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Course Name	Senior Design - CEE:4850:0001
Instructor	Paul Hanley
Community Partners	Keokuk Chamber of Commerce, City of Keokuk

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Downtown to Riverfront

Keokuk, Iowa

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Section I Executive Summary

The Downtown to Riverfront project is a multi-block redevelopment project in Keokuk. The project bounds are Lucas Avenue on the northeast, S 2nd Street on the northwest, Bank Street on the southwest, and the rail lines on the southeast. There is currently a park with an ADA accessible trail, Gateway Park, located on the corner of S 2nd Street and Main Street. On the other side of Highway 136 are private businesses, and south of that a church. On corner of S 2nd Street and Johnson Street is the Keokuk Housing Authority, and within the remainder of that block is Riverview Park. Riverview Park is currently separated by a bluff from the Keokuk Union Depot, which is undergoing many renovations. It serves as a tourist attraction, as evidenced by the volume of private donations to fund said renovations.

The major goal of the Downtown to Riverfront project is to enhance Riverview Park, and make it and the Union Depot more accessible. The key aspects of this project are two dog parks, one for small and one for large dogs, a parking lot for both Union Depot and park visitors, structures to provide shade, bathrooms, a variety of water fixtures, and trails leading from the Gateway park area, down the bluff to the Union Depot, and connecting all the park amenities.

The edge of the bluff is currently littered with trees, blocking the view of the Mississippi River and Union Depot from view of park users. It is desirable that the tree line be cleared, however there is some question as to how that would impact the integrity of the bluff and impact ecosystems in the area. Structural, ecosystem, and grading analyses were performed by the team prior to the determination of amenity locations.

This project is expected to serve as a draw for community members and tourists alike. While the surrounding housing consists of that of elderly populations, as well as the Keokuk Housing Authority, the park is aimed to serve all ages. To do so, however, it is important that safety of the users be held paramount. This was done by ensuring all final grading meets ADA standards. Additionally, lighting was extended from Gateway Park to and throughout Riverview Park.

Finally, to enhance the aesthetic appeal of the area, a landscaping plan will be created. A major element of the site landscaping is the inclusion of trees that can provide shade to the area. More natural landscaping will be applied throughout Riverview Park, and further landscaping of the Union Depot area will also be developed.

Ideal locations of each of the amenities were determined by taking into account several constraints. One of these was a large ditch in the center of Riverview Park. This not only limited the location options of the dog parks, parking lot, and structures, but also needed to be considered in the final design to ensure the safety of park users. One alternative was to fill this ditch, but it would have incurred additional costs.

The ideal view described for the clients is currently partially blocked by train cars that are being stored by the Union Depot. This is a constraint on this project because one aspect is to provide a view to users of the Mississippi. However, it would be very costly to move the train cars, which there currently is not a budget for. As a result, this needs to be considered when determining how to provide park users with the best possible view of the river.

To achieve the desired product, various challenges must be overcome. A key challenge is that the area where the trail would be most convenient to go to the Union Depot is separated from the park by a

bluff. The current steep slope poses a challenge to create an ADA compliant path without extreme earthwork. One option, which was pursued by the team, is to take out the bluff, thus allowing for a design down a more level incline. A second challenge that will need to be addressed moving forward is that the land from the line of trees down to the river, including the bluff, is owned by the railway. While this land is leased by the City of Keokuk, any proposed changes must be approved by the railway. Along these lines, the land that the connecting path would go through is currently owned by the church, and so that land must be acquired prior to implementing the design.

The organization completing these design services is SAZA Consulting. The team consists of Stephanie Krogh, Alexandra Martinez, Allison Wagner, and Zihan Wang. Stephanie Krogh led the site, dog park, and Union Depot trail designs, Allison Wagner led the gazebo and parking lot designs, Zihan Wang led the bathroom and storm shelter design, and Alexandra Martinez led the other trail designs.

A cost analysis was done on each piece of the project and the final project cost was found to be $367,000 including contingency and administration costs.

Section II Organization Qualifications and Experience

1. Name of Organization

SAZA Consulting

2. Organization Location and Contact Information

Project Manager

Stephanie Krogh

stephanie-krogh@uiowa.edu

3. Organization and Design Team Description

We are a team of students from the University of Iowa in the capstone design class. The team is comprised of four members: Stephanie Krogh, Alexandra Martinez, Allison Wagner, and Zihan Wang. Each person oversees a specific aspect of the scope. We separated the project into 5 different sections. The project is in sections as follows: Parking lot, structure with bathroom, trail, site design with landscaping, and dog park.

Stephanie will oversee the site development aspects of the project, and both she and Alexandra will oversee the transportation aspects. Allison and Zihan will oversee the structural portions of the project.

Section III Proposed Services

1. Project Scope

The Downtown to Riverfront project is to be constructed in Keokuk within the boundaries set by Lucas Avenue on the northeast, S 2nd Street on the northwest, Bank Street on the southwest, and the rail lines on the southeast. The focus of the project was on the development and beautification of Riverview Park.

Currently Riverview Park is separated from the Keokuk Union Depot by a 40-foot bluff. Additionally, the view of the Mississippi River is blocked by a line of trees. A major aspect of this project was to make the river and Union Depot more accessible by users of the park. This was done by creating an ADA accessible path from the park to the Union Depot down the side of the bluff. With this, the removal of the blocking trees was suggested. Thus, an analysis of the feasibility of the trees was performed, to ensure that the structural integrity of the bluffs would remain intact.

All development of Riverview Park was focused on providing an accessible and enjoyable area for both members of the community and out of town visitors. A key addition is that of two dog parks, one for large and one for small dogs. Adjacent to the large dog park is the addition of a structure which encompasses bathrooms, a storm shelter, and diverse water fixtures.

A large gazebo will be added next to the Union Depot trail. This provides shaded seating and serve as a viewing area for the river with scopes on the outside deck. This also attracts more visitors to Riverview Park due to the variety of activities.

A landscaping plan for the area, including Riverview Park and the Union Depot, was designed to enhance the area. This includes a natural landscape in Riverview Park. Trees will be the focus of the landscaping, to provide shade to park users. Plant suggestions that are pet friendly to have along the perimeter of the dog parks can be found in later in the report.

Parking for Riverview Park was designed. Ideally, this will also serve as parking for the Union Depot, which is currently lacking in adequate parking. The parking lot is easily accessible from the road and provides easy access to all park amenities.

Currently there is a trail leading from N 2nd Street to N 1st Street that provides an ADA accessible way to get closer to the river. On the other side of Highway 136 there is a staircase, and as part of this project we designed a trail similar to the one currently in Gateway Park, so both sides are ADA compliant. These trails were then extended to connect to Riverview Park. There is currently limited lighting in Riverview Park, and so the Gateway Park lighting was extended down the connecting trail and throughout Riverview Park.

2. Work Plan

A work plan was created to ensure timely completion of major project tasks. Deadlines for tasks were assigned to be on the Wednesday of said week.

The first tasks that were completed were performed by all group members, and they included an analysis of the existing elevations and grades, an analysis of potential impacts caused by removing trees from the area around the bluff, an analysis of the utilities in the area, and creating a compilation of shelter and structure requirements and codes. These took approximately two weeks.

The highway trail design was done over a four-week period which encompassed the preliminary designs, as well as iterations, to achieve the finished product. This trail was completed by Alexandra.

After the determining the locations of the dog park, structures, parking lot, and trail down to the Union Depot, the design of these aspects of the project began. The dog park design took four weeks to complete, the parking lot took three, and the Union Depot trail took five. The dog park design included sizing and dimensions, fencing, landscaping, and a cost analysis. Impacts on the time it took to complete the parking lot design were resizing, repositioning, and layout adjustments. The Union Depot trail took five weeks due to the numerous iterations required to achieve an ADA compliant trail in an area with a large elevation change in the existing elevations.

The bathroom and storm shelter design was performed by Zihan, the Gazebo design by Allison, the parking lot design by Stephanie and Allison, and the Union Depot trail and dog park designs by Stephanie.

Once all four of the previous tasks were completed, the trail connecting all elements within Riverview Park was designed by Alexandra. This is projected took three weeks.

Once the trail design was finished, the landscaping plan, including vegetation and lighting, was performed by Stephanie. This took approximately a week.

For a visual representation of this schedule, refer to the Gantt chart in Appendix 1.

Section IV Constraints, Challenges and Impacts

1. Constraints

The Downtown to Riverfront project has tight boundaries that it must stay within. The Keokuk Housing Authority is on the northeast side of Riverview Park, the Keokuk Union Depot is on the southern side, and on the west of Riverview Park, separating it from Gateway Park, is privately owned land. The private land is owned by multiple businesses, including a restaurant and the United Presbyterian Church.

The parking lot aspect of this project should allow both the visitors for the Union Depot and Riverview Park access, meaning the chosen location should provide access both locations with ease.

There is a large dip in the middle of Riverview Park that connects to the top of the bluff. This proved a limitation to the site design concerning the locations of the dog park, structures, and trail. As a result of this dip, extra considerations must be given to the overall safety of park visitors.

2. Challenges

At the top of the bluff, there are many trees standing blocking the view of the river. Some of these trees have already been cut down, but the removal of the remaining trees is desirable. The land is currently owned by the railroad company, so a proposal must be submitted to and approved by them for permission to remove the trees. This will likely require proof of minimal impacts to the ecosystem and bluff integrity. For the proposed design of the Union Depot trail, the trees that are currently in that location will need to be removed. Also, the trees that will be directly in front of the gazebo with the connected deck will need to be removed so that the scopes on the deck can utilized properly. Due to the close proximity of the Union Depot to the bluff, the Union Depot will likely need to be either partially closed or fully closed during construction. This would most likely result in having to temporarily close the entrance to the Union Depot to ensure safety.

Instead of removing the entire length of the bluff, the trail to the Union Depot is designed to go down the middle of the park, where there is a large dip. The bluff will be removed in this area and the land will need to be regraded. This also involved having to maneuver the trail in a 175 feet wide and 255 feet long area in a way that met required slopes for ADA compliance. This, however, resulted in tight curves that will require proper signage for bikers.

For the proposed location of the highway trail, the slope of the hill is too steep to be safely trekked. There is currently a staircase along the side of the highway that provides a mode to get down this hill, however it is not ADA accessible. This proposed trail design takes into consideration maximum slopes to ensure the safety of users. This caused the use of tight curve and a slope for no more than 6 percent.

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

The proposed development of this area may have a range of societal impacts. Housing around Riverview Park consists of the Housing Authority and housing occupied by elderly populations. The Keokuk Housing Authority may have concerns regarding the placement and design of our site. This could result in NIMBY disputes and/or conversations about changing the site plan, because our design covers the park that is next to the Housing Authority. This park will provide amenities for these populations and would also be a draw for populations throughout the rest of Keokuk. The existence of a dog park and trail will provide recreation for all ages, especially if later development includes building a new playground, or other

recreational elements, in the park. Additionally, connecting Riverview Park to downtown Keokuk via the connection to Gateway Park will provide easy access to Keokuk residents.

The park will ideally boost tourism by paying homage to Keokuk's history. By attempting to stay true to how the area has historically looked though path materials, lighting fixtures, and landscaping, Riverview Park would add to the historical areas throughout Keokuk, especially when coupled with the renovations of the Union Depot. It will also provide easy access to the Union Depot, which may become increasingly valuable. The Depot has a lot of draw, as demonstrated by the volume of private funding, especially by railway buffs. Beautifying the surrounding area may help to boost this even more. Keokuk also has many events to draw tourism throughout the year, and it was proposed that after redevelopment, Riverview Park would be an ideal location for some of these events, such as Bald Eagle Day.

The proposed development does have corresponding issues that may arise. A key issue is the safety of users. Currently the area has limited lighting and is secluded on the sides by trees. Adding lighting throughout the area should help to improve the safety of the area. Additionally, removing some, if not all, of the trees in the area should improve safety. Providing a clear view of the park from either side allows for better monitoring of activities in the park, thus decreasing the likelihood of crime.

Section V Proffer of Alternative Solutions

Our proposed alternative solutions are broken up into seven different sections: the material of the structure, location of the parking lot, removal of the trees at the bluff, connection to the Union Depot, trail materials, lighting, and location of the dog park.

For the material for the structure, we considered wood, concrete, and steel. Wood is the cheapest material, steel is most likely the most expensive, and concrete fits in the middle of the two other materials. Although wood has the shortest design life, it has a good aesthetic, is the easiest to assemble once a design is complete, and it has the smallest labor costs. Concrete is a good material to create the bathrooms out of due to is structural competency, but this may not be the most aesthetically pleasing without adding a different material. Steel is the strongest of the materials, but due to its cost, the entire project would not be able to be made of it.

For structure with the storm shelter, the foundation must be made of concrete. This is because this material can stand the necessary wind load and can guarantee the structure won't tilt. Column footing was tested but rendered unneeded with further calculations. Foundation wall was an alternative solution. Since the column footing underneath the ground surface by 10 feet, the foundation wall would need to enter the ground surface 5 feet at minimum. In our calculations, foundation wall in 5 feet can stand the same load as the column footing in 10 feet.

One solution that was tried was having a separated wall and beam. This would have resulted in a wall made of fully bricks and the beam being made of steel or concrete. The final design would be a merging of the wall and the beam structure. The wall can be all make by brick. In the structure design, the wall is made with concrete on the top and brick on the bottom so that the top side of wall acts as a beam which can stand the weight of load and trusses.

We considered wood, brick, and acoustic ceiling for the roof material. The brick and wood would both maximum safety in design, but we decided on acoustic ceiling. The acoustic ceiling will highlight the aesthetic of the structure but does have a lower factor of safety than our other considerations.

The location of the parking lot had several options we considered. The first location considered is along 2nd Street, near the parking lot for the Keokuk Housing Authority. This location has easy access to the main road, near downtown, and is mostly flat land so there would have been minimal grading. This location is far from the Union Depot which is not ideal for those holding events at the Union Depot. The next location is a bit closer to the Union Depot, but up the hill: Bank Street next to the bluff. Because this location is close to the bluff, there may be some foundation issues when implementing the parking lot. Depending on the size, this location could also get close to the ditch at the center of River view park. This also brings up foundation issues as well as safety. Our last option would be right next to the Union Depot. This would be the ideal place for more parking for the depot, but it is down the hill from the park, it may disrupt the historical look of the surrounding area, it would need to be paved with brick to match the existing area, and the slope of the land would need to be fixed dramatically due to it being next to the bottom of the bluff. Due to the slope on the sides of Riverview park, the parking lot would be very difficult to design on those pieces of land. The final location was chosen to be on the corner of N 2nd Street and Bank Street with the entrance and exit off Bank Street. This was chosen as the prime location because the grading along the street is relatively level, meeting required slopes more feasible. The original design of the parking lot had a two-way traffic flow and perpendicular parking spots. The size of the parking lot with this design did not allow for certain turning requirements to be met. Diagonal

parking spots were then used in the design to try to solve the issue with turning requirements. However, this was not enough and there were still issues with the parking lot. The next design kept the diagonal parking spots, but a one-way traffic pattern was used, and this design accommodated all turning requirements and was used as the final design.

As a group, we talked about the removal of the trees at the bluff. If we did, it would open the view for a lookout point within Riverview park and it would open to show the Union Depot which would promote more visitors. A few issues that have arisen are, since the trees have been growing for so long, we are not sure how much structural integrity they have for the bluff, and the power lines may prevent us from cutting them down. Removing the trees could cause complete failure of the bluff and the surrounding land. With our design of the Union Depot trail and the addition of the gazebo, trees will need to be removed in specific locations. On the bluff, the trees with a trunk diameter under 1 foot can be removed with without affecting the bluff's integrity. The trees that are where the Union Depot trail will be would need to be removed before construction can commence.

In the initial meeting, we talked about connecting the Union Depot with a trail as well. This would help connect the historical area to the more populous downtown, as well as easy walking access to the building, which is currently not available. Our two options are going through the ditch and the bluff, which has a very steep slope and other hinderances mentioned previously, as well as going around the bluff, which puts us near the sidewalk that already exists. The design we decided to pursue was having the trail go through the area of the park that contained the ditch. We determined this would make the earthwork required for the trail less intensive. Additionally, it was found that the steep slope could be managed through a regrading of the bluff in that area, paired with a switchback trail with rest areas.

The trail that will run alongside Highway 136 had a few options for material of the trail. To match the existing trail that is in Gateway park, it will need to be concrete with brick edging. This material may be expensive, but it would match the aesthetic and create continuity when connecting to Riverview Park from the highway. If the design did want to take cost into account, a different material for the trail that had a lower cost could be considered. The same goes for lighting along the trail. Either light fixtures that match the existing park lighting could be used as the trail is continued, which may be more expensive, or other alternatives that may be less expensive could be used. We decided to match the material from the Gateway Park trail to tie all the trails together. This involved using the material in the Highway Trail, the trail from Gateway Park to Riverview Park, the Union Depot Trail, and the trail throughout Riverview Park. The lighting was chosen to match that which is currently in Gateway Park.

There is an existing trail in Gateway Park, and within the project scope is a mirrored version of it on the opposite side of Highway 136. Due to the steep slope in the middle of the land, many design options were considered and tested. The trail design went through a few different iterations, larger curves, no curves, and even a step-down trail. The final design chosen was a switchback trail, but in comparison to the existing Gateway Park trail there are more curves.

The dog park has a few locations that were considered throughout the design. Two of these locations are the same locations we have for the parking lot. These are vetted independently, and once we choose a location for one of them, we will decide on the other. Our options were near Bank Street or Johnson Street, both close to the bluff, or near 2nd Street and Bank Street. The locations near the bluff may be of concern due to the proximity of both the ditch and the bluff. We want to ensure the safety of both the dogs and their owners. Being by the corner of Bank and 2nd could be dangerous due to how

close it is to a main road. Even with that negative, the land is relatively flat so not much landscaping would need to be done at the location. The location of the parking lot was determined to be on the corner of N 2nd Street and Bank Street, and we decided the best placement of the dog parks was to have them form an L-shape around it. This mitigates the problem of having the dog parks near the main road, as they are separated from it in part by the parking lot. It also allows for minimal required grading, as the land is relatively level in this area.

Section VI Design Details

Site Design

The first aspect of the site design was the placement of the various park amenities. This included the trail on the southwestern side of Highway 136, the trail connecting Gateway Park to Riverview Park, the trail providing access from the top of the bluff to the Union Depot, the large and small dog parks, a gazebo and viewing area, a bathroom and storm shelter structure, a parking lot, and a trail within the park to connect all these. The final placement of these can be seen below in Figure 1.

Figure 1. Site Design Illustration

Also included in the site design is the proposed landscaping plan. This encompasses both vegetation, such as trees and shrubbery, as well as lighting. It was determined that to best provide the desired shade throughout the park, deciduous trees would be used. Using the Iowa DOT's Guide to Common Trees and Shrubs of Iowa, the suggested trees for this are: Red Maples, Silver Maples, Bur Oak, and Pin Oak. Determination of the best trees for this project site should be based on the soil classification and moisture level, which were not available to the team. Around the parking lot, coniferous trees were placed to provide year-round shade to parked cars. It is recommended that evergreen trees be used for this purpose. Around the outer perimeter of the dog park fence, it is suggested that shrubs be planted to improve the aesthetic appeal. It is suggested that Grey Dogwood shrubs be planted. These are commonly used for hedges and buffers in urban settings and are non-toxic to dogs. Not included in this landscaping plan, but also suggested, is the planting of perennials along the length of the trails.

The landscaping plan also includes the proposed lighting plan. Similar lighting to that which currently exists in Gateway Park was extended along the trail by Highway 136, the trail that connects Gateway

Park and Riverview Park, the trail leading to the Union Depot, the trail within Riverview Park, and the perimeter of the dog park. Lights were placed approximately every 40 feet.

Refer to Design Drawings Sheet No. 2 for further details on the site plan.

Highway trail

The trail on the southwestern side on the highway was created to help connect the downtown area to Riverview Park. The trail was given tight constraints on both sides; one by the highway and the other by local business-owned property. Given these boundaries, the trail would need to stretch from the intersection of Highway 136 and North 2nd Street down to South 1st Street. The land area outlined in the plan has a section of the trail in which the slope is steep; failing to offer a safe trek without the fear of falling was a priority in the design. As a design team, we decided that a switchback trail was the best way to navigate down the hill for the residents. The trail designed has 5 switchback curves with each curve radius averaging at approximately 15 feet. This radius was chosen to effectively move down the hill, but to also be mindful of increasing slopes. This trail has a slope of 5.45 % downward for the entire length of the walking trail. Since the slope is less than 6%, it is allowable to run any distance according to the ADA Accessibility Guidelines. The trail was created on Autodesk Civil 3D. See Design Drawings for the more detailed plans of the Highway Trail.

Figure 2. Highway Trail Illustration

Off the last switchback, there is a trail that connects the trail to the corner of South 1st Street and Johnson Street. This trail does not exceed a 2% slope, which meets ADA Accessibility Guidelines for maximum running slope. Its path leads through the church's unpaved parking lot, so that residents utilizing the trail can easily follow it to Riverview Park to enjoy the other amenities designed in this project. The trail is 5 feet wide concrete with bricks lining both sides and the length is about a tenth of a mile long. Materials for this trail were a PCC slab on grade with a ¾" crushed stone subbase and brick edging, which mimics the existing Gateway Park trail.

For more detailed drawings, see Design Drawings Sheet No. 9-13.

Union Depot Trail

The trail in the center of the southeastern half of Riverview Park was designed to connect the park to the Union Depot, which are currently separated by a 40-foot bluff. A key goal of this project was to connect the areas at the top and bottom of the bluff, increasing accessibility to the area, which was achieved by the design of this trail.

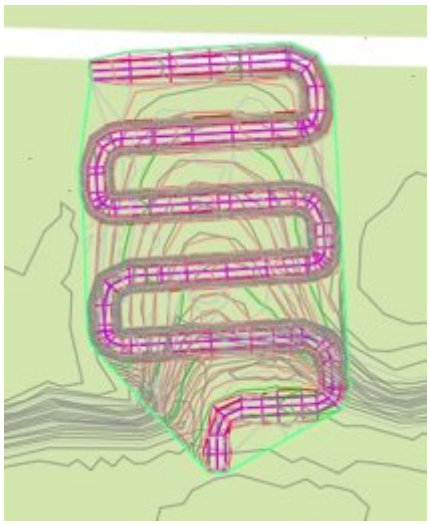

Figure 3. Union Depot Trail Illustration

For improved aesthetics, as well as improved accessibility, a stair-step switchback design of the trail was chosen. In compliance with ADA Accessibility Guidelines, the trail was designed to have a 5% slope for the longer, 125-foot, sections that run parallel to the river. For the smaller, 30 feet, perpendicular sections, a 0% slope was chosen. This allows for a brief “rest area” for those that may desire or require it. The final segment of the trail that runs parallel to the river, closest to the Union Depot, is shorter than the other segments at 50 feet, and has a 6.34% slope. The trail is 10 feet wide concrete with brick edging, and the length is about a quarter of a mile long. Materials for this trail were a PCC slab on grade with a ¾" crushed stone subbase and brick edging, which mimics the existing Gateway Park trail.

Due to the area constraint created by the sidewalk, the turning radii between perpendicular sections of the trail ended up being smaller than would be desired for a trail used by bikers. Thus, it is crucial to ensure proper signage is posted in this area to inform bikers.

For the Union Depot trail details, see Design Drawings Sheet No. 4-8.

Parking Lot

The parking lot for this project needed to accommodate people visiting the dog park and people visiting the union depot. The number of parking spots needed was determined to be 27.

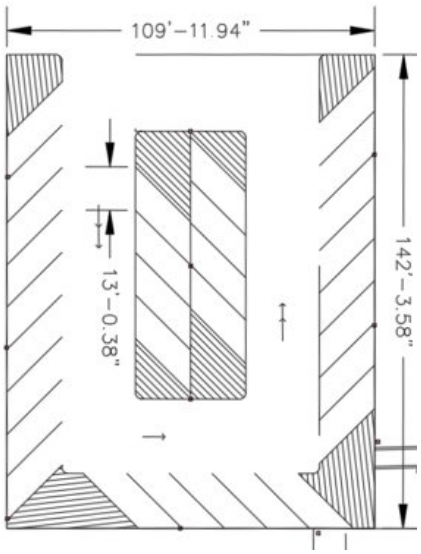

Figure 4. Parking Lot Illustration

The parking lot was designed in Civil 3D utilizing vehicle tracking software to check turning requirements. This parking lot was designed to follow a one-way traffic pattern and has 30 diagonal parking spots. The parking lot material chosen was hot mix asphalt. Assuming a fair subgrade, 8 inches of aggregate base will be placed on top, and then 2 inches of asphalt. The parking lot location was ideal to be close to the dog park as well as avoiding difficult elevations.

For the design of the parking lot, refer to Design Drawing Sheet No. 3.

Bathroom Structure with Storm Shelter

To give tourists convenience and make this park more attractive, the group designed a bathroom structure with storm shelter. This structure is in 30 feet long and 30 feet wide, and the height of 15 feet. This structure consists of a transformer room, storage, six stalls and a thirty-times-ten square feet toilet. The structure was built by normal weight concrete foundation and column, walls combined by brick common and light concrete, wood trusses, Acoustic ceiling, and cast-in concrete floor. The structure was designed based on ICC 500 storm shelter design code.

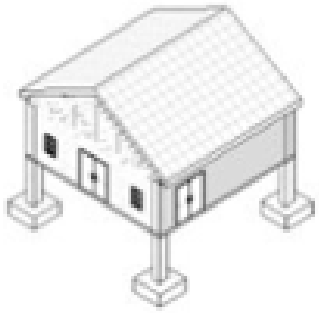

Figure 5. Bathroom/ Storm Shelter Illustration

The roof is made by acoustic ceiling with slope of thirty degrees, which will be effective to drain away water. According to ICC 500 storm shelter design code, to resist storm, the roof must be able to stand

100 pounds per square feet. Acoustic ceiling not only can resist load but also can contribute to aesthetic purpose. The roof is supported by three Howe Gabled Truss 6-panel.

The column is 19 feet concrete rectangular with cross section of 2feet times 1.5 feet. Each column is connected with 6ft times 6ft times 28 inches concrete rectangular footing. Each column should be as the pin support of trusses.

Based on ICC 500 storm shelter design code, the slabs used for floor should be at least 3.5 inches thick. The floor the group used is 6 inches thick, which guarantee the sustainability of the structure.

The wall consists of brick commons and light concrete. The bottom part was used by brick commons, and the top part was used by light concrete because the top part of wall should stand the truss which required high elasticity.

Because there is 100 pounds per square feet load on the roof, there will be 686.67 pounds on the top chord, and there will be 574.34 pounds on each support. The beam wall underneath the truss will stand shear stress of 710.53 pounds and momentum of 10247.25 ft-lbs. Each column will stand 710.53 pounds. The load on column will deliver to the foundation. The design footing can stand maximum shear stress of 71kip load, which fulfill the requirement.

The quantity was estimated by Autodesk Revit, and the cost estimation was calculated based on RSmeans based on those data. The design of the structure can be seen in further detail in Design Drawing Sheet No. 21-25.

Dog Parks (Large and Small)

In accordance with typical dog park design standards, the large and small dog parks were designed to be one acre in area and a quarter of an acre in area, respectively. To best utilize space and limit required grading, the dog parks were placed in the northwestern quadrant of Riverview Park, near the parking lot. The large dog park was designed in an L-shape, and the small dog park was designed to be a rectangle. A 20-foot space was left between the two parks to allow for a trail that would allow owners to observe their dog(s) from the outside.

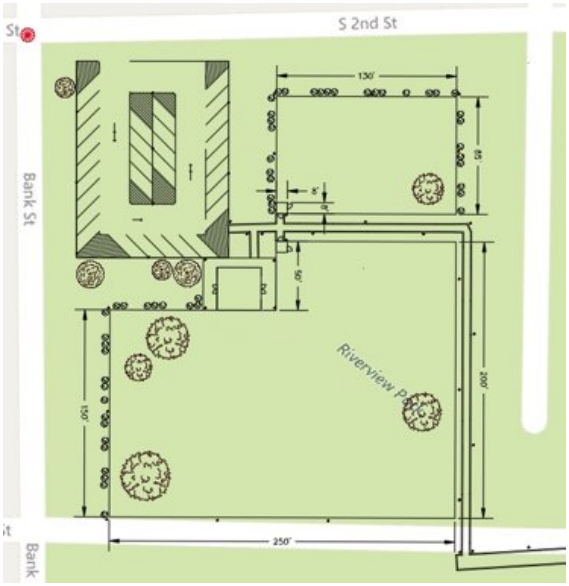

Figure 6. Dog Park Illustration

Along the perimeter of the dog parks it was determined that a 5-foot-tall galvanized steel chain link fence would be used, as is standard practice. This is the minimum height required for most dog parks, as it prevents dogs from jumping over it. The entrances to both dog parks consist of an 8 foot by 8-foot fenced area, with a gate leading into both it and into the dog park. This provides a secure area for owners to remove leashes from their dog(s) prior to entering the park, and to put leashes back on their dog(s) before leaving.

Gazebo

A gazebo was designed provide an aesthetic appeal and a shaded seating area for people who visit the park. This gazebo was designed using architectural design tools in Revit. Audodesk Robot was used for structural analysis of the designed gazebo. The shape of the gazebo was chosen to be hexagon to add uniqueness to the structure. The gazebo also has an unshaded deck area connected to one side of the hexagon. This deck overlooks the union depot trail as well as the union depot and Mississippi River.

Figure 7. Gazebo Illustration

The location of the gazebo was chosen to be on the North East part of the park so that it has the best site lines over the trail and down to the union depot and river. Under the shaded area there are picnic tables for visitors to enjoy and use. The gazebo was designed to be built with a concrete slab foundation, but wood decking is used on top to match the wood trend throughout the rest of the gazebo. The concrete slab was designed to be 6 inches thick which meets and exceeds the requirements for ASCE Building Codes 3-19. The columns, beams, and railings are also made of wood. The National Design Specifications for Wood Construction was used for the design of the columns, beams, and roof. The roofing material chosen for this structure was asphalt shingles which will be the most cost effective while also maintaining the overall aesthetic of the gazebo.

The gazebo plans can be found in Design Drawing Sheet No. 20.

Connecting Trail

The main connecting trail joins the parking lot to the other sections of the park, including the restroom structure with a storm shelter, the entrances to the dog parks, and the walking trail down to the Union Depot. These connecting trails were designed to put the visitors of Riverview Park at ease.

Figure 8. Connecting Trail Illustration

As a design team, it was imperative to make practical connections with the other amenities in the park. The main part of the trail runs in between the two dog parks from the southeastern corner of the parking lot. At the entrances to the dog parks, the trail has sections that extend to the outer gates. The main trail runs continuously to the corner of the park and turns southward to intersect the Union Depot trail. The trail is 5 feet wide concrete with bricks lining both sides and the length is about a tenth of a mile long. Materials for this trail were a PCC slab on grade with a ¾" crushed stone subbase and brick edging, which mimics the existing Gateway Park trail. The trail was designed in Autodesk Civil 3D – See Design Drawings Sheet No. 14-19 for the complete Connecting Trail drawings.

Section VII Project Cost

From the project design, the project cost was found to be $367,000. This cost includes the cost of the trails, the bathroom and storm shelter structure, the gazebo, the landscaping, the parking lot, the lighting, the cut and fill earthwork for the trails, and the fencing around the dog park. This also includes 10% contingency cost and 3% administration cost.

The unit costs for the trail materials were found from the Heavy Construction Costs 2018 manual, using an adjustment factor for the closest city to Keokuk: Burlington, Iowa. The total for all trail designs is estimated to be $32,000.

The bathroom and storm shelter structure cost were estimated using RS Means. The cost includes only the cost for the structure itself, and does not account for the cost of interior necessities, such as toilets and partitions. This cost was found to be $93,000.

The gazebo price was also estimated using RS Means. This, too, does not account for anything outside for the structure itself, such as benches. The total cost for it was found to be $40,700.

The dog park cost is based off the cost for a 5-foot-tall galvanized steel chain link fence. The total for the fence was found to be $8,175.

The cost for landscaping includes the vegetation around the site, the lighting, and a water fountain that has a spout for both humans and dogs. We also suggest that the dog park and surrounding areas should have perennials, but these are not included in the landscaping estimate. These prices were found with multiple references that are listed in Appendix 3. The total cost for landscaping was found to be $52,000.

The parking lot cost was estimated using RS Means, and includes the materials and striping needed to complete the parking lot before use. The total cost for the parking lot was found to be $18,000.

For total cost breakdowns see Appendix 2.

Appendices

Appendix 1 – Gantt Chart and Project Roles

Appendix 2 – Cost Estimate Spreadsheets

Appendix 3 – Reference and Guideline Citations

Appendix 4 – Robot Outputs

Appendix 5 – Design Calculations

Appendix 1

Table 1 – Gannt Chart

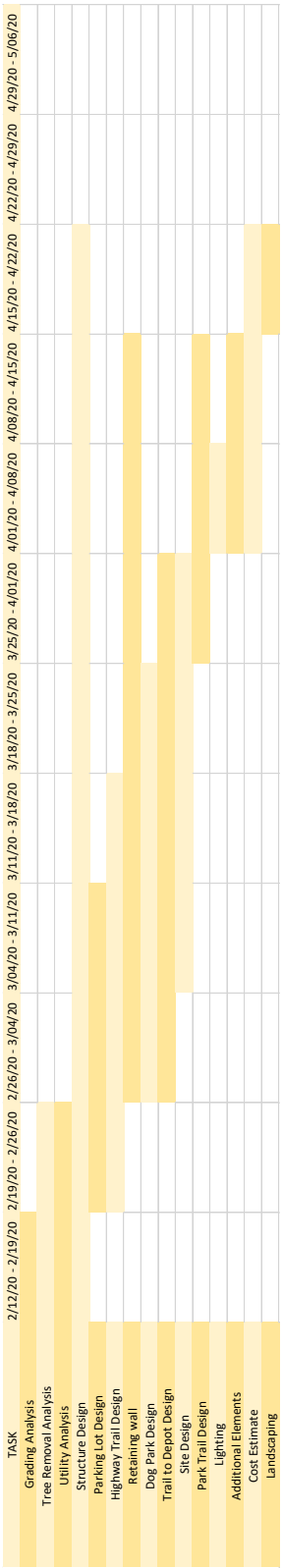

Table 2 – Project Roles

Task	Group Member
Site Layout	Stephanie Krogh
Landscaping (Vegetation, Lighting)	Stephanie Krogh
Union Depot Trail	Stephanie Krogh
Highway Trail	Alexandra Martinez
Riverview Park Trail	Alexandra Martinez
Gazebo Design	Allison Wagner
Storm Shelter Design	Zihan Wang
Dog Park Design	Stephanie Krogh
Parking Lot Design	Stephanie Krogh, Allison Wagner
Retaining Wall	Stephanie Krogh, Allison Wagner

Appendix 2

Table 3. Bathroom Structure Materials

Floor	*Unit Cost (USD/SF)*	*Area (SF)*	*Volume (CF)*	*Cost (USD)*
Cast-in Concrete	$13.35	946.0	472.8	$12,629.10
Wall	*Unit Cost (USD/SF)*	*Area (SF)*	*Volume (CF)*	*Cost (USD)*
Brick (common)	$25.30	2040.0	1375.9	$51,612.00
Concrete (lightweight)	$155.00	2065.0	343.7	$1,971.18
Gypsum Wall Board	$0.35	722.0	34.0	$252.70
Metal Stud Layer	$6.41	324.0	88.2	$2,076.84
Column	*Unit Cost (USD/CY)*	*Area (SF)*	*Volume (CF)*	*Cost (USD)*
Normal Weight Concrete	$101.00	-	228.0	$852.04
Foundation	*Unit Cost (USD/CY)*	*Area (SF)*	*Volume (CF)*	*Cost (USD)*
Normal Weight Concrete	$101.00	-	384.0	$1,435.01
Doors	*Unit Cost (USD/SF)*	*Area (SF)*	*Volume (CF)*	*Cost (USD)*
Exterior Double Doors	$817.00	4.0	-	$3,268.00
Single Flush	$32.30	240.0	-	$7,752.00
Roof	*Unit Cost (USD/SF)*	*Area (SF)*	*Volume (CF)*	*Cost (USD)*
Acoustic Ceiling Tiles (24" x 24")	$1.64	1191.0	1190.7	$1,953.24
Windows Exterior Jambs	*Unit Cost*	*Quantity*	*Volume (CF)*	*Cost (USD)*
Windows Exterior Jambs	$276.50	2	-	$553.00
Trusses	*Unit Cost*	*Quantity*	*Volume (CF)*	*Cost (USD)*
Howe Gabled Trusses (6-Panel, 30.5 ft)	$488.00	18	-	$8,784.00
			Total Cost	**$93,139.10**

Table 4. Trail Materials

Union Depot Trail								
Material	*Quantity*	*Material Cost (USD/unit)*	*Labor Cost (USD/unit)*	*Equipment Cost (USD/unit)*	*Total Unit Cost (USD)*	*Subtotal (USD)*	*Adjustment Factor*	*Total Cost (USD)*
Pave 1 (PCC, CY)	55.0	$140.00	$47.00	$0.28	$187.28	$10,294.93	88.50	$9,111.01
Subbase (gravel, CY)	348.2	$5.40	$0.40	$0.77	$6.57	$2,287.35	97.50	$2,230.16
Brick Edging (Number)	6105.5	$1.00	-	-	$1.00	$6,105.46	-	$6,105.46
							Total	$17,446.63
Highway Trail (with Connecting 1)								
Material	*Quantity*	*Material Cost (USD/unit)*	*Labor Cost (USD/unit)*	*Equipment Cost (USD/unit)*	*Total Unit Cost (USD)*	*Subtotal (USD)*	*Adjustment Factor*	*Total Cost (USD)*
Pave 1 (PCC, CY)	23.5	$140.00	$47.00	$0.28	$187.28	$4,397.33	88.50	$3,891.64
Subbase (gravel, CY)	81.0	$5.40	$0.40	$0.77	$6.57	$531.91	97.50	$518.61
Brick Edging (Number)	2607.2	$1.00	-	-	$1.00	$2,607.16		$2,607.16
							Total	$7,017.41
Dog Park Trail (Connecting 2, Dog, Structure)								
Material	*Quantity*	*Material Cost (USD/unit)*	*Labor Cost (USD/unit)*	*Equipment Cost (USD/unit)*	*Total Unit Cost (USD)*	*Subtotal (USD)*	*Adjustment Factor*	*Total Cost (USD)*
Pave 1 (PCC, CY)	26.3	$140.00	$47.00	$0.28	$187.28	$4,917.20	88.50	$4,351.73
Subbase (gravel, CY)	82.7	$5.40	$0.40	$0.77	$6.57	$543.47	97.50	$529.88
Brick Edging (Number)	2725.5	$1.00	-	-	$1.00	$2,725.53		$2,725.53
							Total	$7,607.14
							TOTAL	**$32,071.19**

Table 5. Gazebo Materials

Material	*Quantity*	*Unit Price*	*Total Cost*
8x8 10' Wood Column	13	$ 70.00	$ 910.00
Concrete (CY)	43.28	$ 101.00	$ 4,371.28
Wood Decking (SF)	2338.2	$ 8.00	$ 18,705.60
Wood Railing (LF)	230	$ 22.00	$ 5,060.00
Roofing Materials (SF)	3326.4	$ 3.50	$ 11,642.40
Total			**$ 40,689.28**

Table 6. Dog Park Fence Materials

Fence					
Corner Supports	*Materials Needed*	*Per Corner*	*Unit Cost*	*# Corners*	*Subtotal*
	End Post Cap	1	$ 1.60	16	$ 25.60
	Rail Cap	2	$ 0.73	16	$ 11.68
	Tension Band	4	$ 0.98	16	$ 15.68
	Corner Post	1	$ 16.48	16	$ 263.68
	Tension Bar	1	$ 5.73	16	$ 91.68
Mid Span Supports	*Materials Needed*	*Per Support*	*Unit Cost*	*# Supports*	*Subtotal*
	Line Post Cap	1	$ 0.98	266	$ 260.68
	Line Post	1	$ 10.98	266	$ 2,920.68
Fencing	*Materials Needed*	*Per Unit Length*	*Unit Cost*	*Length (ft)*	*Subtotal*
	Tension wire	1	$23.98 per 170 feet	1355	$ 191.13
	Top Rail	1	$33.91 for 21 feet	1355	$ 2,188.00
	Tie Wire	1 every 12 to 16 inches	$4.81 for 30	1355	$ 49.98
	Chain Link Mesh	1	$72.90 for 50 ft	1355	$ 1,975.59
Other	*Object*	*Per Unit Length*	*Unit Cost*	*Quantity*	*Subtotal*
	Gate	-	$ 90.85	2	$ 181.70
				TOTAL	**$8,176.08**

Table 7. Landscaping Cost

Vegetation	*Type of Vegetation*	*Number of Units*	*Unit Cost*	*Subtotal*
	Deciduous	4	$ 90.00	$ 360.00
	Coniferous	15	$ 190.00	$ 2,850.00
	Shrubbery	60	$ 14.00	$ 840.00
Other Landscaping	*Landscaping Item*	*Number of Units*	*Unit Cost*	*Subtotal*
	Lamp	82	$ 154.00	$12,628.00
	Lamp Post	82	$ 385.00	$31,570.00
	Water Fountain	1	$3,788.00	$ 3,788.00
			TOTAL	**$52,036.00**

Table 8. Cut and Fill on Trails Cost

Location	*Cut (CY)*	*Fill (CY)*	*Cost*
Highway Trail	-	65.48	$ 982.20
Connecting Highway Trail	356.46	-	$ 5,346.90
Union Depot Trail	4922.26	-	$73,833.90
Park Trail	17.24	-	$ 258.60
		TOTAL	**$80,421.60**
Assuing $15 per cubic yard (CY)			

Table 9. Parking Lot Cost

Parking Lot	*Quantity*	*Unit Price*	*Cost*
Aggregate subbase (6")	7865	$ 0.60	$ 4,719.00
HMA (2")	2621.67	$ 5.00	$13,108.35
Striping	625	$ 0.24	$ 150.00
Total Cost		**Subtotal**	**$17,977.35**
		Contingency	$ 1,797.74
		Administrative Costs	$ 539.32
		Total	**$20,314.41**

Table 10. Total Cost

Component	*Cost (USD)*
Highway Trail	$ 7,025
Union Depot Trail	$ 17,400
Park Trail	$ 7,600
Parking Lot	$ 18,000
Dog Park	$ 8,200
Structure	$ 93,000
Landscaping	$ 52,000
Earthwork	$ 80,000
Gazebo	$ 41,500
Subtotal	$ 325,000
Contingency	$ 32,500
Administration	$ 9,700
TOTAL	**$ 367,000**

Appendix 3

Americans With Disabilities Act of 1990, Pub. L. No. 101-336, 104 Stat. 328 (1990).

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Appendix 4

For structure:

roof design:

Truss Data

Truss Type:	Howe (4/4)
Out-to-out Span:	30 ft.
Top Chord Pitch:	4 /12
Spacing:	24 in. o/c
Bearing Width:	3.5 in.
Overhang:	12 in.

Design Loads

Top Chord Live Load:	25 psf
Top Chord Dead Load:	7 psf
Bottom Chord Live Load:	0 psf
Bottom Chord Dead Load:	10 psf

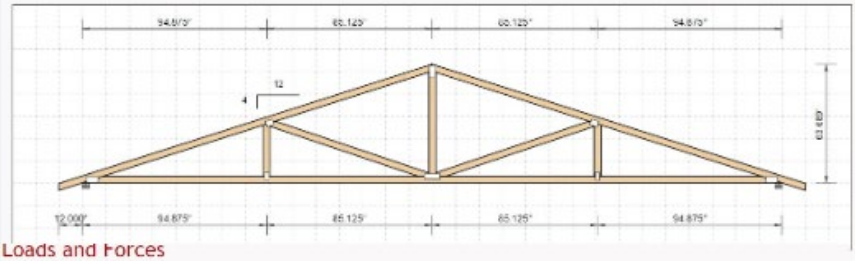
Design Assumptions

Number of Plies:	1 PLY
Butt Cut:	0.25 in.
Bottom Chord Pitch:	0 /12
TC Bracing:	OSB 7/16 in.
BC Bracing:	10 ft. o/c

Geometry

Total Scarf:	9.750 in.
Adj. Scarf:	6.250 in.
Number of Top Chord Panels:	4
Top Chord Panel Lengths:	85.125 in.
Number of Bottom Chord Panels:	4
Bottom Chord Panel Lengths:	85.125 in.

LUMBER (Not Engineered)
Top Chords: 2 X 4 DF No. 1 (Th e size, species and grade is my job for this member. This is not an eng. result.)
Bot. Chords: 2 X 4 DF No. 1 (Th e size, species and grade is my job for this member. This is not an eng. result.)
Webs: 2 X 4 HF No. 2 (Th e size, species and grade is my job for this member. This is not an eng. result.)



Loads and Forces

LRFD DESIGN METHOD: 1.2(D) + 1.6(L)

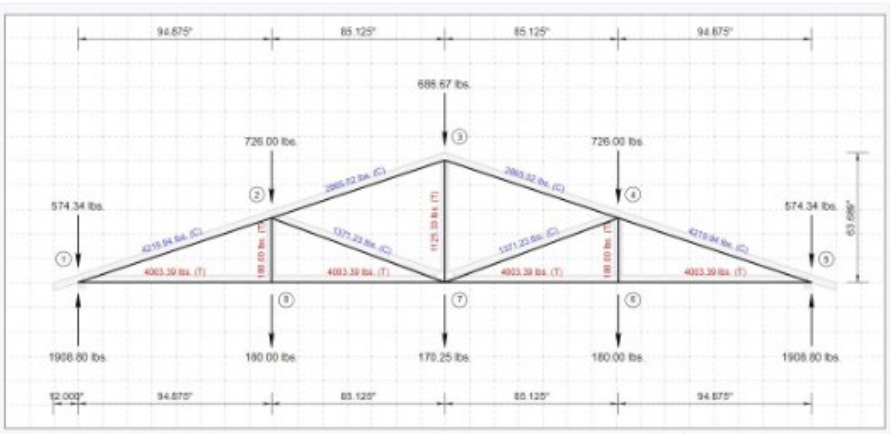
Top Chord: 7(1.2) + 25(1.6) = 48.4 psf = 8.07 lbs./in.
Bottom Chord: 10(1.2) + 0(1.6) = 12 psf = 2.00 lbs./in.

$R_1 = R_5$:	1908.80 lbs.
$P_1 = P_5$:	574.34 lbs.
$P_2 = P_4$:	726.00 lbs.
P_3:	686.67 lbs.
$P_6 = P_8$:	180.00 lbs.
P_7:	170.25 lbs.

$F_{12} = F_{45}$:	4219.94 lbs.
$F_{23} = F_{34}$:	2865.02 lbs.
$F_{18} = F_{56}$:	4003.39 lbs.
$F_{78} = F_{67}$:	4003.39 lbs.
$F_{28} = F_{46}$:	180.00 lbs.
$F_{27} = F_{47}$:	1371.23 lbs.
F_{37}:	1125.33 lbs.

PLATES (Not Engineered)

Joint	Type	Plate Size	X	Y
1	TBD	TBD	TBD	TBD
2	TBD	TBD	TBD	TBD
3	TBD	TBD	TBD	TBD
4	TBD	TBD	TBD	TBD
5	TBD	TBD	TBD	TBD
6	TBD	TBD	TBD	TBD
7	TBD	TBD	TBD	TBD
8	TBD	TBD	TBD	TBD



Thus, the beam that stands these trusses should stand 1334.5lbs load.

beam design:

Beam Data

Load Type:	Single Point Load
Support:	Simple Beam
Beam Type:	Sawn Lumber
Species:	Douglas Fir-Larch
Grade:	DF Construction
Size:	4 x 4
Design Span (L):	29.75 ft.
Clear Span:	29.50 ft.
Total Span:	30.00 ft.
Bearing (l_b):	3 in.
Quantity (N):	1

Design Loads

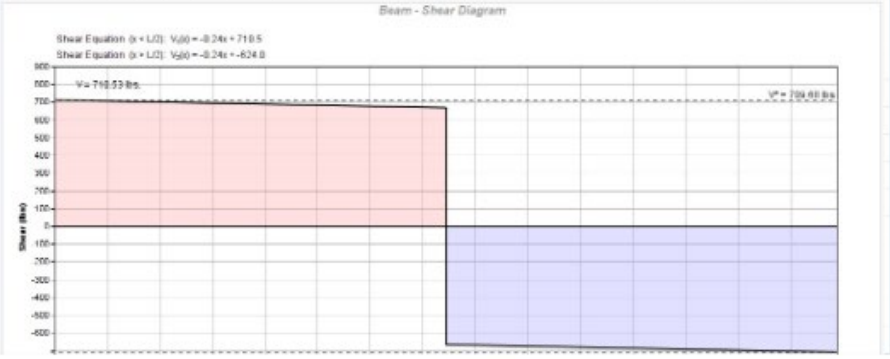
Live Load:		lbs
Dead Load:	1334.5	lbs
Selfweight:	86.6	lbs
Dist. Selfweight:	2.91	plf
Total Weight:	87.3	lbs

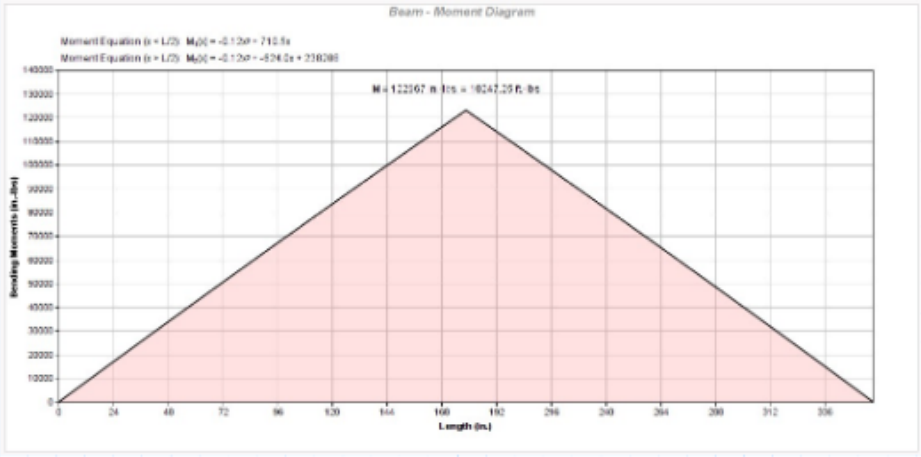
Design Options

Lateral Support:	braced
Defl. Limits:	180|120
Load Duration:	1.33
Exposure:	dry
Temperature:	T <= 100°F
Orientation:	Vertical
Incised Lumber:	No
Rep. Members:	No

Design Assumptions

Code Standard:	IBC 2015, NDS 2015
Bending Stress:	Parallel to Grain
Notes:	





each column should stand 710.53lbs at each end of beam.
footing design:

Spread Footing w/ Pier (concrete, cmu)

footing:
every column is connected to 1 6ft*6ft squared footing

the squared footing is 10 feet under the soil surface

the footing height is 28in
a separate column should stand 39.252kip factored load.

The soil weight in Keokuk is 105lbf/ft^3

$pmin := 0.0018$ $L1 := 6\ ft$ $L2 := 6\ ft$ $h := 14\ in$

$wc := 150\ pcf$ $pd2 := 710.53\ lbf$

$footingweight := wc \cdot L1 \cdot L2 \cdot h = 6.3\ kip$

$$overburdenweight := L1 \cdot L2 \cdot (10\ ft - h) \cdot 105\ \frac{lbf}{ft^3} = 33.39\ kip$$

$$soilpressure := \frac{(footingweight + pd2 + overburdenweight)}{L1 \cdot L2} = (1.122 \cdot 10^3)\ psf$$

$$D4 := 0.5\ in$$

$$qu := \frac{pd2}{L1 \cdot L2} = 0.02\ \frac{kip}{ft^2}$$

$$bardia := D4 = 0.5\ in \qquad cover1 := 3\ in + \frac{bardia}{2} = 3.25\ in$$

$$cover2 := 3\ in + bardia + \frac{bardia}{2} = 3.75\ in$$

$$Averagecover := \frac{(cover1 + cover2)}{2} = 3.5\ in$$

$$d := h - Averagecover = 10.5\ in$$

$$Vu := qu \cdot L2 \cdot \left(\frac{L1 - 24\ in}{2} - d\right) = 0.133\ kip$$

$$\phi Vc := 0.75 \cdot \left(2 \cdot 1 \cdot 4000^{0.5}\ psi \cdot L2 \cdot d\right) = 71.72\ kip$$

$$Vu := qu \cdot (L1 \cdot L2 - (24\ in + d) \cdot (24\ in + d)) = 0.547\ kip$$

$$\beta := 1$$

$$b0 := 2 \cdot (d + 24\ in) + 2 \cdot (d + 24\ in) = 138\ in$$

$$as := 20$$

$$\phi Vc := 0.75 \cdot min\left(4, \left(2 + \frac{4}{\beta}\right), \left(2 + as \cdot \frac{d}{b0}\right)\right) \cdot 1 \cdot 4000^{0.5}\ psi \cdot b0 \cdot d = 242.057\ kip$$

all meet requirement. This can be used for 24in*24in

$$Vu := qu \cdot L2 \cdot \left(\frac{L1 - 32\ in}{2} - d\right) = 0.094\ kip$$

$$\phi Vc := 0.75 \cdot \left(2 \cdot 1 \cdot 4000^{0.5}\ psi \cdot L2 \cdot d\right) = 71.72\ kip$$

$$Vu := qu \cdot (L1 \cdot L2 - (32\ in + d) \cdot (32\ in + d)) = 0.463\ kip$$

$$\beta := 1$$

$$b0 := 2 \cdot (d + 32\ in) + 2 \cdot (d + 32\ in) = 170\ in$$

$$as := 20$$

$$\phi Vc := 0.75 \cdot min\left(4, \left(2 + \frac{4}{\beta}\right), \left(2 + as \cdot \frac{d}{b0}\right)\right) \cdot 1 \cdot 4000^{0.5}\ psi \cdot b0 \cdot d = 273.932\ kip$$

all meet requirement. This can be used for 32in*32in