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SIDNEY PARK EXPANSION

Prepared by Colin Cothern, Olivia Fletcher, Dillon Moore, and Emerson Peaslee

College of Engineering, University of Iowa

May 2023

Section I Executive Summary

This report is a summary of designs for the Sidney Park Expansion project in Sidney, Iowa, prepared by a team of senior Civil and Environmental Engineering students at the University of Iowa. Our team is comprised of Emerson Peaslee (project manager), who oversaw the environmental/water resource design; Olivia Fletcher, who oversaw the site development design; Dillon Moore, who oversaw the structural design; and Colin Cothern, who oversaw the civil design. All members of the team graduated from the University of Iowa in spring of 2023.

This project will expand the park at the intersection of Fillmore Street and Illinois Street in Sidney, IA. It includes several features, including a multipurpose court that can be used for basketball and pickleball and a restroom facility with two single-user restrooms and bike racks. The pre- and post-construction stormwater runoff flows were calculated, and a rain garden was designed to capture excess stormwater flow that will occur because of the construction. A trail system connecting the park to Sidney's elementary school and high school football field was designed. An option for a future swing set was also conceived.

Several constraints and challenges were taken into consideration, including the size of the park. The lot is approximately 0.43 acres and is used for different purposes. The addition of a full basketball/pickleball court will take up much of the existing space, but green space must be conserved in order to allow for Sidney's movies in the park. The City of Sidney did not have a set budget, however it is a small community, so it was important to manage costs while designing the park expansion. Adjacent to the site is a gazebo that was recently constructed by the City of Sidney. This area used to house a gas station that contaminated the soil. It does not appear that the soil on the park site is contaminated, however, copper piping will be used in the park expansion's restroom facilities to ensure that no contamination occurs. The site is also next to the fire station, so the parking spaces had to be designed in such a way that would not disrupt this facility.

The Sidney Park Expansion project is expected to have a positive impact on the surrounding community. Sidney is a small town with a population of 1,063 people (U.S. Census Bureau, 2020). Every year it hosts the Sidney Iowa Rodeo and the annual Christmas Window Walk, which attract nearly 40,000 and 600 people respectively. Both events would be positively affected by the park expansion, which would increase parking and public restroom availability. The addition of a multi-use court will encourage healthy behaviors and increase accessibility to the outdoors. It will provide a safe space for children to play, which is desired by the community. It is expected that the park will be funded by grants to keep taxpayer funding to a minimum. It will likely increase the values of the houses in the surrounding area (Caston, 2012).

Several alternatives were considered for the court design of the court. Three different surfaces were considered for the multi-use court, including concrete, asphalt, and a synthetic material. Ultimately, a synthetic material was selected to be placed on a concrete pad. A green roof was considered for the bathroom; however, a traditional shingled roof was chosen for aesthetic and financial reasons. Several parking design options were considered, and the most functional of these was selected: six 45°

angled parking spots along Indiana St. The street parking cuts into the land area on the east side of the park, reducing the area of the park's greenspace.

A regulation basketball court was designed with a removable pickleball net. The court has dimensions of 50-feet in width and 100-feet in length. The court is backed with a 4-foot retaining wall and a tall fence around the perimeter. A 5-foot walkway space was added along the court for visitors to sit and watch the games.

The 17'0 ¾"x 26'0 ¼" building was designed to allow ADA access to the two restrooms and an extra area for site storage and utilities. The restrooms and utility room are dimensioned to be 7.5'x7.5' to allow the ADA compliance. The water closets and sinks were designed to be on non-exterior walls to ensure the water lines would be protected against freezing. The restroom facilities can be shut down when the court is not being used. It is suggested that they are closed during the months of November-March. The facility sits on top of an 18-inch concrete continuous footing that is 9-inches thick with steel reinforcement. There is a wooden truss that follows a mono design with a 3 on 12 pitch and is manufactured by Menards.

Additional parking spaces were designed and implemented into the park. Six parking spaces were added to the east side of the site along Indiana Street. A 0.5 feet wide curb was added to the lot to prevent vehicles from hitting the multipurpose court when parking. The parking lot was designed so that pavement slopes do not exceed 5%. The lot slopes slightly downward toward the street which will allow stormwater runoff to drain into the water intakes on Indiana Street. The 45° angled parking stalls have dimensions of 9-feet in width and 18-feet in length.

A trail was designed that can be used for future use. The trail connects the park to Sidney Elementary School and the Sidney Cowboy's Football Field. The trail has a surface area of 2,669-square feet, a pavement thickness of 6-inches, and a sidewalk width of 5-feet. The trail was designed so that pavement slopes do not exceed 5%.

Excess runoff from the site due to construction was estimated to be a maximum of

7,100 gallons for typical storm events using the NRCS method. A 30-foot by 30-foot rain garden was designed to capture the majority of this runoff, and help it to percolate into the ground. The garden will have a ponding depth of 12” allowing it to store approximately 6,732 gallons of water. The garden will feature a variety of native plant species with long roots that will be able to increase drainage.

A cost estimate was completed for each of the design elements for this project using RSMeans cost data for total material and labor cost along with Iowa DOT bid prices. The project was broken up into 3 phases with the first being site design, the multi-purpose court, and the rain garden for a total construction cost of $140,100. The second phase is the restroom and storage area with a total construction cost of $33,900. The third phase is the future trail and swing set with a total construction cost of $25,700. The final cost comes to roughly $280,000, which includes a 20% contingency fee for any costs that may arise and a 20% engineering and administration cost for overhead and profit.

Section II Organization Qualifications and Experience

1. Organization and Design Team Description

We are an engineering team comprised of University of Iowa students Emerson Peaslee, Olivia Fletcher, Dillon Moore, and Colin Cothern.

Emerson Peaslee served as the project manager for this team. She is majoring in environmental engineering and specializing in environmental planning and public health. She led the environmental/water resource design. Olivia Fletcher is majoring in civil engineering with an environmental focus. She will lead the site development design. Dillon Moore is majoring in civil engineering with a general practice focus. He will be leading the structural design. Colin Cothern will be leading the civil design. He is majoring in civil engineering with a general practice focus.

Section III Design Services

1. Project Scope

This project will expand the park located at the intersection of Fillmore Street and Illinois Street in Sidney, IA. A court that can be used for basketball and pickleball was designed. A restroom facility was designed with two single user restrooms. There are bike racks attached to the restroom facility for bicycle parking. The pre- and post-construction stormwater runoff flows were calculated, and a rain garden was designed to capture excess stormwater flow that will occur because of the construction. A trail system that connects the park to Sidney's elementary school as well as Sidney's high school football field was designed. The option of a swing set for future construction was also conceived.

Currently, movies are shown in the greenspace on the west side of the park. The existing road between the park and the post office and gazebo is used for parking for the post office, The gravel drive through the east side of the park and the rest of the lot is used for parking during football games and other community events.

2. Work Plan

The Spring 2023 semester was 16 weeks long, and the team was given about 12 weeks for design. The team started with preliminary research in their focus area. Next, preliminary designs for the project, including the restroom facilities, the multi-use court, and the trails, were started. Next, designs were finalized, and drainage calculations were performed. Renderings were completed last. The entire schedule can be seen in the Gantt Chart in Appendix A-1.

Section IV Constraints, Challenges and Impacts

1. Constraints

The Sidney Park expansion project has several constraints. The most challenging of these is the size of the park. The lot is approximately 0.43 acres and is used for several different purposes. The addition of a full basketball/pickleball court will take up much of the existing space, but green space must be conserved to allow space for summer movies in the park. The City of Sidney did not have a set budget, but the design team was conservative with costs. Additionally, Sidney does not have a robust stormwater management system, so it was important to reduce the amount of water running off the site as a result of the addition of impervious surfaces. Aesthetically, the City like to see the restroom facilities match the existing gazebo on the site. They would also like the court to display the town colors of red and white.

2. Challenges

Sidney Park is small with very limited space to add new elements while retaining open, green space in the park. The client wishes to include additional parking for both cars and bikes. With a restricted amount of land with which to work, there are only a few practical locations to add parking spots without impeding the fire department across the street. Additionally, work crews cannot block the fire department during construction of the park's new features.

Adjacent to the site is a gazebo that was recently constructed by the City of Sidney. This area used to house a gas station that contaminated the soil. It does not appear that the soil on the park site is contaminated, however, copper piping will be used in the park expansion's restroom facilities to be cautious. The northeast corner of the park is rather steep, which could be an issue for bike riders if the sidewalk path is placed there. Dirt will need to be excavated to create a gentler slope for people pedestrians and cyclists. Dirt will also need to be excavated on the court and retaining wall.

3. Societal Impact within the Community and/or State of Iowa

Population Characteristics

Sidney, Iowa, is a small town located in the southwestern portion of the state. It is the seat of Fremont County. According to the 2020 U.S. census, the population is 1,063 people. The population of Sidney is mildly decreasing at a rate of approximately 5 people per year. The town is 97% white (U.S. Census Bureau, 2020).

Sidney has several events that attract tourists to the city, the largest of which is the annual summer rodeo. Considered the world's largest continuous outdoor rodeo, nearly 40,000 people attend every year (Sidney Iowa Rodeo). The town also hosts the annual Christmas Window Walk, which has attracted as many as 600 people in recent years. Additionally, movies are held in the park that is being developed throughout the summer season. New features in the park will provide improvements for visitors to all of these events events, notably restrooms and parking.

Community and Institutional Structure

The town of Sidney does not have a long history of industry. There is a small downtown area with several businesses including a restaurant and photography studio. Many Sidney residents are employed by the government, schools, and other city-owned entities, including the police and fire departments.

Individual and Family Changes

Across the U.S., more cities are putting in pickleball courts. In the last year, more than 36 million people played pickleball, a large increase from the 5 million people that played the year before (Golden, 2023). Both pickleball and basketball are sports that can be enjoyed by people of all ages.

The park being redeveloped is at the geographic center of Sidney, just a short walk from the elementary school, high school, library, and post office. Installing a multi-use court will encourage healthy behavior and foster a sense of community. Families would like to see a place where they feel comfortable sending their children without direct supervision, and the centrality of the park will allow that. Safety is a factor that will need to be considered, as there are cars that drive past the park.

Personal and Property Rights

The City of Sidney plans to apply for grants to fund the park's construction to keep taxpayer contribution at a minimum. The parcel is owned by the city, so no one will be affected by the purchasing of the lot. In fact, Sidney residents will likely see an increase in housing values. Typically, the construction of a park increases the value of houses in the area by 8-20% (Caston, 2012). The current median income for each household is $36,375 (U.S. Census Bureau, 2020).

Community Resources

Sidney has its own fire and police department. Since it is the chair of Fremont County, it also houses the county sheriff. The city owns several houses that are unable to be sold due to their poor condition. Culturally significant sites include a museum, the public library, and the rodeo grounds.

Sustainable Practices

The site was designed to direct water toward a rain garden, which will reduce peak flows and stormwater runoff from the site. The City of Sidney does not have an expansive stormwater management system, so this will prevent significant amounts of water from flowing over the road, which could erode them and shorten their life expectancy. This will also save on costs in the long term and ensure that water flowing offsite to the surrounding houses and buildings is minimized.

Section V Alternative Solutions That Were Considered

Multi-purpose court

Several different alternatives were considered for the court's size and location, including along the north property line and non-regulation sizes. Ultimately, the client requested a regulation court along Illinois Street regardless of methods for placement. Three options were considered for the court's surface: concrete, asphalt, and a synthetic material. A synthetic material was chosen because it will result in a better playing surface for athletes and will not get as hot as other alternatives. Asphalt and a plain concrete pad would be slightly less expensive; however, the synthetic material will allow play even when there is water on the court that would otherwise render it unplayable. It also will allow water to drain from the court at the same time. This surface is absorbent and will prevent injuries when people fall during play. Lastly, unlike asphalt, this can be designed to reduce the heat absorbed by the court helping the area to stay cooler during the summer.

Storage Area

Two storage options for the pickleball net and extra activities for the site were considered. The storage area will be located inside the restroom facility so that the net is stored onsite. The first option was to mirror the dimensions of the restrooms and the utility closet to keep the building modular and adaptable in case more restrooms were needed. This backroom would be used for storage and would be accessible using some form of keypad door lock. An alternative was to create a separate storage locker that would be its own building. The first option was selected due to the size and convenience of having it connected with the restroom facility.

Restroom

For the restroom, two different types of roofs were considered. The first is a traditional shingled roof, and the second is a green roof. Ultimately, a traditional shingled roof was chosen. A green roof would be more expensive and harder to maintain than a shingled roof. Additionally, the City of Sidney would like to see the restroom match the existing gazebo aesthetically, including the roof. The amount of stormwater leaving the site during a typical rain event would not be enough to justify a green roof. Instead, a rain garden will help manage the increase in water volumes from the site.

Trail

A trail was designed to connect Sidney Park to the rest of the town. A trail that connects the park to the Sidney Iowa Rodeo was considered but not chosen because of how far away the rodeo is from the site. A trail was designed to connect to the elementary school located northwest of the park, and the football field located northeast of the park.

Parking

The City of Sidney requested that parking be added during the park expansion. Two options were considered for the location of parking spaces. The first option was to put parking on the site along Indiana Street, and the second was to put parking on the service road between the park and the post office. The second option was chosen, and six parking spaces were added to the east end of the park along Indiana Street. Forty-five-degree parking spaces were selected for the lot. These additional parking spaces will not interfere with the fire department across the street from the park.

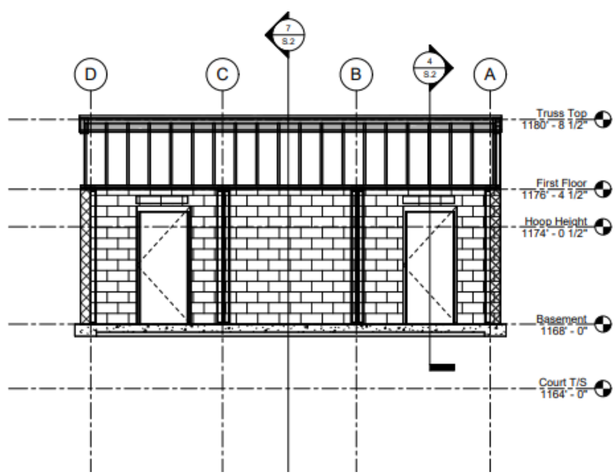
Future expansion

There is a space between the restroom and the rain garden that could be utilized without detracting from the green space where movies are held. Several alternatives for this were considered, including picnic benches and/or park benches and playground equipment. It was decided that it would be best to have playground equipment so that younger children could play while their parents or older siblings use the pickleball or basketball courts. A swing set was chosen because of its ability to be handicap accessible and be utilized by children and adults of all ages.

Section VI Final Design Details

Restroom Facilities

For the restroom and storage area, the constraining dimensions were to have the area be ADA accessible—a 5-foot radius to allow someone to complete a full turn. This was then upsized to a 7.5-foot by 7.5-foot room size for the two stalls, and a third room that will serve as the utility room between the stalls. Using a standard size of a 7-foot doorway and a 3-foot width and an 8-foot tall ceiling maintaining the minimum dimensions from the International Building Code 2022 constrained the rest of the building dimensions. This was to maintain the standard dimensions for the door and ceiling that are used in common practice. For the interior partition, two stud walls are to be placed 16” on center with ½" OSB on either side on each of the walls leaving a ½" gap for insulation. These walls have a built-up beam on top of the assembly to provide proper bearing support from the trusses above as this is a style of partition wall that will behave as a bearing wall allowing for an increased loading. A utility closet containing heating and plumbing along with other utilities is between the two restrooms. The overall dimensions are 17’0 ¾” by 26’0 ¼"



The truss was designed from a mono-slope design. The spacing is 2’ on center with a 3 on 12 pitch and is designed for a top chord live load of 30 psf, a top chord dead load of 7 psf, and a bottom chord dead load of 10 psf.

A continuous footing was designed and was found to have dimensions less than the minimum standards as the loading calculated for the structure were lower than the typical structure that would be designed for this being a low occupancy restroom and storage area rather than a housing unit, so the standards were used for the sizing of the footing and the reinforcing rebar as a default to ensure the compliance of the structure and safety of the public.

Multi-use Court

The concrete slab that the multiuse court will be placed on was designed using concrete slab on grade to ensure the slab did not need steel reinforcement to handle the designed loading. As the sizing of the slab would need to be at a minimum of 6-inches regardless of reinforcement as per the standard, and again 6-inches when the concrete reduction calculations were done it also was 6-inches thick for an oversized loading of an ambulance on the slab modeled by a 25 kip loading with the reinforcement. It was determined that the slab would perform as needed without the extra cost of steel reinforcement. The specified synthetic material will not only provide enough friction when it's wet but also can facilitate drainage from the court. This material will have an allowed deflection within the material so that there are fewer injuries if there is a fall while in use. The rendering for the multi-use court can be found in Appendix E-2.

Trail

A trail was designed using AutoCAD Civil 3D that can be implemented into the town and used for future use. The trail starts at Sidney Elementary School, runs south to connect with the park, then runs east to connect to Sidney Cowboy's Football Field. The trail has a surface area of 2,669-square feet and a pavement thickness of 6-inches. SUDAS specifies in section 12A-2 that pavement slopes must not exceed 5%. This standard is used for the trail and the sidewalks within the park. SUDAS also specifies in section 12A-2 that the width of a standard sidewalk must be at least 5-feet wide. This specification was used for the sidewalk that runs through the park, as well as the trail. A drawing of the trail layout can be found in Appendix D-2. The horizontal alignment and plan profile drawings can be found in Appendix D-6.

Parking

Additional parking spaces were designed using AutoCAD Civil 3D. This will allow visitors to have a place to park if they choose to drive their vehicle. Six parking spaces were added to the east side of the site along Indiana Street. A 0.5 feet wide curb was added to the lot to prevent vehicles from hitting the multipurpose court when parking.

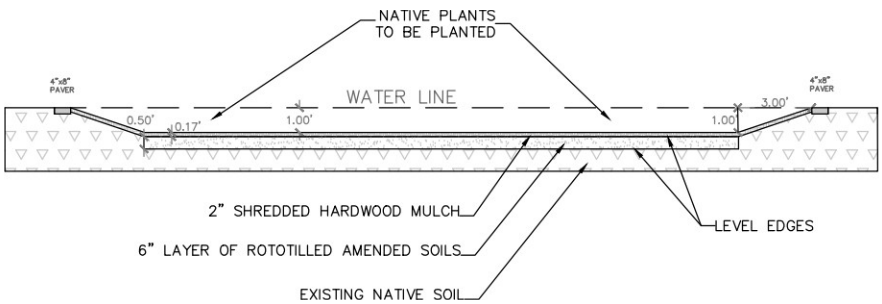
The north end of the parking lot has a curb radius of 10-feet and the south end of the parking lot has a curb radius of 4.5-feet. The radius on both the north and south ends are in compliance with SUDAS standards and allow for vehicles to turn into the parking spaces with ease. SUDAS specifies in section 8B-1 that pavement slopes must not exceed 5%. This standard was used for stalls in the parking lot. The lot slopes slightly downward toward the street to allow stormwater runoff to drain into the water intakes on Indiana Street. SUDAS also specifies that the dimensions for 45° angled parking spaces must be at least 9-feet in width and 18-feet in length. Table 8B-1.02 and Figure 8B-1.01 support these standards and can be found in Appendix B-4 and B-5. The drawing of the site layout can be found in Appendix D-1. The drawings for the existing ground grading plan and the proposed ground grading plan can be found in Appendix D-3.

Stormwater Management and Rain Garden

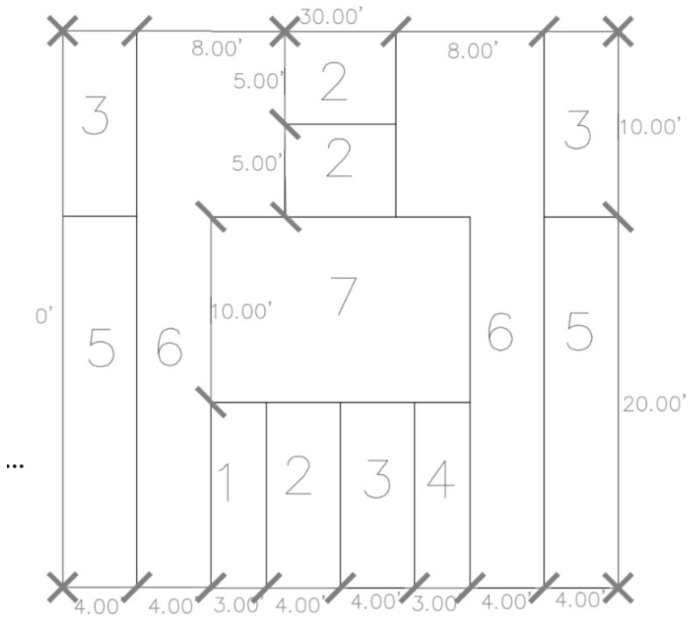
To calculate the stormwater flows leaving the site before and after construction, the NRCS method was used. This method was selected because of the small size of the lot. The travel time was found to be approximately 3 minutes, so this method would be appropriate. The travel time calculations can be found in Appendix C-1. Through the NRCS method, the water quality volume for pre-construction and post-construction were found. First, the soil type for the site was determined using the web survey soil tool developed by the USDA. The soil type was found to be Monona silt loam. This is a very well-draining soil, and as such was classified as Type C. From this, the curve numbers were found. The lawn was assumed to be in fair condition for both pre and post construction as a conservative estimate, however restoring the lawn to good condition in post construction would reduce the amount of water leaving the site even more. The curve number calculations can be seen in Appendix C-1. From this, the water quality volumes for before and after construction were found and subtracted. The difference was found to be 7,100 gallons for a 1.25-inch storm event. In Iowa, approximately 90% of stormwater events are equal to or less than 1.25 inches.

A rain garden was designed to minimize the excess stormwater leaving the site. The Iowa Rain Garden Design and Installation Guide (3rd edition) was followed. A basic rain garden was selected over an enhanced rain garden because the latter are typically used in locations where there is soil with a high clay content, causing slower percolation rates. The soil at the site of the Sidney Park has relatively high percolation rates and good drainage, so a basic rain garden was more appropriate. According to the Iowa Rain Garden Design and Installation Guide, rain gardens should be approximately 10% of the size of the impervious surface draining to them. There will be approximately 9,800-square feet of impervious surfaces added through construction. The rain garden will be

30’ x 30’, making it slightly less than 10% of the impervious surfaces. The garden will be 12” deep, so it will be able to hold approximately 6,732 gallons of excess stormwater. This is slightly under the water quality volume found, however if the grass is maintained in good condition, this will reduce runoff as well. The perimeter of the garden will be surrounded with pavers. The side slope is 3:1. The top layer is 2” of hardwood mulch. The next layer is 6” of amended soils, which are a combination of 75% concrete sand and 25% topsoil to allow for better percolation. Underneath will be the existing soil, which as mentioned previously is a well-draining soil type. A cross-section of the garden can be seen below, and in Appendix D-5.



It is recommended that the plants are spaced out approximately 1.5 feet from each other. Native plants that grow in full sun are recommended. The suggested plant layout can be found below and in Appendix D-5. The suggested plants are listed in bold, and the alternative options are in standard typeface. The garden is located 10 feet from the court foundation, per the rain garden guide standards. The plant layout selected was recommended in the Iowa Rain Garden Design and Installation Guide. The supporting calculations can be found in Appendix C-1. The cost estimate for this design element can be found in Section VII of this report.



1. **Wild Sweet William**, Prairie Smoke
2. **Smooth Blue Aster**, Bottle Gentian
3. **Brown-eyed Susan**, Black-eyed Susan
4. **Wild Geranium**, Nodding Onion
5. **Foxglove Beardtongue**, Prairie Phlox
6. **Little Bluestem**, Prairie Dropseed
7. **Switchgrass**, Little Bluestem

Swing Set

For future park expansion, a swing set is recommended. It is suggested that it is placed in the open space between the rain garden and the restroom facilities. There are several manufacturers that this could be purchased from. It is recommended that an arch post swing set be selected, as these are generally more stable and aesthetically pleasing. One with two bays would allow for four swings, e a good number for the size of the park. One of the swing seats can be replaced with an ADA compliant swing seat that would ensure the swing set was accessible for everyone.

Section VII Engineer’s Cost Estimate

The park expansion was divided into three phases to allow Sidney to implement the project when funds are available. The first phase includes the civil site design, grading, multipurpose court, and the rain garden. The second phase is the restroom facility. The third phase includes additional park expansion, including the trail that connects to the Sidney Elementary School and the Sidney Cowboy’s Football Field and the swing set. The costs were obtained using RSMeans Cost Data along Iowa DOT Bid Price Data. The 20% contingency cost accounts for any unforeseen costs that may arise during the project. The 20% engineering and administration cost accounts for overhead and profit.

Figure 1: Total Cost Estimate

Item Number	Item Description	Units	Quantity	Unit Price	Total
Phase 1: Site Design					
1	6" PCC Sidewalk	SY	332.608	$ 85.76	$ 28,524.44
2	Cut	CY	673.95	$ 10.22	$ 6,887.77
3	Special Backfill	CY	266.42	$ 40.70	$ 10,843.29
4	Driveway, P.C. Concrete, 6 in	SY	170.586	$ 74.08	$ 12,636.98
Court					
5	6 in Concrete Slab	SY	564	$ 75.93	$ 42,824.52
6	Polymeric rubber	SF	564	$ 5.25	$ 2,961.00
7	Striping/Painting	Each	1	$ 1,500.00	$ 1,500.00
8	Basketball hoops	Each	2	$ 400.00	$ 800.00
9	Pickleball net	Each	1	$ 180.45	$ 180.45
10	Fencing/gate	LF	564	$ 4.50	$ 2,538.00
11	Lighting poles	Each	2	$ 5,755.55	$ 11,511.10
12	Concrete Retaining Wall	CY	8	$ 1,913.41	$ 15,307.28
Environmental Design					
13	Hardwood Mulch	yd3	6.2	$ 26.50	$ 451.00
14	Concrete Sand	yd3	13	$ 35.00	$ 455.00
15	Topsoil	yd3	4.3	$ 38.00	163.4
16	Plant Plugs	each	600	$ 4.00	2400
17	Edging	each	210	$ 0.50	$ 98.00
Construction Total					$ 140,082.23
20% Contingencies					$ 28,016.45
20% Engineering and Administration					$ 28,016.45
Total Phase Cost					$ 196,115.13
Phase 2: Restroom					
18	1'x4' Fluorescent Light Fixture	Each	9	$ 124.50	$ 1,120.50
19	9" Concrete Foundation/Floor	SY	111.5	$ 68.15	$ 7,598.73
20	6" Concrete Floor	SY	49.3311	$ 79.44	$ 3,918.86
21	8" CMU Wall	SF	585.21	$ 2.77	$ 1,621.03
22	Exterior Finishes	SF	199.19	$ 2.05	$ 408.96
23	Interior Finishes	SF	974.69	$ 1.42	$ 1,386.41
24	Toilet	Each	2	$ 578.00	$ 1,156.00
25	Sink	Each	2	$ 417.00	$ 834.00
26	Metal Piping 1.5"	LF	77	2.81799	$ 216.99
27	Mirror 18"x24"	Each	2	$ 64.70	$ 129.40
28	Water Heater	Each	2	$ 686.00	$ 1,372.00
29	Roof Truss Labor	Each	14	$ 26.00	$ 364.00
30	Roof Sheathing	SF	460.3	$ 1.07	$ 492.52
31	1/4" Water Membrane	SF	460.3	$ 0.45	$ 207.14
32	5/8" Gypsum Board	SF	460.3	$ 0.76	$ 349.83
33	3 on 12 Truss	Each	14	$ 94.64	$ 1,324.96
34	Steel Shingles	Sq	4.603	$ 473.69	$ 2,180.40
35	Water Fountain	Each	2	$ 832.05	$ 1,664.09
36	6" Sanitary Piping	LF	156	$ 36.30	$ 5,662.80
37	1" Water Piping	LF	146	12.46	$ 1,819.16
Construction Total					$ 33,827.77
20% Contingencies					$ 6,765.55
20% Engineering and Administration					$ 6,765.55
Total Phase Cost					$ 47,358.88
Phase 3: Trail and Swing Set					
38	Excavation, Class 10, Waste	CY	75.81	$ 10.22	$ 774.78
39	Special Backfill	CY	39.28	$ 40.70	$ 1,598.70
40	Recreation Trail, PCC, 6 in	SY	315.32	$ 53.37	$ 16,828.63
41	Arch Post Swing Set (4 seat, 2 bays)	Each	1	$ 5,811.99	$ 5,811.99
42	Wheelchair Accessible Swing	Each	1	$ 593.99	$ 593.99
Construction Total					$ 25,608.08
20% Contingencies					$ 5,121.62
20% Engineering and Administration					$ 5,121.62
Total Phase Cost					$ 35,851.32
Total Project Cost					$ 279,325.32

Figure 2: Truss Cost Estimate

Family:	Mono
SKU:	1004547
Span:	17'
Left Overhang:	0
Pitch:	3/12
Spacing:	2'
Left Heel:	3-7/8"
Right Heel:	4' 6-7/8"
Loadings:	30-7-0-10

Quantity:	14
Price Each:	$94.64
Extended Price:	$1,324.96

Spec Sheets

Select

Appendix A: Gantt Chart Schedule

Figure A-1: Gantt Chart

Sidney Park Expansion

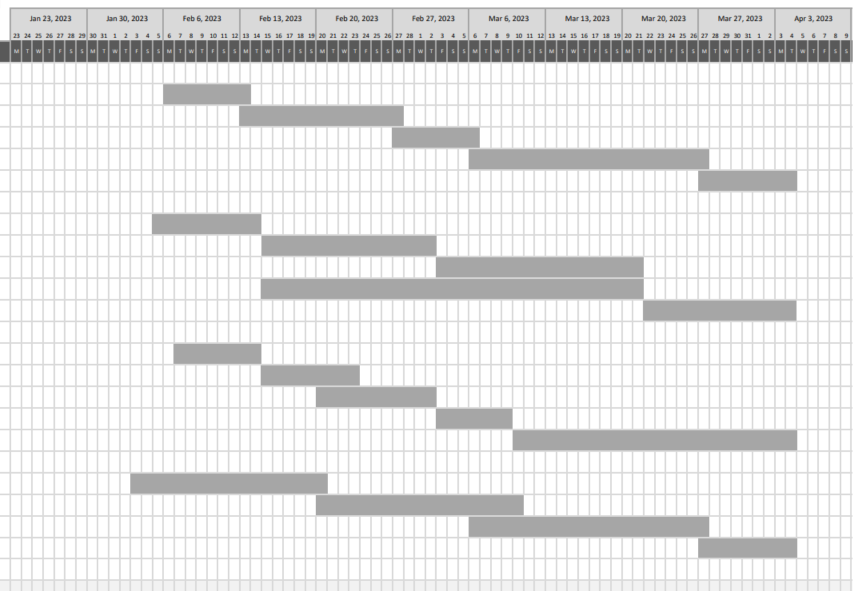
BTG Engineering

Project Start: Mon, 1/23/2023

Display Week: 1

TASK	ASSIGNED TO	PROGRESS	START	END
Structures				
Research Materials/Brainstorm	Dillon	100%	2/6/23	2/13/23
Initial Design/Structural Analysis	Dillon	100%	2/13/23	2/27/23
Structural and Foundation Calcs	Dillon	100%	2/27/23	3/6/23
Main Design	Dillon	100%	3/6/23	3/27/23
Finalize Design/Rendering	Dillon	100%	3/27/23	4/4/23
Site Development				
Brainstorm Layouts and Alternatives	Olivia	100%	2/5/23	2/14/23
Initial Parking Design	Olivia	100%	2/15/23	3/2/23
Initial Sidewalk Design	Olivia	100%	3/3/23	3/21/23
Grading	Olivia	100%	2/15/23	3/21/23
Finalize Designs	Olivia	100%	3/22/23	4/4/23
Civil				
Research Courts and Alternatives	Colin	100%	2/7/23	2/14/23
Initial layout and placement of court	Colin	100%	2/15/23	2/23/23
Design alternatives	Colin	100%	2/20/23	3/2/23
Building Model finished	Colin	100%	3/3/23	3/9/23
Final Court design and Estimates	Colin	100%	3/10/23	4/4/23
Environmental/Water Resources				
Preliminary Research	Emerson	100%	2/3/23	2/20/23
NRCS Method Calculations	Emerson	100%	2/20/23	3/10/23
Rain Garden Design	Emerson	100%	3/6/23	3/27/23
Rain Garden Cost Estimates	Emerson	100%	3/27/23	4/4/23

Insert new rows ABOVE this one



Appendix B: Design Standards

Figure B-1: Concrete Slab Design Manual

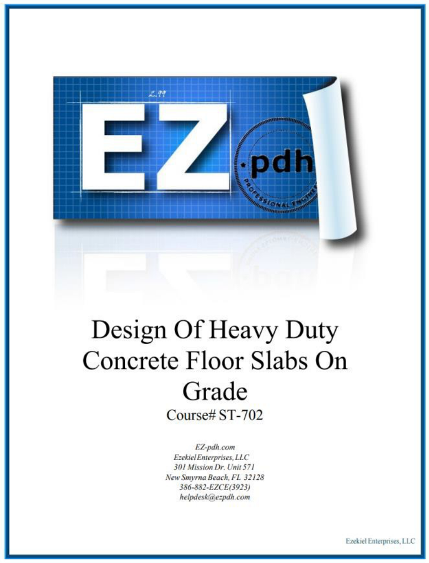


Figure B-2: Foundation Design Manual

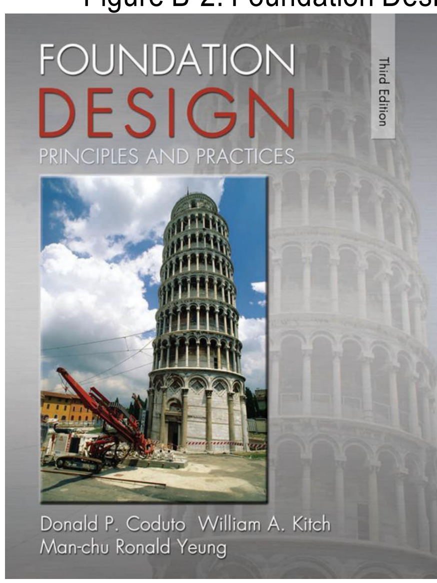


Table B-3: Presumptive Load Bearing Values

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.

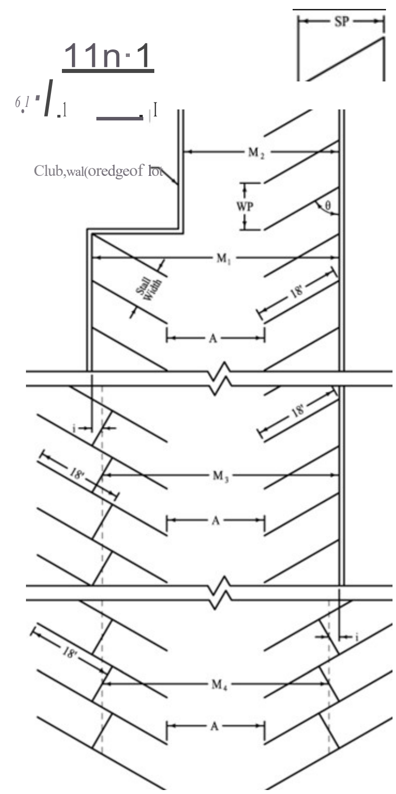
a. Coefficient to be multiplied by the dead load.

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

Table B-4: Minimum Parking Dimensions

Parking Lot Dimension		Parking Angle (θ)				
		Two-way Aisle			One-way Aisle	
		90°	60°	45°	60°	45°
Stall Projection	SP	18’-0”	15’-7”	12’-9”	15’-7”	12’-9”
Aisle Width	A	24’-0”	25’-10”	29’-8”	20’-4”	21’-6”
Base Module	M_1	60’-0”	57’-0”	55’-2”	51’-6”	47’-0”
Single Loaded Module	M_2	42’-0”	39’-0”	37’-7”	32’-6”	29’-5”
Wall to Interlock	M_3	60’-0”	55’-10”	52’-2”	49’-4”	44’-0”
Interlock to Interlock	M_4	60’-0”	53’-8”	49’-2”	47’-2”	41’-0”
Overhang	o	2’-6”	2’-2”	1’-9”	2’-2”	1’-9”
Stall Width 8’-6” Width Projection	WP	8’-6”	9’-10”	12’-0”	9’-10”	12’-0”
Stall Width 8’-6” Interlock	i	0’-0”	2’-2”	3’-0”	2’-2”	3’-0”
Stall Width 9’-0” Width Projection	WP	9’-0”	10’-5”	12’-9”	10’-5”	12’-9”
Stall Width 9’-0” Interlock	i	0’-0”	2’-3”	3’-2”	2’-3”	3’-2”

Figure B-5: Parking Dimensions



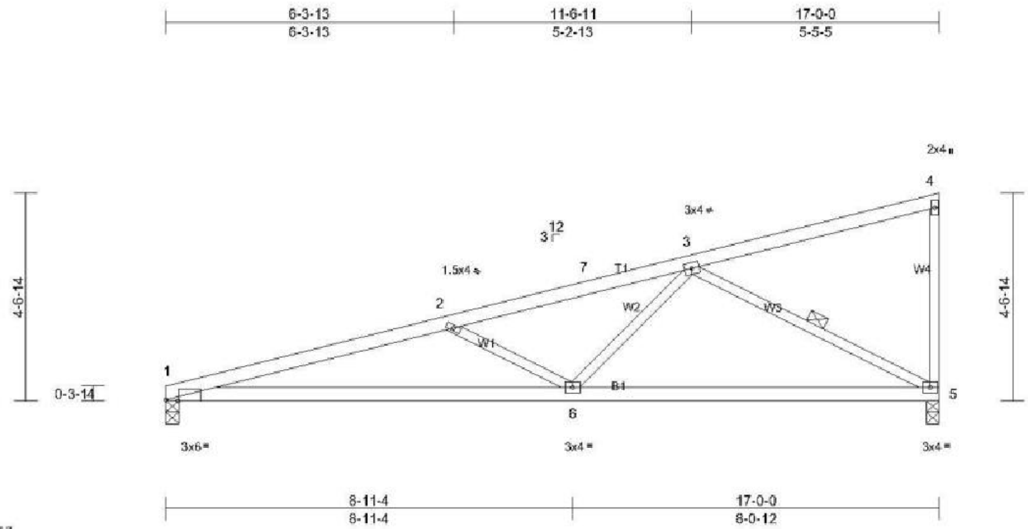
SP = Stall Projection	M1 = Base Module	(2SP + A)
A = Aisle Width	M_2 = Single loaded Module	(SP + A)
WP = Width Projection	M3 = Wall to Interlock	(M1 - i)
i = Interlock	M4 = Interlock to Interlock	(M1 - 2i)

Figure B-5: Truss Specifications

Job	Truss	Truss Type	Qty	Ply	
QTREC0675775	M1	MONO	7	1	Job Reference (optional)

Midwest Manufacturing, Eau Claire, WI — Run: 8.4 S 0 May 13 2020 Print: 8.400 S May 13 2020 MiTek Industries, Inc. Wed Apr 14 07:46:58 — Page: 1

ID:PZyFxB_l10vptUg35nbzSOzQfLd-Pf5VtHsHD6cpDeOj80QZQXRgXWD2W?7PNzAHEPzQsox



Scale = 1:37.7

Plate Offsets (X, Y): [1:0-3-4,Edge]

Loading	(psf)	Spacing	2-0-0	CSI		DEFL	in	(loc)	l/defl	L/d	PLATES	GRIP
TCLL (roof)	30.0	Plate Grip DOL	1.15	TC	0.71	Vert(LL)	-0.16	1-6	>999	240	MT20	197/144
Snow (Ps/Pg)	27.7/40.0	Lumber DOL	1.15	BC	0.81	Vert(CT)	-0.35	1-6	>580	180		
TCDL	7.0	Rep Stress Incr	YES	WB	0.65	Horz(CT)	0.05	5	n/a	n/a		
BCLL	0.0 *	Code	IRC2015/TPI2014	Matrix-S								
BCDL	10.0										Weight: 53 lb	FT = 15%

LUMBER
TOP CHORD 2x4 SPF No.2
BOT CHORD 2x4 SPF No.2
WEBS 2x3 SPF Stud

BRACING
TOP CHORD Structural wood sheathing directly applied or 2-7-13 oc purlins, except end verticals.
BOT CHORD Rigid ceiling directly applied or 10-0-0 oc bracing.
WEBS 1 Row at midpt 3-5

MiTek recommends that Stabilizers and required cross bracing be installed during truss erection, in accordance with Stabilizer Installation guide.

REACTIONS (lb/size) 1=749/0-3-8, (min. 0-1-8), 5=749/0-3-8, (min. 0-1-8)
Max Horiz 1=135 (LC 11)
Max Uplift 1=-75 (LC 10), 5=-91 (LC 14)
Max Grav 1=796 (LC 20), 5=910 (LC 20)

FORCES (lb) - Max. Comp./Max. Ten. - All forces 250 (lb) or less except when shown.
TOP CHORD 1-2=-2209/339, 2-7=-1695/175, 3-7=-1602/165
BOT CHORD 1-6=-326/2105, 5-6=-132/1169
WEBS 2-6=-619/226, 3-6=0/674, 3-5=-1312/214

NOTES
1) Wind: ASCE 7-10; Vult=115mph (3-second gust) Vasd=91mph; TCDL=4.2psf; BCDL=6.0psf; h=25ft; Cat. II; Exp B; Enclosed; MWFRS (envelope) exterior zone and C-C Exterior (2) zone; cantilever left and right exposed ; end vertical left and right exposed;C-C for members and forces & MWFRS for reactions shown; Lumber DOL=1.60 plate grip DOL=1.60
2) TCLL: ASCE 7-10; Pr=30.0 psf (roof live load: Lumber DOL=1.15 Plate DOL=1.15); Pg=40.0 psf (ground snow); Ps=27.7 psf (roof snow: Lumber DOL=1.15 Plate DOL=1.15); Category II; Exp B; Fully Exp.; Ct=1.10
3) Roof design snow load has been reduced to account for slope.
4) Unbalanced snow loads have been considered for this design.
5) This truss has been designed for a 10.0 psf bottom chord live load nonconcurrent with any other live loads.
6) * This truss has been designed for a live load of 20.0psf on the bottom chord in all areas where a rectangle 3-06-00 tall by 2-00-00 wide will fit between the bottom chord and any other members.
7) Provide mechanical connection (by others) of truss to bearing plate capable of withstanding 75 lb uplift at joint 1 and 91 lb uplift at joint 5.
8) This truss is designed in accordance with the 2015 International Residential Code sections R502.11.1 and R802.10.2 and referenced standard ANSI/TPI 1.

LOAD CASE(S) Standard

Appendix C: Calculations

Figure C-1: Rain Garden Calculations

$n := 0.24$

$l := 186\ ft$

$P := 3.12\ \frac{in}{hr}$

$S := 4.1\ \frac{ft}{ft}$

$$Tt := \frac{.007\ (n \cdot l)^{.8}}{(P)^{.5} \cdot (S)^{0.4}}$$

$Time := 2.82\ min$

Pre-Construction	Area (ft2)	CN
Paved Surfaces	3858	98
Lawn (Fair Condition)	16727	69
Gravel Surface	7549	85
Weighted CN	28134	77.26992

Post-Construction	Area (ft2)	CN
Paved Surfaces	9450	98
Lawn (Fair Condition)	18312.75	69
Gravel Surface	0	85
Roof	371.25	98
Weighted CN	28134	79.12356

$CN1 := 77.27$

$CN2 := 79.12$

$$S1 := \left(\frac{1000}{CN1}\right) - 10 = 2.942$$

$$S2 := \left(\frac{1000}{CN2}\right) - 10 = 2.639$$

$P := 1.25$

$$Pe1 := \frac{(P - (0.2\ S1))^2}{P + 0.8 \cdot S1} = 0.122$$

$$Pe2 := \frac{(P - (.2 \cdot S2))^2}{P + .8 \cdot S2} = 0.155$$

$DrainageArea := 28139.8$

$Runoff1 := Pe1 \cdot DrainageArea \cdot 7.48 = 2.557 \cdot 10^4$

$Runoff2 := Pe2 \cdot DrainageArea \cdot 7.48 = 3.266 \cdot 10^4$

$Difference := Runoff2 - Runoff1 = 7.087 \cdot 10^3$

The difference in runoff volumes between pre
and post construction is 7100 gallons

Figure C-2: Roof Dead Load Calculations

ROOF LOAD CALC

$$osbperquaterinch := \frac{1.7\ psf}{2} = 0.85\ psf$$

DECKING AND INSULATION

3/8 inch thick Plywood / OSB	1.2
1/2 inch thick Plywood / OSB	1.7
5/8 inch thick Plywood / OSB	2.1
3/4 inch thick plywood / OSB	2.5
1-1/8 inch thick plywood / OSB	3.6
1 inch nominal wood	2.3
2 inch nominal wood decking	4.3
16 ga. Corrugated Steel	2.5
20 ga. Corrugated Steel	1.8
22 ga. Corrugated Steel	1.5
24 ga. Corrugated Steel	1.3
28 ga. Corrugated Steel	1.0
Rigid Fiberglass - 1 inch thick	1.5
Styrofoam - 1 inch thick	0.2
Insulrock - 1 inch thick	2.7
Poured gypsum - 1 inch thick	6.5
Rock Wool - per 1 inch of thickness	0.4
Glass Wool - per 1 inch of thickness	0.2
Vermiculite - per 1 inch of thickness	2.6

$$gammaW := 30\ \frac{lbf}{ft^3}$$ hem-fir group and increasing from 29.2lb/ft^3

$$Tiles := 0.563\ psf$$

$$waterproofing := 1.5\ psf$$ bitumen smooth

$$roofsheathing := 1.7\ psf$$ 1/2" osb roof sheathing

$$rooframing := 3.\ psf$$ assuming 2x8 top chord 2x8 bot chord 24" oc and added misc loading

$$insulation := \frac{33\ lbf \cdot 5.5}{27\ ft \cdot 18\ ft} = 0.373\ psf \qquad r_{value} := 13$$ unbonded loose fill insulation

$$gypsumboard := .55 \cdot 5\ psf = 2.75\ psf$$

$$misc := 1.5\ psf$$

$$MEP := 6\ psf$$ lighting, plumbing, electrical, and mechanical loads

$$conv := \frac{\sqrt{3^2 + 12^2}}{12} = 1.031$$ roof geometry to convert to horizontal loading

WOOD TRUSSES - (APPROXIMATE)

Based on Southern Pine

Top Chord	Bottom Chord	PLF	24" oc.
2x4	2x4	5.2	2.6
2x6	2x4	6.1	3.1
2x6	2x6	6.9	3.5
2x8	2x6	7.8	3.9
2x8	2x8	8.5	4.3
2x10	2x8	9.3	4.7
2x10	2x10	10.1	5.2
2x12	2x10	10.9	5.5
2x12	2x12	11.6	5.8

We suggest the addition of 1.5 psf for misc. dead loads

$$RoofSystemUpper := \left(\begin{pmatrix} Tiles + roofsheathing \\ + waterproofing + rooframing \cdot .5 + misc \cdot .5 \end{pmatrix} \cdot conv \right) = 6.198\ psf$$

references from Encyclopedia of Trusses

$$RoofSystemLower := \begin{pmatrix} insulation + gypsumboard \\ + misc \cdot .5 + MEP + .5 \cdot rooframing \end{pmatrix} = 11.373\ psf$$

$$\frac{(35\ ft + 6.25\ in)}{2} = 17.76\ ft$$

$$RSUadj := 7\ psf$$

Default to the load table from provider

$$RSLadj := 10\ psf$$

Figure C-3: Foundation Calculations

Foundation

IBC Table 1806.2 for clay, sandy clay, silty clay, clayey silt, silt and sandy silt (silt loam)

(web soil survey)

Fremont County, Iowa (IA071)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent o AOI
10B	Monona silt loam, 2 to 5 percent slopes	0.1	98.5%

$q_z := 1500\ psf$ Bearing Capacity

$q_h := 100\ \frac{psf}{ft}$ Lateral Bearing Pressure

$\frac{P}{B} \le 1500\ psf$ Allowable Bearing Pressure Approach Chapter 9.3

$$P_d := 17\ psf \cdot 0.5 \cdot (26\ ft + 1\ in) + 125\ pcf \cdot 8\ in \cdot 8\ ft = 888.375\ \frac{1}{ft} \cdot lbf$$

$$P_L := 20\ psf \cdot 0.5 \cdot (26\ ft + 1\ in) = 260.833\ \frac{1}{ft} \cdot lbf$$

$$P := P_d + P_L = (1.149 \cdot 10^3)\ \frac{1}{ft} \cdot lbf$$

$$B := \frac{P}{q_z} = 9.194\ in$$

Use 16 in

$B := 16\ in$

$P_u := 1.2 \cdot P_d + 1.6 \cdot P_L = (1.483 \cdot 10^3)\ \frac{1}{ft} \cdot lbf$ Chapter 10.6

$b_w := 1\ ft$ Unit width

$c := 8\ in$ wall width

$\phi := 0.75$ resistance factor

$f_c' := 3500\ psi$ minimum average net compressive strength per ASTM C90

$$d := \frac{1500 \cdot P_u \cdot (B - c)}{500 \cdot \phi \cdot b_w \cdot \sqrt{\left(\frac{f_c'}{psi}\right)} \cdot psi + 3 \cdot P_u} = 5.564\ in$$

required depth of rebar

$d := 6\ in$ Minimum depth

$d_{LateralSteel} := 12.7\ mm$ Assuming metric #13 bars

$d_{LongitudinalSteel} := d_{LateralSteel}$

$T := d + 0.5 \cdot d_{LateralSteel} + d_{LongitudinalSteel} + 3\ in = 9.75\ in$ Round to nearest multiple of 3

$T := 9\ in$ Footing thickness

Appendix D: Design Drawings

Figure D-1: Site Layout

Figure D-2: Trail Layout

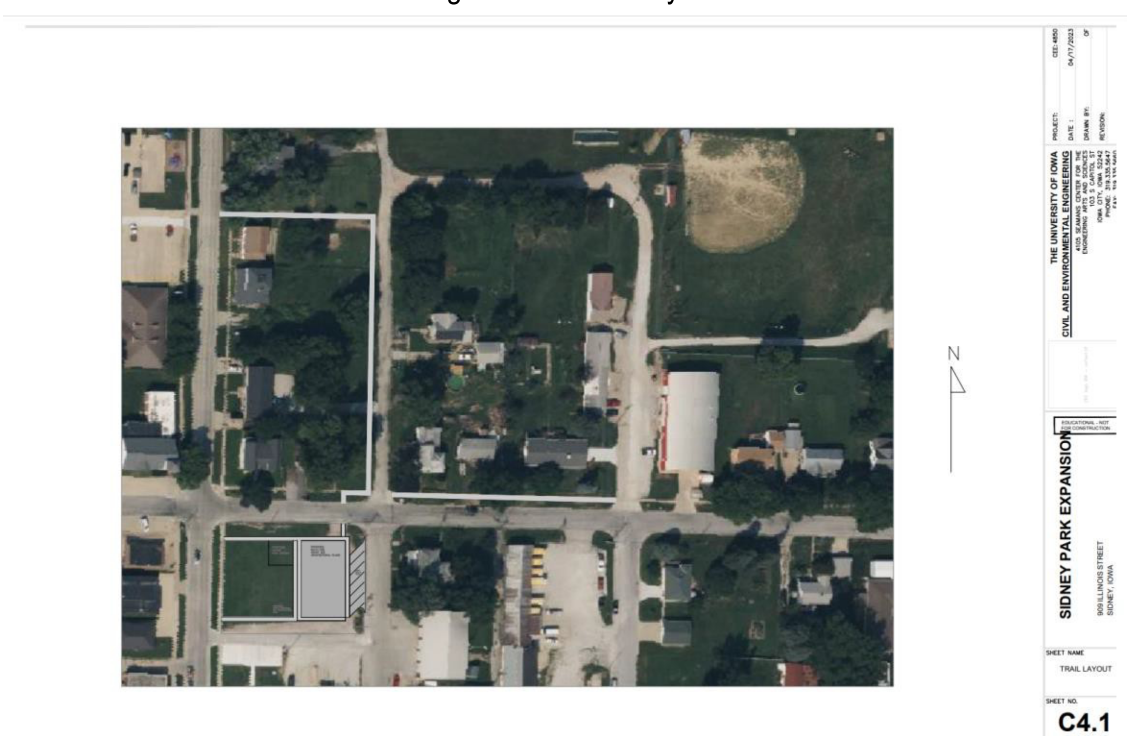


Figure D-3: Existing Ground Grading Plan

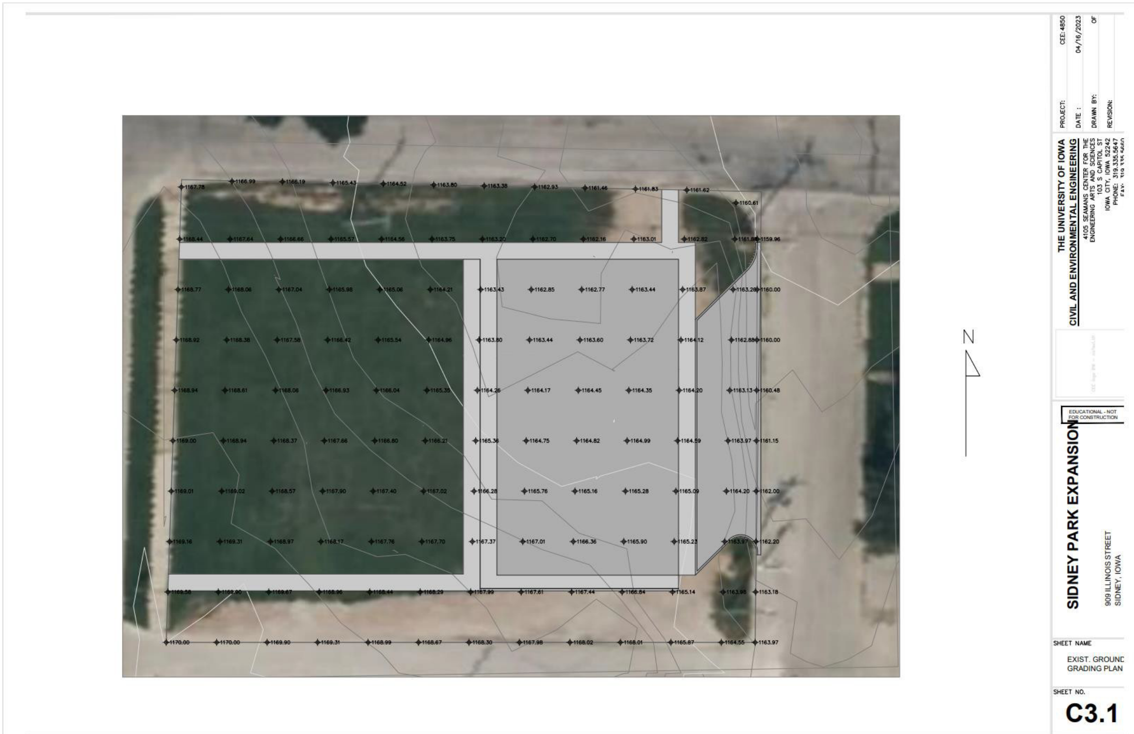


Figure D-4: Proposed Ground Grading Plan

Figure D-5: Rain Garden and Bike Parking Layout

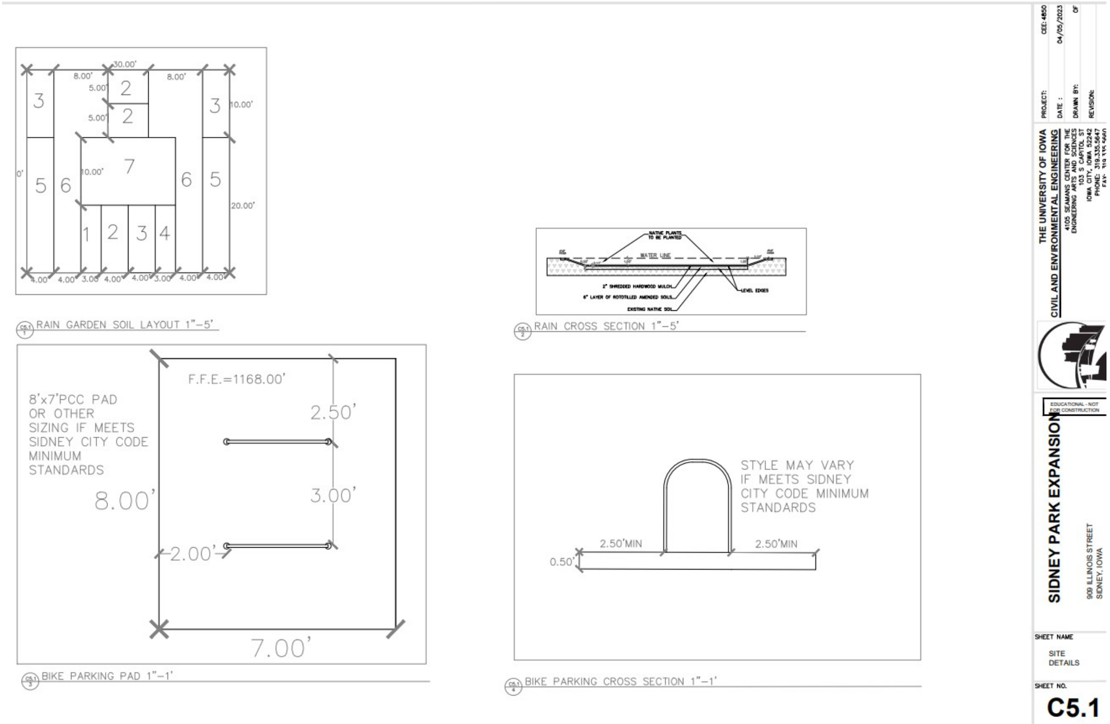
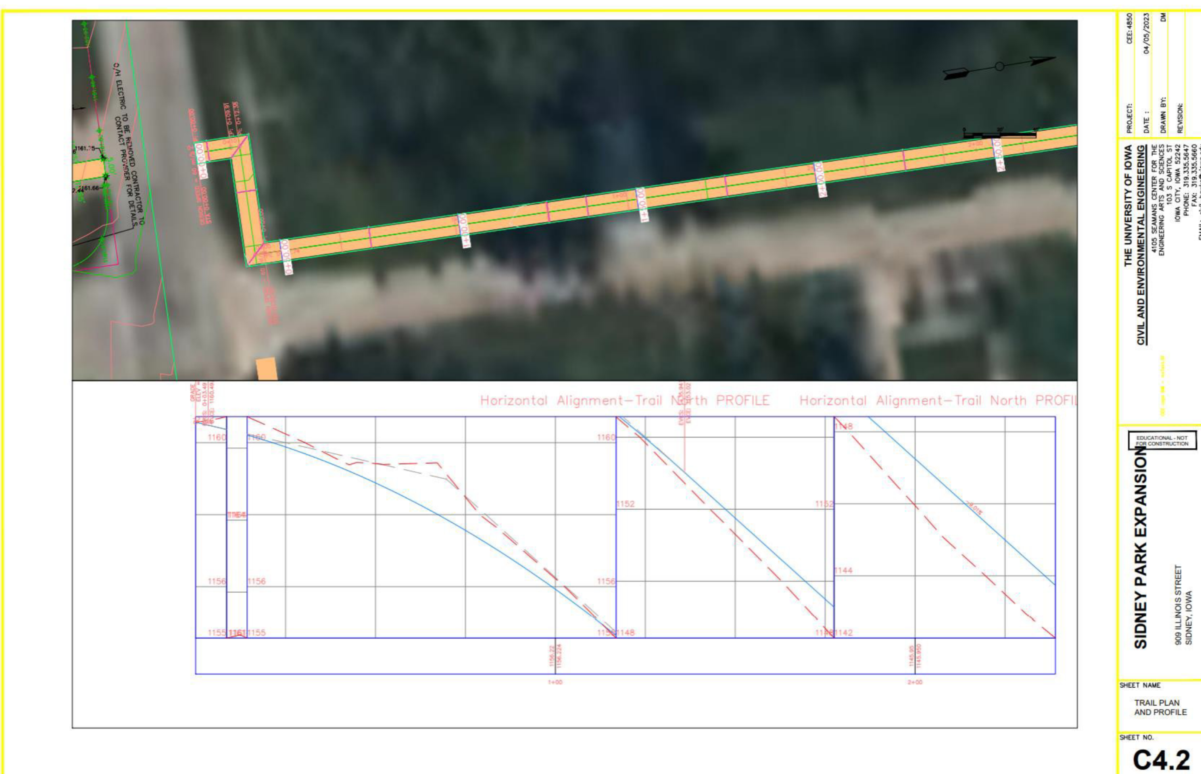


Figure D-6: Horizontal Alignment and Plan Profile Sheets



PROJECT: CEE:4850
DATE: 04/05/2023
DRAWN BY: DM
REVISION:

THE UNIVERSITY OF IOWA
CIVIL AND ENVIRONMENTAL ENGINEERING
4105 SEAMANS CENTER FOR THE ENGINEERING ARTS AND SCIENCES
103 S. CAPITOL ST
IOWA CITY, IOWA 52242
PHONE: 319.335.5647
FAX: 319.335.5660
EMAIL: civil-enviro@uiowa.edu

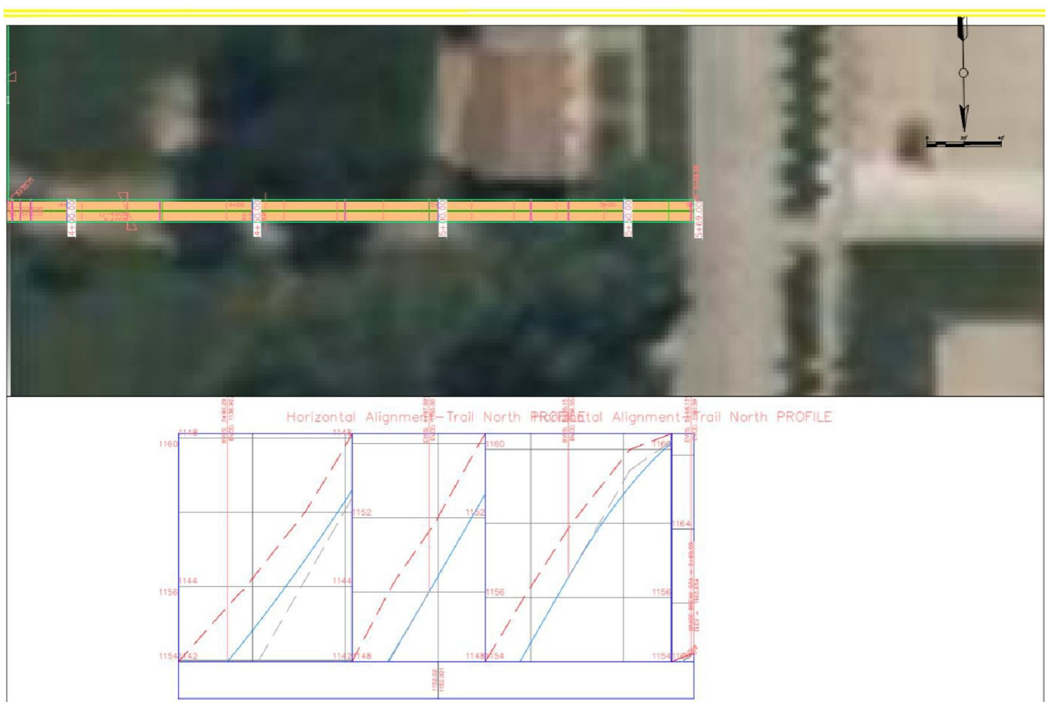
EDUCATIONAL - NOT FOR CONSTRUCTION

SIDNEY PARK EXPANSION

909 ILLINOIS STREET
SIDNEY, IOWA

TRAIL?LAN AND PROFILE

C4.3



PROJECT:
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SIDNEY, IOWA

ANO PROFILE

C4.4

Appendix E: Design Renderings and Models

Figure E-1: Restroom Rendering

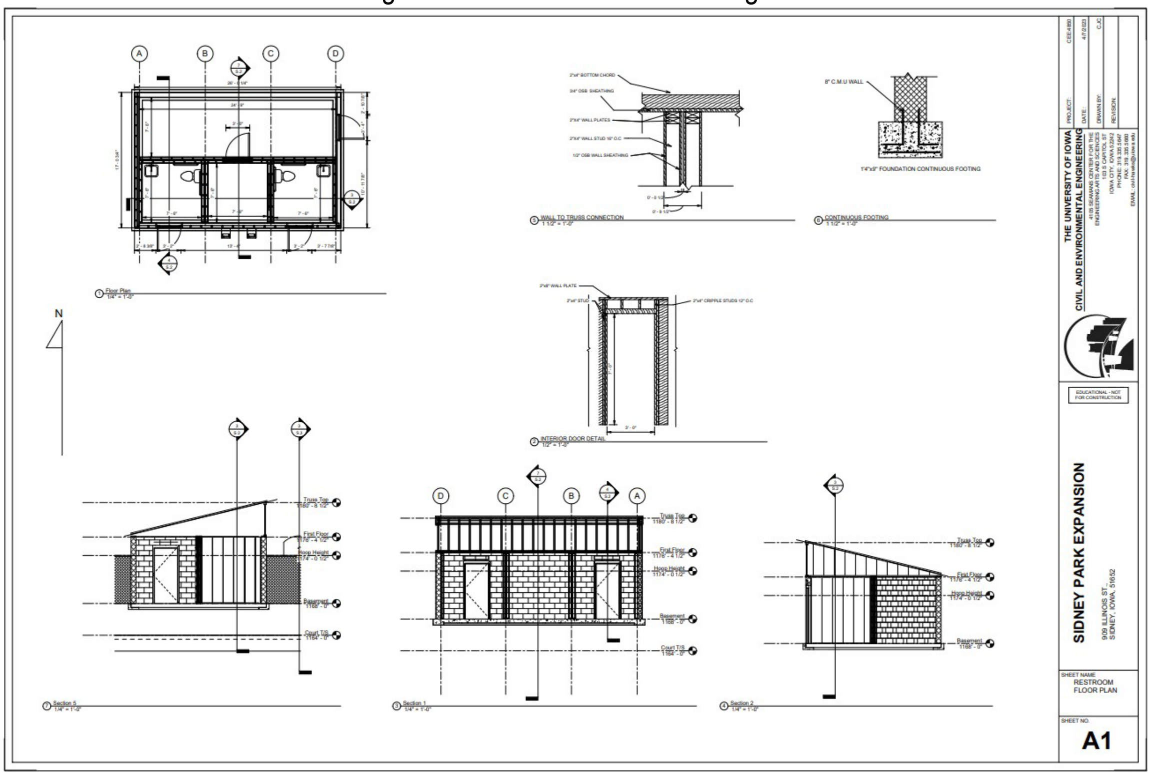


Figure E-2: Multi-use Court Rendering

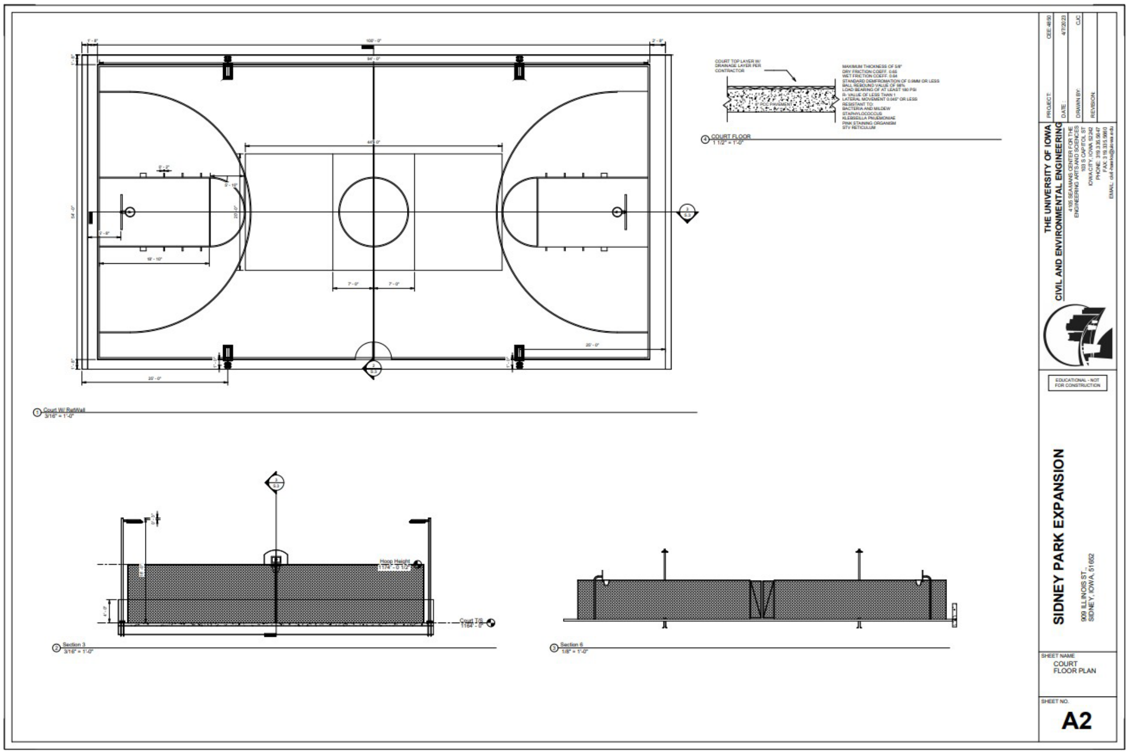
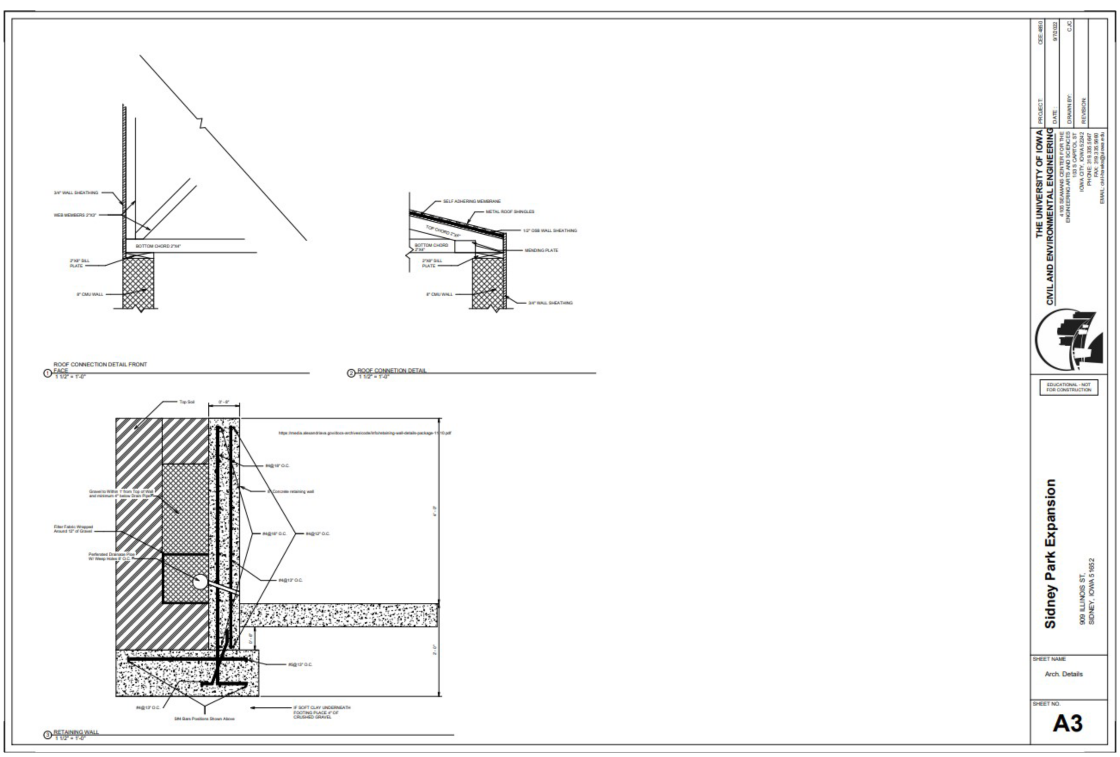


Figure E-3: Roof Connection and Retaining Wall Renderings



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