THE UNIVERSITY OF IOWA | Office of Outreach and Engagement

FINAL DELIVERABLE

Title	North Liberty Showcase Pavilion and Outdoor Venue Engineering & Design
Completed By	John Kopach, Ty Leibold, Zihan Wang
Date Completed	May 2019
UI Department	Civil and Environmental Engineering
Course Name	CEE:4850:0001 Project Design & Management Civil Engineering
Instructor	Richard Fosse
Community Partners	City of North Liberty, Iowa

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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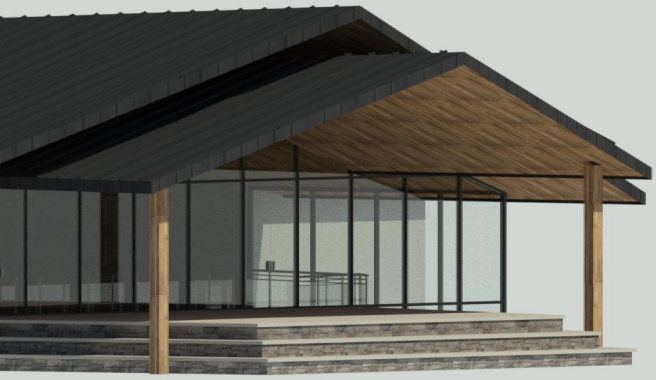
MAY 3, 2019

Final Design Report

CENTENNIAL PARK PAVILION



KOBOLDAN GROUP

NORTH LIBERTY

THE UNIVERSITY OF IOWA | College of Engineering

Designed for Guy Goldsmith and Nick Bergus
of the City of North Liberty, Iowa

KOBOLDAN GROUP • 103 SOUTH CAPITOL ST.
IOWA CITY, IA 52242

Table of Contents

Section I Executive Summary

The City of North Liberty, Iowa expressed it's need for a multi-functional facility to serve the community. Centennial Park has quickly developed into a popular hub for events such as North Liberty Blues and BBQ. This project was developed and designed to enhance these events with the creation of a mid-century modern style enclosed pavilion that features both an indoor and outdoor stage, patio area, and large interior gathering area. Koboldan Group, consisting of University of Iowa Engineering students, have prepared this design report to help North Liberty achieve their goals for this unique addition to their park system.

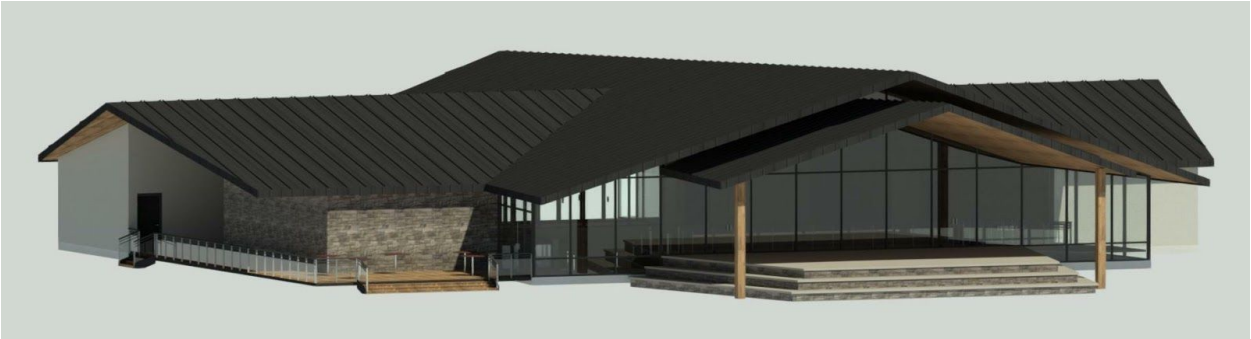


Figure 1. Final Design Rendering

On January 23rd, 2019 Koboldan Group met with representatives from the City of North Liberty to discuss their desires for the design. They expressed the idea of creating a park pavilion that could house events such as weddings, concerts, and community events. A large connected outdoor stage would host their annual Blues and BBQ festival. They indicated that the indoor facility would need to be able to hold up to 400 people, but also be able to serve as a green room for concerts. Koboldan Group then captured these ideas into three alternatives: Compact Design, Abstract Design, and Open Design. Koboldan Group recommended the Open Design because it kept the pavilion and patio area at the same grade creating unique viewing opportunities towards the stage. It also allowed for the opportunity to stage the construction out for future budget purposes. The City chose the Abstract Design for its eye-catching looks and bold materials. As we proceeded with the design we came to appreciate the functionality and appeal of this selection.

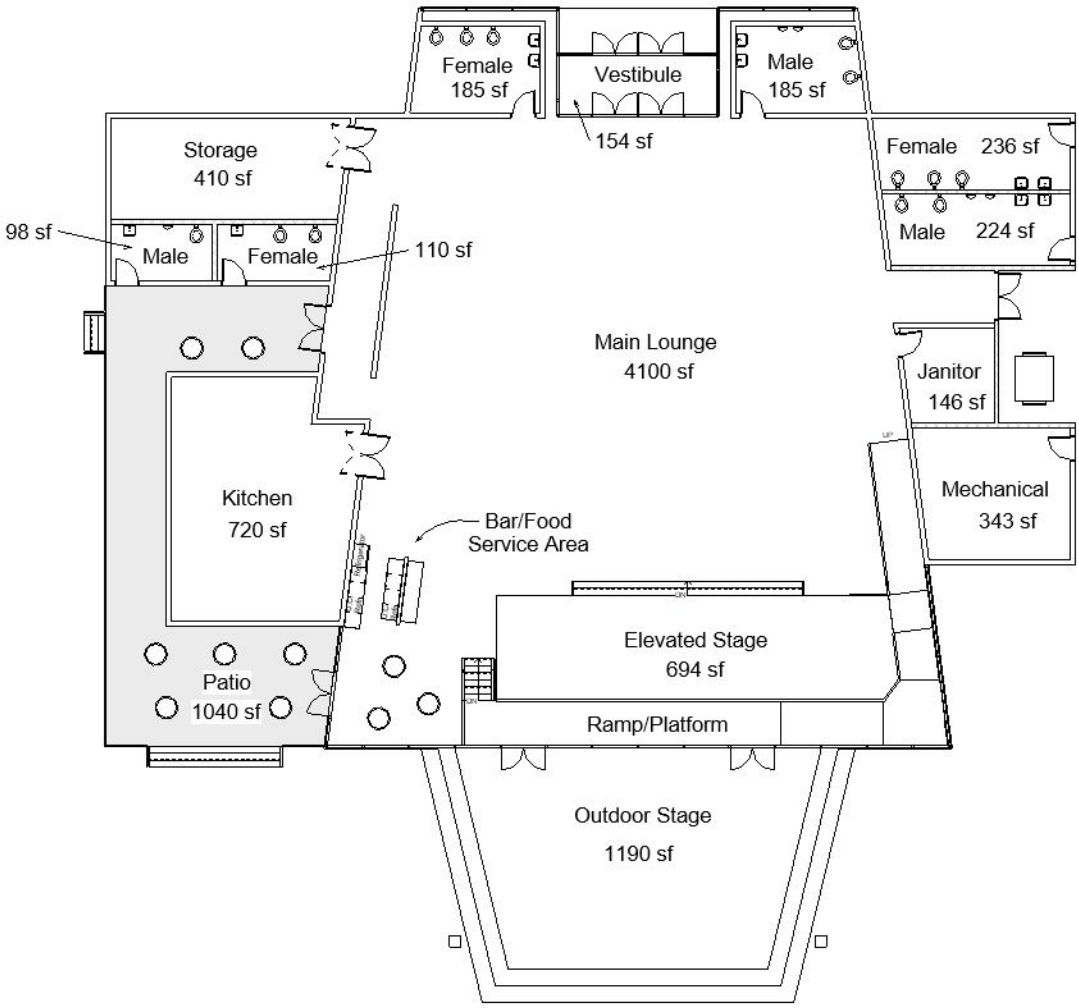


Figure 2. Interior Floor Plan

Koboldan Group then set out designing the floorplan of the facility. The 10,000 square foot building was to include the following features: main lounge, indoor stage, kitchen, storage area, three sets of bathrooms, mechanical and janitor rooms, and an ADA accessible ramp. Outdoor elements included a 1,200 square foot outdoor stage elevated four feet above grade, a patio area, and sidewalk infrastructure connecting the building's site to parking areas developed in phase 1 of the project. The eastern part of the building was designated for equipment services and utilities. The sidewalk was designed to carry a 30 foot single unit truck as well as provide an adequate means of egress. Utilities were designed to trench along this sidewalk to connect to existing lines along St. Andrews Drive, northeast of the project site.

Figure 3. Interior Rendering - Side Stage

Koboldan Group anticipates the cost of the project to be $2.41 million. Costs were broken down into the following categories: building, patio, outdoor stage, paving, and earthwork. Estimates were prepared using square footages and RS Means Data. This will be bid through the public process to a single prime contractor.

There are several important items expected to be field verified before construction ensues. This includes but is not limited to: existing elevation of mainline manholes, bioswale retention capacity, and location of children's rock climbing equipment west of the project site.

Section II Organization Qualifications and Experience

1. **Name of Organization**

   Koboldan Group

2. **Organization Location and Contact Information**

   Team Location: 103 S. Capitol St. Iowa City, IA 52242
   Project Manager: John Kopach
   john-kopach@uiowa.edu
   Cell: (630) 464-9128

3. **Organization and Design Team Description**

   Koboldan Group consists of University of Iowa Civil and Environmental Engineering students as part of a capstone project. John Kopach, focusing in Civil Practice, is the Project Manager. Ty Leibold, focusing in Transportation, serves as Editor. Zihan Wang, focusing in Environmental, provides Technology Support for the group.

Section III Design Services

1. Project Scope

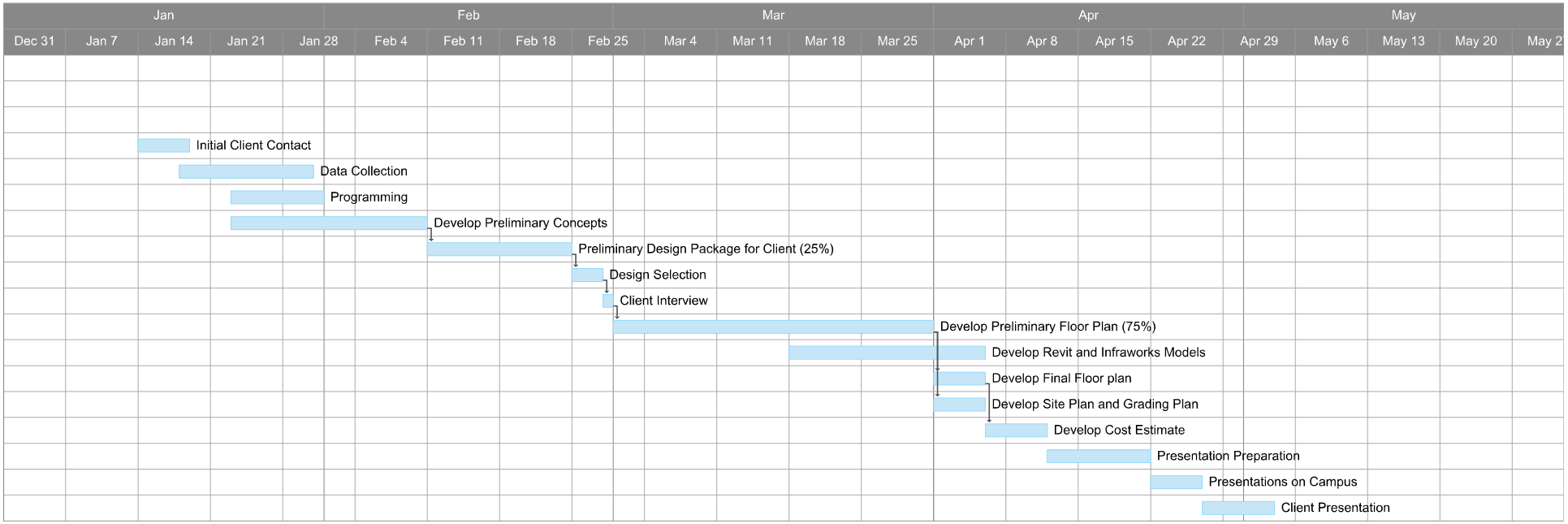
The goal of this project was to design a multi-purpose building capable of holding events such as concerts, weddings, and community meetings. In recent months, Koboldan Group has been coordinating with representatives of the City of North Liberty on key features to be included in the final design. Listed below are the primary elements of the project:

- Enclosed pavilion with catering kitchen
- Indoor and outdoor restroom facilities
- Elevated outdoor performance stage
- Utility services to facility
- Sidewalk for pedestrian use
- Access path for service trucks

Three alternative designs were proposed, each having unique architectural styles and layouts. Option 1 was the Compact Design, Option 2 was the Abstract Design, and Option 3 was the open Design. Upon reviewal of these options, our clients decided on **Option 2 - Abstract Design**. The goal of this option was to provide a more modern, artistic piece for the community. This was achieved by using large glass facades and geometric patterns in the design of the building. Descriptions of the other alternatives can be found in Section V.

The extent of the work done by Koboldan Group does not include field verification or construction. The following list shows the components that have been designed:

- Building floor plan
- Utility service lines
- Proposed site grading
- Interior and exterior design
- Sidewalk and access layouts
- Site runoff analysis



Project Work Plan

Section IV Constraints, Challenges, and Impacts

1. Constraints

Centennial Park has seen quick development in recent years. The design and execution of the project was constrained by working within the boundaries of pre-existing infrastructure, as elements were designed and built in anticipation of our project. This included playground equipment, utilities, and sidewalks. Children's play equipment located in the park east and west of our site limited the amount of glass we could use in those directions due to privacy concerns. All existing utilities ran along St. Andrews Drive north of our project site. Although minor, it is going to force the construction team to bore under concrete pavement three times and work around existing sidewalks raising costs.

2. Challenges

In this design, we encountered a series of challenges. The biggest was dividing the 11,000 square foot inside structure efficiently to support three sets of bathrooms, a large storage space, a patio area, and a indoor and outdoor stage. The client also voiced its concerns with hosting smaller events. We solved this by adding a patio and a bar/food service area to accommodate smaller groups of people, while still having the opportunity to serve large groups. This also helped divide the space into smaller rooms. Also, because of our large stage and pavilion we had to design a sidewalk that doubled as a service entrance to support a large truck and the turning radii it required.

3. Societal Impact

The amphitheater and pavilion will become a hot-spot for residents to spend their leisure time. A well-constructed design will provide North Liberty with concerts, live performances, employment and volunteering opportunities, and a potential source of revenue. This project will also improve the quality and value of the annual Blues and BBQ event held at Centennial Park. Unfortunately, we anticipate that a fair amount spillover may occur from such large events, including noise and parking. Large outdoor concerts will create noise pollution to the neighborhood east of the project site, and it may prove useful to plant broadleaf evergreens along that side of the park to help counteract this. To prevent cars parking in the street and towards the eastern neighborhoods we suggest the use of Grasscrete to create overflow parking along our eastern service entrance which will mesh nicely with the existing landscape.

Section V Alternative Solutions Considered

In the design proposal, three alternative solutions were developed: Compact Design, Abstract Design, and Open Design. The Compact Design was much like our current design in regards to the building layout, but used much more simplistic architecture thus making it the the lowest cost option. It also lacked the ability to hold large audiences. The Open Design featured a standalone stage in the middle of the park that suited both small and large audiences well, but this feature also made it the highest cost option. After contact with our client, the second option, Abstract Design was selected. As the design process began, we started to realize some of the advantages of the attached green room, and the issues created for the performers in the open design. The client was also really drawn to the large glass facades in the Abstract Design which ended up being the deciding factor between the Compact and Abstract Design.

Section VI Final Design Details

The design of project components were all thought out carefully to mesh with the selection of the Abstract Design. The building floor plan takes on the shape of a large trapezoid that widens as people enter, expanding the view of the south side of Centennial Park. The wings that come off either side follow similar geometric designs. Koboldan Group wanted to create a large open space for the public and try to fit necessary rooms into the wings of the building. The roof structure combines all the areas together with a unique sloped, overhanging style. Utility lines were designed for ease of placement and access. Connections to existing infrastructure are located on the northeast corner of the park, and follow along the east parking lot. Centennial Park is a rather flat piece of land, but gradually slopes downhill from the north. The building was designed to be raised slightly above grade to help aid the elevated stage and patio. To complement the mid-century modern architectural style, the materials used for the interior and exterior mostly consisted of metals, stone, and wood. Renderings of the model can be seen below. The surrounding sidewalks were designed to connect the building to existing parking lots and paths. To provide access for service vehicles, the east path was designed for an SU-30 truck. The final design component was the site runoff analysis, which yielded minor additional runoff for the site. The raised structure allows for proper drainage into the existing bioswales surrounding the building.

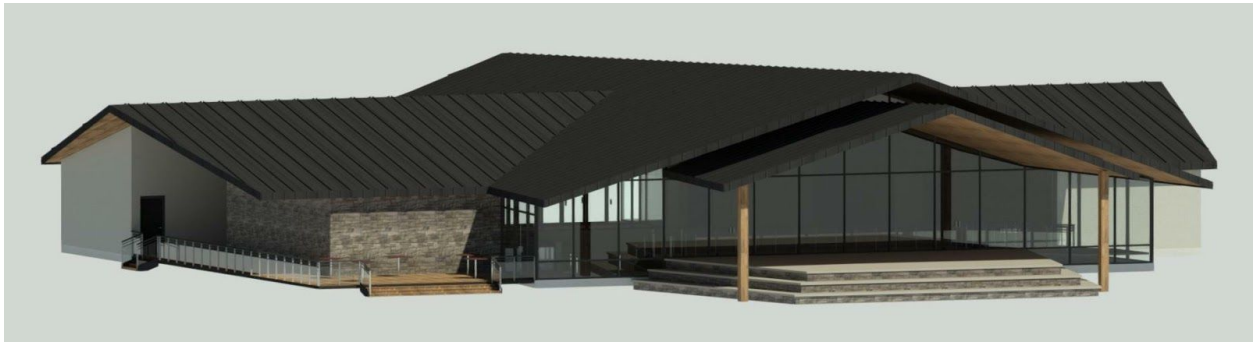


Figure 1. Final Design Rendering

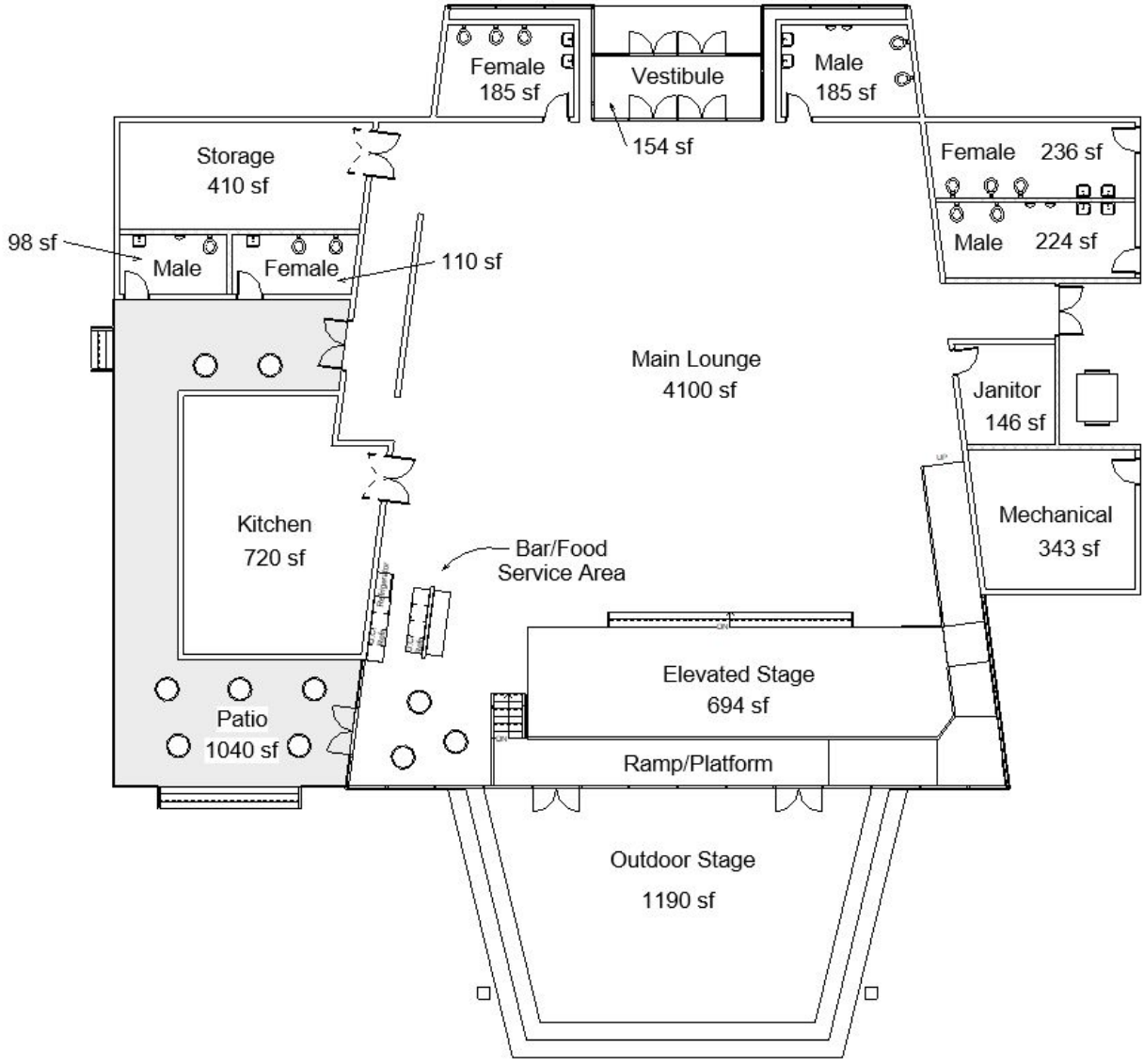


Figure 2. Interior Floor Plan

Figure 3. Interior Rendering - Side Stage

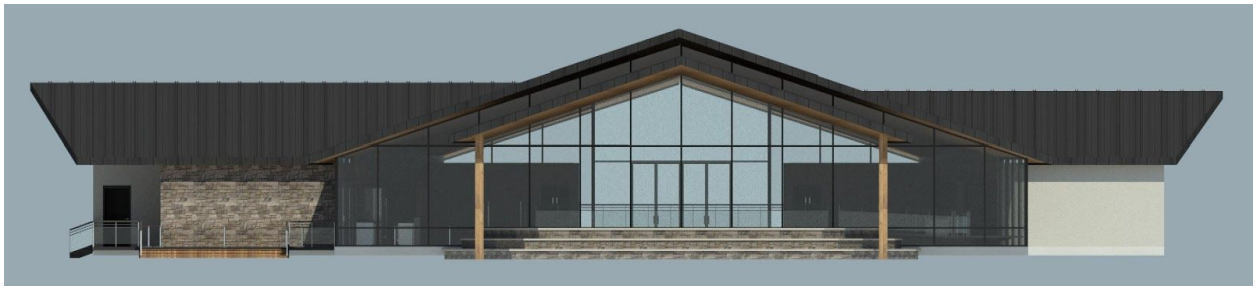


Figure 2. Southern Stage View

Figure 3. Northern Entrance View

Figure 5. Interior Floor Plan Rendering

Figure 7. Interior Looking South

Figure 8. Interior Looking at North Entrance

Figure 9. Interior Looking at East Wall

1. Building and Stage Layout

The building and stage layout was designed to efficiently suit the needs of the City of North Liberty. The City expressed that their primary objective for the pavilion was that it act as a green room for concerts and performances, so a large storage room in the north west corner of the building was included. They also mentioned that their primary access road was to be from the eastern side, along with utilities and their dumpster location. Because of this, a mechanical and janitor's closet was placed the eastern side of the building. In order to hide the dumpster as much as possible, an indentation was featured on the eastern side of the building. A stand-alone wall was placed along the eastern side of the main lounge to be used as a projector area for presentations and community meetings. After delivering a 25% preliminary floor plan with two sets of bathrooms, the City indicated that a third set of bathrooms would prove useful on the western side to serve the children's climbing area, as well a patio for adults to watch their children. This feature, along with the bar/food service area, will allow for smaller groups to gather without feeling overwhelmed by the space. A multilevel ADA accessible ramp was also included to wrap around the back of the indoor stage, which will assist the transportation of stage equipment from the service entrance to the outdoor stage. The indoor stage also

helps integrate the outdoor stage with the main lounge, as the change in grade proved to be visually unappealing. The outdoor stage was designed to a thickness of 3.75 feet made with portland cement concrete and features tiered steps. Two steel columns were placed in the front of the stage to help support the roof structure, as well as mount speakers and support a light bar for large performances.

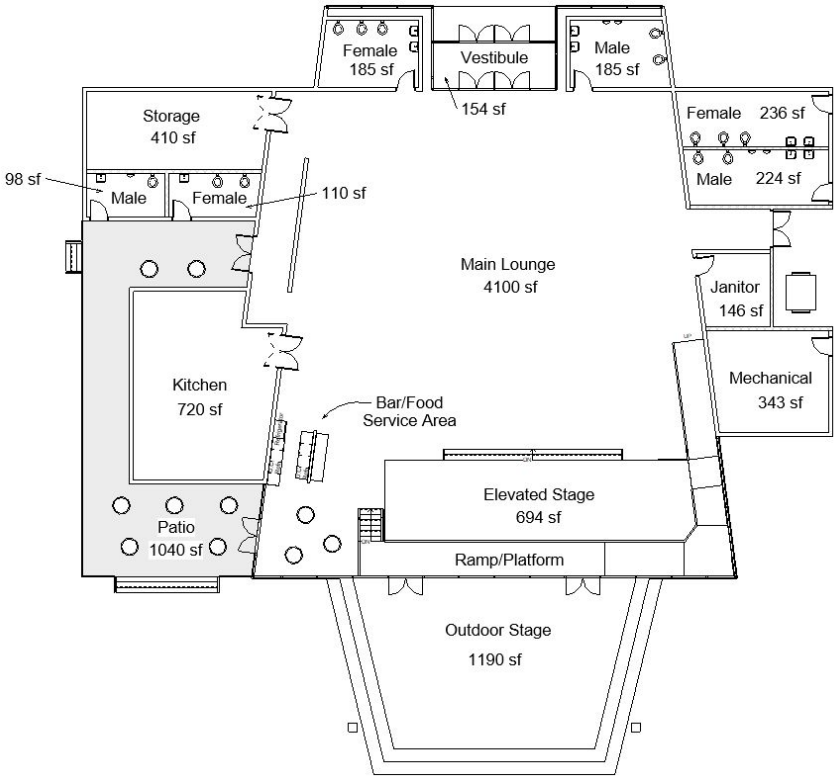


Figure 10. Interior Floor Plan

2. Sanitary Sewer Service

A 1050 foot 6-inch PVC sanitary sewer service line is to be installed to connect our proposed pavilion to the gravity sewer main along St. Andrews Drive, which can be seen in the proposed site plan. The sanitary line shall be installed at a 1 percent slope which requires 10.5 feet of fall from the building site. These parameters equate to a velocity of 2.86 ft/s as can be seen in Appendix A. This will satisfy the minimum 2 ft/s self cleaning velocity which Section 3C-1 of the Iowa SUDAS design manual requires . A field engineer will need to verify that the existing sanitary manhole along the sewer main is deep enough to allow for this. If not, the utility path shall be redesigned to take a more direct approach to the manhole which will require less fall. The construction inspector shall refer to Figure 4010.201 of the Iowa SUDAS specifications manual for more details regarding placement of the service line.

3. Stormwater Analysis

An additional 1.11 cubic feet per second of runoff is anticipated from developing the site. This was calculated using the rational flow method in the Hydraflow Express extension for Autodesk. This produced hydrographs and expected runoff volumes for corresponding critical times, and can be seen in Appendix A. The additional runoff will be collected in the existing bioswales as can be seen in the proposed site plan. We plan to verify with the designer of the bioswale that it was designed with enough capacity for the proposed pavilion.

4. Sidewalk and Access Road Design

Surrounding sidewalks are to be constructed as 6" PCC, built at-grade with a cut/fill slope of 4:1. The north and west walkways are 8' planar slabs designed solely for pedestrian use. The perimeter walkway surrounding the building follows the same design. The access road connecting the east parking lot to the east wing of the building was designed in accordance with the Iowa DOT Design Manual. Layouts were constructed using an SU-30 design vehicle, with minimum turning radius of 38 ft. Section 6A-2 provided the design vehicle standards. The main stretch of the access road is a 16' wide, 7" PCC slab on a 4" aggregate base with 2% slope off the crown. The transitions at the east and west ends widen for truck access, but follow the same cross-section parameters. Due to limited room and placement of the building, pavement may be placed over existing bioswale ditches, which would require additional costs.

Section VII Engineer's Cost Estimate

Feature		Sub-total Cost
Building		$1,480,500.00
Patio		$13,100.00
Outdoor Stage		$201,500.00
Paving		$141,500.00
Earthwork		
	Sidewalks	$11,300.00
	Bldg. Footprint	$5,850.00
Total		$1,853,750.00
10% Contingency		$185,375.00
20% Engineering and Administration		$370,750.00
Total Project Cost		**$2,409,875.00**

Cost data obtained from RS Means 2018 reference guides.

Appendix A. Design Calculations

1. Sanitary Sewer Service Line

L = 1050 ft (measured in Civil3D)
S = 1 % (minimum for 6” service lines according to Iowa SUDAS Section 4010)
Fall = 1050 * .01 = 10.5 feet

diameter = 6 in
n = 0.013
S = 1 %
fraction flowing = 0.5

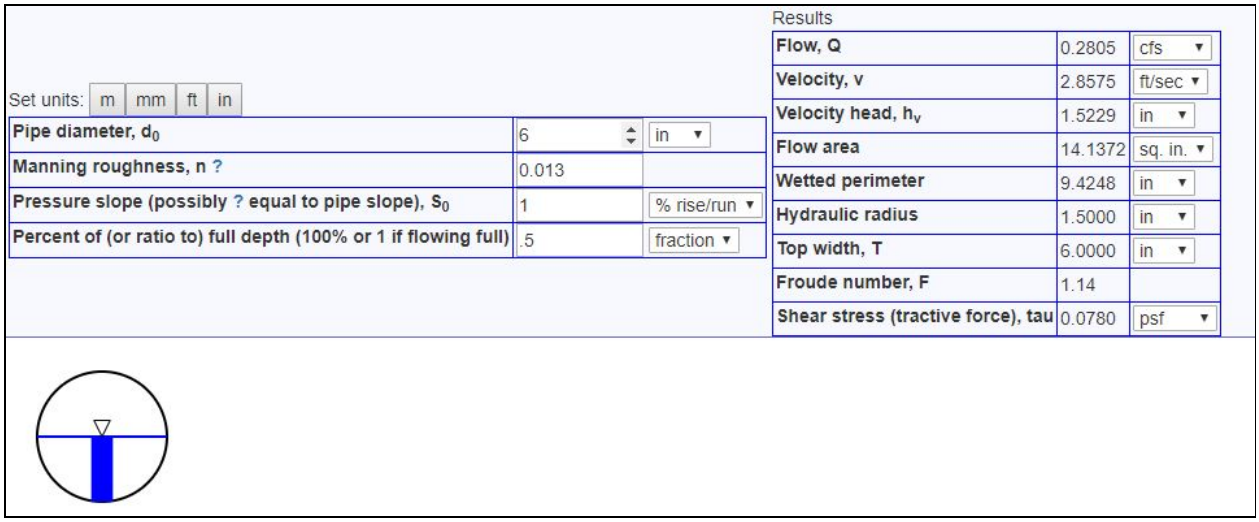


Figure 1. Manning’s Equation calculator displaying expected sewer velocity

V = 2.8575 ft/sec
Q = 0.2895 cfs

Self Cleaning Velocity (required) = 2 ft/s (minimum according to Iowa SUDAS Section 3C-1)

2. Storm Sewer Analysis (Hydraflow Express extension in Civil3D)

(Before Sitework)

Hydrology Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Apr 10 2019

Koboldan Group

Hydrograph type	= Rational	Peak discharge (cfs)	= 0.296
Storm frequency (yrs)	= 2	Time interval (min)	= 1
Drainage area (ac)	= 0.260	Runoff coeff. (C)	= 0.2
Rainfall Inten (in/hr)	= 5.693	Tc by User (min)	= 5
IDF Curve	= SampleExpress.IDF	Rec limb factor	= 1.00

Hydrograph Volume = 89 (cuft); 0.002 (acft)

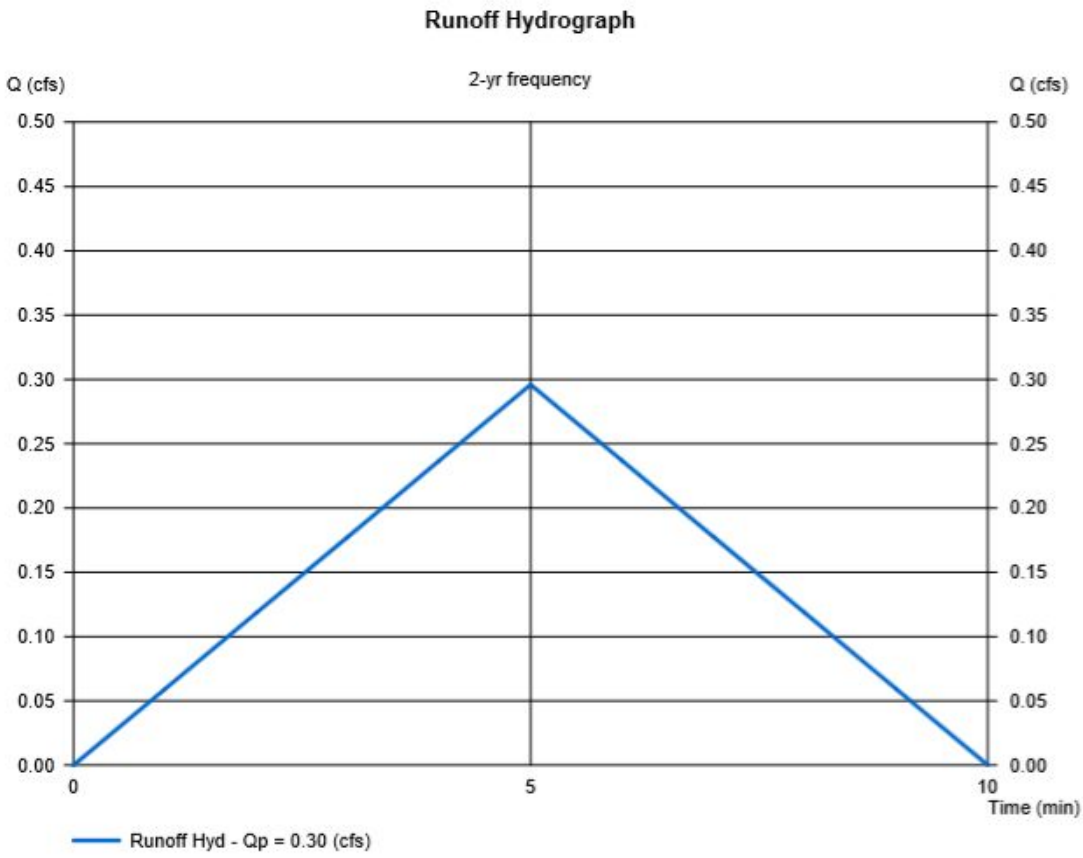


Figure 2. Hydrograph displaying site runoff before development

(After Sitework)

Hydrology Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Apr 10 2019

Koboldan Group

Hydrograph type	= Rational	Peak discharge (cfs)	= 1.406
Storm frequency (yrs)	= 2	Time interval (min)	= 1
Drainage area (ac)	= 0.260	Runoff coeff. (C)	= 0.95
Rainfall Inten (in/hr)	= 5.693	Tc by User (min)	= 5
IDF Curve	= SampleExpress.IDF	Rec limb factor	= 1.00

Hydrograph Volume = 422 (cuft); 0.010 (acft)

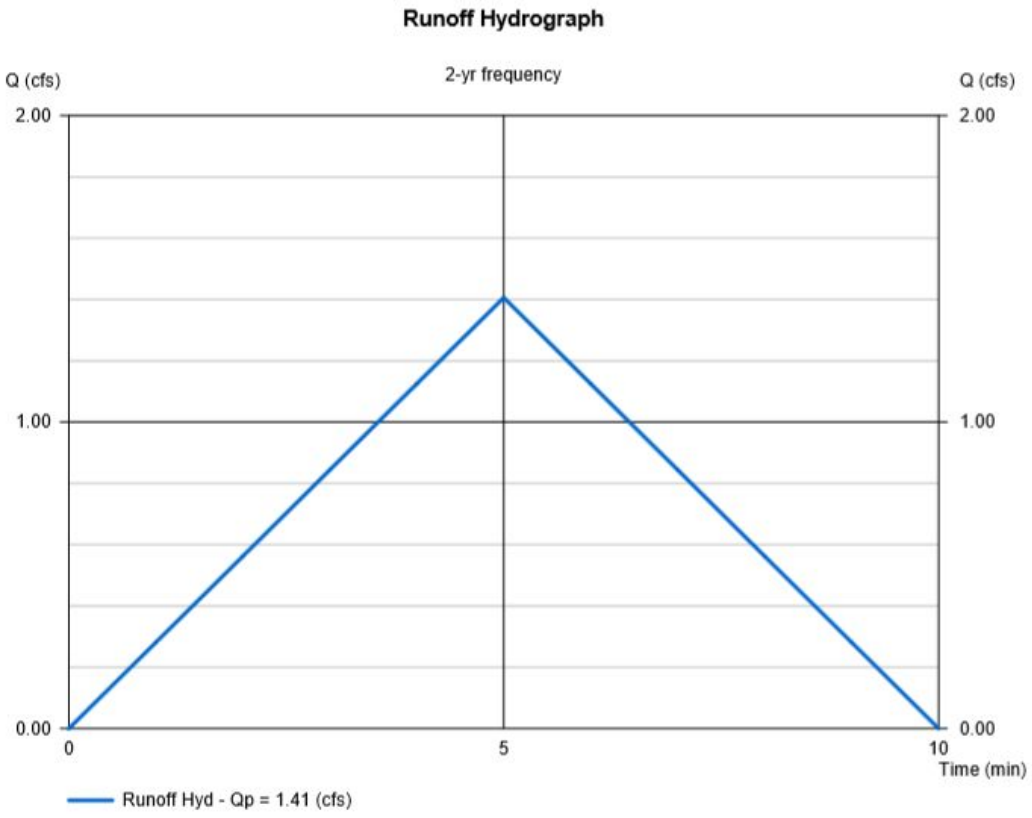


Figure 3. Hydrograph displaying site runoff after development

Calculated T_c of 3 min on TR-55 feature, but according to Section 4A-5 of the Iowa DOT Design Manual the minimum T_c to be used is 5 minutes. The runoff coefficient was found using Table 2B-4.01 in Section 2B-4 in Iowa SUDAS manual, soil group B and a 10 year return period were assumed.

3. Sidewalk Analysis

Cut/Fill Report

Generated: 2019-04-12 13:54:00

By user: jkopach

Drawing: \\iowa.uiowa.edu\shared\engineering\home\jkopach\windowsdata\Desktop\Senior Design Models\\\iowa.uiowa.edu\shared\engineering\home\jkopach\windowsdata\Desktop\Senior Design Models\New Paving Plan.dwg

Volume Summary

Name	Type	Cut Factor	Fill Factor	2d Area (Sq. Ft.)	Cut (Cu. Yd.)	Fill (Cu. Yd.)	Net (Cu. Yd.)
cut fill	full	1.00	1.00	36745.29	117.18	96.20	20.98<Cut>

Totals

	2d Area (Sq. Ft.)	Cut (Cu. Yd.)	Fill (Cu. Yd.)	Net (Cu. Yd.)
Total	36745.29	117.18	96.20	20.98<Cut>

* Value adjusted by cut or fill factor other than 1.0

Figure 4. Cut/Fill Report for Sidewalk and Access Road

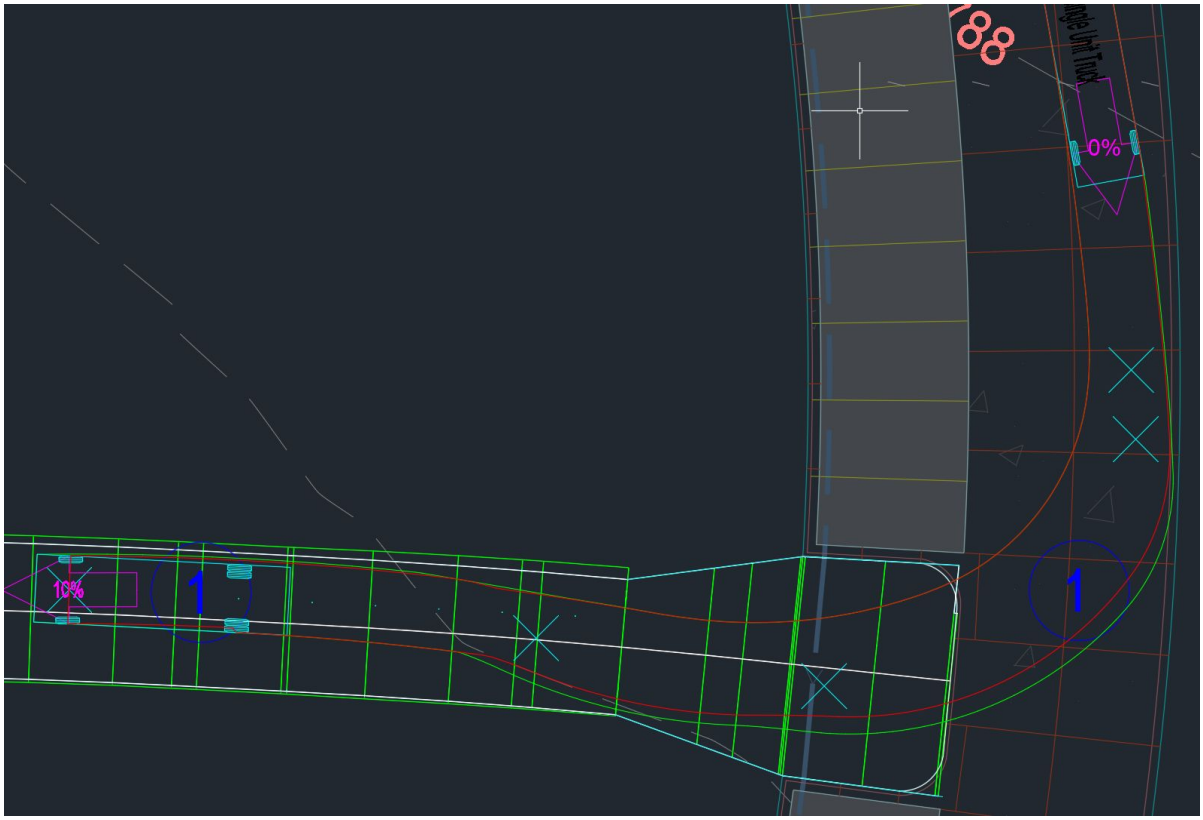


Figure 5. E Access Road SU-30 Entry

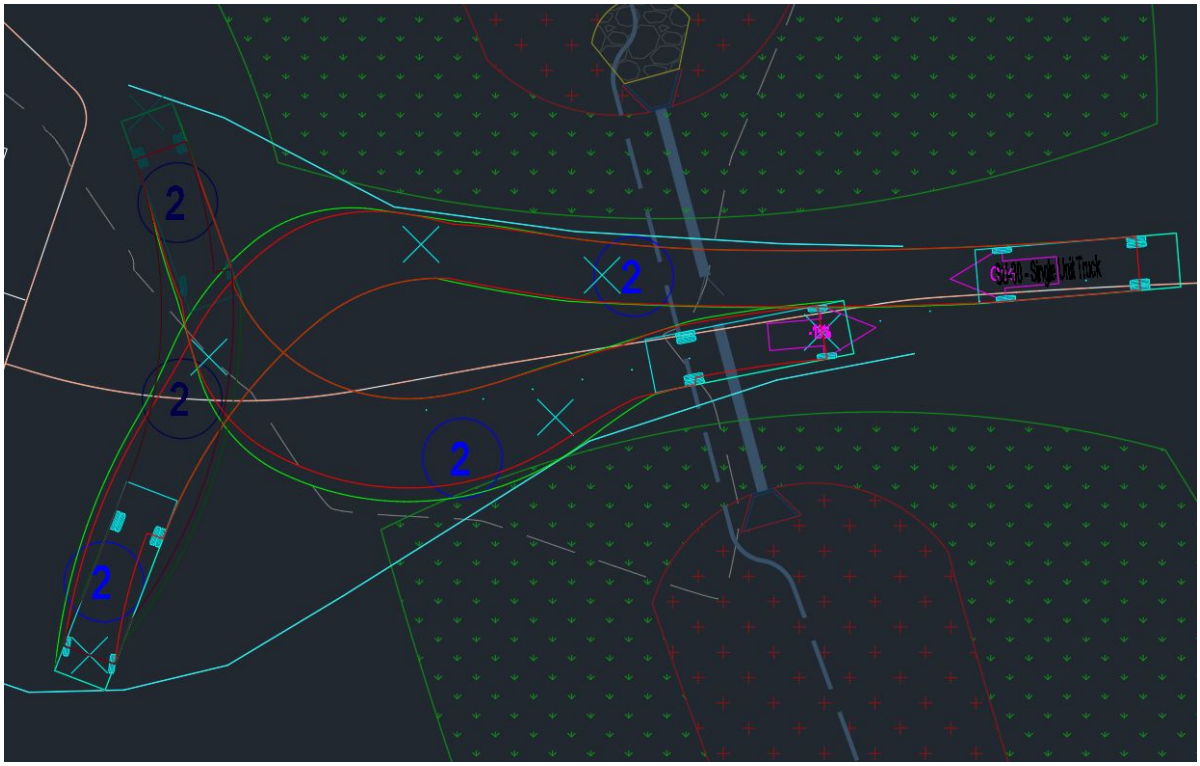


Figure 6. East Wall Service Area SU-30 Entry and Exit

Appendix B. Cost Estimate Breakdown

Building Area	9825	SF
Building Perimeter	505	LF
Stories	1	EA
Location Factor	0.93	Cedar Rapids

Costs per Square Foot of Floor Area

	SF Area	**10000**	**12000**
Exterior Wall	**LF Perimeter**	**453**	**460**
	Bearing Walls	$153.00	$146.90
Face Brick and Concrete Block	Rigid Steel	$156.10	$150.05
Perimeter Adj. Add or Deduct	Per 100 LF	$8.35	$6.90

Interpolated Perimeter (LF)	452.39
Interpolated Cost per SF	$153.53
Interpolated Perimeter Adj. Cost	$8.48
Total Cost per SF	$162.01
Total Building Cost	**$1,480,331.58**

	Cost per SF	**% of Sub-total**
Substructure	$18.79	11.60%
Shell		
Superstructure	$11.99	7.40%
Exterior Enclosure	$27.06	16.70%
Roofing	$10.69	6.60%
Interior	$33.37	20.60%
Services		
Plumbing	$21.71	13.40%
HVAC	$16.69	10.30%
Fire Protection	$5.35	3.30%
Electrical	$13.12	8.10%
Equipment/Furnishings	$3.24	2.00%
Total Cost per SF	$162.01	
Total Building Cost	**$1,480,331.58**	

	Cost per Unit	Total Unit	Cost
Patio			
Decking SF	$7.30	1050	$7,665.00
Joists LF	$1.89	681	$1,287.09
Posts LF	$4.70	72	$338.40
Girder LF	$4.33	210	$909.30
Accesories	$2.74	1050	$2,877.00
Total Patio Cost			**$13,076.79**

	Cost per Unit	Total Unit	Cost
Stage			
Concrete CY	$1,043.00	193.1111111	$201,414.89
Total Stage Cost			**$201,414.89**

	Length LF	Width LF	Area SF	Cost per SF	Cost
Paving					
W Walk	383	8	3064	$7.00	$21,448.00
N Walk	210	8	1680	$7.00	$11,760.00
Surrounding	538	8	4304	$7.00	$30,128.00
Access Area (Pave)		11180	11180	$7.00	$78,260.00
Total Paving Cost					**$141,596.00**

	Cut (cu. yd)	Fill (cu. yd)	Cut Cost	Fill Cost	Total
Earthwork					
Sidewalks	117.18	96.2	$7.20	$7.20	$11,324.56
Bldg. Footprint	46.57	124.27	$7.20	$7.20	$5,839.09
Total Earthwork Cost					**$17,163.65**

Appendix C. Bibliography

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