# UNIVERSITY OF IOWA
# DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING Project Design & Management (CEE:3084:0001)
# RFP # 09-spr2015
# Southbridge Industrial Park Utility and Drainage Improvements

| HAWKEYE SOLUTIONS |
| --- |
| Jason Cárdenas: Project Manager |
| Proposed Cost: **$10.6 million** |
| *The proposed cost listed above is for reference purposes only, not evaluation purposes. In the event that the cost noted above does not match the Bidder's detailed cost proposal documents, then the information on the cost proposal documents will take precedence.* |

- This proposal and the pricing structure contained herein will remain firm for a period of 180 days from the date and time of the bid opening.
- No personnel currently employed by the Department participated, either directly or indirectly, in any activities relating to the preparation of the Bidder's proposal.
- No attempt has been made or will be made by the Bidder to induce any other person or firm to submit or not to submit a proposal.
- The undersigned is authorized to enter into obligations on behalf of the above-named organization

*To the best of my knowledge all information provided in the enclosed proposal, both programmatic and financial, is complete and accurate at the time of submission.*

[signature] Jason Cárdenas, PM

Authorized Signature Date Name and Title (Typed)

THE UNIVERSITY OF IOWA
IOWA INITIATIVE
FOR SUSTAINABLE COMMUNITIES

## Executive Summary

Hawkeye Solutions is a new civil engineering firm that has been requested to help in the Southbridge Industrial Park Utilities and Drainage Improvements by the City of Sioux City, IA. This task required the development of approximately 300 acres of land for future arriving businesses. The firm has five engineers that specialize in various disciplines of civil engineering such as: transportation, hydrology, and structures. Their specializations have taken them to work with local, state, and private agencies. They have acquired this knowledge and experience through previous internships and academic projects for distinct professors.

Hawkeye Solutions has provided three designs that may be of satisfaction to the client, and increase potential industrial growth. Each design divides the 300 acre land into separate lots. Depending on the design, some of the lots are bigger than the others, while some lots have access to the developing railroad. The designs provide a building, a main road, and smaller roads to access the lots. The later sections of this report provide a detail description of each design.

The building in each design is a 6 acre warehouse (720ft x 360ft x 36ft clear). This warehouse was designed to match Sabre Industries, which is located in the vicinity and to conform to the ASCE 7-10 and IBC 2012 manuals. The frame of the structure is a steel beam-column frame with columns spaced at every 45 feet, providing plenty of open space, while also being structurally stable on the greater area of the building. Bracing is needed to support the frame on the smaller area of the side. Different types of framings that could be considered are X-bracing and Portal frames. The design of the bracing is outside of our expertise, therefore it will need to be designed for the building to be stable in both directions. We chose to design it in that matter rather than using a standard pre-engineered building. The foundation of the building consists of a spread footing with a foundation wall. Each footing is 12ft x 12ft x 2ft. The total cost of the building and the foundation is approximately **$7.8 million.**

Around the perimeter of the building is a parking lot that allows cars, trucks, and lifts to access either side of the building.

It is necessary to include an infiltration basin account for the addition of impervious surfaces such as the building and the parking lot. The infiltration basin would be an effective measure to prevent pollutant runoff by allowing time for suspended solids to settle out. In addition the infiltration basin acts as a buffer during high flow events, collecting runoff and releasing it over time.

The cost of the development of the road and parking lot is approximately **$2.8 million.** The total cost for the development of the site would be **$10.6 million.**

Hawkeye Solutions believe this would greatly impact the community of Sioux City. Although it is a large investment, this allows for the establishment of business in the city while providing diversity of businesses.

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# Introduction

Hawkeye Solutions' mission is to provide quality civil engineering solutions to surrounding communities. As a new company, we provide a fresh perspective on arising engineering issues, and strive to provide a quality solution. Our firm oversees three main technical disciplines of Civil Engineering: Structural, Hydrological, and Transportation engineering. With these three disciplines working as a team, our solutions are efficient, providing superior results. Hawkeye Solutions is completely cognizant that the caliber of our services depends on the quality of the engineers. For this reason, Hawkeye Solutions has taken pride in hiring five young, talented, and experienced engineers, to ensure impeccable service.

**Organization Location**

Hawkeye Solutions is an engineering solutions company located at 30 N. Dubuque, Iowa City, Iowa, 52245, #350. Our firm has worked on projects with state, local, and private agencies. These projects include river water pollution testing, transportation studies, and structure design. Hawkeye Solutions will oversee the project and manage the contract from their corporate headquarters in Iowa City.

**Organization Experience and Qualifications**

Our company is comprised of a very diverse group of people, who together bring a few years of experience and qualifications. In our firm, we have structural, transportation, and hydrology engineers that all contribute to the completion of our projects. The body of engineers is comprised of Jack Machalek, Alex Bramhall, Silas Tappendorf, Suyin Yao, and Jason Cardenas.

Mr. Machalek is a transportation engineer whose experience includes performing traffic studies for the City of Coralville Route I-80 interchange. Although he specializes in transportation, he has also conducted a research study on the Iowa River for Professor Larry Weber, where he developed an understanding of mineral and contaminant levels in the water.

Mr. Bramhall is a transportation engineer who not only has completed school work, but also has work experience. With Professor Allen Bradley, he was able to work on the North Ralston Creek project where he estimated water demand by looking at historical rainfall data and peak hour factors. As well, at his previous employment with *StanTec*, he was able to put in practice what he learned in school, and therefore was able to gain an understanding about where to place sanitary and storm sewers.

Mr. Tappendorf is a hydrology engineer, but has worked very closely with geotechnical engineers. While in school, he was a part of the North Ralston Creek project, where he worked closely with team members to estimate water demand. He also conducted soil analysis under the supervision of Professor Colby Swan. Mr. Tappendorf has had the opportunity to work at *Midwest Engineering and Testing* for four consecutive summers, where he was able to conduct a variety of civil engineering materials tests.

Ms. Yao is a structural engineer whose education and experience extends beyond the United States. She has had multiple internships, one which was with the Guangzhou Municipal Engineering Design and Research Institute in China. Here she was able to work as a research assistant and as a drafter. As well, she conducted internal transportation planning for DeLanShan Ecologic Scenic Area in China. When she came to the University of Iowa, she was able to implement what she learned, and used AutoCAD and Revit to construct 3D geometric models for Professor Colby Swan, and do structural analysis of the Art Building West for Professor George Constantinescu.

Mr. Cardenas is a structural engineer who has experience working in construction as well as a structural engineering consulting firm. While in school, he worked on the design of a new rec center under the supervision of Professor William Eichinger. He has had the opportunity of working at *Shive-Hattery* where has been able to design concrete structures as well as retaining walls.

With all the skills and qualifications of each engineer, we believe we are very well qualified for the task that our client requests. Provided below are detailed outlines of each engineers' experience and qualifications.

## Problem Statement

### Design Objectives

The Southbridge Industrial Park is a section of Sioux City that has previously served as farmland for years. As Sioux City expands, the site has proven to be of value to industrial businesses, as it lies along a newly added Union Pacific rail line. One of the biggest challenges for the site is the lack of durable roadways capable for industrial traffic and no utility lines close to the site. Making the site attractive to businesses will help utilize the Southbridge Industrial Site for the City of Sioux City by bringing new businesses into the area.

### Approaches

Many features of our designs came together through using federal, state, and city codes. Because Sioux City has an airport, it is possible that Federal Aviation Administration (FAA) project approval may be required. The presence of the airport also means that anything constructed will have to follow FAA Code AC 150/3500-13 Change 8 which will impact the height of buildings based on their proximity to the runways. Another federal code that must be followed pertains to wetland impact. To meet these requirements, we followed section 12.16 of Sioux City's city code. Another mandatory code is the MPDES MS4 Phase II. This is the wastewater discharge permitting authorization. The state of Iowa also requires many site work permits that are required for construction. All of the applicable permits for this site can be found in Table 1. Building permits found in section IBC311 from IBC2009 were also used in the design process; these permits are also state sanctioned. Additional forms that need to be obtained are form 640004 and form 810123. These two forms are from the Iowa Department of Transportation (IDOT) and are for traffic maintenance. IDOT also requires permits for oversized and overweight trucks. Depending on the schedule, several different permits may be needed for this project. Round Trip Permits are valid for five days for unlimited complete round trips along the same route. The more likely permits needed would be the Multitrip Permit or the Annual Oversize/Overweight Permit. The Multitrip Permit is valid for Sixty days and covers unlimited round trips of up to 156,000 lbs. gross maximum weight. Similarly the Annual Oversize/Overweight permit covers the same maximum weight, but is valid for one full year.

State and Federal codes are not the only codes that this project must meet. City codes also factor into the design of the industrial park. The City of Sioux City requires that grading permits cannot be received without first meeting the requirements in chapter 12.16 (Ord. 2002-1015) which handles storm water requirements. Then, the actual grading permit application and SWPPP must be filled out. Water and Sewer tap permits are also required by the city, and can be found in section 12.12.090 of the city code. It should also be noted that possible air quality permits may need to be obtained depending on the future businesses that move into the industrial park.

**TABLE 1: Iowa DNR Site Work Permits (Iowa DNR)**

| Name | Form # |
|---|---|
| Schedule 2a, Water Mains - General | 542-3030 |
| Schedule 2b, Water Mains - Specifications | 542-3031 |
| Schedule 3a, Water System's Preliminary Data | 542-3032 |
| Schedule 3c, Water Quality Data | 542-3028 |
| Schedule 4, Site Approval | 542-3078 |
| Schedule 5d, Surface Water Supply | 542-3139 |
| Schedule 12, Filters | 542-3147 |
| Schedule 13e, Sampling and Testing | 542-3133 |
| Schedule 16a, Wastewater General | 542-3136 |
| Schedule16b, Waste Treatment Ponds | 542-3137 |
| Schedule 16c, Filtration and Mechanical | 542-3138 |
| Schedule 16d, Dischare to Sewer | 542-3103 |
| Notification of Completion of Construction | 542-3019 |

When determining the infiltration basin design two main references were used, both the Iowa *Stormwater Management Manual* (SWMM) from the Department of Natural Resources and the Iowa *Statewide Urban Design and Specifications* (SUDAS). These reference materials provided information on historical regional rainfall data as well as guidelines for basin sizing and outlet structure design. As per the request of Sioux City representatives the designs were made considering the peak flows from both the 10 and 100 year storms.

## Constraints

For the warehouse design, there are constraints related to the design of an industrial warehouse. The first and the main constraint is that the design needs to fulfill the needs of industrial productions. The space ought to be able to handle large facilities occupation, regular circulation of merchandise, and accommodate business tenants. This type of space needs to integrate several functional and operational requirements such as large range of storage alternatives, access to different transportation methods, and large shipping and loading capacity. The proposed site is planned for a variety of industries and business. Therefore, the designed building should be flexible for occupation.

A warehouse is typically designed with high bay in order to take advantage of vertical storage. Large amount of clear space is also required for the occupancy. Generally, the best solution for getting more open space is to have pre-engineered framing for which allows less columns stand in between. Most warehouses that use traditional steel frame have columns spacing at 45 ft. and up. In addition, adequate paths need to be provided for workers and manufacture processes properly in order to connect each functional area and provide safe pathways.

The warehouse is expected to handle heavy live load for the occupation of industrial facilities and manufacturing materials. Most of the occupying live load goes to the concrete slab and foundation. Thus during the foundation design process, soil bearing capacity mainly control the design. Also, the structural design needs to consider wind load, snow load, and other installation live loads.

The warehouse requires having power supply and being connected to the sewer system. The proposed site is adjacent to the power plant and the water treatment plant. According to the information provided by the clients, the water treatment plant and the power plant are able to provide adequate services to the site. Thus, the design is going to connect the site to the two nearby facilities.

The proposed site is bounded by roads on three sides, and rails on one side. The clients will want to take advantage of the existing roads and the projected rails. Thus the design should provide multiple accesses that efficiently connect the warehouse to the surrounding transportation system.

As for industrial utilities, it is required to have waste and pollution control processes. The design constraints should follow any acts and regulations that apply to the site. Also, the city of Sioux City has been implementing the snow water control regulation. Thus the design also needs to take that into considerations. The site lies within the 100-year flood plain. Flood protection and snow runoff control are required to be implemented into the design.

The purpose of an infiltration basin is to prevent on-site pollutants from running off of the site, polluting downstream. To ensure this capability, the infiltration basin was sized by calculating the volume that would be required to store all of the impervious surface runoff from a 2.5 cm rainfall event. This means that for any rainfall event less than or equal to 2.5 cm all of the runoff from impervious surfaces is allowed ample space to be held on site and time to infiltrate into the ground. In addition to the low-flow events where pollutants are the main concern the basin also needs to be able to handle high-flow events without backing up and causing flooding. To do this the 100-year storm peak runoff from the impervious surface was found using the rational method, then that peak flow used to size the outflow structure.

**Challenges**

Our firm was faced with many challenges during the development of the Sioux City Industrial Park. The Sioux City Airport and Sabre Industries are both large industries that are close to the land to be developed. Our biggest challenge was to match our design with these two major industries. After looking at these two factors, we determined that a 6 acre building would be suitable for the location we are in. Some major challenges include the design of the spec building, road and parking lot layout, and retention basin design.

The challenges we faced when constructing the roadways were focused on the type of traffic that would be travelling through them. Industrial parks require that roadways have a maximum $ESAL_{20}$ value of 10 million. This is due to the heavy loads sustained over time by trucks, and we needed to be sure the new roadway satisfied this requirement.

With the design of our spec building, Hawkeye Solutions' felt the best way to approach this was by having a pre-engineered building. A pre-engineered building would reduce the production, engineering, and erection time. The design of this sort of building is outside of Hawkeye Solutions' expertise, therefore we sought out manufacturing companies that would be able to do this. Although we consistently tried, we were unable to find a manufacturing company that would be able to help us. Due to this, the challenge we were faced with was designing a beam-column building. This type of building increases erection time, building material, and reduces column spacing. Our team has designed small buildings before, but this was the first 6 acre building that our team has designed. We were faced with learning new ways to efficiently design, as well as new resources.

Within the design process, other challenges we faced were: bracing, deflection, and lack of information. The development of this land is for future growth, therefore, we are unsure on who will be occupying this building. This lack of information presented some challenges. Some components that affect our building severely are the roof loads and wind loads. In this particular case, we found that our wind loads significantly impacted our building, requiring that we provide bracing. There are two major forms of bracing: X-bracing and Portal frames. Because we are unsure on who will be occupying this space, we are challenged on what form of bracing to provide for the stability of the building. Although X-bracing is less expensive, it requires a lot of space. Although portal frames do not take up a lot of space, it increases the amount of steel. Those factors played into our design.

Per ASCE 7-10, the deflection of each joint is limited to Length/360 and Height/240. When determining the deflection of each member, if its deflection exceeded the criteria above, we needed to select a new member. This allowed us to carefully choose the beams and columns that would meet this criteria.

One of the main challenges in the infiltration basin design was determining the allowable depth of the basin. The site lies with in the 100 year flood plain for the area and there were concerns as to whether or not the water table would sit at too high of an elevation and could potentially be breached by the digging of the basin.

**Societal Impacts**

Hawkeye Solutions is a company that consists of five members currently living in the state of Iowa. We will all be paying state taxes for every hour we work, and one of our team members has been paying state taxes in Iowa for his entire career. He previously worked at *Shive-Hattery* for over a year. Two other members of our team also have experience working in Iowa and have contributed to the state though paying state taxes. Since our firm is located in the state of Iowa, we will also be paying for all of the state's required licensing fees and permits.

Aside from financially contributing to the state of Iowa, Hawkeye Solutions will be partnering with the community itself during this project. We will be designing everything that the Southbridge Industrial Park needs to attract new businesses. This will not only provide jobs for members of the community, but will also help its economy in less direct ways.

The development of this industrial park has the ability to impact Sioux City in a global, economic, environmental, and societal context. Because of the proposed layout of the sites, several businesses would have access to the rail system that currently exists. This means that businesses with a global reach may be attracted to the site due to the ease of shipping or receiving products. Similarly, businesses that do not currently have a global reach could use the rail system to expand their reach. The economic benefits of an industrial park are all positive. New business puts more money into both the State of Iowa and the City of Sioux City. The US Department of Commerce, Economic Development Administration will even potentially fund up to fifty percent of the cost of industrial park projects. The only negative economic issue is that the remainder of the funding would likely come from the community. Perhaps the largest downside of the industrial park could be the economic affects. Although it cannot be guaranteed that society will negatively be affected by the construction, the industrial park will likely increase emissions from large vehicles. Depending on the types of businesses that enter the site, their waste or emissions could also negatively impact Sioux City. Also, an infiltration basin is being provided to the site, but it is still possible that contaminants could reach the nearby creek. Sioux City would be positively impacted in a societal context. Each new business that enters the city has the potential to create hundreds of jobs. The only potential negative societal impact is the aesthetics of the industrial park itself. Overall, the positives of the generated wealth and jobs far outweigh the negatives.

## Alternative Solutions

Our engineers at Hawkeye Solutions have created three unique design alternatives that use the land differently and have different access points to the Industrial Park. All three of our designs include a spec building (approximately 720' x 360') and assume that 235th will be improved at some point. Each of the three designs also have the same parking lot layout around the building.

The first design that our engineers came up with divides the 300 acre lot into five smaller lots ranging from 50 to 120 acres; it can be seen in Figure 1. Design 1 places the two larger lots along the rail system, thus cutting off the three smaller lots access. The road layout was chosen because we decided that it would be best to create a loop. We determined that this would allow traffic to flow easily to all of the lots.

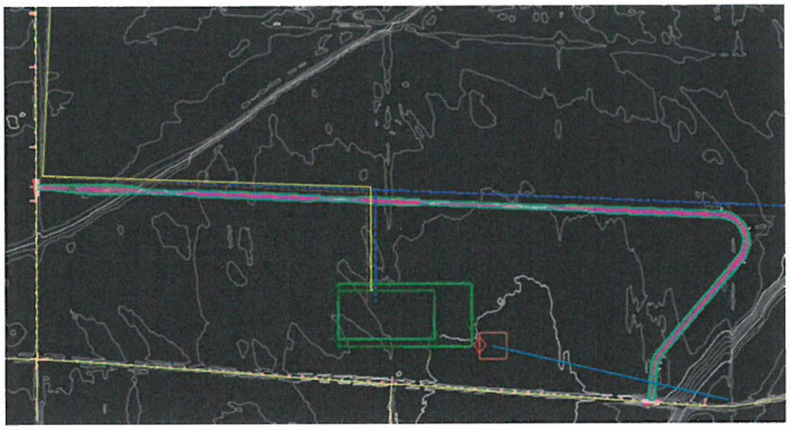

**Figure 1: Alternative 1**

Hawkeye Solutions' second design divides the lot into four smaller lots. The sizes of the lots are approximately the same as in design 1, ranging from 50 acres to 120 acres. Design 2 can be seen in Figure 2. This design also provides rail access to only two of the lots. For design 2, a smaller, interior loop is used. This is done to fit the lot shapes better while still providing easy access to each of the lots. The different shapes and sizes of the lots also allow for a more diverse range of businesses to move into the industrial park and the interior road loop still allows for traffic to be free flowing.

**Figure 2: Alternative 2**

Figure 3 shows our third design alternative. It uses the same lot divisions and design 2. Design 3 uses an exterior road loop as opposed to the interior loop used in the previous design. Although it adds more road length and may possibly require a retaining wall along the rail road, design 3 should allow for traffic to flow the easiest.

**Figure 3: Alternative 3**

## Selection Process

Design alternative 3 was eliminated from the selection process first. The major issue with design 3 was the possible retaining wall though would be needed between the proposed road and the railway. This wall would have been incredibly costly and would have required constant maintenance. Over time, the wall would have cost too much money to justify building. Design 3 also had the longest road, leading to the highest total cost of approximately $3.7 million.

The first design alternative was also eliminated during the selection process. Design 1 was similar to design 2, but the higher price of design 1 and the more diverse lots in design 2 separated the two. Although design 1 is cheaper than design 3, the estimated $3.5 million is approximately $700,000 more expensive than the design we ultimately ended up choosing.

## Final Design

Of the three design alternatives it was decided that the second alternative should be selected. The second alternative requires the shortest length of interior roads to be constructed as well as providing adequate access to the entire site. The interior road will be constructed as a secondary road with curbs on each side. Each intersection with 235$^{th}$ Avenue should be constructed at 90 degrees and the interior curves should be wide enough for semi-trucks to pass through without any problems. The interior road will be paved with 3" of asphalt over 6" of base course materials.

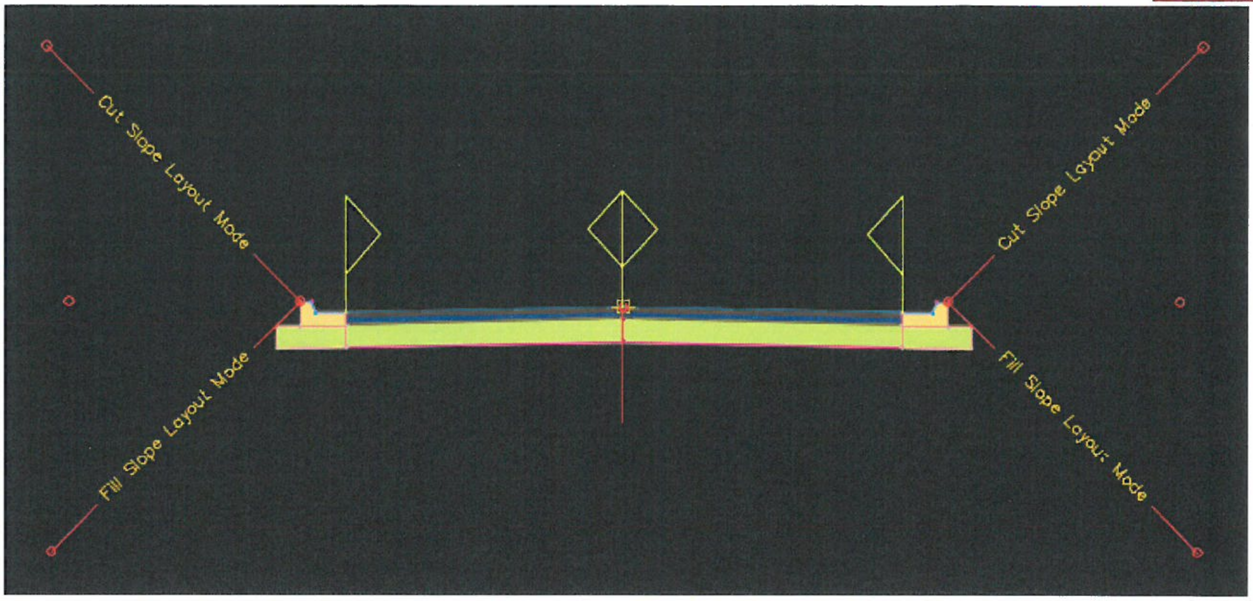


**Figure 4: Cross Section of Roadway**

**Structural**

Based on the lot divisions, Hawkeye Solutions proposed a 6 acre building that would be suitable for each of the three alternatives. The building has dimensions of 720ftx360ft. The frame of the building can be seen Figure 5.

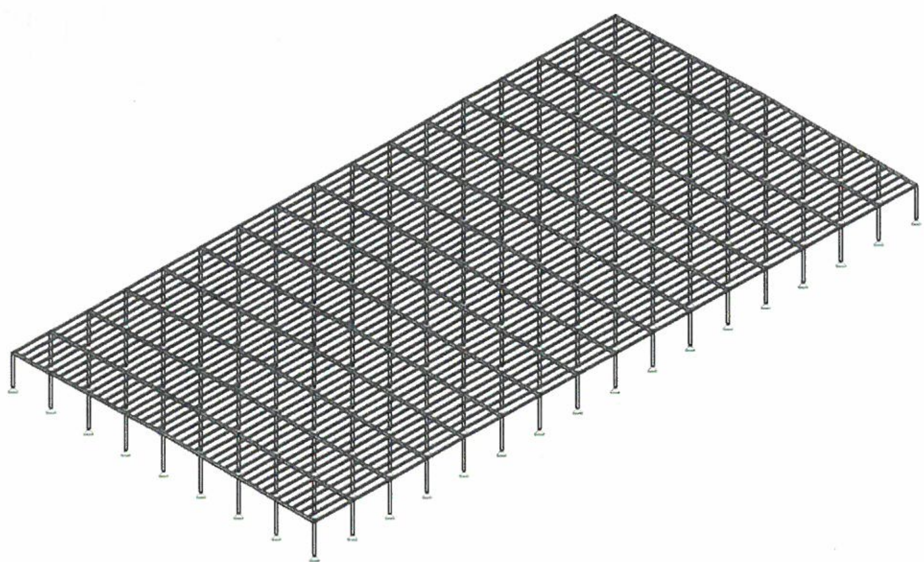

**Figure 5: Spec Building Frame**

In order to create a design for the building, the ASCE 7-10, the IBC, 2012, and the LRFD code books were referenced. The initial assumptions were as follows: columns spaced at 45ft, beams spaced at 9 feet, a ¼:12 roof slope, the structure is fully exposed, unheated and open air structure, risk category 4, exposure C, and enclosed building. With these assumptions in mind, Hawkeye Solutions proceeded with determining important factor based on the location of the building, which in this case is Sioux City. The factors are shown in Table 2.

**Table 2: Snow and Wind Factors for Sioux City, IA**

| Factors | | | | |
|---|---|---|---|---|
| **Snow** | | **Wind** | | |
| Is | 1.2 | kd | 0.85 | |
| Ct | 1.2 | kzt | 1 | |
| Ce | 0.9 | Gf | 0.85 | |
| Cs | 1 | GCpi | 0.18 | -0.18 |
| | | Kz(z=36ft) | 1.016 | |
| | | Kh(h=37.875ft) | 1.026 | |
| | | V (mph) | 120 | |
| | | Cp | 0.8 | -0.5 |

With the factors listed in the table above, we were able to determine the wind load, snow load, and dead load acting on the roof of the building. Table 3 provides the wind and snow loads.

**Table 3: Snow, Wind, and Dead Load**

| **Snow Load** | | **Wind Load** | | **Dead load, psf** | |
|---|---|---|---|---|---|
| pg (psf) | 35 | qz (psf) | 31.84 | mechanical | 4 |
| pf (psf) | 31.75 | qh(psf) | 32.15 | deck, 20g | 2.5 |
| **ps (psf)** | **31.75** | pw (psf) | 15.86 | beam sw | |
| | | pl (psf) | -19.45 | lights | 4 |
| | | **p (psf)** | **35.31** | **Total, psf** | 10.5 |

The following figures show the loads on the moment frames with pinned columns.

**Figure 6: Wind load over the longer span**

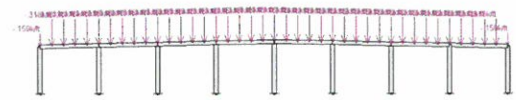

**Figure 7: Snow load on frame**

The ultimate goal is to transfer the load from the roof down to the foundation. Our load path was assumed to be: Roof→ Beam→ Girder→ Column→ Foundation. Using these loads and a 9ft beam spacing, a beam size of W24x76 was selected and is shown in Figure 8. The Girders were selected to be W36x231, and the Columns were selected to be W33x130. These members resulted as being able to adequately to withstand the loads on the building.

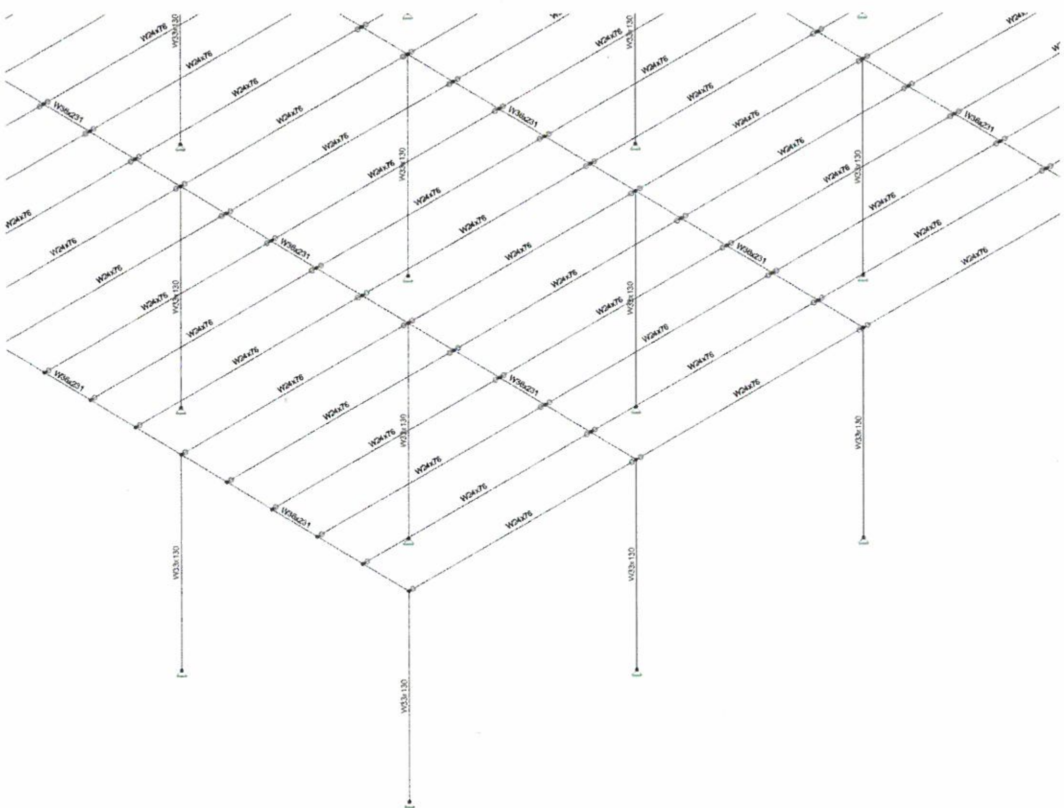


**Figure 8: Member selection**

In order to design the foundation, the forces and moments at each of the columns was determined. This would indicate the forces and moments acting at the footings. Prior to designing the footing, it was necessary to determine the soil profile that the building will be placed upon. It was determined that the soil is a silty sand, therefore the following table provides the bearing capacity of the soil.

**Table 4: Soil Bearing Capacity**

| Bearing Capacity | |
|---|---|
| vertical, psf | 3000 |
| lateral, psf/ft | 100 |
| cohesion, psf | 130 |

Using these values and the forces from the columns, and appropriate foundation was designed in Figures 8-10.

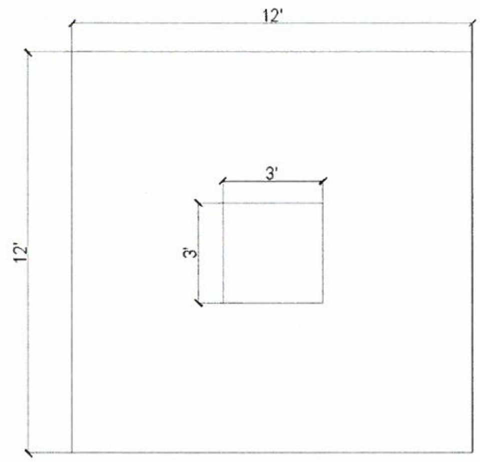


**Figure 8: Top view of Foundation**

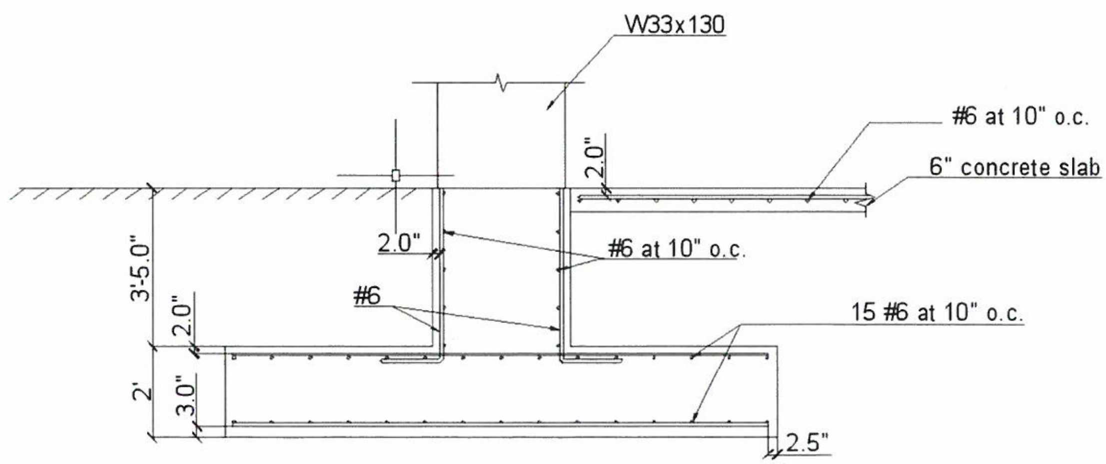


**Figure 9: Exterior footing**

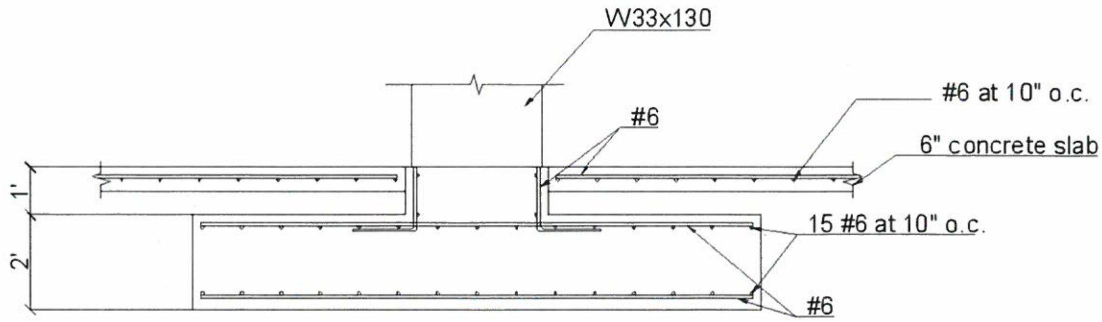


**Figure 10: Interior footing**

Two designs of footing are provided for the building. Plan view dimensions are the same for both designs while the interior footing is 2'-5" shorter in height than the exterior footing. The footings are reinforced by No. 6 rebar spacing at 10" on both top and bottom of the footing base. Anchorages are provided to tie up the columns. The exterior footings are placed along the building perimeter and interior footings are used for the interior columns. 3'-5" high and 12" thick foundation walls are placed under the exterior walls connecting each exterior footings. A spread footing is used to support the foundation walls. 6" concrete slab is used as the floor slab. The design calculations are provided in Appendix B.

**Building design**

Based on the structural design, a warehouse design is proposed for the site. The potential design is shown in Figure 11.

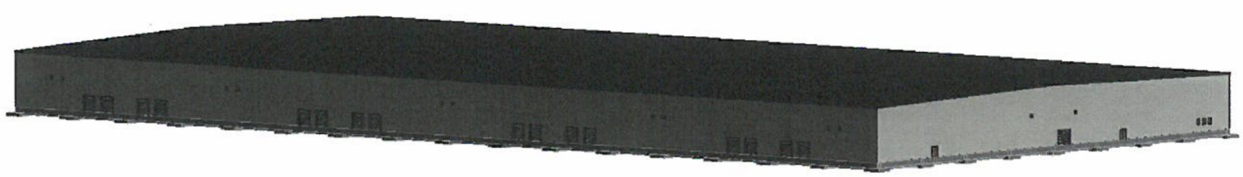

**Figure 11: Warehouse Design Finishing**

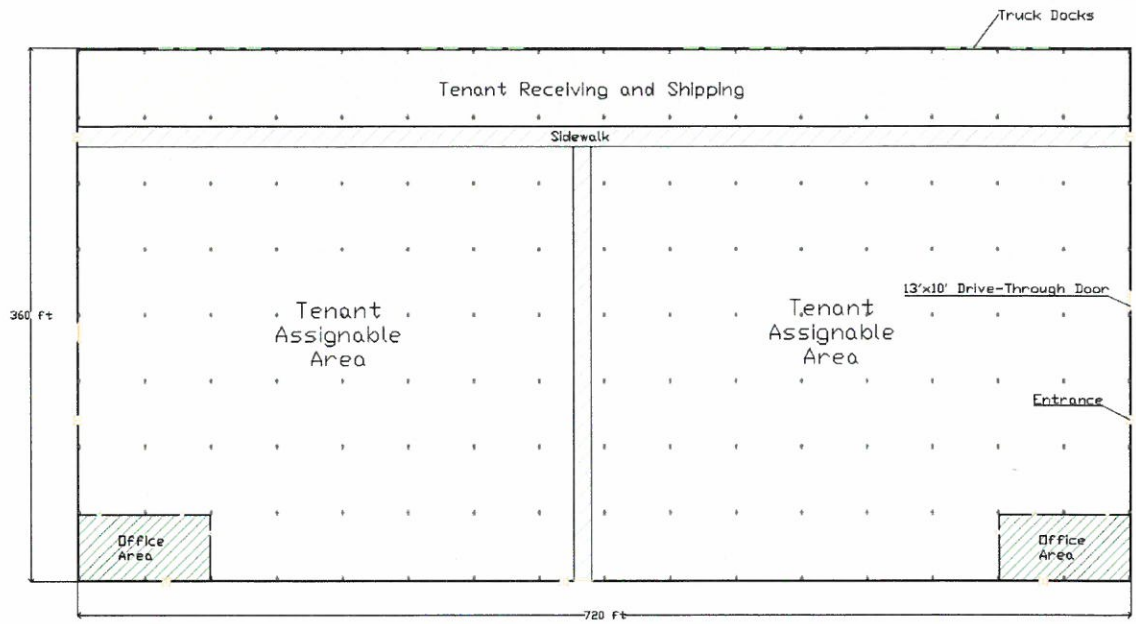


**Figure 12: Floor plan**

The design above is featured with the following characteristics:

- Size
  Dimension: 720' x 360'
  Ceiling height: 36' at sides, 39'-9" at center
  Total available area: 259,000 sq. ft.
  Available manufacturing area: 207,900 sq. ft.
  Total office area: 8100 sq. ft.
  Column spacing: 45' x 45'

- Specification
  Wall installation: 8" concrete exterior wall; 3 1/8" interior partition wall (1 hr fire protection)
  Roof installation: 9" basic roof
  Floor slab: 6" concrete slab
  No. of truck docks: 16
  Entrances: 3 drive-through bay doors (13' x 10'); 7 entrances
  Occupation: multiple tenants
  Adjustment: Same design will be used within the lot divisions. Layout of the building could be adjusted according to the clients' requests.

By using the water quality volume and other relevant calculations found in the appendix, the infiltration basin has a required minimum area of 3,561 $m^2$. To satisfy this requirement a basin that is 60 m by 60 m with an area of 3,600 $m^2$ is a conservative estimate. The basin should have a maximum depth of 0.7 m to allow appropriate freeboard over the outlet structure and the side slopes should be graded to 4:1 (H:V). The bottom of the basin should be graded with a mild 1-2% slope toward the outflow structure at the center. The parking lot should be graded so that the runoff from the impervious surfaces flows toward the southeast corner of the parking lot where it then enters the basin through an opening in the curb. The side slope of the infiltration basin at the curb opening should be reinforced with rip rap to prevent scour and erosion. The outflow structure should be a 1 m by 1 m single stage riser with a height of 0.5 m. The riser should have a 0.5 m wide weir located 0.3 m above the bottom of the basin to allow flow into the structure. The outflow from the riser is then directed through a 1 foot diameter reinforced concrete pipe which travels underground to a nearby stream.

## Cost and Construction Estimate

The estimated costs of the project were configured using the square root method of the R.S Means software. For the structure costs, we calculated the total square footage of the substructure, superstructure, exterior enclosure, and roofing, as seen in Table 5. We then used the bare total costs to create and estimated cost for the structure.

**Table 5: Cost Breakdown of Spec Building**

| Description | $/S.F. | COST , $ |
|---|---|---|
| SUBSTRUCTURE | 12.15 | 3147746.55 |
| SHELL: SUPERSTRUCTURE | 11.17 | 2890980.00 |
| SHELL: EXTERIOR ENCLOSURE | 2.4 | 622669.00 |
| SHELL: ROOFING | 4.46 | 1155300.00 |
| | **BUILDING SUBTOTAL:** | **$ 7,816,695.55** |

Estimating the cost of the roadways and utilities for Alternative 2 was performed using the same method as the structure as seen in Table 6. This gave us a consistent process of calculating costs, in order to accurately depict how much this design would cost.

**Table 6: Cost Breakdown of Roadways and Utilities**

| ALTERNATE 2 | | | |
|---|---|---|---|
| ITEM | Cost per Unit | Quantity | COST ($) |
| ASPHALT ROADS 3" ($/SY) | $ 22.40 | 13700 | $ 306,880.00 |
| ASPHALT PARKING 2" TOPPING 3" BINDER 6" STONE ($/LF) | $ 3.31 | 280000 | $ 926,800.00 |
| BASE COURSE 6" ($/SY) | $ 6.00 | 32000 | $ 192,000.00 |
| SANITARY 12" ($/LF) | $ 16.64 | 11020 | $ 183,372.80 |
| WATERMAIN PVC 16" ($/LF) | $ 25.54 | 19220 | $ 490,878.80 |
| 2 @ 4" ELECTRIC UTILITY ($/LF) | $ 52.74 | 13070 | $ 689,311.80 |
| EXCAVATION, ($/CY) | | | |
| FILL, ($/CY) | $ 6.05 | 3610 | $ 21,840.50 |
| | | **ROADWAYS AND UTILITY SUBTOTAL:** | **$ 2,789,243.40** |

# Conclusions

For this project, we recommend to use Alternative 2 for the Southbridge Industrial Park. This alternative will make the site an attractive plot of land for industrial businesses, while minimizing costs. The construction of a roadway surrounding the 6 acre spec building will allow access to each site for all types of traffic, as well as providing easy access to rail transport. All storm water treatment and flow control requirements will be met using an infiltration basin, and the recommended locations of all necessary utilities have been specified. The spec building was designed in an attempt to make the site attractive to a wide of a variety of businesses, the space is mostly open and can be purposed for whatever a developer needs, whether it be storage or manufacturing. The overall cost for this project comes out to a total of $14.6 million dollars. This cost includes all labor and materials, and allows a new business to come to our site, with all major costs already paid for. Overall the proposed site improvements will help make the Sioux City Industrial Park a viable option for expanding industries. By taking the initiative to start developing infrastructure now, Sioux City ensures that they will not miss out on any potential developers seeking to occupy the site as soon as possible.

## Bibliography


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6. Balboni, B. (2015). *Square foot costs, 2015* (36th annual ed.). Kingston, MA: R.S. Means.
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# Appendices

## Appendix A: Resumes

## Appendix B: Design Calculations

- **B.1: Load Calculations**
- **B.2: Building Calculations using RISA**
- **B.3: Foundation Design using TEDDS**
- **B.4: Cut and Fill**
- **B.5: Infiltration Basin**

## Appendix C: Permits

# Appendix A - Resumes

**Alex Bramhall**
327 E. College St. #1727 Iowa City, IA 52240
Phone: (480) 686-6587
E-mail: alex_bramhall@yahoo.com

Objective:
To obtain an engineering job where my skills can be applied and new skills can be learned.

Education:
Red Mountain High School — Graduation: 2010
7301 E. Brown Rd. Mesa, AZ 85205 — 2007-2010

University of Iowa — Expected Graduation: May 2015
Civil Engineering BSE with a Structural Focus Area

Qualifications:

| | | |
|---|---|---|
| **Auto CAD**: | Semester-long design course using Auto CAD | |
| **Revit**: | Designed houses and large structures using Revit | |
| **Programing**: | Semester-long course learning to program in C | |
| **Inspection**: | Inspection for MnDOT on **$380,000,000 St. Croix Crossing**, City of Cottage Grove, City of Chaska, City of Woodbury | |
| **Surveying**: | Experienced using GPS and Total Station | |
| **Team Player**: | Red Mountain High School **Student Council** | 2009-2010 |
| **Leader:** | SALT Company Leadership Team | 2012-Present |
| | RMHS Club RIF **President** Elect | 2008 |
| **Responsible:** | Arrive early and stay late | |
| | Complete all tasks thoroughly and in a timely manner | |

Experience:
Intern at **Stantec Inc.** — May-December 2013, May-August 2014
2335 State Highway 36 Service Road
Roseville, MN 55113

Camp Counselor at Mount Hermon Christian Camps — 2011, 2012 Summer
37 Conference Drive Mount Hermon, CA 95041

Awards:
**Dean's List** at University of Iowa — 2014
**Honor Roll** at Red Mountain High School — 2007-2010

Community Service:
Kinnick Stadium Concession Stand — 2012, 2014
Constructed Homes in Mexico — 2008-2010
Club RIF (Reading Is Fundamental) — 2008-Present
Inner City Resource Management in San Francisco and Denver — 2009, 2007

References:
Craig Larson (Construction Manager at Stantec) — Phone: (651) 775 - 5154
Melinda Koenig (Boss at Mount Hermon) — Phone: (661) 805 - 5424
Mark Staples (Youth Pastor & Leader of Service Trips) — Phone: (480) 258 - 2671

# Jack A. Machalek

1825 Spring Green Drive, Wheaton Illinois, 60189
(630) 877-2272 Jack-Machalek@uiowa.edu


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**Objective:** To obtain a full time position as a construction engineer within a company focused on safety and providing superior quality construction.

## Education:

The University of Iowa, Iowa City, IA — Fall 2011- Present
Major- Civil Engineering — Expected Graduation Date: May 2015

## Project Experience:

2013 City of Wheaton Sidewalk Renovation Project — Summer 2013

**Supervised the removal and installation of sidewalk in Wheaton**

- Recorded measurements of concrete on an Ipad device
- Communicated with and responded to resident's questions
- Communicated with contractor on what progress has been made as well as answer questions

## Internship Experience:

City of Wheaton, Wheaton, IL — Summer 2013

**Supervise various projects happening within Wheaton**

- Surveyed roads that needed reconstruction
- Performed erosion control tests
- Recorded measurements including cut/fill, water main lengths, concrete quantities

Gilbane Building Company, Iowa City, Iowa — Summer 2014- Present

**Worked under project managers on three different projects, including a Children's Hospital**

- Kept several drawing sets and specifications up to date through constant revisions during design and construction of the project
- Supervised construction crews during off hour concrete pours and off hour shifts while updating daily reports
- Recorded weekly progress of the project
- Used excel to log crew hours and keep track of change order payments
- OSHA 30 Hour Certified

## Leadership:

Mentor for the Children of Promise One-on-One Mentoring — Summer 2011-2013

- Motivate less fortunate children to become the best they can be
- Encourage having fun the safe way

Theta Tau Professional Engineering Fraternity — Spring 2012-Present

- Member of 2012 Pledge Class

Two Time 7A Football State Champion — Fall 2009- Fall 2010

## Employment:

Wheaton Park District — Spring 2011-Present

**Camp Counselor**

- Led sports camps during the winter and summer terms
- Taught children the key ideas to various sports
- Motivated children through fun exercise

**References:** Available Upon Request

# Jason Cárdenas, EI

213 East 5th Street
West Liberty, IA 52776

www.linkedin.com/in/jcstructural/

319.936.6419
jason-cardenas@uiowa.edu

## Education

University of Iowa, Iowa City, IA — Graduation Date: May 2015
Major: Civil Engineering with a focus in **Structural Engineering** — GPA: 3.2/4.0

## Internship Experience

*Structural Engineer Intern*, Shive-Hattery, Iowa City, IA — October 2013-Present

- Completed structural assessment of 35 vaults and 17,000 feet of tunnel for the University of Iowa campus
- Drafted structural components for the Clear Creek Amana Middle School addition
- Designed 25 concrete electrical vaults for the University of Iowa Grand Avenue reconstruction
- Represented Shive-Hattery at the 2014 University of Iowa Engineering Career Fair
- In charge of field inspections and observation reports
- Revise shop drawings to assure requirements are met per engineer's specifications. Shop drawings include: steel, rebar, masonry, joists, and roof deck
- Attend monthly one-hour structural engineering seminars and construction meetings

## Computer Skills

- ***Revit*** - Versatile modeling and drafting in Revit 2014
- ***AutoCAD*** - Skillful drafting in 2D and 3D model space in AutoCAD 2014
- ***Tedds*** - Competent in Tedds for calculation of design moment and shear of structural components
- ***Enercalc*** - Well-versed in Enercalc for the design of concrete reinforced beams
- ***Risa*** - Use of Risa to extract maximum loads and deflections of structures
- ***ANSYS*** - Experienced using ANSYS for the analysis of structures
- ***Microsoft Office*** - Proficient in Excel, Word, and PowerPoint

## Work Experience

*Apprentice,* Advanced Electrical Services, Iowa City, IA — Summer 2009-2011

- Wired new commercial developments including a school and the Iowa City Press-Citizen building
- Installed underground coax cable across North Liberty, IA for street cameras

*Crew Member*, Akers' Construction — September 2009-May 2010

- Collaborated as crew member for framing single and multi-family dwellings

*Property Manager*, Family-Owned, West Liberty, IA — June 2008-February 2013

- Managed 7 rental units, including screening applications and monthly rent collection
- Responsible for property repairs and maintenance

## Leadership

***Project Manager**, Senior design Project* — January 2015- Present

- Managed Senior design project which included organizing team meetings and contacting the client

*Secretary of the **Society of Hispanic Professional Engineers*** — August 2012-May 2014

- Responsible for keeping members informed of upcoming local and national events
- In charge of member recruitment and retention
- In charge of program development for fundraising events

*Band/Choir Director* — 2007-2013

- Led band and coordinated various concerts and socials

## Communications Experience

*Public Speaker* — 2005-Present

- Fluent in Spanish and English
- Travel across the USA, Guatemala, and Honduras to speak at church events and youth gatherings

# Silas Daniel Tappendorf

Silas-tappendorf@uiowa.edu Cell: (217) 621-7206

Permanent Address:
2104 Belmont Park Lane
Champaign, IL 61822

University Address:
14 N Lucas
Iowa City, IA 52245

## Education

**University of Iowa,** Iowa City, IA — August 2012 – May 2015
Major: Civil Engineering (Focus Area: Management) — Projected Date of Graduation: May 2015
Major GPA: 2.93 / 4.00

• Coursework: Thermodynamics, Dynamics, Circuits, Natural Environmental Systems, Mechanics of Deformable Bodies, Matrix Algebra, Differential Equations, Probability and Statistics for Engineers, Soil Mechanics, Fluid Mechanics, Principles of Transportation Engineering, Principles of Structural Engineering, Principles of Environmental Engineering, Principles of Hydraulics and Hydrology, Civil Engineering Materials, Water Resource Design, Design of Concrete Structures, Foundations of GIS, Microeconomics, Macroeconomics, Financial Accounting, Managerial Accounting, Introduction to Law

**Parkland College,** Champaign, IL — August 2010 – May 2012

• Coursework: Chemistry I &II, Calculus I, II, & III, Physics I, II, & III, Programming in C++

## Work Experience

**Midwest Engineering and Testing,** Champaign, IL — Summer 2010 – Summer 2013

• Conducted various field material tests including
  - Concrete slump and air tests
  - Assisted on a Dietrich D-120 drill rig collecting soil cores
  - Floor flatness tests
  - Collected pavement cores
  - Used a Trimble Dini Laser Level
  - Collecting samples to be analyzed for asbestos

• Conducted various lab soil and concrete tests
• Helped generate preliminary project proposals and geotechnical reports

**University of Iowa Surplus,** Iowa City, IA — Summer 2014

• Worked for the University for flexible hours to accommodate taking summer classes

## Software Experience

• AutoCAD, both Civil and 3-D Manufacturing Versions
• ArcGIS and ArcMAP
• Storm Water Management Model (SWMM)
• ANSYS
• Microsoft Office

# Suyin Yao

**Current Address:**
29 W Burlington Apt201
Iowa City, IA 52240

**Phone:** +1(319)-855-0334
**Email:** suyin-yao@uiowa.edu
suyinyaov3@gmail.com


## Education

2011-present The University of Iowa — GPA: <3.52>/4.0
Civil Engineering---structures, mechanics and materials EFA
International study: CIEE Paris Summer Program, France — summer 2014

## Internship

**Scenic Area Transportation Planning** — December, 2015-January, 2014
Guangzhou Municipal Engineering Design and Research Institute, China

- Investigation on current development of sightseeing rail
- Analyzing potentials, constrains, and existing projects
- Analyze scenic site and develop possible rout map

## Engineering Experience

**Casino design** Civil & Environmental Engineering Practice — Fall 2013

- Design a casino building
- Drafting site plan and detailed floor plan for the utilities
- Report the design idea, consideration and accommodations for the design

**AutoCAD projects**

**3D model of Hagia Sophia** Computer Aid Design — Fall 2014

- Construct a simplified 3D model of Hagia Sophia
- Break down the structure into several components and showing the details

**Floor plan drawing**

- Draw a floor plan for a floor in a building with detailed equipment and furnishing
- Include schedules and add attributes to the elements showing in plan

**Revit Architecture projects**

**Residential house design** Computer Aid Design — Fall 2014

- Design an residential house
- Create an architecture model with details

**Office building design** Computer Aid Design — Fall 2014

- Design a office building base on a steel framing, incorporate with the specified details
- Create an architecture model of the office building using Revit

**Statistical analysis** Statics — Fall 2012

- Doing a structural analysis on the internal and external section of the Art Building West on campus
- Write a business intend for the purpose of the project
- Estimate the cost of the study and report the analysis and the work plan

## Leadership Experience

Delta Phi Lambda Sorority Inc. Academic Chair & Policy Chair

## Volunteer Experience

FSL booklet and Family Guide Translation

## Honors and Awards

UI National Scholars Award — 2011-Present

## Memberships

Delta Phi Lambda Sorority Inc.

## Language Skill

English, Chinese, Cantonese

## Hobbies

Painting, piano, tennis

## Appendix B - Calculations

## B.1: Load Calculations

SHIVE HATTERY

PROJECT: Senior Design JOB NO. LRFD PAGE ____ OF ____ PAGES

SUBJECT: Calculated loads DATE: ____ COMP BY: ____ OK'D BY ____

**Snow**

(tributary width)

$$31.75 \frac{lb}{ft^2} \times 9 ft = 285.75 \frac{lb}{ft}$$

$$31.75 \frac{lb}{ft^2} \times 4.5 ft = 142.88 \frac{lb}{ft}$$

**Dead**

$$6.5 \frac{lb}{ft^2} \times 9 ft = 58.5 \frac{lb}{ft}$$

$$6.5 \frac{lb}{ft^2} \times 4.5 ft = 29 \frac{lb}{ft}$$

**Wind**

(tributary width)

$$35.31 \frac{lb}{ft^2} \times 45 ft = 1,588 \frac{lb}{ft}$$

$$35.31 \frac{lb}{ft^2} \times 22.5 ft = 794 \frac{lb}{ft}$$

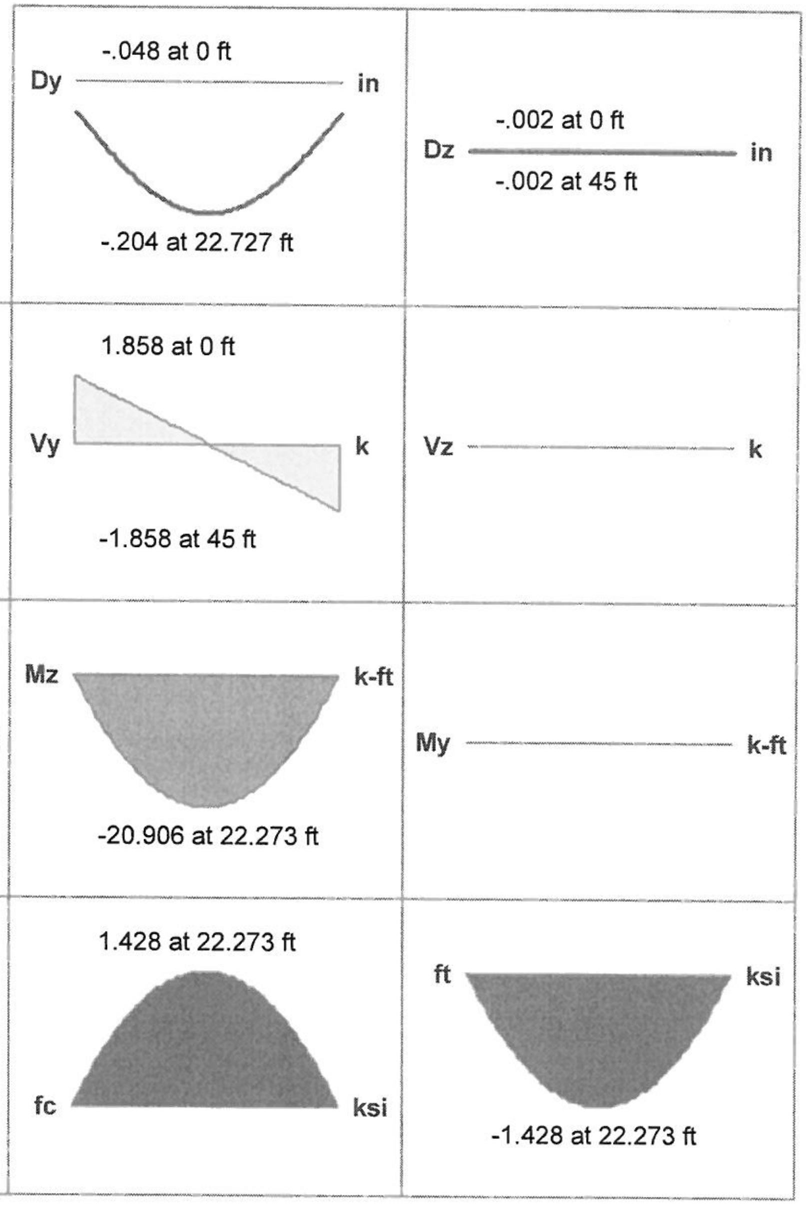
**Live load**

$$20 \frac{lb}{ft^2} \times 9 ft = 180 \frac{lb}{ft}$$

## B.2: Building Design Using RISA (example of one member)

Beam: ***M131***

Shape: **W24x76**
Material: **A992**
Length: **45 ft**
I Joint: **N99**
J Joint: **N190**
LC 1: IBC 16-1
Code Check: **0.135 (bending)**
Report Based On 100 Sections




### *AISC 14th(360-10): LRFD Code Check*
**Direct Analysis Method**

| | | | |
|---|---|---|---|
| Max Bending Check | **0.135** | Max Shear Check | **0.006 (y)** |
| Location | **22.273 ft** | Location | **0 ft** |
| Equation | **H1-1b** | Max Defl Ratio | **L/3453** |
| Bending Flange | **Compact** | Compression Flange | **Non-Slender Qs=1** |
| Bending Web | **Compact** | Compression Web | **Slender Qa=1** |

| | |
|---|---|
| Fy | **50 ksi** |
| phi*Pnc | **63.916 k** |
| phi*Pnt | **1008 k** |
| phi*Mny | **107.25 k-ft** |
| phi*Mnz | **155.315 k-ft** |
| phi*Vny | **315.48 k** |
| phi*Vnz | **330.113 k** |
| Cb | **1.14** |

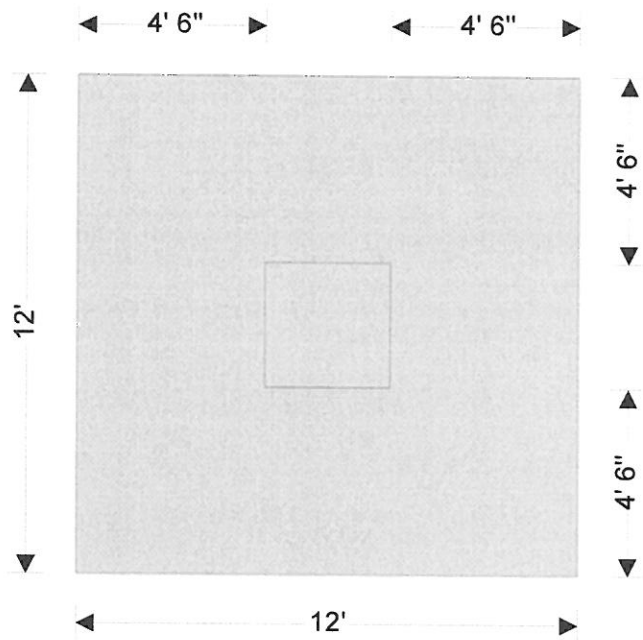
| | y-y | z-z |
|---|---|---|
| Lb | **45 ft** | **45 ft** |
| KL/r | **281.378** | **55.771** |

| | |
|---|---|
| L Comp Flange | **45 ft** |
| Warp Length | **NC** |
| L-torque | **45 ft** |
| Tau_b | **1** |

| Tedds<br>**APPENDIX B.3** | Project: Southbridge Industrial Park | | | Job Ref. | |
|---|---|---|---|---|---|
| | Section: Footing design | | | Sheet no./rev. 1 | |
| | Calc. by: HS | Date: 4/7/2015 | Chk'd by | Date | App'd by | Date |

## COMBINED FOOTING ANALYSIS AND DESIGN (ACI318-11)

TEDDS calculation version 2.0.05.06




### Combined footing details

| | |
|---|---|
| Length of combined footing | L = **12.000** ft |
| Width of combined footing | B = **12.000** ft |
| Area of combined footing | $A = L \times B =$ **144.000** ft$^2$ |
| Depth of combined footing | h = **24.000** in |
| Depth of soil over combined footing | $h_{soil}$ = **42.000** in |
| Density of concrete | $\rho_{conc}$ = **150.0** lb/ft$^3$ |

### Column details

| | |
|---|---|
| Column base length | $l_A$ = **36.000** in |
| Column base width | $b_A$ = **36.000** in |
| Column eccentricity in x | $e_{PxA}$ = **0.000** in |
| Column eccentricity in y | $e_{PyA}$ = **0.000** in |

### Soil details

| | |
|---|---|
| Density of soil | $\rho_{soil}$ = **120.0** lb/ft$^3$ |
| Angle of internal friction | $\phi'$ = **25.0** deg |
| Design base friction angle | $\delta$ = **19.3** deg |
| Coefficient of base friction | $\tan(\delta)$ = **0.350** |
| Allowable bearing pressure | $P_{bearing}$ = **3.000** ksf |

### Axial loading on column

| | |
|---|---|
| Dead axial load on column | $P_{GA}$ = **48.780** kips |

Live axial load on column $P_{QA}$ = **0.000** kips
Wind axial load on column $P_{WA}$ = **2.970** kips
Total axial load on column $P_A$ = **51.750** kips

**Foundation loads**

Dead surcharge load $F_{Gsur}$ = **0.000** ksf
Live surcharge load $F_{Qsur}$ = **0.350** ksf
Footing self weight $F_{swt} = h \times \rho_{conc}$ = **0.300** ksf
Soil self weight $F_{soil} = h_{soil} \times \rho_{soil}$ = **0.420** ksf
Total foundation load $F = A \times (F_{Gsur} + F_{Qsur} + F_{swt} + F_{soil})$ = **154.080** kips

**Horizontal loading on column base**

Dead horizontal load in x direction $H_{GxA}$ = **2.330** kips
Live horizontal load in x direction $H_{QxA}$ = **0.000** kips
Wind horizontal load in x direction $H_{WxA}$ = **34.000** kips
Total horizontal load in x direction $H_{xA}$ = **36.330** kips
Dead horizontal load in y direction $H_{GyA}$ = **0.000** kips
Live horizontal load in y direction $H_{QyA}$ = **0.000** kips
Wind horizontal load in y direction $H_{WyA}$ = **0.000** kips
Total horizontal load in y direction $H_{yA}$ = **0.000** kips

**Check stability against sliding**

Resistance to sliding due to base friction

$H_{friction} = \max([P_{GA} + (F_{Gsur} + F_{swt} + F_{soil}) \times A], 0 \text{ kips}) \times \tan(\delta)$ = **53.391** kips

Passive pressure coefficient $K_p = (1 + \sin(\phi')) / (1 - \sin(\phi'))$ = **2.464**

**Stability against sliding in x direction**

Passive resistance of soil in x direction $H_{xpas} = 0.5 \times K_p \times (h^2 + 2 \times h \times h_{soil}) \times B \times \rho_{soil}$ = **31.932** kips
Total resistance to sliding in x direction $H_{xres} = H_{friction} + H_{xpas}$ = **85.323** kips

***PASS - Resistance to sliding is greater than horizontal load in x direction***

**Check stability against overturning in x direction**

Total overturning moment $M_{xOT} = M_{xA} + H_{xA} \times h$ = **72.660** kip_ft

**Restoring moment in x direction**

Foundation loading $M_{xsur} = A \times (F_{Gsur} + F_{swt} + F_{soil}) \times L / 2$ = **622.080** kip_ft
Axial loading on column $M_{xaxial} = (P_{GA}) \times (L / 2 - e_{PxA})$ = **292.680** kip_ft
Total restoring moment $M_{xres} = M_{xsur} + M_{xaxial}$ = **914.760** kip_ft

***PASS - Restoring moment is greater than overturning moment in x direction***

**Calculate base reaction**

Total base reaction $T = F + P_A$ = **205.830** kips
Eccentricity of base reaction in x $e_{Tx} = (P_A \times e_{PxA} + M_{xA} + H_{xA} \times h) / T$ = **4.236** in
Eccentricity of base reaction in y $e_{Ty} = (P_A \times e_{PyA} + M_{yA} + H_{yA} \times h) / T$ = **0.000** in

**Check base reaction eccentricity**

$\text{abs}(e_{Tx}) / L + \text{abs}(e_{Ty}) / B$ = **0.029**

***Base reaction acts within middle third of base***

| Tedds<br>Shive-Hattery<br>2834 Northgate Drive<br>Iowa City, IA 52245 | Project | | | Job Ref. | |
|---|---|---|---|---|---|
| | Section | | | Sheet no./rev.<br>3 | |
| | Calc. by<br>J | Date<br>4/7/2015 | Chk'd by | Date | App'd by | Date |

**Calculate base pressures**

$q_1 = T / A - 6 \times T \times e_{Tx} / (L \times A) - 6 \times T \times e_{Ty} / (B \times A) = \mathbf{1.177}$ ksf

$q_2 = T / A - 6 \times T \times e_{Tx} / (L \times A) + 6 \times T \times e_{Ty} / (B \times A) = \mathbf{1.177}$ ksf

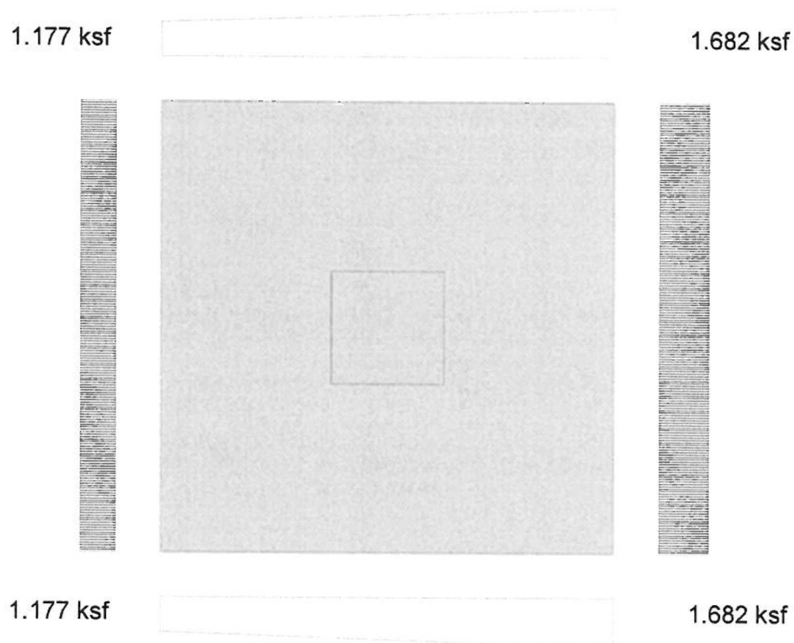
$q_3 = T / A + 6 \times T \times e_{Tx} / (L \times A) - 6 \times T \times e_{Ty} / (B \times A) = \mathbf{1.682}$ ksf

$q_4 = T / A + 6 \times T \times e_{Tx} / (L \times A) + 6 \times T \times e_{Ty} / (B \times A) = \mathbf{1.682}$ ksf

Minimum base pressure $q_{min} = \min(q_1, q_2, q_3, q_4) = \mathbf{1.177}$ ksf

Maximum base pressure $q_{max} = \max(q_1, q_2, q_3, q_4) = \mathbf{1.682}$ ksf

***PASS - Maximum base pressure is less than allowable bearing pressure***




**Load combination factors for loads**

Load combination factor for dead loads $\gamma_{fG} = \mathbf{1.20}$

Load combination factor for live loads $\gamma_{fQ} = \mathbf{1.60}$

Load combination factor for wind loads $\gamma_{fW} = \mathbf{0.00}$

**Strength reduction factors**

Flexural strength reduction factor $\phi_f = \mathbf{0.90}$

Shear strength reduction factor $\phi_s = \mathbf{0.75}$

**Ultimate axial loading on column**

Ultimate axial load on column $P_{uA} = P_{GA} \times \gamma_{fG} + P_{QA} \times \gamma_{fQ} + P_{WA} \times \gamma_{fW} = \mathbf{58.536}$ kips

**Ultimate foundation loads**

Ultimate foundation load $F_u = A \times [(F_{Gsur} + F_{swt} + F_{soil}) \times \gamma_{fG} + F_{Qsur} \times \gamma_{fQ}] = \mathbf{205.056}$ kips

**Ultimate horizontal loading on column**

Ultimate horizontal load in x direction $H_{xuA} = H_{GxA} \times \gamma_{fG} + H_{QxA} \times \gamma_{fQ} + H_{WxA} \times \gamma_{fW} = \mathbf{2.796}$ kips

Ultimate horizontal load in y direction — $H_{yuA} = H_{GyA} \times \gamma_{fG} + H_{QyA} \times \gamma_{fQ} + H_{WyA} \times \gamma_{fW}$ = **0.000** kips

**Ultimate moment on column**

Ultimate moment on column in x direction — $M_{xuA} = M_{GxA} \times \gamma_{fG} + M_{QxA} \times \gamma_{fQ} + M_{WxA} \times \gamma_{fW}$ = **0.000** kip_ft

Ultimate moment on column in y direction — $M_{yuA} = M_{GyA} \times \gamma_{fG} + M_{QyA} \times \gamma_{fQ} + M_{WyA} \times \gamma_{fW}$ = **0.000** kip_ft

**Calculate ultimate base reaction**

Ultimate base reaction — $T_u = F_u + P_{uA}$ = **263.592** kips

Eccentricity of ultimate base reaction in x — $e_{Txu} = (P_{uA} \times e_{PxA} + M_{xuA} + H_{xuA} \times h) / T_u$ = **0.255** in

Eccentricity of ultimate base reaction in y — $e_{Tyu} = (P_{uA} \times e_{PyA} + M_{yuA} + H_{yuA} \times h) / T_u$ = **0.000** in

**Calculate ultimate base pressures**

$q_{1u} = T_u/A - 6 \times T_u \times e_{Txu}/(L \times A) - 6 \times T_u \times e_{Tyu}/(B \times A)$ = **1.811** ksf

$q_{2u} = T_u/A - 6 \times T_u \times e_{Txu}/(L \times A) + 6 \times T_u \times e_{Tyu}/(B \times A)$ = **1.811** ksf

$q_{3u} = T_u/A + 6 \times T_u \times e_{Txu}/(L \times A) - 6 \times T_u \times e_{Tyu}/(B \times A)$ = **1.850** ksf

$q_{4u} = T_u/A + 6 \times T_u \times e_{Txu}/(L \times A) + 6 \times T_u \times e_{Tyu}/(B \times A)$ = **1.850** ksf

Minimum ultimate base pressure — $q_{minu} = \min(q_{1u}, q_{2u}, q_{3u}, q_{4u})$ = **1.811** ksf

Maximum ultimate base pressure — $q_{maxu} = \max(q_{1u}, q_{2u}, q_{3u}, q_{4u})$ = **1.850** ksf

**Calculate rate of change of base pressure in x direction**

Left hand base reaction — $f_{uL} = (q_{1u} + q_{2u}) \times B / 2$ = **21.733** kips/ft

Right hand base reaction — $f_{uR} = (q_{3u} + q_{4u}) \times B / 2$ = **22.199** kips/ft

Length of base reaction — $L_x = L$ = **144.000** in

Rate of change of base pressure — $C_x = (f_{uR} - f_{uL}) / L_x$ = **0.039** kips/ft/ft

**Calculate footing lengths in x direction**

Left hand length — $L_L = L / 2 + e_{PxA}$ = **6.000** ft

Right hand length — $L_R = L / 2 - e_{PxA}$ = **6.000** ft

**Calculate ultimate moments in x direction**

Ultimate moment in x direction — $M_x = f_{uL} \times L_L^2 / 2 + C_x \times L_L^3 / 6 - F_u \times L_L^2 / (2 \times L) + H_{xuA} \times h$ = **90.600** kip_ft

**Calculate rate of change of base pressure in y direction**

Top edge base reaction — $f_{uT} = (q_{2u} + q_{4u}) \times L / 2$ = **21.966** kips/ft

Bottom edge base reaction — $f_{uB} = (q_{1u} + q_{3u}) \times L / 2$ = **21.966** kips/ft

Length of base reaction — $L_y = B$ = **12.000** ft

Rate of change of base pressure — $C_y = (f_{uB} - f_{uT}) / L_y$ = **0.000** kips/ft/ft

**Calculate footing lengths in y direction**

Top length — $L_T = B / 2 + e_{PyA}$ = **6.000** ft

Bottom length — $L_B = B / 2 - e_{PyA}$ = **6.000** ft

**Calculate ultimate moments in y direction**

Ultimate moment in y direction — $M_y = f_{uT} \times L_T^2 / 2 + C_y \times L_T^3 / 6 - F_u \times L_T^2 / (2 \times B)$ = **87.804** kip_ft

**Material details**

Compressive strength of concrete — $f'_c$ = **4000** psi

Yield strength of reinforcement — $f_y$ = **60000** psi

Cover to reinforcement — $c_{nom}$ = **3.000** in

Concrete type — Normal weight

Concrete modification factor $\lambda$ = **1.00**

**Moment design in x direction**

Reinforcement provided 15 No. 6 bars bottom and 15 No. 6 bars top

Depth of tension reinforcement $d_x = h - c_{nom} - \phi_{xB} / 2 = \mathbf{20.625}$ in

Area of tension reinforcement provided $A_{s\_xB\_prov} = N_{xB} \times \pi \times \phi_{xB}^2 / 4 = \mathbf{6.627}$ in$^2$

Area of compression reinforcement provided $A_{s\_xT\_prov} = N_{xT} \times \pi \times \phi_{xT}^2 / 4 = \mathbf{6.627}$ in$^2$

Minimum area of reinforcement $A_{s\_x\_min} = 0.0018 \times h \times B = \mathbf{6.221}$ in$^2$

Spacing of reinforcement $s_{xB\_prov} = (B - 2 \times c_{nom}) / \max(N_{xB} - 1, 1) = \mathbf{9.857}$ in

Maximum spacing of reinforcement $s_{max} = \min(3 \times h, 18in) = \mathbf{18.000}$ in

***PASS - Reinforcement provided exceeds minimum reinforcement required***

Depth of compression block $a_x = A_{s\_xB\_prov} \times f_y / (0.85 \times f'_c \times B) = \mathbf{0.81}$ in

Neutral axis factor $\beta_1 = \mathbf{0.85}$

Depth to the neutral axis $c_{na\_x} = a_x / \beta_1 = \mathbf{0.96}$ in

Strain in reinforcement $\varepsilon_{t\_x} = 0.003 \times (d_x - c_{na\_x}) / c_{na\_x} = \mathbf{0.06176}$

***PASS - The section has adequate ductility (cl. 10.3.5)***

Nominal moment strength required $M_{nx} = abs(M_x) / \phi_f = \mathbf{100.667}$ kip_ft

Moment capacity of base $M_{capx} = A_{s\_xB\_prov} \times f_y \times [d_x - (A_{s\_xB\_prov} \times f_y / (1.7 \times f'_c \times B))]$

$M_{capx} = \mathbf{669.934}$ kip_ft

***PASS - Moment capacity of base exceeds nominal moment strength required***

**Moment design in y direction**

Reinforcement provided 15 No. 6 bars bottom and 15 No. 6 bars top

Depth of tension reinforcement $d_y = h - c_{nom} - \phi_{xB} - \phi_{yB} / 2 = \mathbf{19.875}$ in

Area of tension reinforcement provided $A_{s\_yB\_prov} = N_{yB} \times \pi \times \phi_{yB}^2 / 4 = \mathbf{6.627}$ in$^2$

Area of compression reinforcement provided $A_{s\_yT\_prov} = N_{yT} \times \pi \times \phi_{yT}^2 / 4 = \mathbf{6.627}$ in$^2$

Minimum area of reinforcement $A_{s\_y\_min} = 0.0018 \times h \times L = \mathbf{6.221}$ in$^2$

Spacing of reinforcement $s_{yB\_prov} = (L - 2 \times c_{nom}) / \max(N_{yB} - 1, 1) = \mathbf{9.857}$ in

Maximum spacing of reinforcement $s_{max} = \min(3 \times h, 18in) = \mathbf{18.000}$ in

***PASS - Reinforcement provided exceeds minimum reinforcement required***

Depth of compression block $a_y = A_{s\_yB\_prov} \times f_y / (0.85 \times f'_c \times L) = \mathbf{0.81}$ in

Neutral axis factor $\beta_1 = \mathbf{0.85}$

Depth to the neutral axis $c_{na\_y} = a_y / \beta_1 = \mathbf{0.96}$ in

Strain in reinforcement $\varepsilon_{t\_y} = 0.003 \times (d_y - c_{na\_y}) / c_{na\_y} = \mathbf{0.05941}$

***PASS - The section has adequate ductility (cl. 10.3.5)***

Nominal moment strength required $M_{ny} = abs(M_y) / \phi_f = \mathbf{97.560}$ kip_ft

Moment capacity of base $M_{capy} = A_{s\_yB\_prov} \times f_y \times [d_y - (A_{s\_yB\_prov} \times f_y / (1.7 \times f'_c \times L))]$

$M_{capy} = \mathbf{645.084}$ kip_ft

***PASS - Moment capacity of base exceeds nominal moment strength required***

**Calculate ultimate shear force at d from top face of column**

Ultimate pressure for shear d from face of column $q_{su} = (q_{1u} - C_y \times (B / 2 + e_{PyA} + b_A / 2 + d_y) / L + q_{4u}) / 2$

$q_{su} = \mathbf{1.830}$ ksf

Area loaded for shear at d from face of column $A_s = L \times (B / 2 - e_{PyA} - b_A / 2 - d_y) = \mathbf{34.125}$ ft$^2$

Ultimate shear force at d from face of column — $V_{su} = A_s \times (q_{su} - F_u / A) =$ **13.872** kips

**Shear design at d from top face of column**

Strength reduction factor in shear — $\phi_s =$ **0.75**

Nominal shear strength — $V_{nsu} = V_{su} / \phi_s =$ **18.496** kips

Concrete shear strength — $V_{c\_s} = 2 \times \lambda \times \sqrt{(f'_c \times 1 \text{ psi})} \times (L \times d_y) =$ **362.018** kips

***PASS - Nominal shear strength is less than concrete shear strength***

**Calculate ultimate punching shear force at perimeter of d / 2 from face of column**

Ultimate pressure for punching shear — $q_{puA} = q_{1u}+[(L/2+e_{PxA}-l_A/2-d/2)+(l_A+2\times d/2)/2]\times C_x/B-[(B/2+e_{PyA}-b_A/2-d/2)+(b_A+2\times d/2)/2]\times C_y/L$

$q_{puA} =$ **1.830** ksf

Average effective depth of reinforcement — $d = (d_x + d_y) / 2 =$ **20.250** in

Area loaded for punching shear at column — $A_{pA} = (l_A+2\times d/2)\times(b_A+2\times d/2) =$ **21.973** $ft^2$

Length of punching shear perimeter — $u_{pA} = 2\times(l_A+2\times d/2)+2\times(b_A+2\times d/2) =$ **18.750** ft

Ultimate shear force at shear perimeter — $V_{puA} = P_{uA} + (F_u / A - q_{puA}) \times A_{pA} =$ **49.604** kips

**Punching shear stresses at perimeter of d / 2 from face of column**

Nominal shear strength — $V_{npuA} = V_{puA} / \phi_s =$ **66.139** kips

Ratio of column long side to short side — $\beta_A = \max(l_A, b_A) / \min(l_A, b_A) =$ **1.000**

Column constant for interior column — $\alpha_{sA} = 40$

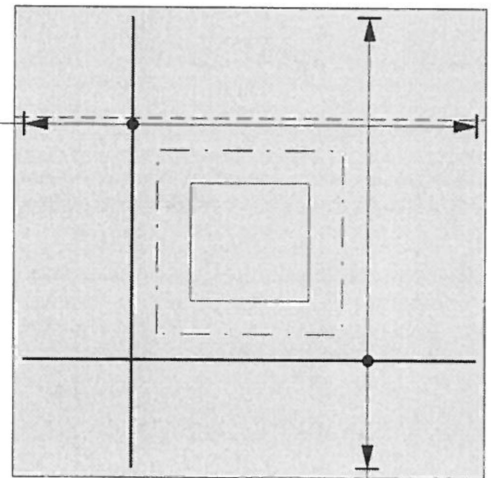
Concrete shear strength — $V_{c\_p\_i} = (2 + 4 / \beta_A) \times \lambda \times \sqrt{(f'_c \times 1 \text{ psi})} \times u_{pA} \times d =$ **1728.975** kips

$V_{c\_p\_ii} = (\alpha_{sA} \times d / u_{pA} + 2) \times \lambda \times \sqrt{(f'_c \times 1 \text{ psi})} \times u_{pA} \times d =$ **1613.710** kips

$V_{c\_p\_iii} = 4 \times \lambda \times \sqrt{(f'_c \times 1 \text{ psi})} \times u_{pA} \times d =$ **1152.650** kips

$V_{c\_p} = \min(V_{c\_p\_i}, V_{c\_p\_ii}, V_{c\_p\_iii}) =$ **1152.650** kips

***PASS - Nominal shear strength is less than concrete shear strength***



15 No. 6 bars btm (10" c/c)
15 No. 6 bars top (10" c/c)
15 No. 6 bars btm (10" c/c), 15 No. 6 bars top (10" c/c)
One way shear at d from column face
Two way shear at d / 2 from column face

## B.4: Cut and Fill Calculations

Cut:

- Exterior footing:

  Per footing: $V = 5'5" * 12' * 12' = 780\ ft^3/footing$

  $V_{cut,ex} = 48counts * 780 = \mathbf{37440\ ft^3}$
- Interior footing:

  Per footing:: $V = 3' * 12' * 12' = 432ft^3/footing$

  $V_{cut,in} = 105counts * 432 = \mathbf{45360\ ft^3}$
- Foundation wall:

  12" thickness, 3'5" height

  $L = (360' - 9 * 3') + (720 - 17 * 3') = 1002\ ft$

  $V_{cut,wall} = 1002 * (3'5" * 1') = \mathbf{3423.5\ ft^3}$
- Concrete slab:

  6" thickness

  $A = 720 * 360 - 153 * 3^2 = 257823ft^2$

  $V_{cut,slab} = 0.5' * 257823 = \mathbf{128911.5ft^3}$

Fill:

- Exterior footing:

  $V = 12^2 * (3'5 - 6")\text{-}3^2*(3'5\text{-}6") = 393.75ft^3/footing$

  $V_{fill,ex} = 393.75 * 48 = \mathbf{18900ft^3}$
- Interior footing:

  $V = 12^2 * 0.5 - 3^2 * 0.5 = 67.5ft^3/footing$

  $V_{fill,in} = 105 * 67.5 = \mathbf{7087.5ft^3}$

Total:

$$V_{cut} = 37440 + 45360 + 3423.5 + 128911.5 = \mathbf{215135ft^3}$$

$$V_{fill} = 18900 + 7087.5 = \mathbf{25987.5ft^3}$$

$$\underline{V_{net} = 215135 - 25987.5 = \mathbf{189147.5ft^3}\ (cut)}$$

## B.5: Infiltration Basin Calculations

### Peak Runoff from Impervious Surface Calculations

The peak runoff flow can be calculated using the rational method

$$Q_p = C*i*A_{impervious}$$

Where C is the runoff coefficient, i is the rainfall intensity and $A_{impervious}$ is the impervious area. The runoff coefficient is 1 because all of the surface is impervious, the area impervious is 42,733 $m^2$ and the intensity for the 10 year 24 hour storm is $1.27*10^{-6}$ m/s with the 100 year 24 hour storm intensity being $2.04*10^{-6}$ m/s.

$$Q_{p10} = 1*1.27*10^{-6}*42{,}733 = 0.0543 \text{ m}^3/\text{s}$$

$$Q_{p100} = 1*2.04*10^{-6}*42{,}733 = 0.0872 \text{ m}^3/\text{s}$$

### Infiltration Basin Sizing Calculations

The first step is to find the water quality volume using a depth of 2.5 cm spread across the entire area of impervious surface.

$$\text{Water Quality Volume (WQV)} = 0.025*42{,}733 = 1{,}068 \text{ m}^3$$

Use the WQV and a max depth of 0.3 m to find the required area for the infiltration.

$$1{,}068/0.03 = A_{infiltration} = 3{,}561 \text{ m}^2$$

Use a basin with an area of 3,600 $m^2$ and 60 m x 60 m dimensions as a conservative estimate.

### Infiltration Basin Outflow Structure Calculations

Use the equation for discharge over a weir to determine the required weir length of the outflow structure.

$$Q_w = C_w*L_w*h^{3/2}$$

$$C_w = 1.81 + 0.22*h/H_w$$

$H_w$ is 0.3 m because that is the maximum depth of the infiltration basin and assuming a head buildup of 0.15 m the weir coefficient is found to be 1.92. Then set $Q_w$ equal to $Q_{p10}$ to find the weir length.

$$L_w = Q_{p10} / (C_w*h^{3/2)}$$

$$L_w = 0.0543 / (1.92*0.15^{3/2}) = 0.5 \text{ m}$$

The pipe diameter flowing from the outflow structure can be found using Manning's equation. Assume a reinforced concrete pipe with a diameter of 1 foot to find the flow capacity, then compare it to peak flows.

$$Q_{max} = 1/n*A*R^{2/3}*S_0^{1/2}$$

$$Q_{max} = 1/.011*0.073*0.0762^{2/3}*0.01^{1/2} = 0.119 \text{ m}^3/\text{s}$$

This flow is greater than both the 10 and 100 year storm which is acceptable.

# Appendix C: Permits

# IOWA DEPARTMENT OF NATURAL RESOURCES
# NOTIFICATION OF COMPLETION OF CONSTRUCTION

Notice is hereby given that construction of the project authorized by the Iowa Department of Natural Resources was completed in accordance with approved plans and specifications.

| | | | |
|---|---|---|---|
| **Permit #** | **Project #** | | ☐ Water Mains<br>Further Action Required: |
| **PWSID #** | **FO#** | **Reviewer** | ☐ Final FO Inspection<br>☐ Other (Requiring ES Follow-up) |
| **Date Issued** | | | |
| **Date of Project Completion** | **Signature of Applicant or Authorized Agent** | | |

Mail completed form to:

Iowa Department of Natural Resources
Water Supply Engineering Section
502 E 9$^{th}$ St
Des Moines, IA 50319-0034

**IOWA DEPARTMENT OF NATURAL RESOURCES**
**WATER SUPPLY ENGINEERING SECTION**

**CONSTRUCTION PERMIT APPLICATION**
SCHEDULE-2a, Water Mains, General

| Date Prepared: | Project Name/Description: |
|---|---|
| Date Revised: | |

1. List the purpose of the project (e.g., expand service area, improve system pressures or flows): __________

2. Does the water system have adequate source, treatment, and storage capacity to serve the additional demand resulting from the proposed project? ☐ Yes ☐ No ☐ N/A
   **If No, explain:** __________

3. Proposed Piping Inventory: (attach additional sheets if necessary)

| Material (Designate Alternates) | AWWA or ASTM Standard | Pipe Class | Pipe Pressure Rating (psi) | Maximum System Pressure (psi) | Nominal Diameter (inches) | Length of Water Main (feet) |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

4. Will any of the proposed water main be within 500 feet of an identified leaking underground storage tank (LUST) site? Yes ☐ No ☐
   Known LUST sites are shown on this webpage: https://facilityexplorer.iowadnr.gov/facilityexplorer/
   **If Yes**, attach a copy of the Utility Company Notification Form (DNR Form 542-1531) that has been completed for that site and any associated plume maps. Archived notification forms and plume maps may be obtained by contacting the DNR Records Center at 515-242-5818. If a notification was not prepared for a LUST site, the Records Center will provide you with pertinent documentation.
   **NOTE:** Where distribution systems are installed in areas where groundwater is contaminated by organic compounds, pipe and joint materials which do not allow permeation of the organic compounds must be used.

5. Have standard fire hydrants been provided as a part of this project? Yes ☐ No ☐
   If Yes, can adequate fire flows be provided to these hydrants:
   a. while maintaining a pressure of 20 psi at the fire hydrants? Yes ☐ No ☐
   b. without causing pressures of less than 20 psi to develop within the system? Yes ☐ No ☐
   c. Source of pressure data: __________
   d. What is the minimum size of water main serving fire hydrant? _____ inches
   e. What is the minimum size of fire hydrant lead? _____ inches
   f. Are all hydrant leads valved? Yes ☐ No ☐

6. Minimum depth of cover from the springline of the pipe: _____ feet

7. Does each water main dead end have a fire hydrant, flushing hydrant, or blow off for flushing purposes? Yes ☐ No ☐ N/A ☐

8. Is there a history of corrosive problems with buried pipes in the project area? Yes ☐ No ☐
   **If Yes**, explain corrosion protection measures: __________

9. Are DNR-approved Standard Specifications being applied on this project? Yes ☐ No ☐
   **If Yes,** Approved Standard Specifications of (name of municipality or firm) __________
   Date Approved: __________
   **If No,** Schedule 2b must also accompany this application.

**NOTE***:* If the applicant for this Construction Permit is someone other than the supplier of water (the water utility), a properly executed ***Water Supply Service Agreement (DNR Form 542-3121)*** must accompany this application.
**NOTE***:* If this is a joint Water–Wastewater project, a construction permit application should be submitted separately to the Wastewater Engineering Section of the Iowa Department of Natural Resources.

IOWA DEPARTMENT OF NATURAL RESOURCES
WATER SUPPLY ENGINEERING SECTION

## CONSTRUCTION PERMIT APPLICATION

SCHEDULE-2b, Water Mains, Specifications

| Date Prepared: | Project Name/Description: |
|---|---|
| Date Revised: | |

1. For the following, list the page of the specifications (or plans) where the description can be found.

| Materials and Construction Details | Materials | Specification (or Plan Sheet) Page Number |
|---|---|---|
| Pipe | PVC | |
| | DIP | |
| | PE | |
| | | |
| | | |
| Fittings | Ductile | |
| | | |
| Pipe Joints | Mechanical Joint | |
| | Gasket | |
| | | |
| Pipe Lining | | |
| | | |
| Valves | Gate | |
| | | |
| | | |
| Hydrants | Fire | |
| | Flushing | |
| Pipe Encasement | | |
| Corrosion Protection Wrap | | |
| Trench Width at Top of Pipe | | |
| Backfilling | | |
| Inspection Prior to Laying | | |
| Uniform Bedding and Laying Conditions | | |
| Pipe Cleaning Prior to Joining | | |
| Cutting Procedure | | |
| Temporary Plugging During Construction | | |
| Maximum Pipe Deflection | | |
| Thrust Blocking and Tie Rods | | |
| Water and Sewer Line Separation | | |
| Valve Setting | | |
| Hydrant Setting | | |
| Pressure and Leakage Testing | | |
| Disinfection | | |
| Valve, Air Relief, Meter and Blow-Off Chamber Construction | | |
| Stream or River Crossing | | |
| Highway Crossing | | |
| Railroad Crossing | | |

2. If water mains, valves, fittings, etc., are reused, they will be cleaned and restored to meet the above standards in accordance with the specifications on page ______________ N/A ☐

**IOWA DEPARTMENT OF NATURAL RESOURCES**
**WATER SUPPLY SECTION**
**CONSTRUCTION PERMIT APPLICATION**

SCHEDULE-4, Site Approval

| Date Prepared | Project Identity |
|---|---|
| Date Revised | |

1. Location:
   - #1 ____ 1/4 of ____ Section: ____ Township: ____ Range: ____ County
   - #2 ____ 1/4 of ____ Section: ____ Township: ____ Range: ____ County
   - #3 ____ 1/4 of ____ Section: ____ Township: ____ Range: ____ County

II Briefly describe the following potential sources of contamination and state their distance and direction from the proposed facility:

(a) Sewers ____
(b) Waste Water Treatment or Disposal Facilities ____
(c) Wastewater Discharges ____
(d) Chemical and Mineral Storage Handling and Transmission Facilities ____
(e) Chemical Applications on Land ____
(f) Solid Waste Disposal Sites ____
(g) Cemeteries ____
(h) Animal Confinement Facilities ____
(i) Other ____

Well Site

1. Provide as an attachment, a plat or aerial photo (minimum scale 1" = 200') showing all potential sources of contamination within a 1000 foot radius of the well as well as the surface drainage characteristics of the site (contours at 5' or less intervals are preferred).
2. Has the withdrawal of water from this well been approved by this Department? Yes ☐ No ☐
   **If no, explain =>** ____
3. Name of aquifer: ____
3. Type of overburden: ____
4. Will this well have a continuous layer of low permeability soil or rock at least five feet thick located at least 25 feet below the normal ground surface and above the aquifer from which water is to be drawn? Yes ☐ No ☐
5. Is the site subject to flooding? Yes ☐ No ☐
6. How does the owner of the facility plan to control the use of land within 200 feet of the well?
   ____

Surface Water Site

1. Provide, as an attachment, a detailed plat (minimum scale 1" = 660') showing all potential sources of contamination within 2,500 feet of the shoreline. Continue the plat six miles upstream from the proposed intake structure for river supply projects. In addition, provide information on any facility within the entire watershed that might have a significant negative impact on water quality.
2. How does the owner of the facility plan to control the use of land within the watershed within 400 feet of the shoreline?
   ____
3. Provide seasonal information concerning microbiological, physical, chemical and radiological characteristics of the water.
   Are all contaminants which exceed standards treatable? Yes ☐ No ☐
4. Has this withdrawal or storage of water been approved by this Department? Yes ☐ No ☐
   **If no, explain =>** ____

Below Ground-Level Storage Reservoir Site

1. Provide as an attachment, a plat (minimum scale 1" = 50') showing all potential sources of contamination within a 200 foot radius of the reservoir.

## IOWA DEPARTMENT OF NATURAL RESOURCES - WATER SUPPLY ENGINEERING SECTION

## CONSTRUCTION PERMIT APPLICATION

### SCHEDULE-3a, Water Systems - Design Capacity Data

| Date Prepared: | Project Name/Description: |
|---|---|
| Date Revised: | |

1. Population:
   a. Existing Population: ____________
   b. Design Year: ____________ Design Year Population: ____________

2. Water Requirements:

| A. Consumptive Uses (excluding fire flow) | Existing Demand | | Design Year Demand | |
|---|---|---|---|---|
| | Average Day (gpd) | Peak Day (gpd) | Average Day (gpd) | Peak Day (gpd) |
| Domestic | | | | |
| Commercial | | | | |
| Industrial | | | | |
| Water Plant | | | | |
| Unaccounted for losses | | | | |
| Other (specify): | | | | |
| TOTAL | | | | |

| B. Fire Flow Capacity [1] at 20 psi Residual Pressure | | Existing Capacity | | Design Capacity with Improvements | |
|---|---|---|---|---|---|
| | | gpm | hours | gpm | hours |
| Residential | Minimum | | | | |
| | Maximum | | | | |
| Commercial | Minimum | | | | |
| | Maximum | | | | |
| Industrial | Minimum | | | | |
| | Maximum | | | | |

3. Source Capacity

| | Existing Capacity (gpd) | Design Capacity with Improvements (gpd) |
|---|---|---|
| Firm Capacity | | |
| Total Capacity | | |

4. Treatment Facility Capacity:
   Design Capacity of Existing Facility: ____________ gpm
   Design Capacity of Existing Facility with Proposed Improvements: ____________ gpm

5. High Service Pumps

| | Existing Capacity (gpm) | Design Capacity with Improvements (gpm) |
|---|---|---|
| Firm Capacity | | |
| Total Capacity | | |

6. Storage

| | Existing Capacity (gallons) | | Design Capacity with Improvements (gallons) | |
|---|---|---|---|---|
| | Total | Effective | Total | Effective |
| Clearwell | | | | |
| Standpipe | | | | |
| Elevated | | | | |
| Pressure Tank | | | | |
| TOTAL | | | | |

[1] Please note that projects primarily intended for fire flow capacity improvements are ineligible for Drinking Water State Revolving Fund (DWSRF) loans, pursuant to IAC 567—subrule 44.6(2).