings for the elevator doors. For the opening we needed to design supports in the form of steel lintels. Our second design element was the new entrance on the west wall. For that we had to design a ramp and stair set. The ramp also needed to be ADA compliant which was a main

concern in our design. Our third element of the solar panel array we needed to do an uplift calculation to make sure they would not be uprooted and do a load take down of the building with panels included. Our fourth design element included the bathroom design. For this we just needed to update the old bathrooms to make them ADA compliant. Our last design element was the building restoration. For this we recommend replacing the deteriorated brick on the west and south walls along with mortar repair for the south wall. For the interior the drywall and ceiling panels had been severely damaged in areas and need to be replaced. The total cost of the restoration project is projected to be $559,596.16. It includes the cost of materials, labor, equipment, overhead, profit, contingency, possible easements or property acquisition, final design and administration cost for the construction

II. Organization Qualifications and Experience

Name of organization:

JPY Engineering

Organization Location and Contact Information:

Contact Info:

Joe Ranard - Project Manager
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Organization and Design Team Description:

We are a dedicated group of students attending the University of Iowa majoring in Civil Engineering. We are currently enrolled in a capstone design class as part of the curriculum for our senior year. Our team consists of three members, each with specific roles that helps contribute to our team's overall success. Our project manager, Joe Ranard, is focusing in structures, mechanics, and materials. He was primarily responsible for the drawing of the 3D Revit model, elevator design, solar array design and assisted in the structural analysis of the existing building and the additional entrance/ramp design. Our editor, Paul Hansen, is also focusing in structures, mechanics, and materials and performed the primary structural analysis of the existing building and site design. Our technology specialist, Yuyan Chen, is focusing in pre-architecture and oversaw the architectural design and design of the new ramp and bathrooms to make the building ADA compliant. Below we have stated our experience and qualifications.

Description of Experience with Similar Projects:

Through school and past work experiences our team has developed a diverse set of skills that lines up with the scope of this project. Joe has worked as an engineering intern in Iowa City at MMS Consultants Inc. for one year. He has gained a lot of experience assisting on site plans, design work on various civil engineering projects and has had thorough experience with AutoCAD Civil 3D. He has also completed numerous structural design courses including, Design of Concrete Structures, Design of Wood Structures, and Foundations of Structures and he is currently enrolled in Structural Systems for Buildings. In Design of Wood Structures, he worked on numerous projects where he designed individual structural members made of wood such as, columns, beams, roofs, walls and floor systems for a 5-unit apartment complex using ASD methods to comply with ASCE 7, and IBC codes/regulations. In Design of Concrete Structures, he learned how to design the same structural members as in Wood Design, only this time using concrete. In Foundations of Structures he learned how to design different types of shallow footings, pile foundations, and retaining structures for buildings. Through his internship and classroom experience he has developed the ability to work with programs such as AutoCAD

Civil 3D, Revit, Robot Structural Analysis, Mathematica, and Mathcad and well as the ability to work as part of a team.

Paul Hansen spent last summer working as an engineering intern for Washington County engineer's office. During this internship, he worked on a variety of civil engineering projects throughout the county. While in school he has completed numerous structural design courses. These include Design of Concrete Structures, Introduction to Bridge Engineering and Foundations of Structures. Currently, he is enrolled in Structural Systems for Buildings and Design of Steel Structures. In Design of Concrete Structures, he designed numerous individual structural members including columns, beams and floor systems using LRFD methods in accordance with ACI 318-14 building codes. In Introduction to Bridge Engineering he worked on numerous projects where he designed steel bridge girders in accordance with AASHTO bridge design specifications. In Foundations of Structures he became familiar with the design process of different types of shallow footings, pile foundations, and retaining structures for buildings. Through internship and classroom experience he has developed the ability to work with programs such as AutoCAD, Civil 3D, Revit, Robot Structural Analysis and Mathcad.

Yuyan has completed a variety of structural design and graphic design classes at the University of Iowa. Her structural design courses include Design of Concrete Structures, Foundations of Structures and Design of Transportation Systems. Design of Concrete Structures required numerous designs of concrete structural members including columns and beams using LRFD methods in accordance with ACI 318-14 building code. In Foundations of Structures, she gained knowledge about shallow foundations, pile foundations and retaining structures for buildings. In Design of Transportation Systems, she designed a parking lot for an apartment building and worked with a team of students on a highway bypass project. In addition, she has also studied graphic design. She began with, basic drawing and design fundamentals. After further developing her skills in art design, she completed a 3-D problem solving course that involved computer modeling with 3D Max. In these courses, she designed various things such as: a wall, a layer comprised of wood sticks, a wood box, an underground tunnel connecting two buildings and a bus station by utilizing different software. Currently, she also studies painting and is enrolled in an AutoCAD Design course. Through work in these courses, she has gained extensive experience working with design-oriented computer programs, including AutoCAD, Civil 3D, Robot Structural Analysis, Mathcad, Photoshop and 3D Max.

III. Design Services

<u>Project Scope</u>

The Elks Club Lodge located in the 200 block of 2nd street in Webster City, IA is to be rehabilitated and restored on the exterior and interior for the building's new intended use. There are multiple new uses for the building, including the basement interior being restored to function as a bar and recreation area for the building and the surrounding area. Also, our team will update the main floor to function primarily as office space in the building. The office space is to be either used for building management or rented out to other businesses in the area. Finally, the second floor shall be restored and updated to function as a banquet hall to be used as an event space which can be rented

out by the community. The exterior of the building must be updated as there has been some deterioration of the brick work along some sections of the west and north walls. In the past there has been some restoration of the exterior, mostly replacing some of the brickwork with a similar color and style to the original brickwork. Our recommendation would be to carry out a similar replacement as before, as it would follow the guidelines put forth by the Iowa Historical Society keeping the building eligible for historical designation. To make the building more resilient and efficient our team has added a solar panel array to the roof of the building. This addition is allowed under the historical guidelines as we chose lower set panels that will not be able to be seen from street level which is necessary for historical designation. Due to the construction of the building in the year 1906, it is currently not compliant under the regulations set by the American with Disabilities Act. For that reason, we have added an exterior ramp on the west wall leading up to a new main entrance for the building as well as an additional elevator. Community members will enter the elevator at the main floor and will have the option to travel between the basement, main floor and second floor in accordance with ADA regulations. The elevator will also be set back to the middle of the west wall as to not be seen easily from the street which is necessary to satisfy historical code requirements. To further make the building ADA compliant the bathrooms on the main floor and basement need to be updated. The existing restrooms in the building were not ADA compliant and frankly just outdated. To restore the building to functional use while complying with ADA standards. Our team decided to completely remodel the restrooms on each floor. In the basement level the existing bathrooms were small, so we decided to increase the area of each restroom by taking out two dividing interior walls and using the extra space to make two larger restrooms. On the main level the existing restrooms were of adequate size so only a simple restoration is necessary. The restrooms on the second floor needed to be moved to behind the added kitchenette in the interest of architectural design and ADA compliance. Furthermore, the removal and reinstall of drywall and ceiling is recommended in much of the building.

Work Plan

Table 1: Work Plan for Project Design

Task	Start date	Duration	Due date	Person Responsible
Basic information research	16-Jan-19	6	21-Jan-19	Team Manager
Site Visit	01-Feb-19	1	01-Feb-19	Team Manager
organize the data from site visit	01-Feb-19	2	02-Feb-19	Team Manager
Sep-up CAD File	04-Feb-19	8	11-Feb-19	Technical Support
Set-up Revit File	04-Feb-19	19	22-Feb-19	Team Manager
Elevator Design	11-Feb-19	15	25-Feb-19	Team Manager
Restroom Design with ADA standard	25-Mar-19	26	22-Mar-19	Technical Support
Ramp, Stairs, Public Door Design	08-Mar-19	15	22-Mar-19	Technical Support
Structural Calculation	08-Mar-19	22	29-Mar-19	Editor
Solar Panel Design	22-Mar-19	15	05-Apr-19	Team Manager
Snow and Wind Load Calculation	29-Mar-19	15	12-Apr-19	Editor
Cost Estimate	05-Apr-19	22	26-Apr-19	Technical Support
Floor Plan Production	15-Apr-19	12	26-Apr-19	Technical Support
Report Production	05-Apr-19	22	26-Apr-19	Editor
Presentation Production and Practice	26-Apr-19	15	03-May-19	Team Manager

Table 2: Work Plan for Construction

Task	Start date	Duration	Due date	Person Responsible
Design project (Detail in Table 1)	16-Jan-19	107	03-May-19	Team Manager
Clear and check facility	01-Jul-19	12	12-Jul-19	Project Manager
Elevator Shaft basement (excavation, tamping, cushing, etc.)	01-Jul-19	61	30-Aug-19	Project Manager
Elevator Shaft(Reinforcement, Pouring, etc.)	02-Sep-19	60	01-Nov-19	Project Manager
Structure Repair	01-Jul-19	60	01-Nov-19	Project Manager
open the elevator wall	04-Nov-19	5	08-Nov-19	Project Manager
installing the elevator	11-Nov-19	12	22-Nov-19	Project Manager
outside ramp and stairs and public door	02-Mar-20	60	01-May-20	Project Manager
Solar Panel	02-Mar-20	88	29-May-20	Project Manager
ceiling (including restroom)	11-May-20	35	15-Jun-20	Project Manager
wall (including restroom)	01-Jun-20	53	24-Jul-20	Project Manager
Floor (including restroom)	27-Jul-20	32	28-Aug-20	Project Manager
door and window (including restroom)	31-Aug-20	11	11-Sep-20	Project Manager
landscaping (road)	08-Jun-20	53	31-Jul-20	Project Manager
completion clear	14-Sep-20	12	25-Sep-20	Project Manager

*See Gantt Chart in Appendix C

IV. Constraints, Challenges and Societal Impacts

Constraints

Constraints for this project included time and scope. No budget was given for the project; however, our team has completed an attractive design for the lowest possible cost. The time frame our firm had been given to complete the project was a period of nearly 3 months, specific dates ranging from February 4th to May 5th. The scope of the project included having the building to be used as a community center for Webster City,

IA, updating the building in accordance with ADA regulations and to complete a full rehabilitation and restoration of the exterior and interior. The design also included an elevator to be added to building. The building is also eligible to be considered for a historical designation. Our firm adhered to the guidelines set forth by the Iowa Historical Society. Technology used for this project was provided by the University of Iowa which included AutoCAD 2019, Civil 3D 2019, ArcMap 10.6, Revit 2019, and Robot Structural Analysis 2019. The information provided by the city was sparse, no existing building plans, soil report or material takeoffs were given to our team to aid in design work.

Challenges

There are several challenges associated with this project. Due to the historical nature of this project, constructed in 1906, there were no building plans available. All measurements of the existing building needed to be completed on site lacking adequate time to measure every detail. Furthermore, the material used in the rehabilitation must be similar to the original material used in the building. Finding a suitable replacement material could pose a challenge. We also considered the damage and deterioration done to the building over time. The interior of the building was mostly damaged due to a previous partial roof collapse that allowed rain inside the building causing water damage to the ceiling panels and drywall. The ceiling panels and dry wall will need to be replaced for a full restoration. The exterior of the building experienced damage from weather and natural deterioration from the elements over time. Our team needed to determine how to replace the damaged bricks and what material type to use for restoration. Elevator placement for the building posed another challenge as the project's proximity to other buildings and land may not have allowed the elevator to be on the outside of the building. Whereas placing the elevator on the inside of the building would have drastically altered the layout of the building and the building's structural integrity. Our client also wanted us to utilize the roof space in some capacity however there was no easy access to the roof of the structure so assumptions had to be made regarding materials, member sizes, and condition of the roof. Lastly, the exact layout of structural members was hard to see in some locations of the building, such as the member sizes such as floor and roof joist sizes due to existing ceiling/floor material covering. This made use assumed sizes of the members for our structural analysis of the project.

Societal Impact within the Community and/or State of Iowa

Once complete, the building is to be used as a new banquet hall and commercial space for the City of Webster City, IA. The banquet hall could be used as a venue for public and private use. This would allow members of the town and surrounding communities a place to socialize and strengthen community relationships. The commercial use of the area along with the historic significance of the building could lead to increased foot traffic in the surrounding area. An increase in foot traffic in the town could lead to an increase of consumers for surrounding businesses and provide incentive for people from out of town to travel to Webster City. Given that 2nd street is the main commercial

center in the town, and the project site is in close proximity to numerous shops and restaurants, an increase in foot traffic around the area could add an economic benefit for numerous surrounding establishments. Lastly, the age and former use of the building results in many sentimental memories for local community members. The fact that this building is keeping its historic look and being repurposed rather than being completely torn down will make many community members happy, specifically the older generation that was around when the building was in its prime condition. Saving this structure has the potential to provide motivation for the community to save other old outdated structures rather than demolishing them.

V. Alternative Solutions That Were Considered

Throughout the design phase our team had a few design alternatives that we would discuss with our client at Webster City. One alternative was the placement of the elevator either near the front end of the building or towards the back end of the building. For the placement near the front end of the building the elevator would cause visitors to travel a far distance to enter the building if coming from the parking lot located at the back of the building and it would intrude into a section on the interior of the building that we designated as office space. Ultimately, we did not choose this option as it would not have been in accordance with historical code as it would be a highly visible addition from the outside and it wouldn't be in a convenient location for the multi-use functionality of the building. We also discussed the possibility of adding a balcony to the second floor of the banquet hall. This had upside as an idea as it would provide a nice aesthetic to the building and another area of the building for event goers to explore. We did not go through with this design as the balcony would have added a non-essential exterior addition which is not in accordance with historical code. We also discussed moving the bathrooms on the basement level to create more space and have a new uni-sex bathroom. Our team decided to not move forward with this as the movement of the bathroom would infringe on the storage space in the basement and would further complicate the area as well as cost more for moving of the piping. Another alternative solution that we considered was the addition of a rooftop patio or greenspace. This would create a space for community members to enjoy the weather and views of their town while strengthening community relationships. However, know that either of these options would create a large load to act on the building we decided against carrying out this alternative. We went with the solar panel array knowing the existing structure would be capable of carrying this lighter load. The last alternative we considered was how we would get easy roof access. Our two options were to either add another stop of the elevator at roof level or to install a drop-down ladder/staircase. We decided to go with the drop-down ladder since it would be much cheaper and since we aren't expecting much human traffic on the roof at all.

VI. Final Design Details

Design Element #1 - Elevator Addition

Due to the need for ADA accessibility throughout the building the design and addition of an elevator was necessary for the completion of this project. This design process consisted of contacting the elevator company KONE. Utilizing their interactive website and inputting our design constraints KONE offered a couple different solution that would be viable options based on a few different things such as building height and number of floor serviced. KONE then sent us a few design drawings and applied forced from the elevator based off of the elevator type we chose. Using the applied forces provided by KONE we were able to calculate the total forces of the elevator pit floor on the soil and see if the soil type would support the elevator shaft. Since no Soil logs were provided, we used the International building code and the U.S. Department of Agriculture assume a value for the areas soil bearing capacity. A version of the design details we used can be seen below in the appendix in drawing D-1. The pressure calculations for the soil on the elevator can be seen below in the appendix as well. Furthermore, since we were adding the elevator to the existing building, we had to cut door opening into our structure to access the elevators. In doing so we had to design the door headers to see what kind of reinforcement was needed in these locations. To do this we used the brick industry associations handout on structural steel lintels and found out two L-shaped lintels was a viable option for our size of openings.

Design Element #2 - New Building Entrance (West Wall)

To comply with International Existing Building Code requirements the addition of an accessible entrance is required if feasible. Since the original main entrance wasn't ADA compliant, we needed to provide a new entrance that would be compliant. Since our client said the city would be able to acquire the open lot next to our building, we had plenty of space for this additional entrance. For a ramp to meet ADA standards there are many requirements. First, the ramp must have a maximum slope of 1:12. Next, there must be a 5ft x 5ft unobstructed area at the top and bottom of the ramp. Then, in order to have a turning space the ramp must span at least 30 feet in one direction followed by a 5ft x 5ft minimum turning space. Lastly, the width of the lanes must be at least 3ft. and have a handrail height of 36 to 42 inches. Our ramp meets all these standards and is therefore ADA compliant. Regarding the staircase, stairs must have a maximum riser height of 7 inches and a minimum depth of 11 inches. Our staircase is designed to have a 6-inch riser height and a 12 inch depth therefore meeting stair requirements.

Design Element #3 - Solar Panel Addition

For the addition of the solar panel array a structural analysis of the existing building had to be completed to see if the structure could support the additional load. A wind and uplift analysis also had to be complete to see what kind of connection would be suitable to prevent uplift on the solar panels. Based of the geographical location of Webster City we calculated the angle of the solar panels needed to be around 35 degrees. After doing some research on different mounting options our team chose one that would allow for this angle to be achieved on our existing roof

type. ASCE 7-16 was used to help determine the uplift loads and requirements for spacing of the solar panels. The respective calculations can be seen in the appendix along with the details for the solar panels in drawing D-2.

Design Element #4 - ADA Compliant Restrooms

Bathroom design was governed using the ADA standards for a single-use restroom on the basement and second level. On the main floor guidelines for a multi-use restroom were followed. Details for the ADA compliant restrooms can be seen in site drawing D-3. All grabs bars should be 34 inches off the ground and 1-½ inches diameter. The toilet seat and urinal heights should 18 inches from the ground surface as well as a sink height of 27 inches from the ground surface. Other details relating to compliant restroom design can be observed on the drawings.

Design Element #5 - Building Restoration

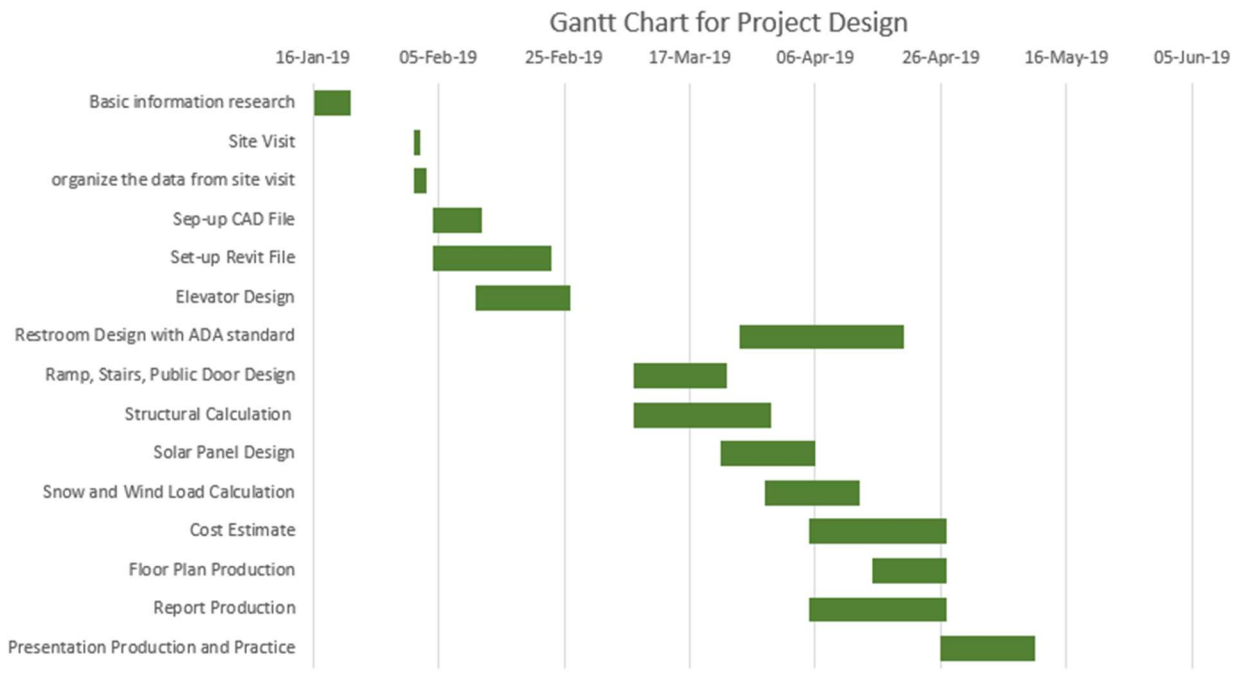
The building restoration of the exterior is minimal as only the north and west walls require new brickwork. The guidelines of the Iowa Historical Society dictate that the replacement bricks must be as similar style and color to the original. To replace the bricks on the wall it requires a tedious but effective method. Our team recommends the process of tuckpointing. This way you grind down the mortar in between the bricks. Once that is done you can then use a chisel or a saw to cut out the individual bricks and replace them with the new bricks. The details for this brickwork can be seen in drawings E-2 and E-3.

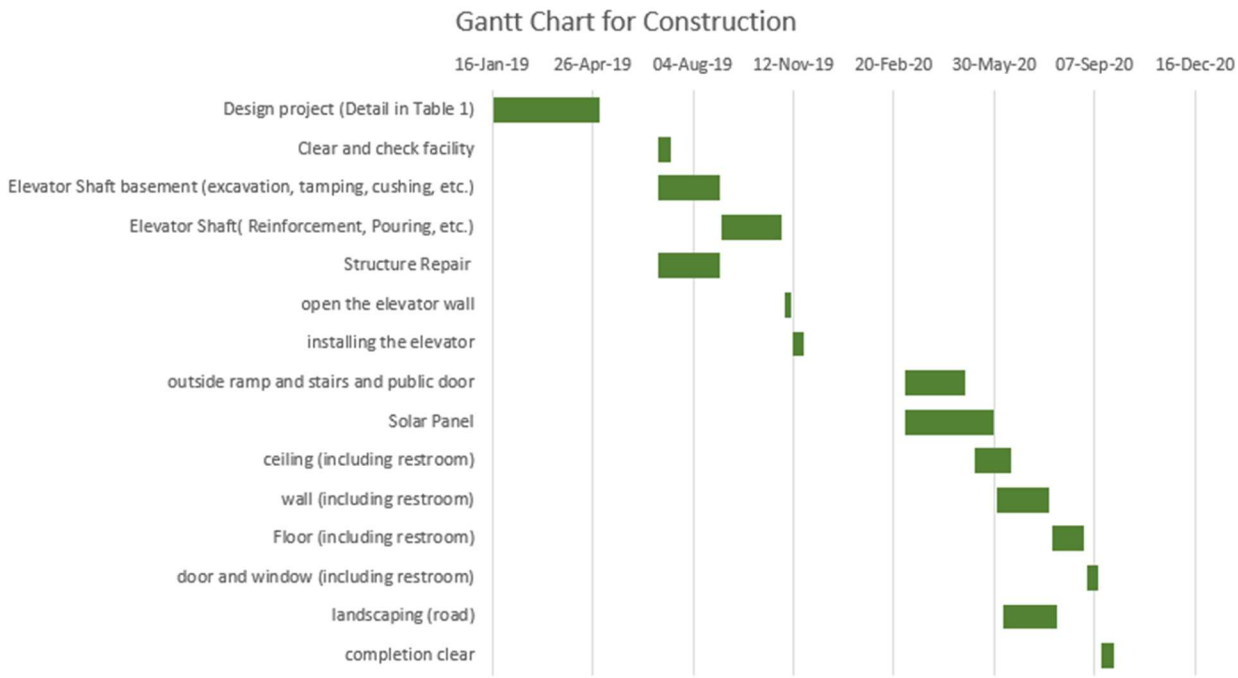
VII. Engineer's Cost Estimate

The total cost of the restoration project is projected to be $559,596.16. It includes the cost of materials, labor, equipment, overhead, profit, contingency, possible easements or property acquisition, final design and administration cost for the construction. The restoration project will take about 51 weeks to finish. The first 21 weeks will take place in 2019 (from July 2019 to November 2019) and the final 30 weeks will take place in 2020 (from March 2020 to September 2020). For a more detailed of cost breakdown, see Appendix B and Appendix C.

Appendices

Project Name: Webster City Elks Club Restoration								
Location:	Webster City, IA, USA							
Line Number	Description	Qty	Unit	Material	Labor	Equipment	SubContract	Estimate Total
01 31 13 20 0020	Clerk, average	12	Week	$0.00	$ 5,520.00	$0.00	$0.00	
01 31 13 20 0180	Project Manager, average	12	Week	$0.00	$ 27,900.00	$0.00	$0.00	
01 31 13 20 0240	Superintendent,average	12	Week	$0.00	$ 26,100.00	$0.00	$0.00	
Division 03	Subtotal			$0.00	$59,520.00	$0.00	$0.00	$59,520.00
03 30 53 40 3200	6" slab	98	S.F.	$216.58	$90.16	$27.44	$0.00	
03 30 53 40 7000	Stair landings, free standing	750	S.F.	$3,457.50	$8,512.50	$120.00	$0.00	
03 20 53 40 7050	Cast on ground	750	S.F.	$2,707.50	$3,585.00	$52.50	$0.00	
Division 03	Subtotal			$6,381.58	$12,187.66	$199.94	$0.00	$18,769.18
08 11 16 10 0300	6'-0'' x 7'-0" opening	2	Ea.	$2,550.00	$1,310.00	$0.00	$0.00	
08 13 13 15 0370	4'-0'' x 7'-0"	4	Ea.	$2,820.00	$206.00	$0.00	$0.00	
08 13 13 15 0360	3'-0" * 7'-0"	15	Ea.	$8,175.00	$727.50	$0.00	$0.00	
08 11 16 10 0600	7'-0'' x 7'-0" opening	2	Ea.	$3,600.00	$1,700.00	$0.00	$0.00	
08 71 13 10 1750	handicap actiatpr nuttons, 2, including 12 V DC wiring add	1	Pr.	$470.00	$258.00	$0.00	$0.00	
Division 08	Subtotal			$17,615.00	$4,201.50	$0.00	$0.00	$21,816.50
09 29 10 30 0300	1/2" thick, on wall, standard, no finish included	14963	S.F.	$4,937.79	$5,835.57	$0.00	$0.00	
09 29 10 30 0500	water resistant, no finish included	14963	S.F.	$6,134.83	$5,835.57	$0.00	$0.00	
09 29 10 30 0590	With compound skim coat (level 5 finish)	14963	S.F.	$7,631.13	$14,963.00	$0.00	$0.00	
09 51 23 10 6000	Remove and replace ceiling tiles, min fiber, 2' x 2' or 2' x 4', 5/8"thk.	8605	S.F.	$8,260.80	$9,981.80	$0.00	$0.00	
09 53 23 30 0320	2' x 2' grid	8605	S.F.	$8,605.00	$5,163.00	$0.00	$0.00	
09 53 23 30 0360	for fire rated grid, add	8605		$774.45				
09 66 13 10 1500	Floor, banded to concrete, 1-3/4" thick, gray cement	2000	S.F.	$6,700.00	$17,500.00	$8,260.00	$0.00	
Division 08	Subtotal			$43,044.00	$59,278.94	$8,260.00	$0.00	$110,582.94
10 56 13 10 0020	Metal, industrial, cross-braced, 3' wide, 12" deep	6	SF Shlf	$0.00	$0.00	0	$158.00	
Division 10	Subtotal			$0.00	$0.00	$0.00	$158.00	$158.00
	Solar Panel	96	Ea.	$32,144.16	$24,000.00	$0.00	$0.00	
	Elevator	1	Ea.	$50,000.00	$20,000.00	$0.00	$0.00	
	Structural Engineer, average	250	Hour	$0.00	$0.00	$0.00	$32,250.00	
	Civil Engineer, average	60	Hour	$0.00	$0.00	$0.00	$7,920.00	
	Drafter, average	50	Hour	$0.00	$0.00	$0.00	$3,900.00	
Website resource	Subtotal			$82,144.16	$44,000.00	$0.00	$44,070.00	$170,214.16
		Subtotal		$149,184.74	$179,188.10	$8,459.94	$44,228.00	
Division 01	General Requirements @15%			$22,377.71	$26,878.22	$1,268.99	$6,634.20	
		Estimate Subtotal		$171,562.45	$206,066.32	$9,728.93	$50,862.20	$438,219.90
		Sales Tax @ 6%		$10,293.75		$583.74	$3,051.73	
		Subtotal A		$181,856.20	$206,066.32	$10,312.67	$53,913.93	
		GC O & P		$18,185.62	$20,606.63	$1,031.27	$5,391.39	
		Subtotal B		$200,041.82	$226,672.95	$11,343.93	$59,305.33	$497,364.02
		Contingency @ 10%						$49,736.40
		Subtotal C						$547,100.43
		Bond @ $12/1000 + 10% O&P						$12,495.74
		Grand Total						$559,596.16


Gantt Chart for Project Design
16-Jan-19
05-Feb-19
25-Feb-19
17-Mar-19
06-Apr-19
26-Apr-19
16-May-19
05-Jun-19
Basic information research
Site Visit
organize the data from site visit
Sep-up CAD File
Set-up Revit File
Elevator Design
Restroom Design with ADA standard
Ramp, Stairs, Public Door Design
Structural Calculation
Solar Panel Design
Snow and Wind Load Calculation
Cost Estimate
Floor Plan Production
Report Production
Presentation Production and Practice


Gantt Chart for Construction
16-Jan-19
26-Apr-19
04-Aug-19
12-Nov-19
20-Feb-20
30-May-20
07-Sep-20
16-Dec-20
Design project (Detail in Table 1)
Clear and check facility
Elevator Shaft basement (excavation, tamping, cushing, etc.)
Elevator Shaft(Reinforcement, Pouring, etc.)
Structure Repair
open the elevator wall
installing the elevator
outside ramp and stairs and public door
Solar Panel
ceiling (including restroom)
wall (including restroom)
Floor (including restroom)
door and window (including restroom)
landscaping (road)
completion clear

Calculations and Design Drawings

Building Risk Catergory II: $RiskCategory := \text{“II”}$

Live Loads - PSF

Assumptions:

- Uniform Live Loads of 100 psf for each floor

Uniform Floor Load: $L_o := 100\ psf$

Stairs: $L_{stairs} := 100\ psf$

Stage: $L_{stage} := 150\ psf$

Roof: $L_{roof} := 20\ psf$

Storage: $L_{storage} := 20\ psf$

Offices: $L_{office} := 50\ psf$

Read Room: $L_{readroom} := 60\ psf$

Elevator Room: $L_{elevroom} := 150\ psf$ *Use Larger is Equipment Weighs More

Live Loads - LBF

Ladders (every 10ft): $L_{ladder} := 300\ lbf$

Grab Bars: $L_{GB} := 250\ lbf$

Maintenace Work: $L_{MW} := 300\ lbf$

Dead Loads - PSF

Electrical Hardware	$D_{elec} := 1\ psf$
Mechanical Hardware	$D_{mech} := 4\ psf$
Plumbing	$D_{plumb} := 1\ psf$
Suspended Steel:	$D_{ssteel} := 2\ psf$
Softwood (Spruce):	$D_{softwood} := 29\ psf$
Plaster on Lath:	$D_{P\&L} := 10\ psf$
Asphalt Tile:	$D_{asphalt} := 1\ psf$
Rubber roofing member:	$D_{EPDM} := 0.62\ psf$
Solar Panels:	$D_{solar} := 3\ psf$
Frame Walls:	$D_{wall} := 20\ psf$
2x14 Joists:	$D_{2x14} := 8\ psf$
2x4 Framing:	$D_{2x4} := 4\ psf$
Parapet Brick:	$D_{cmu} := 64\ psf$
Fixtures:	$D_f := D_{ssteel} + D_{elec} + D_{mech} + D_{plumb} = 8\ psf$

Dead Loads - PCF

Cast Iron Columns:	$D_{CastI} := 450\ pcf$

Live Loads Per Floor

1. Roof Live Loads:

$Roof_{LL} := L_{roof} = 20\ psf$ **Uniform Live Load on Roof**

2. Second Floor Live Loads:

$Floor2.1_{LL} := L_{stairs} = 100\ psf$ **Live Load on Stairs up to Floor 2**

$Florr2.2_{LL} := L_o = 100\ psf$ **Uniform Live Load on Floor 2**

$Floor2.3_{LL} := L_{stage} = 150\ psf$ **Live on Stage on Floor 2**

3. Main Floor Live Loads:

$Floor1.1_{LL} := L_{stairs} = 100\ psf$ **Live Load on Main Stairs up to Floor 2**

$Floor1.2_{LL} := L_{stairs} = 100\ psf$ **Live Load on Back Stairs up to Floor 2**

$Floor1.3_{LL} := L_o = 100\ psf$ **Uniform Live Load on Main Floor**

4. Basement Live Loads:

$Basement_{LL} := L_o = 100\ psf$ **Uniform Live Load on Basement**

Dead Loads Per Floor

1. Roof Dead Loads:

$Roof1_{DL} := D_{EPDM} + D_{softwood} + D_{P\&L} + D_f = 48\ psf$ **Dead Load from Roof covering**

$Roof2_{DL} := Roof1_{DL} + D_{solar} = 51\ psf$ **Dead Load from Roof and Solar Panels**

2. Floor 2 Dead Loads:

$Floor2.1_{DL} := D_f + D_{softwood} + D_{P\&L} + D_{asphalt} + D_{2x4} = 52\ psf$ **Dead load from Floor**

$Floor2.2_{DL} := Floor2.1_{DL} + D_{wall} - D_{2x4} = 68\ psf$ **Dead load from Floor and Wall Partitions**

$Floor2.3_{DL} := Floor2.2_{DL} + D_{cmu} = 132\ psf$ **Dead load from Floor, Partitions, and Parapet**

3. Floor 1 Dead Loads:

$Floor1.1 := Floor2.1_{DL} = 52\ psf$ **Dead load from Floor**

$Floor1.2 := Floor2.2_{DL} = 68\ psf$ **Dead load from Floor and Wall Partitions**

4. Basement Dead Loads:

$Basement1.1_{DL} := D_f + D_{softwood} + D_{P\&L} + D_{asphalt} + D_{2x14} = 56\ psf$ **Dead load from Ceiling**

Snow Loads

Risk Category:

$I_s := 1.0$

Ground Snow Load:

$p_g := 20\ psf$ Figure 7.2-1

Determine roof snow load factors:

$C_e := 1.0$ Partially exposed with roughness catagory C

$C_t := 1.0$ "All structues except indicated below"

$C_s := 1.0$ 5/8" slope with "all other surfaces" line

Calc flat roof snow load:

$p_{f\_theo} := 0.7 \cdot C_e \cdot C_t \cdot I_s \cdot p_g = 14\ psf$

$p_m := \text{if}\left(p_g \le 20\ psf, I_s \cdot p_g, I_s \cdot 20\ psf\right) = 20\ psf$

$p_f := \max\left(p_{f\_theo}, p_m\right) = 20\ psf$

Calc sloped roof snow load

$p_s := C_s \cdot p_f = 20\ psf$

Calc snow density

$\gamma_{snow} := min\left(\frac{0.13}{ft} \cdot p_g + 14\ pcf, 30\ pcf\right) = 16.6\ pcf$

$h_b := \frac{p_f}{\gamma_{snow}} = 1.205\ ft$

$h_r := 3\ ft$

$h_c := h_r - h_b = 1.795\ ft$

$checkDrift := \text{if}\left(\frac{h_c}{h_b} < 0.2, \text{“No”}, \text{“Yes”}\right)$ $\qquad checkDrift = \text{“Yes”}$

Calc height of windward drift on parapet wall (E-W):

$l_{u\_windward} := 100\ ft$

$h_{d\_windward} := 0.75\left(0.43\ ft \cdot \sqrt[3]{\frac{l_{u\_windward}}{ft}} \cdot \sqrt[4]{\frac{p_g}{psf} + 10} - 1.5\ ft\right) \cdot \sqrt[2]{I_s} = 2.378\ ft$

$h_d := min\left(h_{d\_windward}, h_c\right) = 1.795\ ft$

$w_{d1} := 4 \cdot h_d = 7.181\ ft \qquad w_{d2} := \frac{4\ h_d^{\ 2}}{h_c} = 7.181\ ft$

$w_{d\_theo} := \text{if}\left(h_d \le h_c, w_{d1}, w_{d2}\right) = 7.181\ ft$

$w_{d\_max} := min\left(8 \cdot h_c, l_{u\_windward}\right) = 14.361\ ft$

$w_d := min\left(w_{d\_theo}, w_{d\_max}\right) = 7.181\ ft$

Calc snow drift load:

$p_d := h_d \cdot \gamma_{snow} = 29.8\ psf$

Calc height of windward drift on parapet wall (N-S):

$l_{u\_windward} := 45\ ft$

$h_{d\_windward} := 0.75\left(0.43\ ft \cdot \sqrt[3]{\frac{l_{u\_windward}}{ft}} \cdot \sqrt[4]{\frac{p_g}{psf} + 10} - 1.5\ ft\right) \cdot \sqrt[2]{I_s} = 1.56\ ft$

$h_d := min\left(h_{d\_windward}, h_c\right) = 1.56\ ft$

$w_{d1} := 4 \cdot h_d = 6.238\ ft \qquad w_{d2} := \frac{4\ h_d^{\ 2}}{h_c} = 5.42\ ft$

$w_{d\_theo} := \text{if}\left(h_d \le h_c, w_{d1}, w_{d2}\right) = 6.238\ ft$

$w_{d\_max} := min\left(8 \cdot h_c, l_{u\_windward}\right) = 14.361\ ft$

$w_d := min\left(w_{d\_theo}, w_{d\_max}\right) = 6.238\ ft$

Calc snow drift load:

$$p_d := h_d \cdot \gamma_{snow} = 25.889\ psf$$

https://
www.solarpaneltilt.com/

http://brightstarsolar.net/
common-sizes-of-solar-
panels/

UPLIFT CALCS:
Wind Loads

Define Variables: **East-West Direction**

$z_1 := 4.0\ ft$ $z_2 := 18\ ft$ $z_3 := 32.5\ ft$ $z_{p1} := 35.5\ ft$

$h := z_3$

$B := 45\ ft$

$L := 100\ ft$

1.
(Insert sketch)

2. Risk Catagory

Risk Category = II
$I_w := 1.0$ (Table 1.5-2)

3. Select basic wind speed

$V := 111\ mph$ (Figure 26.5-1B)

4. Determine K_d

$K_d := 0.85$ Table 26.2.1 > Building >MWFRS

5. Determine exposure category

$surfaceRoughness := \text{“B”}$ Building is in Iowa City
$exposure := \text{“B”}$

6. Determine K_zt

$K_{zt} := 1.0$ Assumed - site specific topography unknown at this time

7. Determine K_e

$z_{ground} := 1040\ ft$ From google search for "Iowa city, Elevation")

$$K_e := \exp\left(-0.0000362 \cdot \frac{z_{ground}}{ft}\right) = 0.963$$

Could assume 1.0 for simplicity

8. Calculate G

Check if approzimate natural frequency may be used for frequency determination

$$L_{eff} := \frac{L \cdot (z_1 + z_2 + z_3)}{(z_1 + z_2 + z_3)} = 100\ ft$$

$$approxFreq := \text{if}\left(h \le 300\ ft \wedge h < 4\ L_{eff}, \text{“Yes”}, \text{“No”}\right) = \text{“Yes”}$$

Calculate approzimate Natural Frequency

$$n_a := \frac{43.5}{\left(\frac{h}{ft}\right)^{0.9}}\ Hz = 1.896\ Hz$$

$$n_1 := \begin{array}{l} \text{if } approxFreq = \text{“Yes”} \\ \quad \| \ n_a \\ \text{else} \\ \quad \| \ 0 \end{array}$$

$$n_1 = 1.896\ Hz$$

Determine if building is rigid or flexible

$$dynamicResponse := \begin{array}{l} \text{if } n_1 < 1\ Hz \\ \quad \| \ \text{“Flexible”} \\ \text{else} \\ \quad \| \ \text{“Rigid”} \end{array}$$

$$dynamicResponse = \text{“Rigid”}$$

Since building is flexible, use
ASCE 7, Section 26.11.5

Determine terrain exposure constants (Table 26.11-1)

$$z_{min} := \begin{cases} 30\ ft & \text{if } exposure = \text{"B"} \\ 15\ ft & \text{else if } exposure = \text{"C"} \\ 7\ ft & \text{else} \end{cases}$$

$$c := \begin{cases} 0.30 & \text{if } exposure = \text{"B"} \\ 0.2 & \text{else if } exposure = \text{"C"} \\ 0.15 & \text{else} \end{cases}$$

$$z_{min} = 30\ ft \qquad c = 0.3$$

$$\zeta := \begin{cases} 320\ ft & \text{if } exposure = \text{"B"} \\ 500\ ft & \text{else if } exposure = \text{"C"} \\ 650\ ft & \text{else} \end{cases}$$

$$\varepsilon_{bar} := \begin{cases} 3.0^{-1} & \text{if } exposure = \text{"B"} \\ 5.0^{-1} & \text{else if } exposure = \text{"C"} \\ 8.0^{-1} & \text{else} \end{cases}$$

$$\zeta = 320\ ft$$

$$\alpha_{bar} := \begin{cases} 4.0^{-1} & \text{if } exposure = \text{"B"} \\ 6.5^{-1} & \text{else if } exposure = \text{"C"} \\ 9.0^{-1} & \text{else} \end{cases}$$

$$b_{bar} := \begin{cases} 0.45 & \text{if } exposure = \text{"B"} \\ 0.65 & \text{else if } exposure = \text{"C"} \\ 0.80 & \text{else} \end{cases}$$

$$\varepsilon_{bar} = 0.333$$

Calculate geometric factors

$$z_{bar} := \max\left(0.6\ h, z_{min}\right) = 30\ ft$$

$$I_{z\_bar} := c \cdot \left(\frac{33\ ft}{z_{bar}}\right)^{\frac{1}{6}} = 0.305$$

$$L_{z\_bar} := \zeta \cdot \left(\frac{z_{bar}}{10\ ft}\right)^{\varepsilon_{bar}} = 461.52\ ft$$

Calculate gust effect factor

$$Q := \sqrt{\frac{1}{1+0.63\left(\frac{B+h}{L_{z\_bar}}\right)^{0.63}}} = 0.911$$

$g_Q := 3.4$

$g_v := 3.4$

$$g_R := \sqrt{2\ \ln\left(3600\ s \cdot n_1\right)} + \frac{0.577}{\sqrt{2 \cdot \ln\left(3600\ s \cdot n_1\right)}} = 4.339$$

$$G_f := 0.925\left(\frac{1+0.7 \cdot g_Q \cdot I_{z\_bar} \cdot Q}{1+0.7 \cdot g_v \cdot I_{z\_bar}}\right) = 0.89$$

9. Determine enclosure classification

$enclosure :=$ "enclosed"

Assume Ao is small due to stone facade

10. Internal Pressure Coefficient

```
GC_pi := if enclosure = "enclosed"
            0.18
         else if enclosure = "partiallyEnclosed"
            0.55
         else if enclosure = "partiallyOpen"
            0.18
         else
            0
```

$GC_{pi} = 0.18$

11. Calculate K_z

$$\alpha := \text{if}\left(exposure = \text{“B”}, 7.0, \text{if}\left(exposure = \text{“C”}, 9.5, 11.5\right)\right) = 7$$

$$z_g := \text{if}\left(exposure = \text{“B”}, 1200\ ft, \text{if}\left(exposure = \text{“C”}, 900\ ft, 700\ ft\right)\right) = \left(1.2 \cdot 10^3\right)\ ft$$

$$K_1 := 2.01 \cdot \left(\frac{z_1}{z_g}\right)^{\frac{2}{\alpha}} = 0.394$$

$$K_2 := 2.01 \cdot \left(\frac{z_2}{z_g}\right)^{\frac{2}{\alpha}} = 0.605$$

$$K_3 := 2.01 \cdot \left(\frac{z_3}{z_g}\right)^{\frac{2}{\alpha}} = 0.717$$

$$K_{p1} := 2.01 \cdot \left(\frac{z_{p1}}{z_g}\right)^{\frac{2}{\alpha}} = 0.735$$

12. Calculate q_z

$$q_1 := \left(\frac{0.00256\ psf}{mph^2}\right) \cdot K_1 \cdot K_{zt} \cdot K_d \cdot K_e \cdot V^2 = 10.2\ psf$$

$$q_2 := \left(\frac{0.00256\ psf}{mph^2}\right) \cdot K_2 \cdot K_{zt} \cdot K_d \cdot K_e \cdot V^2 = 15.6\ psf$$

$$q_3 := \left(\frac{0.00256\ psf}{mph^2}\right) \cdot K_3 \cdot K_{zt} \cdot K_d \cdot K_e \cdot V^2 = 18.5\ psf$$

$$q_{p1} := \left(\frac{0.00256\ psf}{mph^2}\right) \cdot K_{p1} \cdot K_{zt} \cdot K_d \cdot K_e \cdot V^2 = 19\ psf$$

$$q_h := q_3$$

On solar panels:

29.4.3 Rooftop Solar Panels for Buildings of All Heights with Flat Roofs or Gable or Hip Roofs with Slopes Less Than 7°. As illustrated in Fig. 29.4-7, the design wind pressure for rooftop solar panels apply to those located on enclosed or partially enclosed buildings of all heights with flat roofs, or with gable or hip roof slopes with $\theta \le 7°$, with panels conforming to:

$L_p \le 6.7$ ft (2.04 m),
$\omega \le 35°$,
$h_1 \le 2$ ft (0.61 m),
$h_2 \le 4$ ft (1.22 m),

with a minimum gap of 0.25 in. (6.4 mm) provided between all panels, and the spacing of gaps between panels not exceeding 6.7 ft (2.04 m). In addition, the minimum horizontal clear distance between the panels and the edge of the roof shall be the larger of $2(h_2 - h_{pt})$ and 4 ft (1.2m) for the design pressures in this section to apply. The design wind pressure for rooftop solar panels shall be determined by Eq. (29.4-5) and (29.4-6):

$$p = q_h(GC_{rn})(\text{lb/ft}^2) \quad (29.4\text{-}5)$$

$$p = q_h(GC_{rn})(\text{N/m}^2) \quad (29.4\text{-}5.\text{si})$$

where

$$(GC_{rn}) = (\gamma_p)(\gamma_c)(\gamma_E)(GC_{rn})_{\text{nom}} \quad (29.4\text{-}6)$$

where

$\gamma_p = \min(1.2, 0.9 + h_{pt}/h)$;
$\gamma_c = \max(0.6 + 0.06L_p, 0.8)$; and
$\gamma_E = 1.5$ for uplift loads on panels that are exposed and within a distance $1.5(L_p)$ from the end of a row at an exposed edge of the array; $\gamma_E = 1.0$ elsewhere for uplift loads and for all downward loads, as illustrated in Fig. 29.4-7. A panel is defined as exposed if d_1 to the roof edge $> 0.5h$ and one of the following applies:

1. d_1 to the adjacent array $> \max(4h_2$, 4 ft (1.2m) or
2. d_2 to the next adjacent panel $> \max(4h_2$, 4 ft (1.2m).

$(GC_{rn})_{\text{nom}}$ = nominal net pressure coefficient for rooftop solar panels as determined from Fig. 29.4-7.

When, $\omega \le 2°$, $h_2 \le 0.83$ ft (0.25 m), and a minimum gap of 0.25 in. (6.4 mm) is provided between all panels, and the spacing of gaps between panels does not exceed 6.7 ft (2.04 m), the procedure of Section 29.4.4 shall be permitted.

The roof shall be designed for both of the following:

1. The case where solar collectors are present. Wind loads acting on solar collectors in accordance with this section shall be applied simultaneously with roof wind loads specified in other sections acting on areas of the roof not covered by the plan projection of solar collectors. For this case, roof wind loads specified in other sections need not be applied on areas of the roof covered by the plan projection of solar collectors.
2. Cases where the solar arrays have been removed.

$\omega := 35\ deg$ angle that the solar panel makes with the roof surface in Fig. 29.4-7, in degrees

$qh := q_3$ velocity pressure evaluated at height z= h, in lb/ft2

$h_{pt} := 3\ ft$ mean parapet height above the adjacent roof surface for use with Eq. (29.4-5), in ft

$h := 32.5\ ft$ mean roof height of a building or height

$$\gamma_P := min\left(1.2, 0.9 + \frac{h_{pt}}{h}\right)$$

$Lp := 5.41\ ft$ panel chord length for use with rooftop solar panels in Fig. 29.4-7, in ft

$$\gamma_c := \max\left(0.6 + \frac{0.06\ Lp}{ft}, 0.8\right) = 0.925$$

$\gamma_{E1} := 1.0$ or $\gamma_{E2} := 1.5$

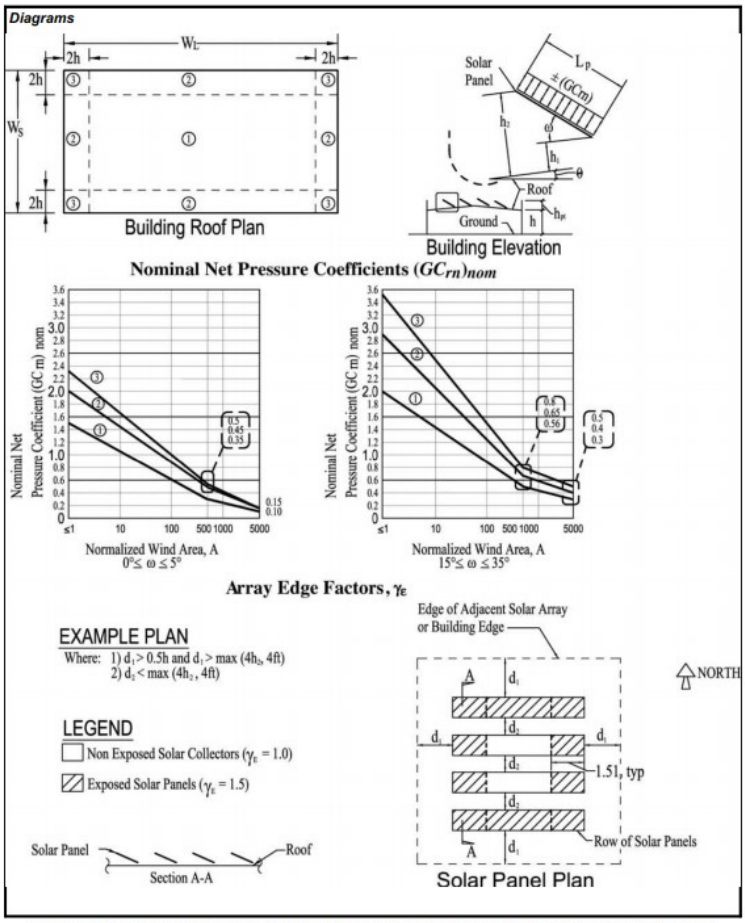


FIGURE 29.4-7 Design Wind Loads (All Heights): Rooftop Solar Panels for Enclosed and Partially Enclosed Buildings, Roof $\theta \le 7°$

$L_{sp} := 65\ in$ $\quad B_{sp} := 39\ in$ $\quad A_{non} := \frac{L_{sp} \cdot B_{sp}}{2} = 8.802\ ft^2$

$GC_{rn\_norm2} := 1.6$
$GC_{rn\_norm3} := 1.9$

nominal net pressure coefficient for rooftop solar panels determined from Fig. 29.4-7

$GC_{rn2} := GC_{rn\_norm2} \cdot \gamma_P \cdot \gamma_c \cdot \gamma_{E1} = 1.468$
$GC_{rn3} := GC_{rn\_norm3} \cdot \gamma_P \cdot \gamma_c \cdot \gamma_{E2} = 2.615$

net pressure coefficient for rooftop solar panels

$p_{min} := q_h \cdot GC_{rn2} = 27.17\ psf$

$p_{max} := q_h \cdot GC_{rn3} = 48.39\ psf$

design pressure to be used in determination of wind loads for buildings, in lb/ft2

27.3 WIND LOADS: MAIN WIND FORCE RESISTING SYSTEM

27.3.1 Enclosed and Partially Enclosed Rigid and Flexible Buildings. Design wind pressures for the MWFRS of buildings of all heights in lb/ft^2 (N/m^2), shall be determined by the following equation:

$$p = qGC_p - q_i(GC_{pi}) \qquad (27.3\text{-}1)$$

where

$q = q_z$ for windward walls evaluated at height z above the ground.

$q = q_h$ for leeward walls, sidewalls, and roofs evaluated at height h.

$q_i = q_h$ for windward walls, sidewalls, leeward walls, and roofs of enclosed buildings, and for negative internal pressure evaluation in partially enclosed buildings.

$q_i = q_z$ for positive internal pressure evaluation in partially enclosed buildings where height z is defined as the level of the highest opening in the building that could affect the positive internal pressure. For buildings sited in wind-borne debris regions, glazing that is not impact-resistant or protected with an impact-resistant covering shall be treated as an opening in accordance with Section 26.12.3. For positive internal pressure evaluation, q_i may conservatively be evaluated at height $h(q_i = q_h)$.

G = gust-effect factor; see Section 26.11. For flexible buildings, G_f determined in accordance with Section 26.11.5 shall be substituted for G.

C_p = external pressure coefficient from Figs. 27.3-1, 27.3-2, and 27.3-3.

(GC_{pi}) = internal pressure coefficient from Table 26.13-1.

Both q and q_i shall be evaluated using exposure defined in Section 26.7.3. Pressure shall be applied simultaneously on windward and leeward walls and on roof surfaces as defined in Figs. 27.3-1, 27.3-2, and 27.3-3.

13. Determine external pressure coefficients

Windward wall:	$C_{p\_windward} := 0.8$	Figure 27.3-1
Leeward wall:	$C_{p\_leeward} := -0.29$	Figure 27.3-1, L/B>2
Windward Parapet:	$GC_{pn\_windward} := 1.5$	Figure 27.3-4
Leeward Parapet:	$GC_{pn\_leeward} := -1.0$	Figure 27.3-4

14. Calculate desgin wind prssures

Positive Internal Pressure:

Windward Wall:

$$p_{1\_pos} := q_1 \cdot G_f \cdot C_{p\_windward} - q_h \cdot (GC_{pi}) = 3.9\ psf$$

$$p_{2\_pos} := q_2 \cdot G_f \cdot C_{p\_windward} - q_h \cdot (GC_{pi}) = 7.8\ psf$$

$$p_{3\_pos} := q_3 \cdot G_f \cdot C_{p\_windward} - q_h \cdot (GC_{pi}) = 9.9\ psf$$

Leeward wall:

$$p_{leeward\_pos} := q_h \cdot G_f \cdot C_{p\_leeward} - q_h \cdot (GC_{pi}) = -8.1 \ psf$$

Net Pressure:

$$p_{1\_netPos} := p_{1\_pos} + \text{abs}(p_{leeward\_pos}) = 12 \ psf$$

$$p_{2\_netPos} := p_{2\_pos} + \text{abs}(p_{leeward\_pos}) = 15.9 \ psf$$

$$p_{3\_netPos} := p_{3\_pos} + \text{abs}(p_{leeward\_pos}) = 18 \ psf$$

Negative Internal Pressure:

Windward Wall:

$$p_{1\_neg} := q_1 \cdot G_f \cdot C_{p\_windward} - q_h \cdot (-GC_{pi}) = 10.6 \ psf$$

$$p_{2\_neg} := q_2 \cdot G_f \cdot C_{p\_windward} - q_h \cdot (-GC_{pi}) = 14.5 \ psf$$

$$p_{3\_neg} := q_3 \cdot G_f \cdot C_{p\_windward} - q_h \cdot (-GC_{pi}) = 16.5 \ psf$$

Leeward wall:

$$p_{leeward\_neg} := q_h \cdot G_f \cdot C_{p\_leeward} - q_h \cdot (-GC_{pi}) = -1.4 \ psf$$

Net Pressure:

$$p_{1\_netNeg} := p_{1\_pos} + \text{abs}(p_{leeward\_pos}) = 12 \ psf$$

$$p_{2\_netNeg} := p_{2\_pos} + \text{abs}(p_{leeward\_pos}) = 15.9 \ psf$$

Parapet Walls:

Windward parapet: $p_{p\_windward} := q_{p1} \cdot GC_{pn\_windward} = 28.5 \ psf$

Leeward parapet: $p_{p\_leeward} := q_{p1} \cdot GC_{pn\_leeward} = -19 \ psf$

Uplift

$$Uplift := q_h \cdot (GC_{pi}) = 3.331 \ psf$$

Elevator

Capacity Info

Indicate the total weight the elevator should be able to carry.

United States

International Building Code Stretcher Requirements for Passenger Shaped Elevators					
	2500lb Capacity	2500lb IBC Capacity	3000lb Capacity	3500lb Capacity	4000lb Capacity
IBC 2000 24" X 76" Stretcher	Left or Right Opening Door	Left or Right Opening Door	Left or Right Opening Door	Left or Right Opening Door	Center Opening Door
IBC 2006 24" X 84" Stretcher		Left or Right Opening Door		Left or Right Opening Door	Center Opening Door

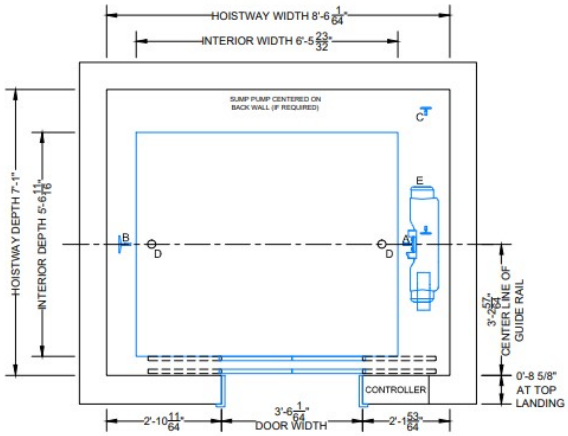
Canada

NBC Stretcher Requirements for Passenger Shaped Elevators		
	1134kg Capacity	1814kg Capacity
National Building Code 610 mm X 2010 mm Stretcher	Left or Right Opening Door	Center Opening Door

Vertical Forces

VERTICAL FORCES ONTO PIT FLOOR (lbf)					
REACTION LOCATION	A	B	C	D	E
Z DIRECTION	21400	10700	6000	12200	1920

****VERTICAL REACTIONS A, B & C OCCUR SIMULTANEOUSLY. VERTICAL REACTIONS D & E OCCUR INDIVIDUALLY AND SEPARATELY FROM A, B & C.**



HOISTWAY PLAN VIEW

TABLE 1806.2
PRESUMPTIVE LOAD-BEARING VALUES

CLASS OF MATERIALS	VERTICAL FOUNDATION PRESSURE (psf)	LATERAL BEARING PRESSURE (psf/ft below natural grade)	LATERAL SLIDING RESISTANCE	
			Coefficient of friction[a]	Cohesion (psf)[b]
1. Crystalline bedrock	12,000	1,200	0.70	—
2. Sedimentary and foliated rock	4,000	400	0.35	—
3. Sandy gravel and gravel (GW and GP)	3,000	200	0.35	—
4. Sand, silty sand, clayey sand, silty gravel and clayey gravel (SW, SP, SM, SC, GM and GC)	2,000	150	0.25	—
5. Clay, sandy clay, silty clay, clayey silt, silt and sandy silt (CL, ML, MH and CH)	1,500	100	—	130

For SI: 1 pound per square foot = 0.0479kPa, 1 pound per square foot per foot = 0.157 kPa/m.

a.Coefficient to be multiplied by the dead load.
b.Cohesion value to be multiplied by the contact area, as limited by Section 1806.3.2 .

soil falls in group 5

$P1 := 21400\ lbf$

$A := 9.75\ ft \cdot 8.25\ ft = 80.438\ ft^2$

$q := \frac{P1}{A} = 266.045\ psf$

$P2 := 10700\ lbf$

$A := 9.75\ ft \cdot 8.25\ ft = 80.438\ ft^2$

$q := \frac{P2}{A} = 133.023\ psf$

$P3 := 6000\ lbf$

$A := 9.75\ ft \cdot 8.25\ ft = 80.438\ ft^2$

$q := \frac{P3}{A} = 74.592\ psf$

$P4 := 12200\ lbf$

$A := 9.75\ ft \cdot 8.25\ ft = 80.438\ ft^2$

$q := \frac{P2}{A} = 133.023\ psf$

$P5 := 1920\ lbf$

$A := 9.75\ ft \cdot 8.25\ ft = 80.438\ ft^2$

$q := \frac{P2}{A} = 133.023\ psf$

$P := P1 + P2 + P3 + P4 + P5$

$A := 9.75\ ft \cdot 8.25\ ft = 80.438\ ft^2$

$q := \frac{P}{A} = 649.2\ psf$

649.2 psf < 1500 psf from IBC so this works

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217 2ND STREET. WEBSTER CITY, IA
HAMILTON COUNTY

SITE LOCATION:

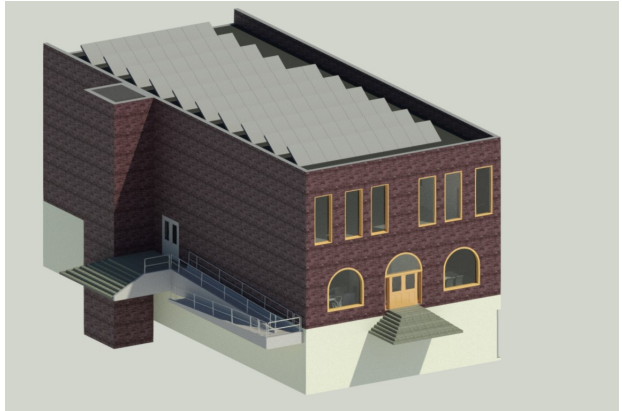

TABLE OF CONTENTS:

PROJECT: 08-SPRING2019
DATE: 3/25/19
DRAWN BY: JJR
REVISION:

THE UNIVERSITY OF IOWA
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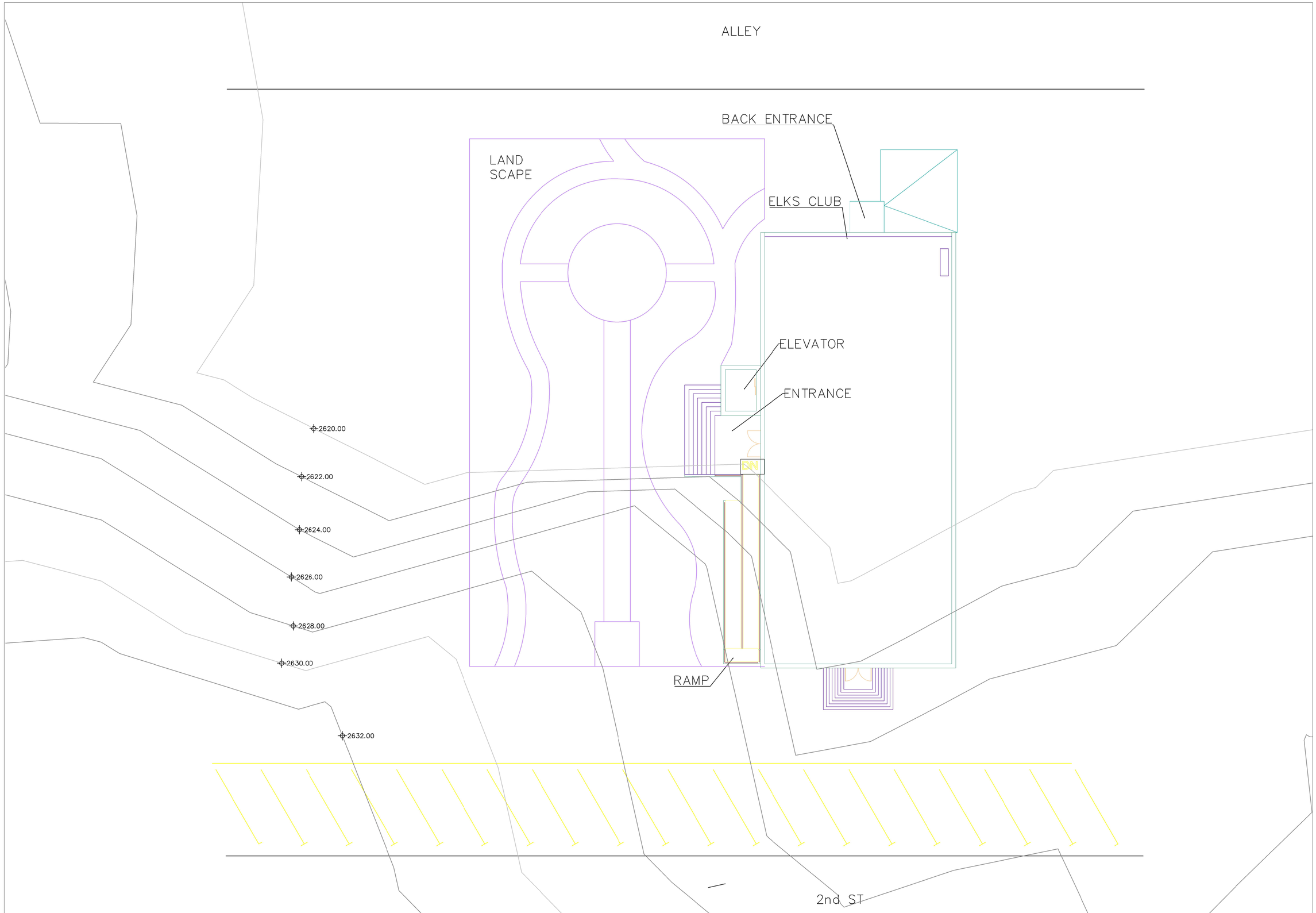
SHEET NAME
COVER SHEET

SHEET NO.
C1



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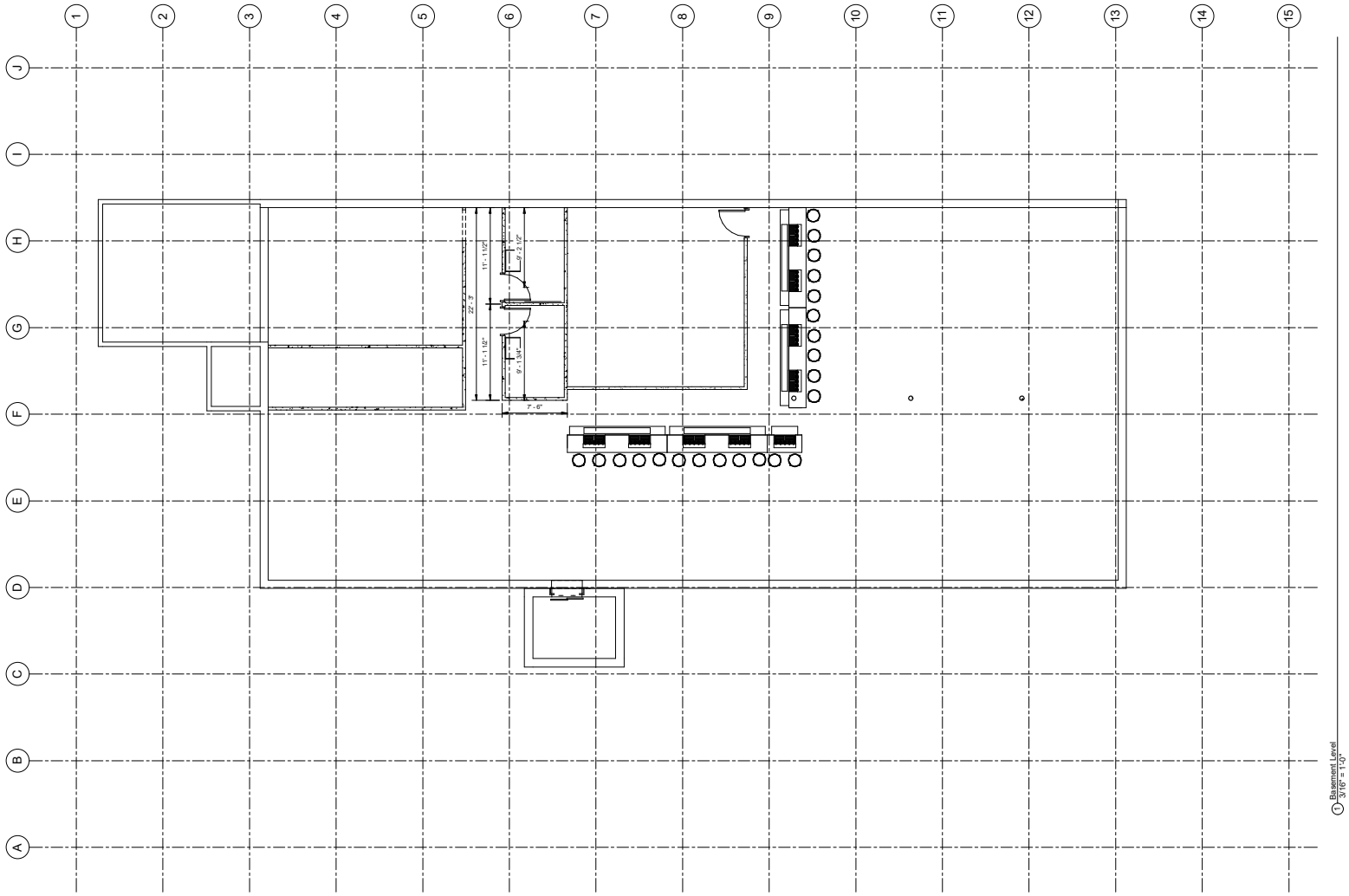
ELKS CLUB RESTORATION

SHEET NAME

SITE PLAN

SHEET NO.

S1



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DATE: 3/25/19

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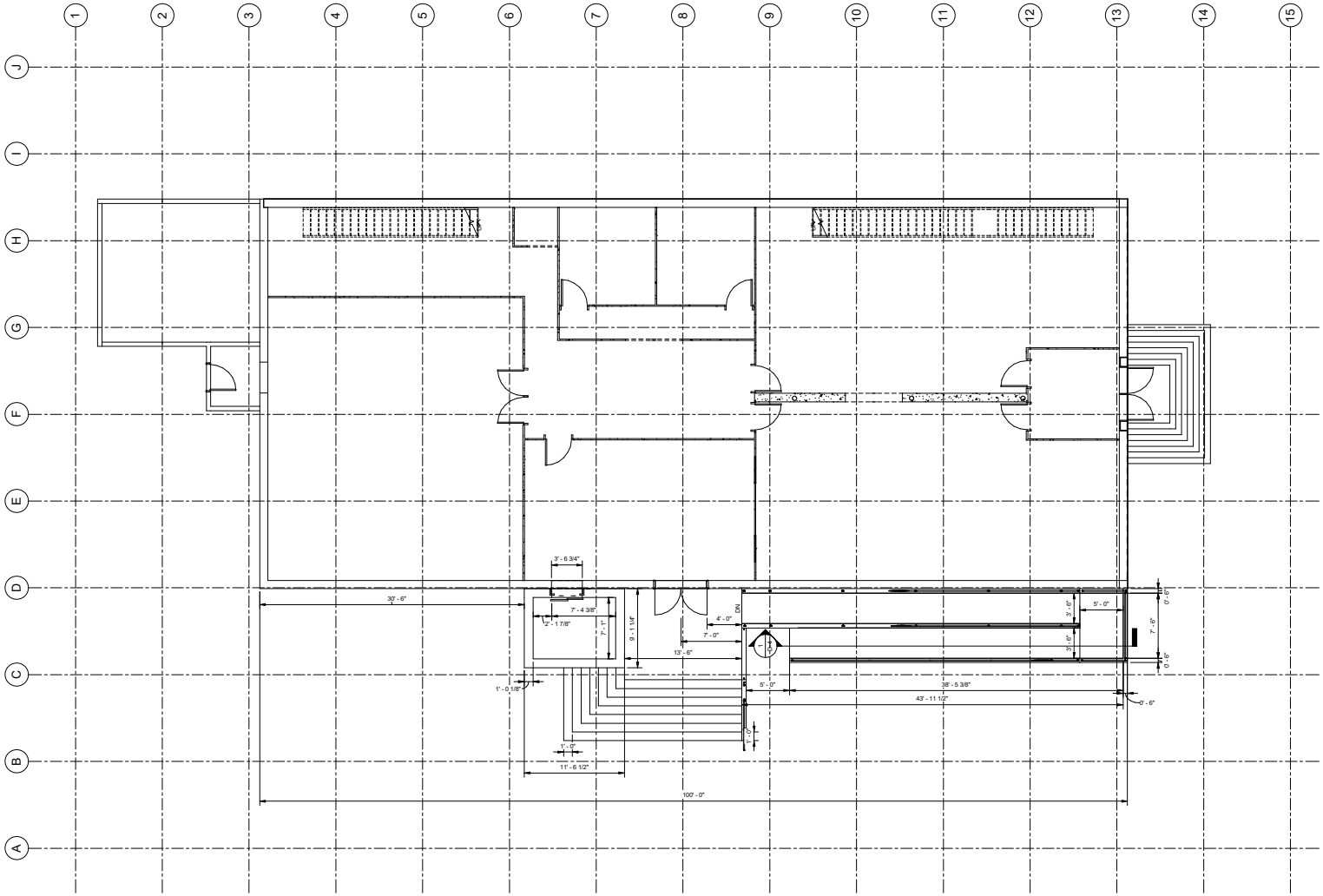
ELKS CLUB RESTORATION

SHEET NAME
BASEMENT FLOOR PLAN

SHEET NO.
F-1



1 First Floor
3/16" = 1'-0"

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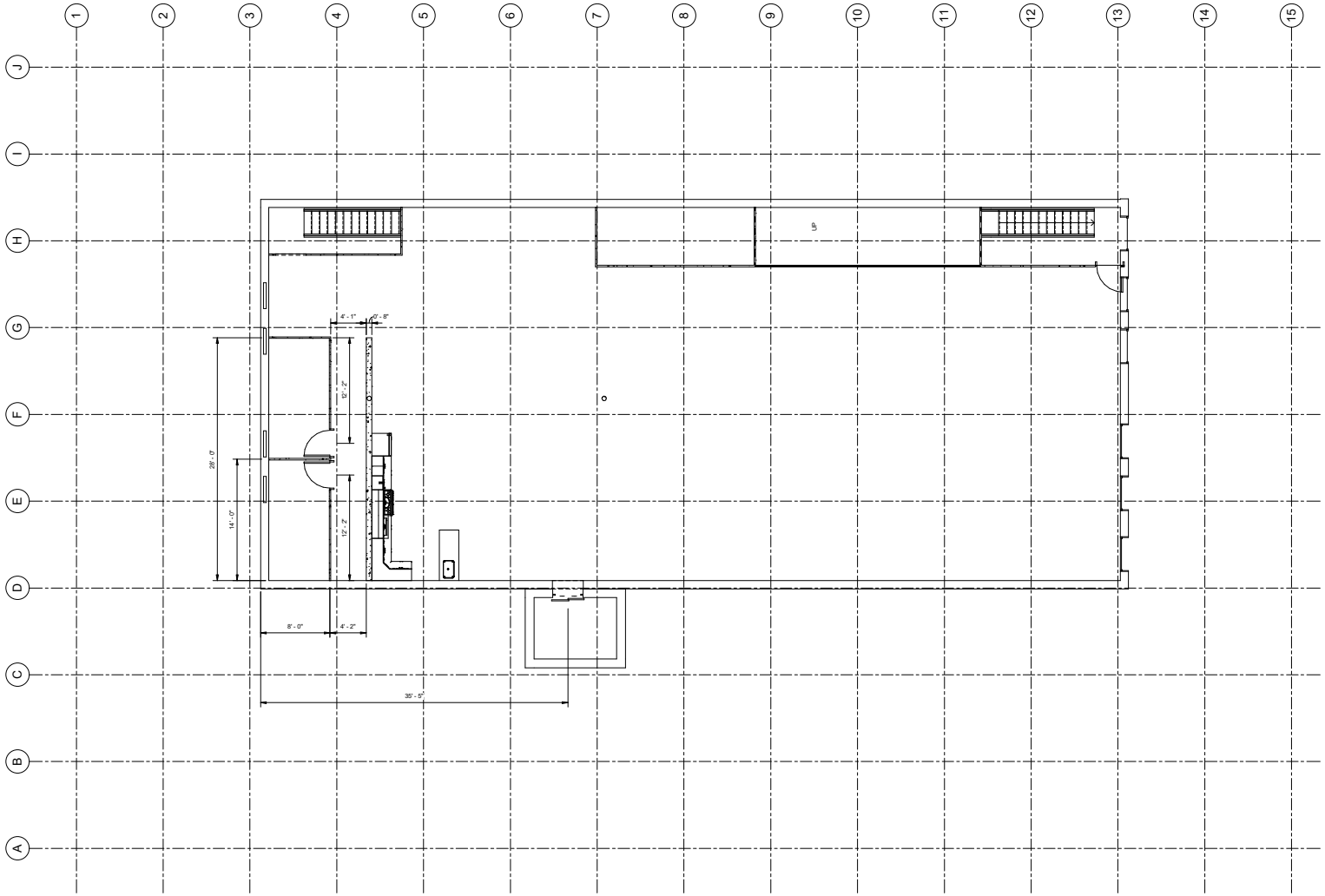
SHEET NAME
FIRST FLOOR PLAN

SHEET NO.
F-2



1 2nd Floor Ceiling
3/16" = 1'-0"

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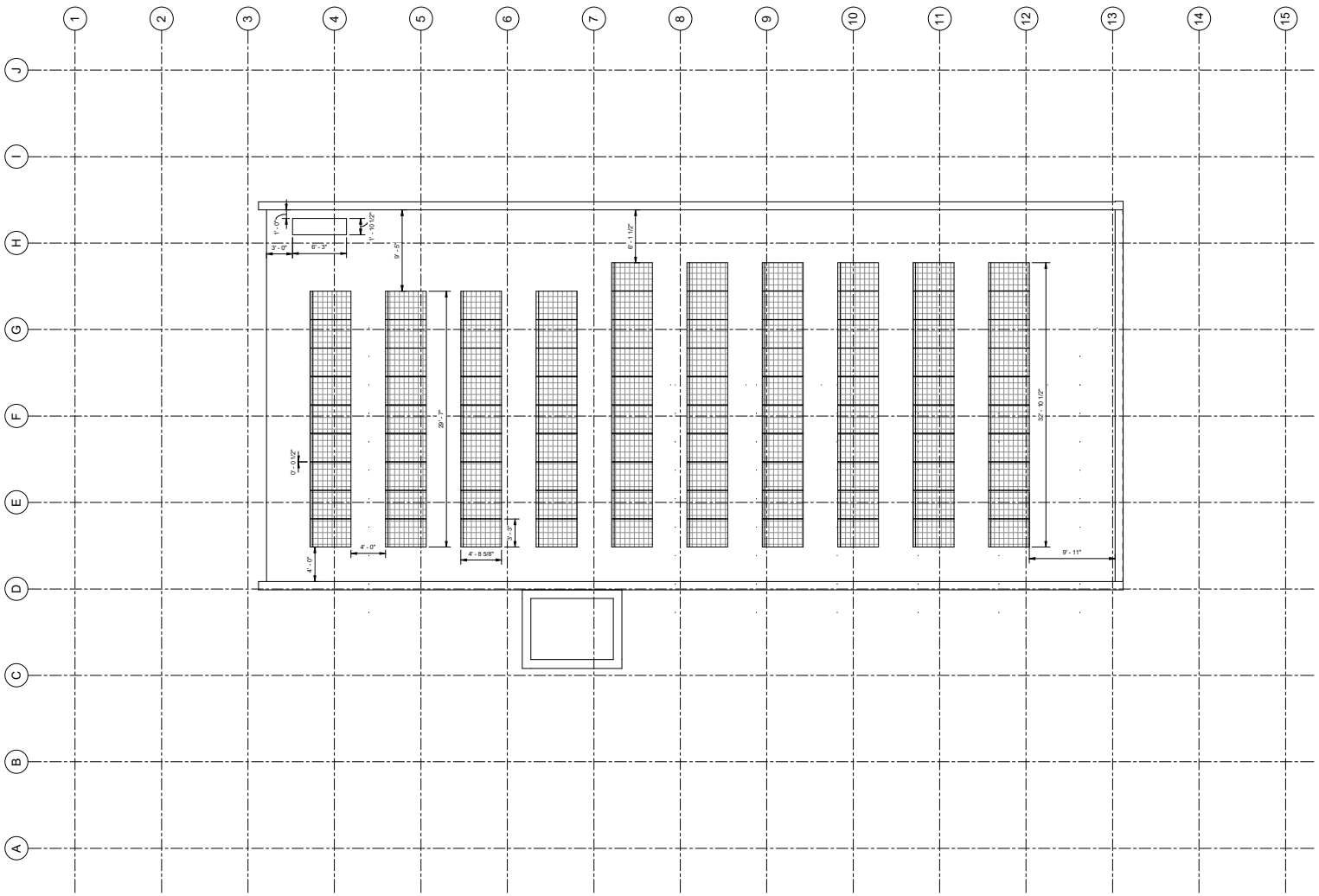
SHEET NAME
SECOND FLOOR PLAN

SHEET NO.
F-3



1 Roof Level
3/16" = 1'-0"

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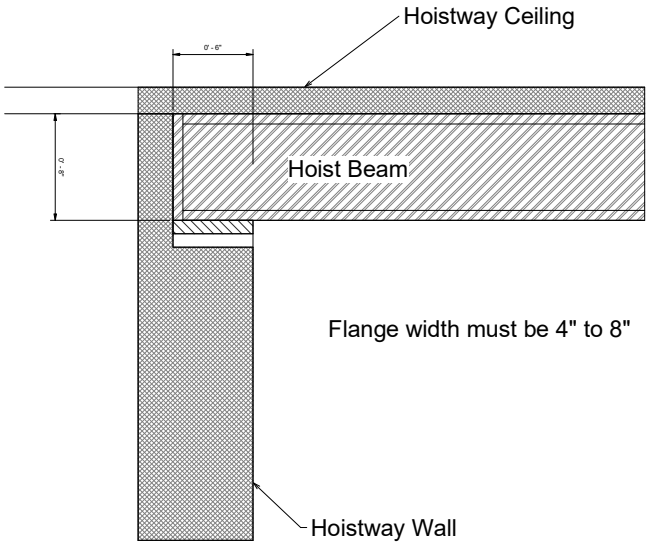
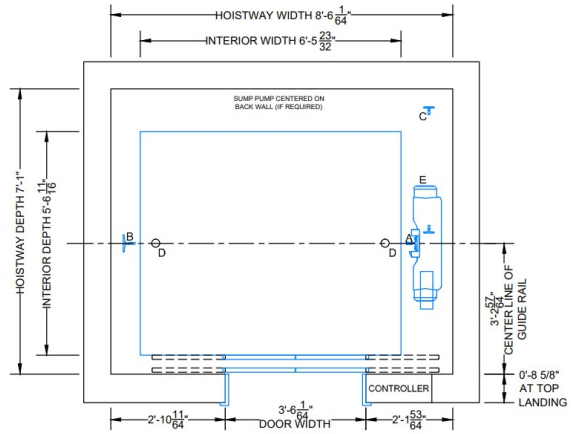
SHEET NAME
ROOF PLAN

SHEET NO.
F-4



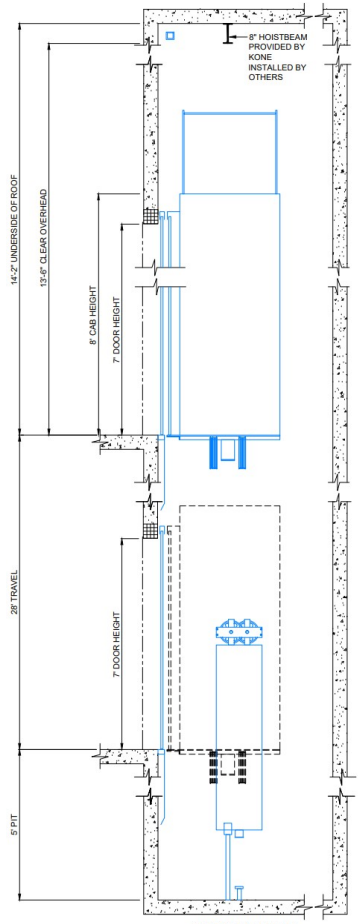


HOISTWAY PLAN VIEW

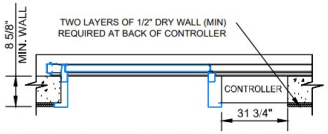
VERTICAL FORCES ONTO PIT FLOOR (lbf)					
REACTION LOCATION	A	B	C	D	E
Z DIRECTION	21400	10700	6000	12200	1920

**VERTICAL REACTIONS A, B & C OCCUR SIMULTANEOUSLY. VERTICAL REACTIONS D & E OCCUR INDIVIDUALLY AND SEPARATELY FROM A, B & C.

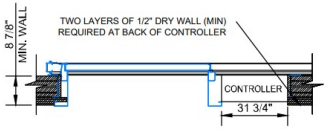
HOISTBEAM & LIFELINE VERTICAL FORCES (lbf)				
REACTION LOCATION	A	B	C	D
Z DIRECTION	4800	4700	5000	5000



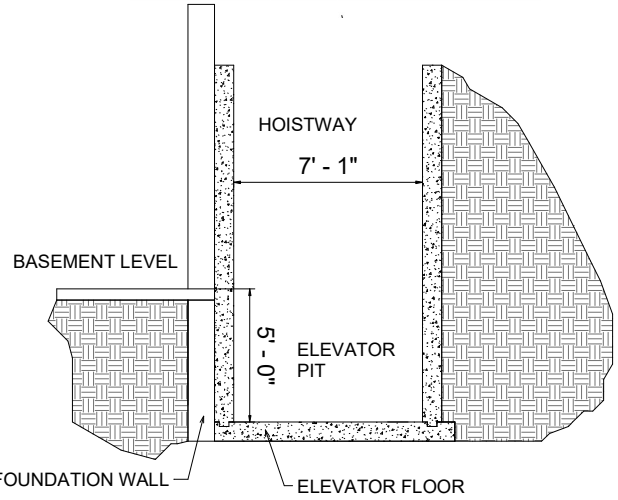
SECTION VIEW



TOP LANDING ENTRANCE / INTEGRATED CONTROL DETAIL
CONCRETE



TOP LANDING ENTRANCE / INTEGRATED CONTROL DETAIL
DRYWALL



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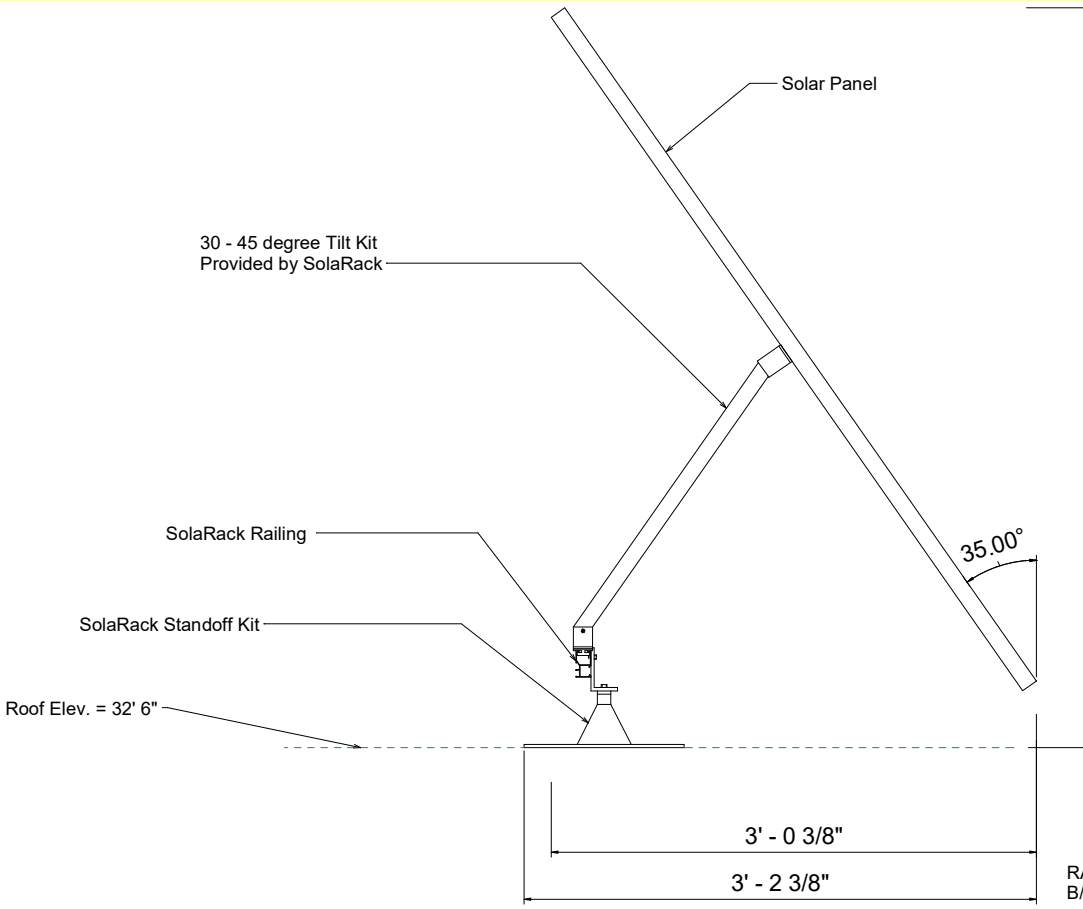
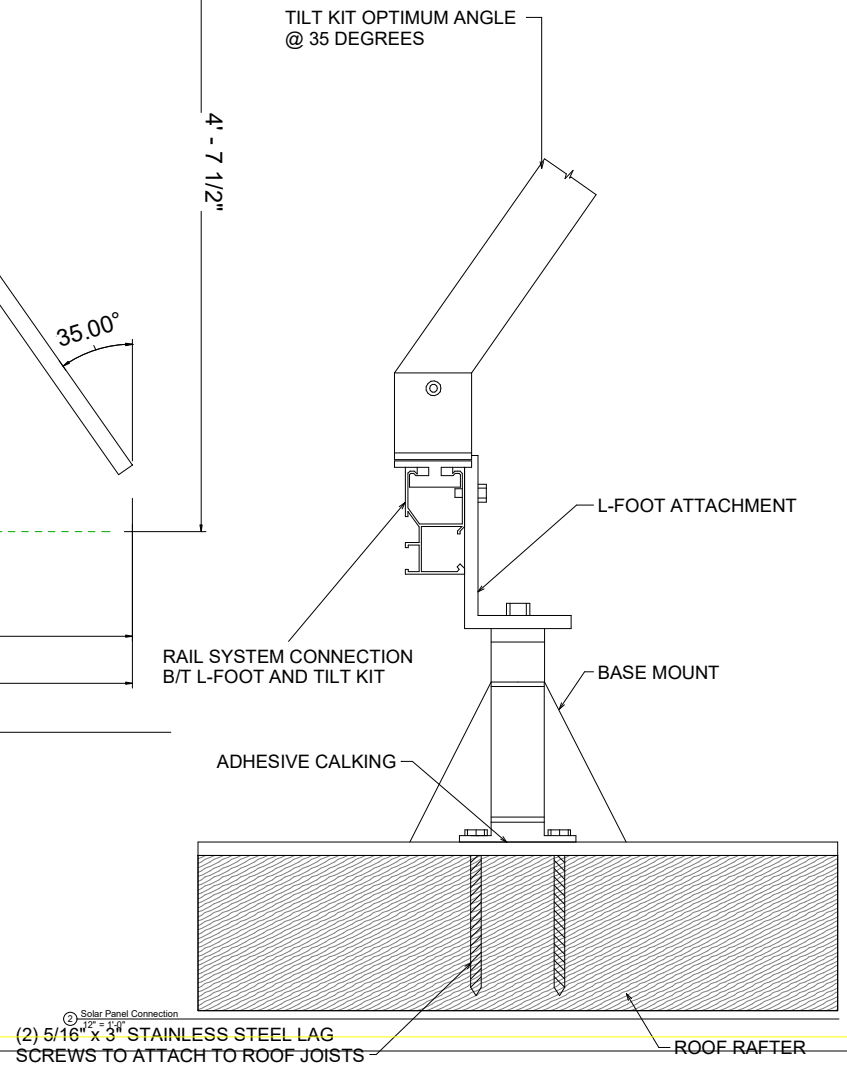
SHEET NAME
ELEVATOR DETAIL

SHEET NO.
D-1



1 Solar Panel Section
3" = 1'-0"



2 Solar Panel Connection
12" = 5'-0"

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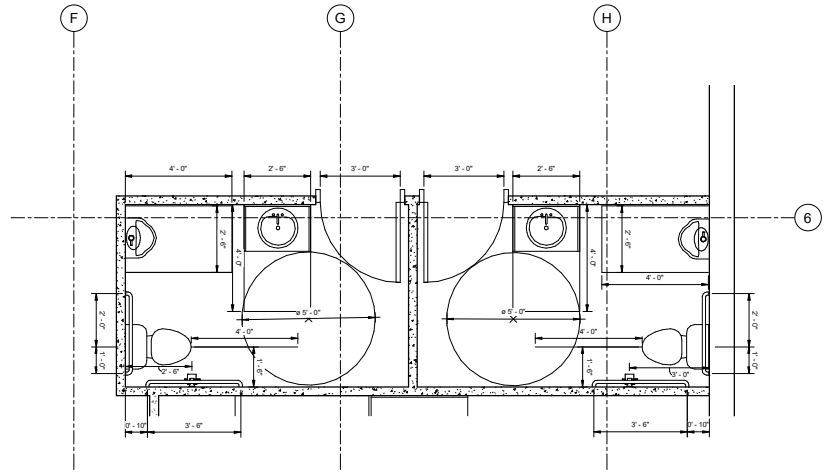
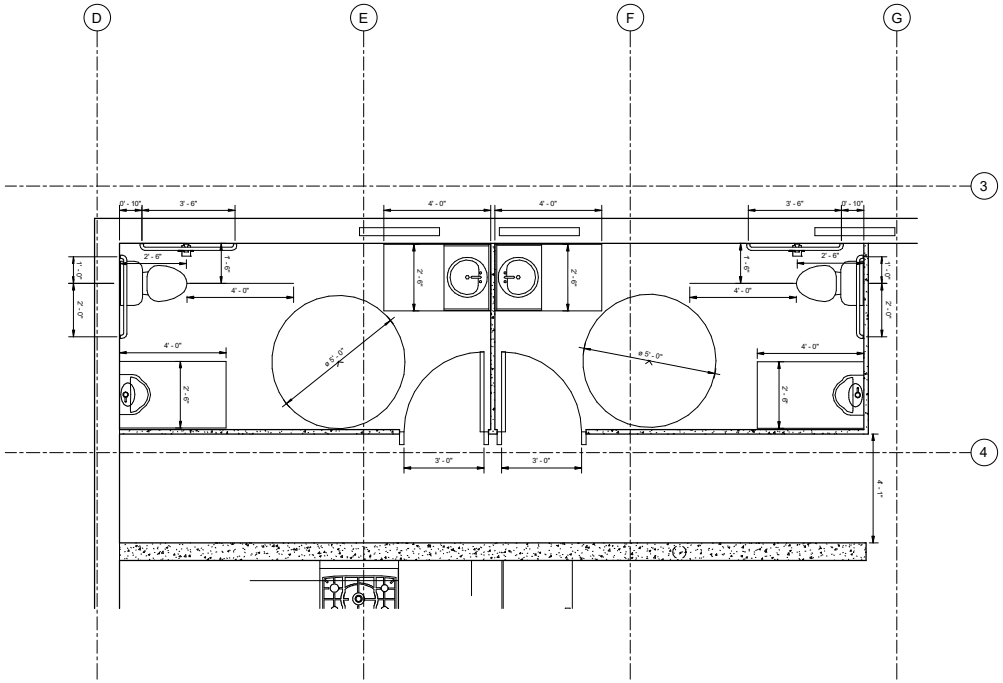
SHEET NAME
SOLAR PANEL DETAIL

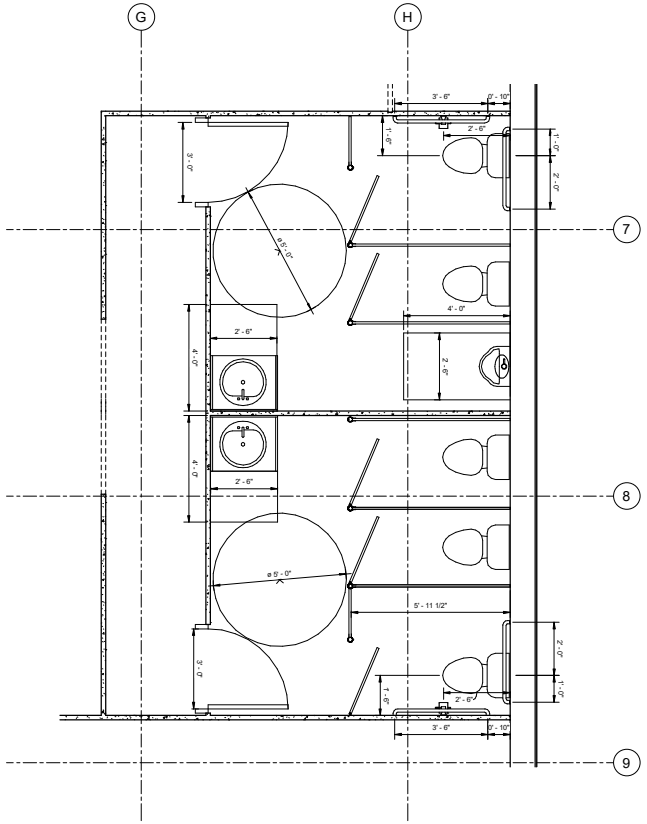
SHEET NO.
D-2



1 Basement Level Restrooms
1/2" = 1'-0"



3 2nd Floor Restrooms
1/2" = 1'-0"



2 First Floor Restrooms
1/2" = 1'-0"

NOTE: TO MEET ADA COMPLIANCE, COMPLY TO THE FOLLOWING

ALL GRAB BARS SHOULD BE
34" IN. OFF THE GROUND AND BE 1-1/2" DIA.

TOILET SEAT HEIGHT OF 18" FROM GROUND SURFACE

SINK HEIGHT OF 27" FROM GROUND SURFACE

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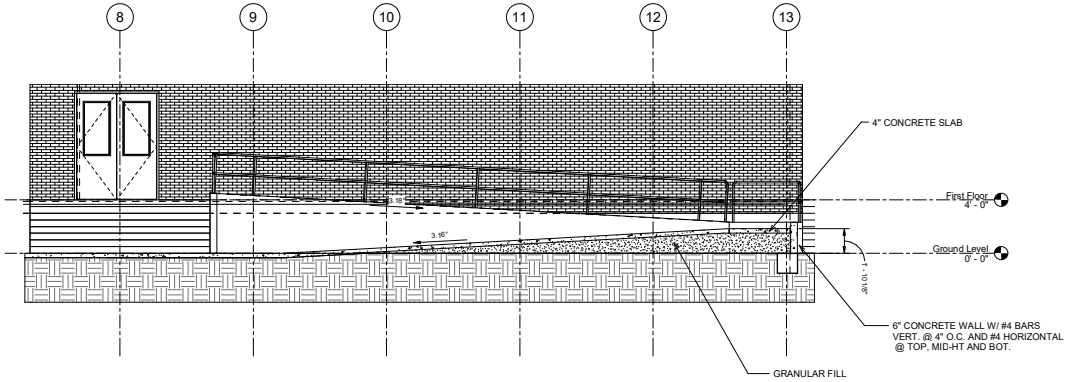
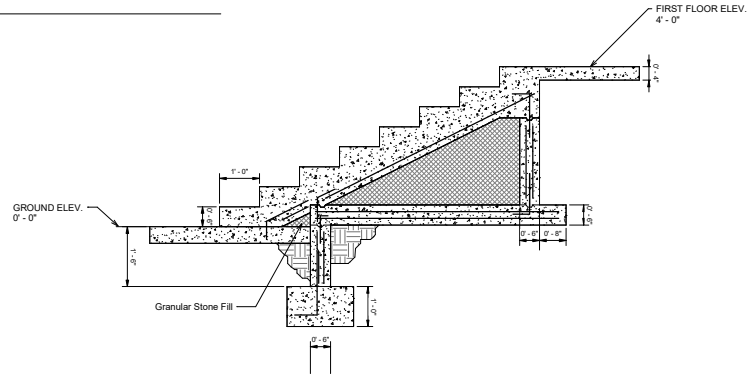
ELKS CLUB RESTORATION

SHEET NAME
CODE REQUIREMETNS

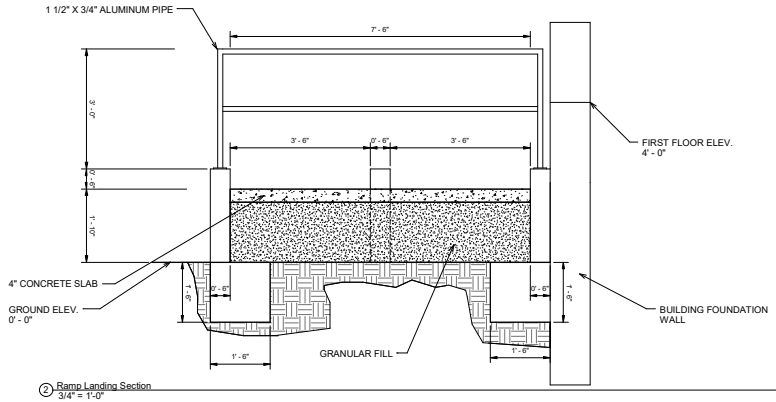
SHEET NO.
D-3



1 S1
1/4" = 1'-0"



3 Stair Section
3/4" = 1'-0"



2 Ramp Landing Section
3/4" = 1'-0"

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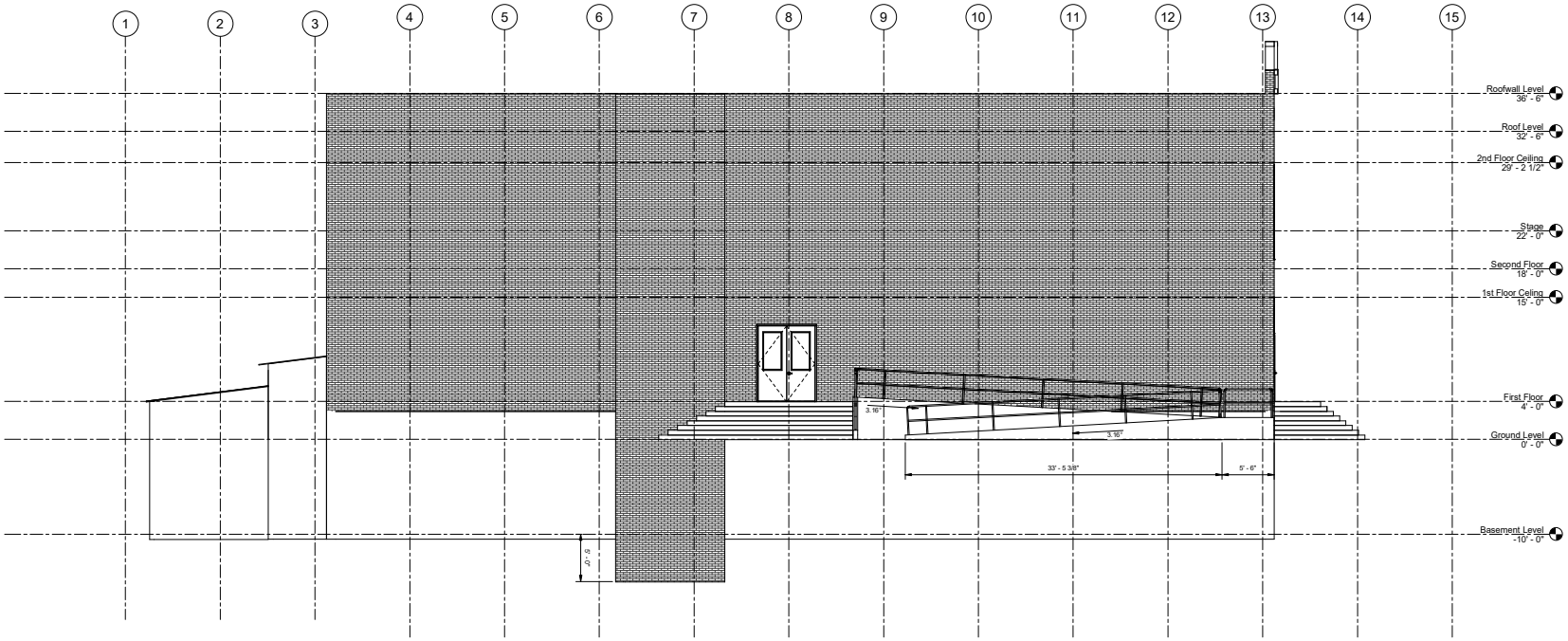
SHEET NAME
RAMP / STAIR SECTIONS

SHEET NO.
D-4



1 West
3/16" = 1'-0"

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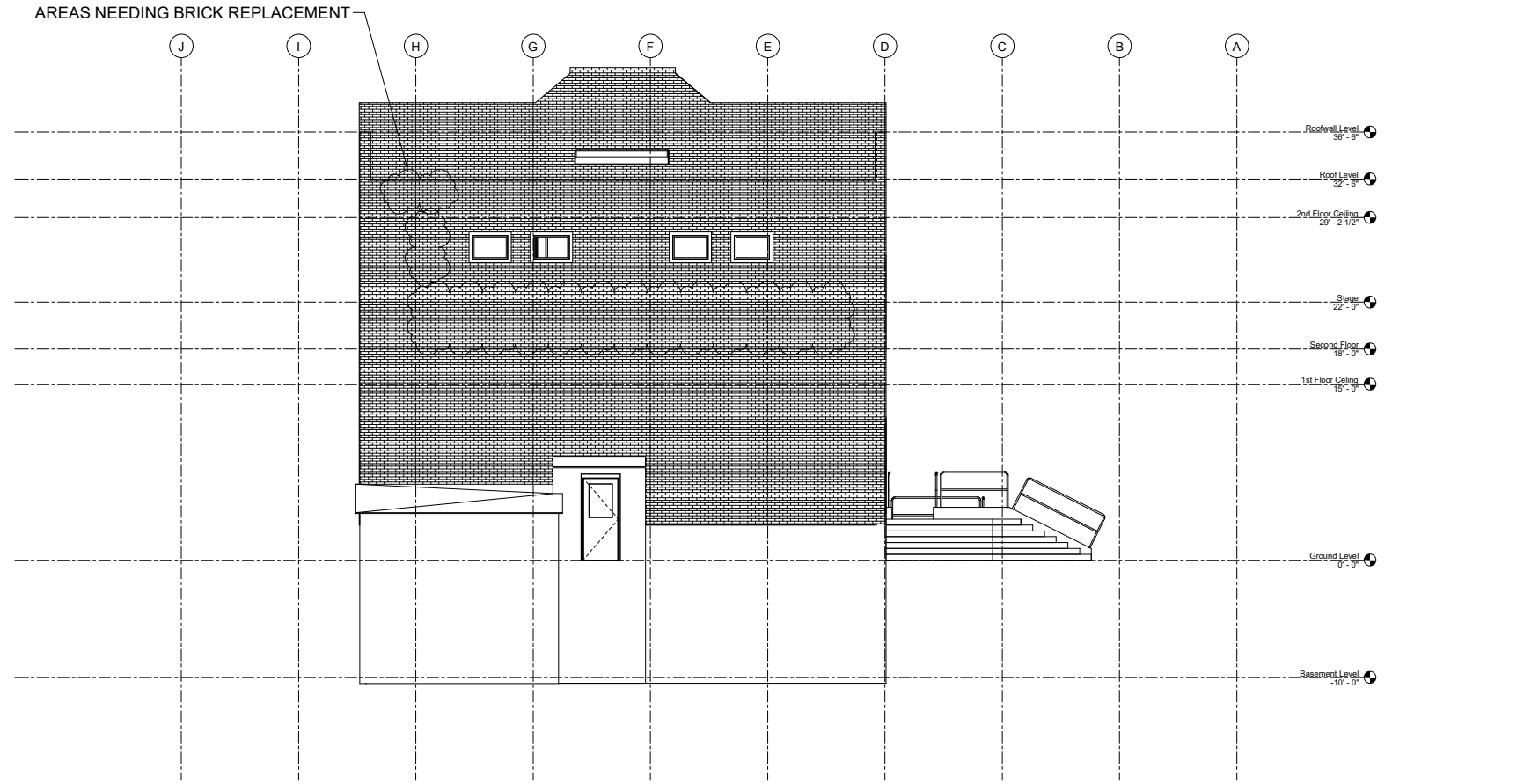
SHEET NAME
RAMP ELEVATION

SHEET NO.
E-1



1 North Brick
1/4" = 1'-0"

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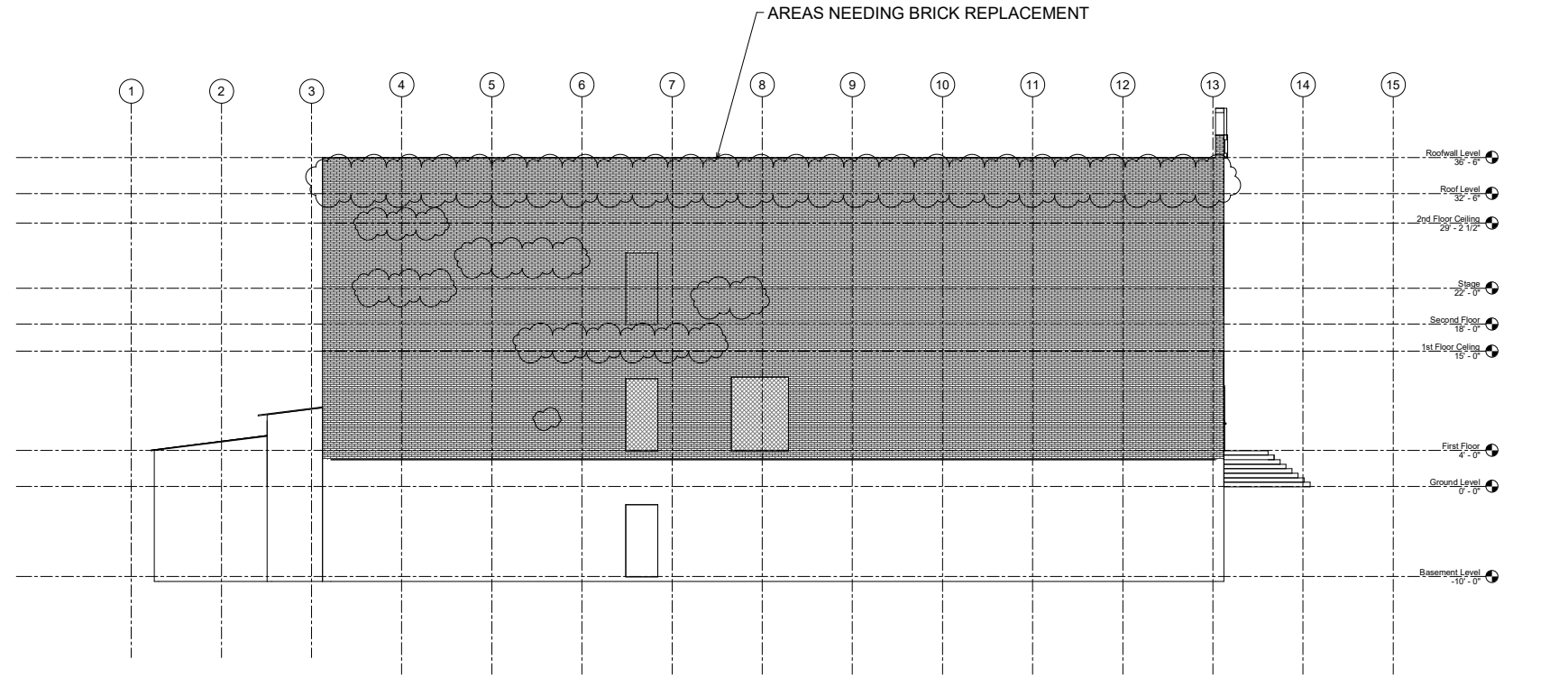
SHEET NAME
EXTERIOR BRICK REPLACEMENT - NORTH WALL

SHEET NO.
E-2



1 West Brick
3/16" = 1'-0"

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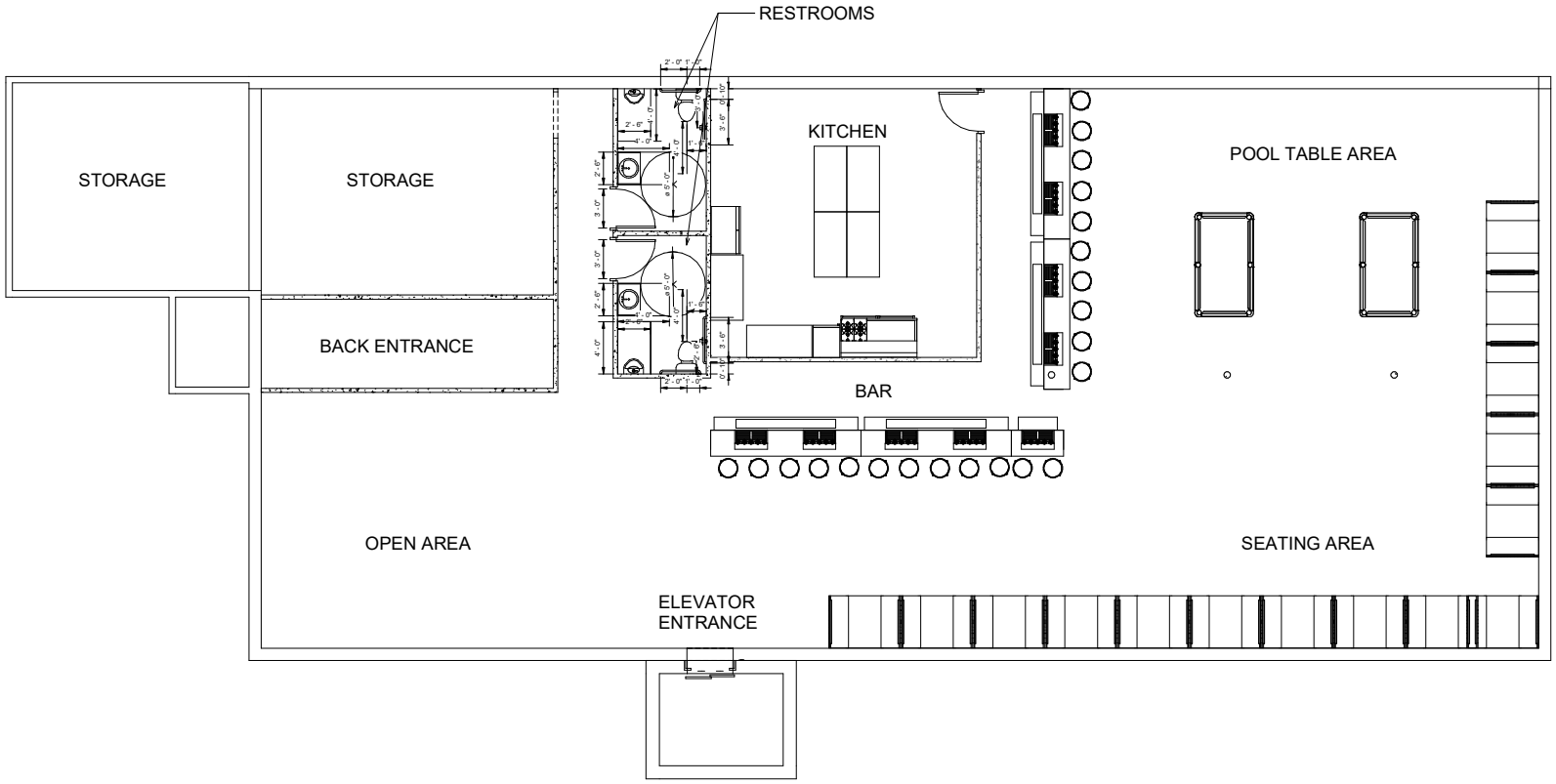
SHEET NAME
WEST WALL
BRICK REPLACEMENT

SHEET NO.
E-3



1 Basement Level Restrooms Floorplan
1/4" = 1'-0"

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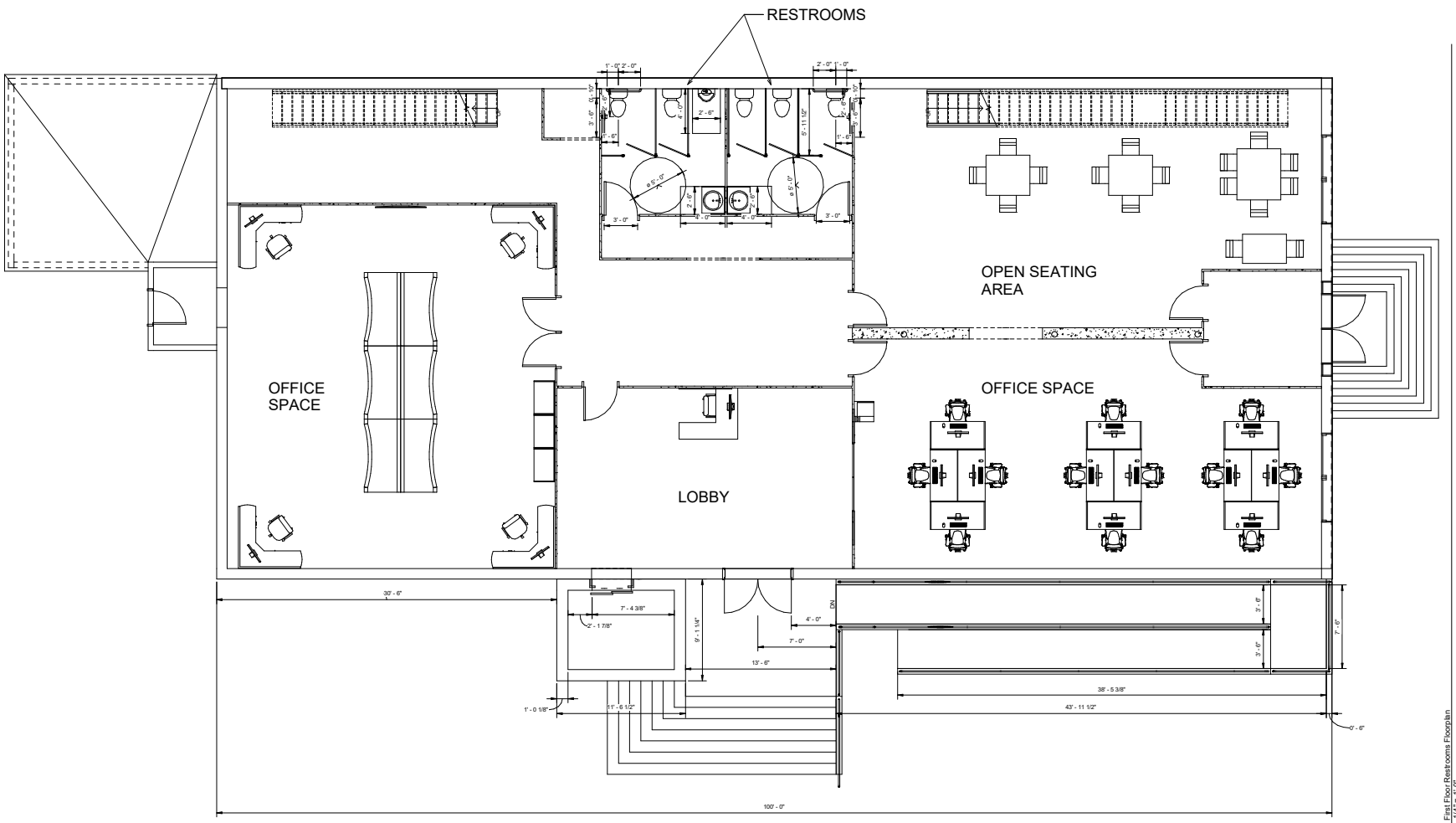
SHEET NAME
BASEMENT ARCHITECTURAL LAYOUT

SHEET NO.
L-1



1 First Floor Restrooms Floorplan
1/4" = 1'-0"

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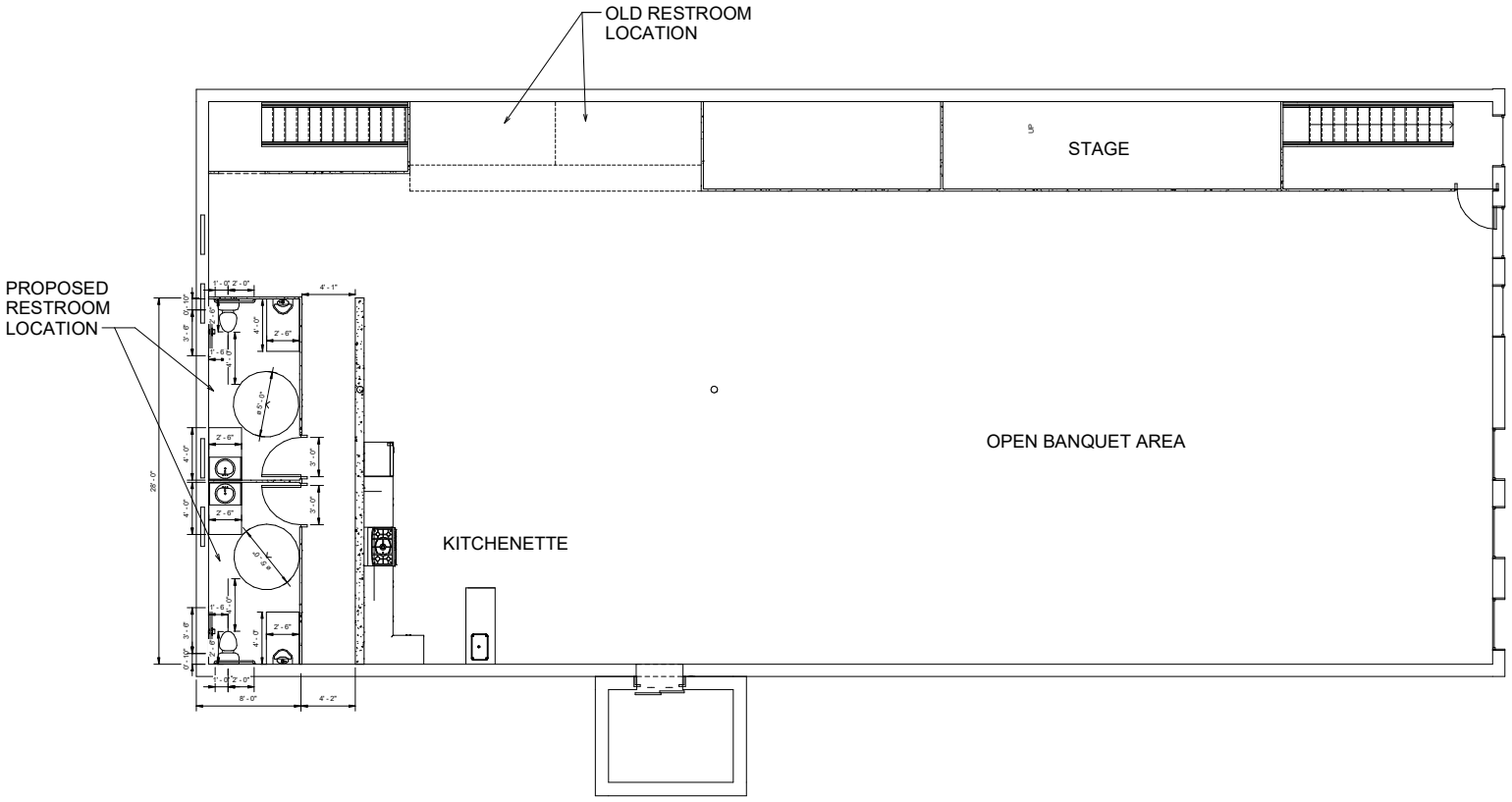
SHEET NAME
FIRST FLOOR ARCHITECTURAL LAYOUT

SHEET NO.
L-2



1 2nd Floor Restrooms Floorplan
1/4" = 1'-0"

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ELKS CLUB RESTORATION

SHEET NAME
SECOND FLOOR ARCHITECTURAL LAYOUT

SHEET NO.
L-3