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D TO Z ENGINEERING

Jacobsen & Brown Building Remodel

DESIGN REPORT

PREPARED BY:

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UNIVERSITY OF IOWA DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING
PROJECT DESIGN AND MANAGEMENT

CEE:4850:0001

MAY 2019

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Section I

Executive Summary

The Jacobsen Building, built by the great lumber baron Chancy Lamb, and the Brown Building are located at 238 and 246 5th Ave S, Clinton, Iowa. D to Z Engineering was tasked to connect the two buildings and redesigning them to be used as residential space above the existing commercial retail space. D to Z Engineering is a team made up of three senior engineering students at the University of Iowa in the capstone design course.

The historic ties that the Jacobsen Building has with the City of Clinton emphasizes the importance of preserving the original architecture and style of the buildings. One key feature of the Jacobsen Building is the ballroom on the third floor which is proposed to be preserved and used as a common space. This common space is a unique asset to the buildings and would be great for resident use as well as small community gatherings. A lock system that can be programmed to open up to the community at certain times is recommended to maintain the security of the building. The façade that currently exists on the Brown Building will be removed to reinstate the original window style into the building to restore its timeless grandeur. The way the façade is attached to the front of the Brown Building may require some additional repairs to be done to the wall once the existing tiles are removed.

Figure 1. Images of the Original Buildings and Façade

The lack of maintenance over the years has caused a lot of deterioration inside of the buildings, however, the buildings are reasonably sound, and the walls show no signs of bowing. Some cracks are visible through the brick masonry which will need to be repaired. The tuckpointing of the masonry walls is currently in good condition but future maintenance repairs and costs should be taken into account. Through a visual inspection, it can be noted that there have been recent structural repairs done on the Jacobsen Building so it was concluded that the most pressing structural concerns were taken care of. The current condition of the buildings as well as the year in which they were built create a concern for some of the hazards that are present. Before anything can

be done, it is recommended that an abatement contract is created for the removal of hazardous lead paint and asbestos as well the large amount of bird droppings found throughout the floors. This will provide a safe environment for the construction workers and subsequent residents. A roof inspection should also be completed before any work is done to ensure no leaking will occur. The recommendation is to replace all of the mechanical systems in the building. The windows are also recommended to be replaced to remove any lead based paint and improve the R-value which helps with the insulation of the windows. A complete sprinkler system will have to be installed according to the International Fire Code. The complete renovation of the buildings will be expensive as new piping, electrical systems, and ductwork will need to be installed throughout both buildings.

There is an existing elevator shaft in the Brown Building that will become a landing for an adjacent exterior elevator that will be installed so both buildings are made accessible to everyone. An outdoor elevator would be unique new feature for the City of Clinton. Retrofitting the elevator shaft that is on the backside of the Brown Building is one of the major tasks for this project. The elevator was sized to easily allow furniture to be transported by the residents up to their units. The elevator will accommodate the basement and the four floors above it. The second and third floors of both buildings align in elevation, however, the fourth floor may not. Since the fourth floor of the Jacobsen Building is proposed storage space, a step can be added to bridge any possible gap between floor elevations. A staircase will be built outside next to the elevator to provide one form of exit for the occupants. The second staircase is placed inside of the building where it will have the least impact on the load bearing walls and commercial space on the first floor. Since this staircase is to be built inside of the building, the structural modifications will have to be taken into the basement. The two stairwells are required to meet fire code standards.

The main entrance for the residential units will be on the west side of the Jacobsen Building which will require an ADA ramp and an easement from the city as the ramp will be constructed on the right-of-way of the sidewalk. In order to connect the two buildings, two openings will be cut through the adjacent walls on every floor and reinforced with a steel lintel to support the openings from the loads above it. A hallway will need to be added on the first floor to connect the main entrance to the elevator and staircases. Since the interior staircase does not directly lead to an exit, it is recommended that the hallway have higher fire rated walls. There is a security door in the design of the first floor to only allow residents and other authorized people to access to the upper levels of the building. The secondary entrance is located behind the Brown Building. The entrance will lead into the landing for the staircase and elevator. Due to the fact that this entrance is located in an alley, the entrance will need to be well lit, have a lot of signage, and have video surveillance to ensure that the residents feel safe in this area. During the winter, snow removal is important to maintain the access to this entrance. The mailboxes are proposed to be in the area by the secondary entrance as this is closest to the elevator. The back of the Brown's Shoe Store will need to be rearranged to accommodate the secondary entrance and mailboxes.

As the buildings are in the downtown district, there is no residential parking at the properties, however, a public parking lot north of the building can be used to accommodate the residents. This off-street parking option is reliable and fortunate enough to be within the 300 foot maximum distance delineated in the City of Clinton Code of Ordinances §159.065. Since this is a public city lot, there needs to be a negotiation with the city to assign the 40 required residential spots as well as

three ADA spots for the two buildings. Negotiations may also be done with the city to have ADA parking spots on the street closer to the building instead of the public parking lot. A secondary parking option is summarized in Section V but was not considered a priority due the high cost of this option.

Multiple alternative solutions that were considered are summarized in Section V. The different markets that were considered are workforce housing, market rate housing, senior citizen housing, and student housing. From these alternatives, the best design was chosen with the client to accommodate for the most demanding market. The markets that were chosen are workforce, market rate, and senior citizen housing. The apartment style will mainly include 1-2 bedrooms as this is what is in high demand whether it's for young members of the workforce or the constantly aging population. Designing the layouts for senior residents means that the apartments are also being designed for ADA needs. These units are to be metered separately and include their own washer and dryer within the unit for convenience to the residents. Based on the codes implemented in Clinton and the building constraints, the recommendation for number of dwelling units is 27 for the Jacobsen and Brown Building.

There is a window requirement in the building code that requires windows to be placed in livable areas such as the bedrooms. This constrained the design significantly as the apartments were located according to the existing window placements. Several of the existing windows were blocked up and would have to be unblocked to reinstall windows in those locations. The fourth floor of the Brown Building had new windows design for the east side and skylights were also considered as a potential option for bringing in natural light to the units that had a limited number of windows. The other floors on the east side of the Brown Building could not have windows installed as there is an existing building on that side and fire code regulations require windows to be a certain height above an existing structure. Two units on the third floor were made into lofts that extend into the fourth floor as the fourth floor would have access to windows. For units that are deeper and have access to less windows, it is recommended to utilize transom windows, high on the bedroom walls, to allow natural daylight to penetrate deeper into the unit. The custom size of the windows drastically increased the cost of the windows and installation. Having less units throughout the buildings also decreased the revenue of the buildings which highly affected the cost viability of the project.

For the areas in the building where it is not possible to have an apartment, there is much potential for mixed use. Some of these areas can be office space, storage space, mechanical system storage, and resident accommodations. The incorporation of commercial rental space within the buildings has proven to be beneficial in the past in bringing in revenue and long-term customers. Having the common space where the ballroom is located is a much needed asset to the City of Clinton as there are not many meeting spaces in the town. In order to create some privacy between the mixed use areas and the residential units, privacy doors were located strategically to avoid people from wandering into the residents living area. Walls that separate occupancy types can be made thicker and incorporate wall deadening technology to provide noise separation for the residents. The fourth floor of the Jacobsen building is predominantly made up of trusses and has part of the ballroom dome protruding into this level. Due to this, the fourth floor was considered a good space to include locked storage for the residents.

An HVAC system with three separate systems is recommended due to the design of the buildings. The commercial space on the first floor will require its own system, this is done to allow the air handler to be set at the commercial's business hours. The second system is used for the commercial and common spaces on the second and third floor and can programmable to the needs of these spaces. All of the residential unit in the entire complex will run on system three. Each residential unit is recommended to be equipped with a two ton heat pump; this is important as each tenant will want autonomous control of the temperature in their space. The residential system loop will also include a cooling tower as well as a gas boiler. All of the heavy mechanical equipment must be placed on structural platforms whether it is located in the basement, roof, or on the fourth floor. In compliance with the International Mechanical Code, all exit/emergency signs must be generator powered, transfers must be fire rated, and dampers must be motorized in the case of an emergency which all contributes to the cost.

The renovation of these buildings will have a positive impact on the City of Clinton. The apartments have the potential of bringing more people to the downtown area which would benefit the businesses. The central location of the building could also increase the use of different modes of transportation that are more beneficial to the environment rather than driving. Overall, the buildings will maintain their historic appeal while bringing in new opportunities for the city. Some of the incorporated features are unique assets to the City of Clinton. These renovations may even be used as a model going forward for residential development in other parts of the downtown area. It is important to note that these recommendations are for the upper floors, however, in the final design deficiencies in the lower floors can be fixed while renovations are happening for the upper floors.

The cost of the renovations was found using a square-foot cost estimating technique. According to the cost estimate found in Table 1, Section VII, the total project cost is $7,645,000. With 27 apartment units, this puts the cost to renovate each apartment at $283 thousand. It is important to note that this cost only includes the apartments and does not take into account any revenue that can be produced by renting out the mixed use spaces. Due to this cost, this project may not be financially viable without grants or other financial incentives.

Section II

Organization Qualifications and Experience

1. **Name of Organization**

   D to Z Engineering

2. **Organization Location and Contact Information**

   Vanessa Zaldivar | Project Manager
   D to Z Engineering | Seamans Center
   103 South Capitol Street
   Iowa City, IA 52242
   (510) 935-6085
   vanessa-zaldivar@uiowa.edu

3. **Organization and Design Team Description**

   D to Z Engineering is a team made up of three senior engineering students at the University of Iowa in the capstone design course. Each member brings a unique expertise in their area of study which provides a well-rounded knowledge needed to carry out this project to completion.

   Vanessa Zaldivar | Project Manager

   Vanessa is the main contact for the Project Client and the bridge between the client and the project group. As project manager, her job is to coordinate projects tasks between team members and with faculty oversight. It is the project manager's job to update the client periodically about the progress of the project. Her leadership position in two student organizations has provided the practice and experience needed to navigate this position. With a focus on overall civil engineering, Vanessa can provide assistance in most aspects of the project design.

   Weixi Li | Technology Services

   Weixi ensures that all design and AutoCAD drawings are up to code with current regulations. The floor plans developed were done on AutoCAD to provide the client with a visual representation of the design. Weixi has a focus in structural engineering and has taken concrete, foundation, and wood design courses. His knowledge in structures allows him to provide structural analysis support.

   David Solus | Report Production & Editor

   David is responsible for coordinating the writing and graphics for all reports as well as making the final editing decisions. With knowledge in structure analysis, design, and

construction, David is able to help in other components of the project design on top of coordinating the writing effort.

4. Description of Experience with Similar Projects

Vanessa Zaldivar

Vanessa has had project experience through her courses which include an Apartment Building Design Project, a Highway Bypass Design Project, and a River Flow Rate and Flood Mitigation Analysis Project. The skills learned in these projects provided the foundation needed to tackle this larger Mixed Use Structure Project. From her work experience as a cashier and organization involvement as a social media manager, Vanessa has developed the skills to effectively communicate with her team through any medium necessary.

Weixi Li

Weixi has been a teaching assistant for Fluid Mechanics and Mechanics of Deformable Bodies. He has gained knowledge of structural design and analysis through his courses in Wood Structure Design and Foundations of Structures Design.

David Solus

David has done several designs and floor layouts from his courses including hydraulics and electrical. David has also worked for the City of Iowa City and understands how to communicate effectively to the public and require a certain amount of detail.

Section III

Design Services

1. **Project Scope**

The scope of this project was to evaluate the two buildings built in the 1800's through a visual inspection to prepare a design plan and cost estimate to remodel the upper three floors of both buildings to be used predominately for residential housing. The bearing walls were identified on every floor based off of images and engineering judgement. The first floor of both buildings was kept as commercial retail space. The western (Jacobsen) building has four floors and has had 2 openings designed to enter into the eastern building. The eastern (Brown) building also has four floors and an existing elevator shaft.

The main entrance for the residential units was designed to be on the west side of the Jacobsen Building. A corridor was incorporated on the first floor from the main entrance to give access to the elevator and two stairwells on the opposite end of the building. One of staircases was placed inside of the Jacobsen Building near the elevator. An exterior elevator was attached to the back of the Brown Building behind the current elevator shaft. A secondary, exterior, staircase was attached to the elevator to meet the fire code. This staircase will serve as the secondary entrance to the building for residential use. The mailboxes were placed on the first floor int the Brown Building by the elevator for ease of access to the residents. During a visual inspection of the buildings, it was evident that structural repair has been completed. Based on this, we have assumed that the building has been structurally evaluated and any necessary structural repairs have been implemented. No additional evaluation for structural deficiencies has been performed by this design team.

The roof on the buildings was not inspected, however, due to the age of the buildings a roof inspection would be necessary to ensure there are no possible leaks and it is a secure place to place some HVAC system components.

The apartments were designed for 1-2 bedrooms units with workforce, market rate and senior housing as the market focus. The apartment layout and design were designed to meet International Building Code Standards. The historical significance of the structure's architectural design was preserved and incorporated throughout the design without pursuing National Register of Historic Preservation status; as it would limit what could be done with the building and probably make the renovation more expensive. In the same nature, the unique ballroom in the third floor of the Jacobsen was converted into a multipurpose room for the residents and the community.

Figure 2. Existing Condition of Jacobsen and Brown Buildings

Elevations and floor plans of the two buildings were developed using AutoCAD. There were 27 apartment units developed in the building. All measurements were based off the initial site visit pictures and Google Earth coordinate calibration. Mixed use spaces were incorporated on the second and third floor of the buildings to provide another source of income. These spaces may also be used for residential amenities that will attract more residents. In order to maintain privacy for the apartment units, incorporation of privacy doors will be used in the building.

Due to window requirements for bedrooms, the apartments were design around the existing windows. Windows were added to the locations where windows did not exist, or they were not blocked up to accommodate more apartment units. In the fourth floor of the Brown Building, new windows were designed on the eastern side of the building and skylights were considered as an option to bring in natural light from above.

Three different HVAC systems were considered for the design. The total amps for each unit are proposed to be 200 amps since private laundry washer and dryer will be incorporated into each unit. The HVAC system proposed for each unit would also require the use of the 200 amps.

The parking for the building was established to be the public city lot that can be seen in Figure C-1 in Appendix C. With the current design, 40 parking spots are recommended as the minimum including 3 ADA parking spots. Additional parking considerations can be found in Section V.

2. Work Plan

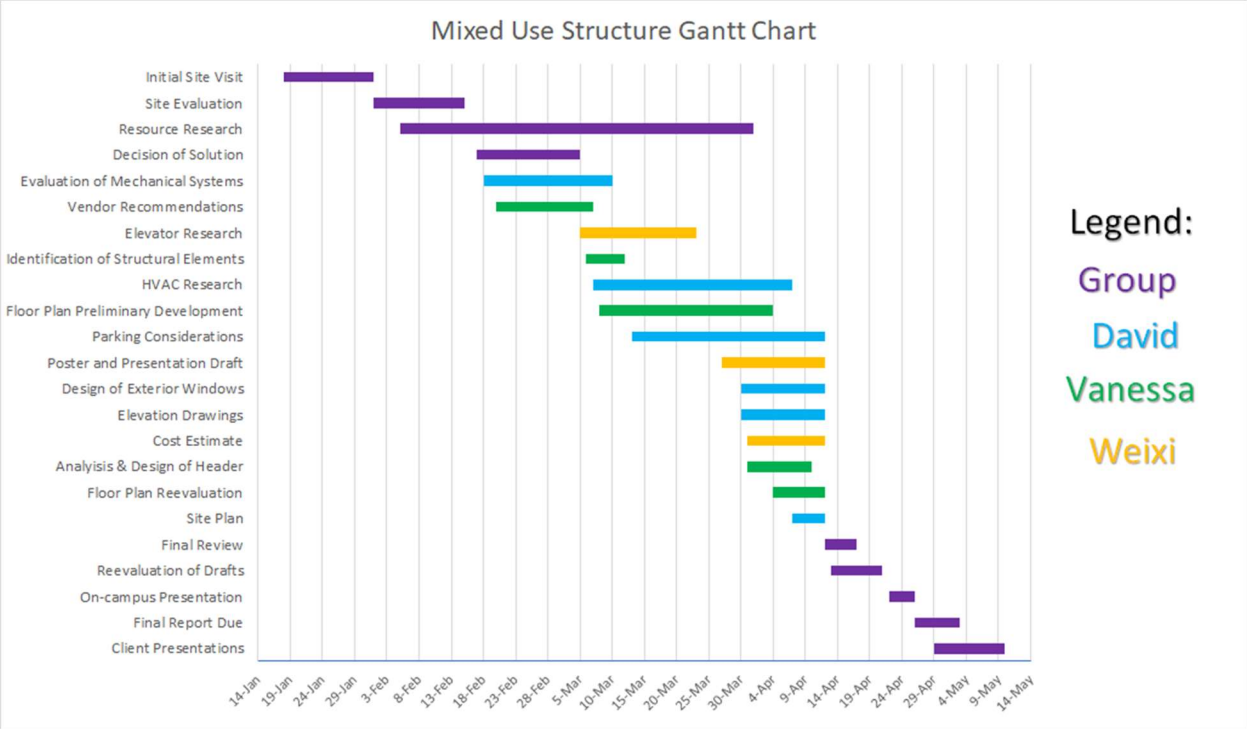

Figure 3. Major Tasks Completed Over the Span of 4 months

The Gantt chart above shows the numerous tasks that were accomplished over the course of the semester. There were some tasks to were done collaboratively amongst the group and other tasks that were led by an individual. The figure is color-coded to identify the role every team member had.

Section IV

Constraints, Challenges and Impacts

1. **Constraints**
   Several constraints impacted the final design including window placement, existing bearing walls, and parking.

   The window to floor space requirement constrained the placement of the apartments as the livable spaces need to have access to windows. From the International Building Code, it is required to have a minimum 8% window area for the total livable square foot of the bedroom. Since the windows cannot be moved, the apartments and bedrooms had to be placed strategically to take advantage of the existing windows. This limited the number of units that were feasible in the buildings which would generally decrease the amount of revenue. Having to work around the windows was one of the major factors that affected the financial viability of the project.

   The bearing walls and beams in the building were a constraint on the design as they are not able to be moved as they sustain the building loads throughout each floor. The placement of these walls narrowed down the locations where apartment units could be placed as well as additional structural features such as stairwells. The interior staircase location was also constrained by the businesses on the first floor which caused the second staircase to be placed outside of the building. These stairwells were required to meet IFC standards.

   Since the location of the building is in the downtown district, parking is not made available directly at the site. The nearest possible parking lot was found to be a public lot located one block north of the Jacobsen Building approximately on the corner of 3rd St and 4th Ave S, and there is more information on this shown in Section V. The limited parking close to the building also limited the locations for the ADA parking spots that would need to be closest to the building.

2. **Challenges**
   Numerous challenges were overcome in the final project design, space optimization, retrofitting the HVAC system, and preserving the unique historical elements of the structure.

   The preference of keeping the historical look limited the exterior of the building from changing too much. Preserving the historic style of the structure lead to the repurposing of the ballroom into a space intended for multi-purpose use of the residents as well as community members that have a need for a meeting space. Although we had to work around the original look, this had an overall positive impact on the final appearance of the project.

Space optimization was considered due to the limited window access on the exterior of the building. We had to take advantage of the space on the inside to add commercial spaces and resident amenities to not waste any space. The final design reflects what we believe to be the best usage of floor spacing based our client's criteria.

Identifying the market and the community was a challenge as we had to consider the demand and the economy of the area. The apartments were designed to best fit the needs of the markets that were identified. Workforce, market rate and senior citizen housing were chosen for the apartment units as these populations are in most need of apartments such as these.

The retrofitting of the HVAC system was also a challenge we ran into. Finding the best location for the mechanical system as well as determining the best plan of action required some thought. The building has only had radiators, so a completely new HVAC system is required for the renovation. The placement of the HVAC system components was key to help minimize the noise and vibrations of the equipment that would be experienced by the residents.

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

Clinton's population is 25,480 according to most recent US census estimates. From the Table B-3 in Appendix B, the trend of the population can be seen slowly decreasing in the last 18 years. The average age of the population is 42.1 which indicates that there is a large number of residents that will be going into retirement in the next decade. The development of these apartments geared towards senior citizens would help accommodate the residents of Clinton with having a good option for living accommodations right in the heart of the downtown district.

Data USA states that the most common method of travel for workers in Clinton is driving with each household having on average two vehicles. Having these apartments located in a central part of the city may reduce the amount of people that are driving and increase the number of people that choose a different mode of transportation that is more environmentally friendly such as biking or walking. Also, a transit bus stop is available around the corner of the building which is another mode of transportation for the residents. The bus stop can be seen in the Site Plan on sheet A-2 of the drawing set.

The average homeownership rate is 69.6%. This value means that nearly 30% of the population are looking to rent. Some of these people are young individuals in the workforce that are not looking for a responsibility of homeownership. Having apartments that would attract younger people in the workforce could potentially increase the population of Clinton as well as increase the workforce to replace the large amount of people retiring in the near future. Creating these apartment buildings downtown could also benefit the businesses as it would attract more people to the downtown area.

Section V

Alternative Solutions That Were Considered

The possibilities of alternatives for this project included, parking location, stairwell location, tenant housing type, and main entrance location among a few other considerations. Each alternative was analyzed based off of what fit best for the design as well as what fit our client's needs.

Elevator Alternatives:

An existing interior elevator shaft is located on the NW corner of the Brown Building as seen in Figure 4 below. The existing elevator shaft is currently not in use and would require major repairs and restorations to become operable. Due to the age of the elevator shaft, custom elevator machinery and components would be needed to retrofit the new elevator within the building. A custom elevator shafts would increase the cost and length of the project which would not be the best option. There also may be some structural constraints if the elevator were to be retrofitted in this location.

Figure 4. Current Elevator Shaft Found in the Brown Building

The construction of a new exterior elevator shaft was considered to cut down on cost, structural limitations, and construction time. The exterior location of the elevator was designed to be directly behind the current elevator shaft which can be seen in Figure 5. The current elevator shaft will be platformed and used as a landing to the exterior elevator shaft. The cost of an exterior elevator shaft is considerably cheaper than retrofitting the existing elevator. Construction time would also decrease since no custom components or machinery would need to be manufactured and delivered to the site. The exterior elevator will also allow a second entry/exit way into the complex. The exterior elevator was chosen for the design.

Figure 5. Exterior Elevator Alternative Location II

Main Entrance Location Alternatives:

With implementing the exterior elevator design, one of the locations of the main entrance that was considered was next to the exterior elevator structure as seen in Figure 6. This design would not impact the first floor commercial level and would provide straight access to the elevator. The downside to this location is the tenants would have to walk through an alleyway to arrive at this entrance which is not a very accessible option. An increase in lighting would be needed to ensure a safe environment for the tenants. Signage and 24 hour security cameras would be a necessary component of this design. Proper maintenance would need to be accounted for snow removal and other routine street cleaning for accessibility.

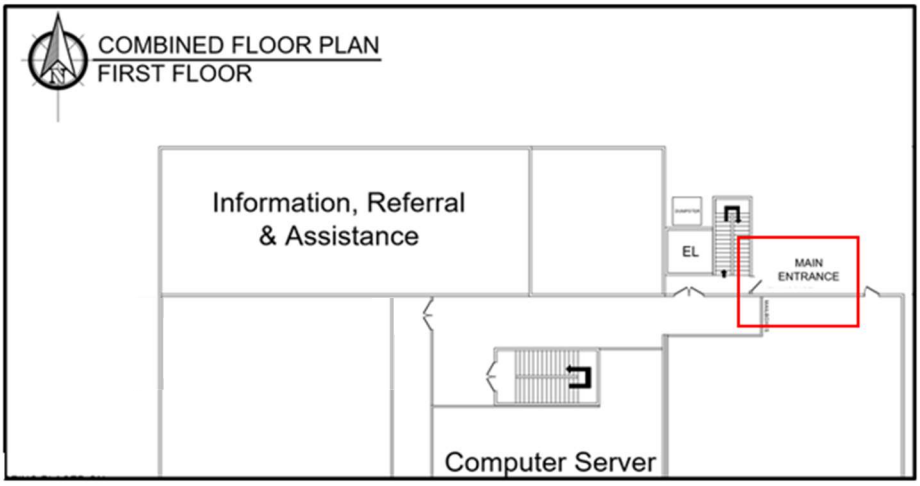

Figure 6. Main Entrance Alternative Location I

The second alternative that was considered was locating the entrance on the west side of the Jacobsen Building. This alternative extends a hallway from the first floor to the elevator as seen in Figure 7 below. Commercial space would need to be compromised for this design to make the hallway large enough to accommodate the residents. At the end of the corridor, a keypad-system door that be implemented to ensure that the public cannot access the tenant spaces other than the commercial businesses on the first floor. This alternative is better as this provides the residents with two entrances. The main entrance is more friendly to the residents as it is on a sidewalk and has a wheelchair accessible ramp that is more accessible than the rear entrance. Lighting and safety precautions would still need to be in place by the secondary entrance to ensure the residents are comfortable entering through this location. This configuration was chosen for the design.

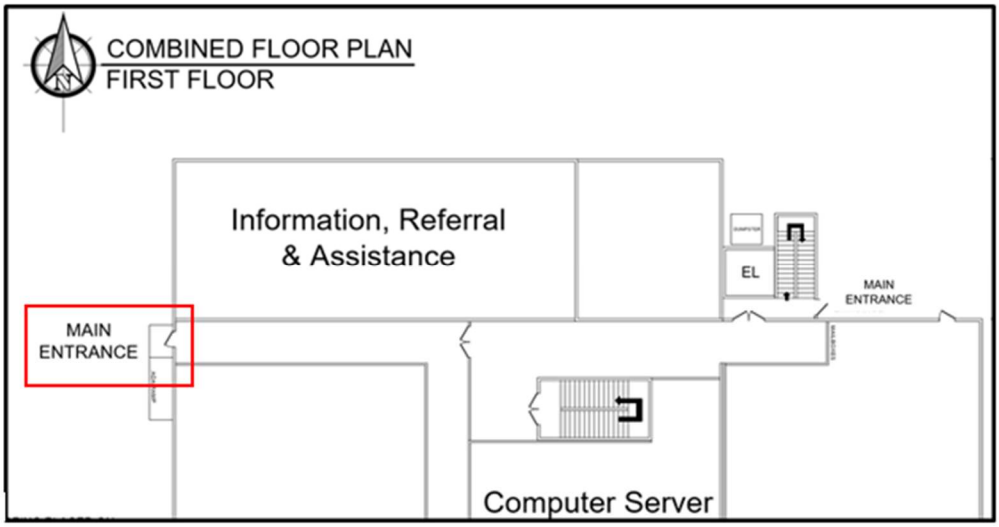

Figure 7. Main Entrance Alternative Location II

Parking Alternatives:

The first parking lot alternative is located on the NW corner of S 3rd St and 4th Ave. S as seen in Figure 9. This location is approximately 300 ft away from the main entrance of the complex. This meets the distance requirement for parking identified in the Code of Ordinances. Currently the parking area is owned by the city and permits, or parking spots can be negotiated to be used as the complex's residential parking area. This location is not ideal for accessible residents due to the distance from the complex, however, is very convenient compared to many other downtown areas in the country. City bus stops are also nearby to both the complex and parking alternative I, which is located on the intersection of 4th Ave and 3rd St.

Figure 8. Parking Alternative I

A second possible alternative for a parking lot is an existing lot located on the SW corner of S 3rd St and 4th Ave. S. seen in Figure 9. This lot was made known to our team as vacant and with potential of being for sale in some future. Alternative II, is slightly closer to the complex compared to Alternative I. The city bus stop is also conveniently located on the corner of the lot. The lot location would need to include demolition of current structures located on the lot and a separate site layout for the structure design. The cost of the parking lot site development in this location rendered this to option to not be a priority. Therefore, parking alternative I was chosen.

Figure 9. Parking Alternative Solution II

Senior Citizen Housing:

This alternative would accommodate for the increased number of residents going into retirement within the next decade. As of 2016, the average age of a person living in Clinton, IA was 42.1. While in 2015 the average age was 40.9. Based on these predictions, a good strategy would be to plan ahead and design the residential apartments specifically towards senior residents. This includes but not limited to adding extra space for mobility, ease of access to building accessories and amenities. These accommodations can influence older generations, who would prefer a more simply and more labor free housing lifestyle. This alternative would also accommodate people with disabilities and was chosen as one of the alternatives.

Student Housing:

Student housing was considered as there is an estimated increase of international students at the nearby learning institution. The residential apartments can be used to accommodate for this increase in young population. This alternative would be designed with a more modern design to attract a younger crowd. This alternative was not chosen as there is not enough demand for it at the moment and would most likely not fill all of the apartments in the building.

Workforce & Market Rate Housing:

Workforce and Market Rate housing are similar as they would both help bring in a younger crowd. Since Clinton has been designated distressed for workforce, this alternative would be great to bring in young residents that are starting in the workforce and do not want the pressure of homeownership. This option was chosen as one of the alternatives for this project.

Section VI

Final Design Details

Parking

Parking alternative I was chosen as the primary option for all tenants. This alternative provides a mixture of beneficial needs for the residentials and lower cost to the client. Contacting the city will be needed to develop an agreement to ensure a fair deal for the parking spaces. Due to ADA requirements, two wheelchair accessible and one van drop off parking spots will be needed as seen in Table B-2 in Appendix B. Since there are 14 units that are 2-bedroom, this will require 28 parking spots according to the Code of Ordinances §159.065. The remaining 12 units only require 12 parking spots. The minimum required parking spots are 43 with the current design. Possible usage of a current wheelchair accessible parking spot in front of the building however will also require a negotiation with the city.

Elevator & Stairwells

The exterior elevator location allows the connectivity of the two buildings at a centralized location. The exterior construction will start immediately, due to the fact it will not interfere with current projects inside the structure. The elevator structure itself was based off of a Schumacher hydraulic elevator model with a 9'0 ½" x 7'-2" hoistway that can be seen in Appendix D. The structure was selected as a steel frame, brick veneer wall which would also enclose the staircase adjacent to the elevator. The elevator was sized to make move in for the residents easier as they can fit larger items in the elevator. The exterior masonry/concrete shaft will have a width of 6'. The recommended type of elevator is a roped hydraulic elevator with a minimum of 3,500 lb capacity. The client can use any vendor they prefer for this design. The existing elevator shaft will be used as a platform for the new exterior elevator shaft. Removal of rear exterior wall of the Brown will need to follow the demolition code of ordinance, the width of exterior masonry removal will be determined by the current status of the existing elevator and the specifications of the elevator vendor chosen.

The stairwells incorporated were don so to meet the IFC and IBC standards as well as provide access to the residents to all of the floors. The staircase on the inside of the building was made to be wider than the minimum to be comfortable for the residents to go through. This staircase was located so that it had the least impact on the commercial space on the first floor. The second staircase on the outside with the elevator will be the location of the secondary entrance. The elevator and staircase will have a small shared corridor that will lead to the opening into the building on each level. The standards and specifications for this are found in Appendix D as well as sheet S-2 of the drawing set. Both the elevator and the stairwells will service all four floors as well as the basement.

Bearing Walls

Since there are no existing floor plans of the buildings, we had to recreate the floor plans based off of our best engineering judgement. From our initial site visit evaluation and exterior structural layout of the two buildings, we determined to a close degree the locations of the bearing walls. The existing

floor joist direction was the first step in determining which walls were load bearing. Our provided details of the bearing walls and beams were sufficient enough to get a rough estimate constraints mentioned previously. Locating the bearing walls was an important task as these walls help distribute the building loads and should remain where they are. If the bearing walls were to be moved, it would cost a lot of money to make that happen which is why we worked around the existing layout.

The bearing walls on the second and third floor of the Jacobsen Building were determined at four central points as shown in sheet A-14 and A-15 in the drawing set. On the second floor of the Jacobsen Building, the bearing walls were designed to hold the load of the ballroom above. The bearing structures in Brown Building were located directly down the center of the building from the second floor into the fourth floor. A y-shape beam configuration was found towards the south end of the building as it straddled the middle window. This beam configuration can be found in the drawing sets on every floor plan.

The bearing walls and beams in the building were a constraint on the design as they are not able to be moved as they sustain the building loads throughout each floor. The placement of these walls narrowed down the locations where apartment units could be placed as well as additional structural features such as stairwells. The interior staircase location was also constrained by the businesses on the first floor which caused the second staircase to be placed outside of the building.

Structural Header

Since there has to be openings cut into the bearing walls, it is important to ensure that the loads are continued to transfer correctly. For this reason, we decided to use a steel lintel design from the Technical Notes on Brick Construction. Some assumptions had to be made on the loads of the buildings that would affect the area of the openings. The calculations can be found in Appendix D. The steel lintel beam with a plate was chosen to withstand the loads and be the cheapest option. The steel beam chosen was the W12x26.

Windows

Due to the current conditions of the exterior windows, it is recommended to have them all replaced to remove any lead based paint and improve the R-value which helps with the insulation. The current window layout was maintained on the south and west side of the Jacobsen Building. The Brown Building has existing windows on the north and south side that are blocked up. These windows will be unblocked to be used as windows for the apartments. It is important to note that because the elevator and staircase enclose will be on the north side of the Brown Building, some windows will not need to be unblocked and other window opening will need to be made larger to become the door entrance to the building. The demolition notes can be seen in sheets D-1 to D-3 in the drawing set.

The north side of the Jacobsen Building had additional windows designed onto the wall that matched the same style as the existing ones. The fourth floor of the Brown Building was designed to have new windows installed on the eastern wall. The window layout of this wall is designed to imitate the historical look and optimize the window to floor spacing layout. The windows on the east side of the Brown Building could only be on the fourth floor as the lower floors would interfere

with future development of the neighboring commercial building. The layout of the new windows can be seen in sheet A-6

Mechanical Systems & HVAC

The IFC and NFPA standards and codes were used for the selection of the water supply system for the sprinklers. The minimum size allowed for the main pipe is a 6 in diameter pipe. This minimum criterion is to ensure an adequate water supply to sprinkler systems; less than 4 in diameter pipes would require additional hydraulic calculations to determine if the pipe can handle flow of both fire systems and other non-fire demands.

Three different types of HVAC systems were incorporated in the design. The first system was designed as a separate unit to allow separate control for the commercial units on the first floor. The second system was designed to be adjustable for all mixed use spaces and will not require as much extension heating. The third system was designed for all residential spaces, including a separate condenser for each unit. An exterior cooling fan was planned to be on the roof of the structure. A mechanical room from MEP, Plumbing, and HVAC are located in the same general area, however, are isolated separately due to IFC standards. All dimension specifications are based off of Syska Hennessy's blended rate calculation for this type of mixed use design. The total amps for each unit will be 200 amps. There were 27 apartment units developed in the building.

ADA Ramp

In order to make the main entrance accessible to everyone, an ADA Ramp was designed to accommodate for the building entrance elevation. We assumed there was a 12" step so the ramp was designed accordingly to be 12 feet in length in accordance to the ADA standards that are found in Appendix D. The top and bottom ramp landings were designed to meet the 60"x60" landing size requirement. The top landing was made a bit larger to accommodate the traffic at the main entrance. There is an additional step on the opposite side of the ramp to meet the maximum rise requirement for stairs which is 7".

Floor Layout

All of the units were designed to be 1-2 bedroom units as this is what is most popular for the markets that were identified. Some of the units include a study as this is a popular option for more senior residents. Most units only include one bathroom as having two bathrooms does not usually benefit the overall cost of the project. All units include a washer and dryer unit for the convenience of the residents. Larger units generally have larger room and features which is great for accessibility.

The first floor layout was designed to impact the current commercial tenants as minimal as possible. Floor plans are shown in sheet A-7. A compromise must be made to the current computer service tenant to allow construction of the staircase that is located inside of the building. The mailboxes were placed by the elevator and the rear entrance.

The second floor layout utilized all of the window space and aligned the livable units on the outer edge of the complex. The interior space that was not designated for apartments has many uses such as a gym, common space, or commercial/office space. There is a large section in the middle of the Jacobsen Building that was designated as a Vanilla Box Finish which is a finish that results in a commercial space that is neutral, impersonal, and ready for tenant improvement once the lease or sales agreement is signed. Since there is commercial space on this level, privacy doors were placed to only let residents into the residential area. The longer units that have only access to one window such as Unit 201 benefit from the use of transom windows which would allow natural light to penetrate into the apartment. The basic floor plan and sample developed floor plan can be seen in sheets A-8 and A-11 in the drawing sheet.

The third floor layout takes advantage of the ballroom as a common space for the residents. This space could also be used for small community meetings as there is a need for this kind of space in the Clinton area. A lock system would have to be put in place to allow community members in during the meeting time as well as keep the residents safe. There is an additional lounge that serves the same purpose, however, it is for much smaller gatherings and it includes a kitchenette. Because of the common space, bathrooms were incorporated on this floor to accommodate the guests. Some mechanical rooms can be found on this floor. For units 301 and 311, the bedroom is tucked in behind the common space to take advantage of the windows. In order to reduce the noise into the bedrooms it is recommended to us wall deadening technologies along this wall. Another unique feature on this floor is the incorporation of lofts in the Brown Building. This was done to be able to have more units in this building since having no windows on the eastern wall was limiting the use of this area. The third floor has the kitchen and living area while the fourth floor has the bedrooms. The basic floor plan and sample developed floor plan can be seen in sheets A-9 and A-12.

The fourth floor of the Jacobsen building is labeled as proposed lock storage because there is not much room on this floor for development. There are a lot of trusses and the ballroom dome protrudes into this level as seen in Figure C-5 and C-6 in Appendix C. Since the fourth floor of the Jacobsen Building is proposed storage space, a step can be added to bridge any possible gap between floor elevations if the floors do not align. The second level of the loft that is found on the fourth floor of the Brown Building has some rooms with no windows. In order to meet the IBC standards, there need to be skylights installed to let in light to those rooms if they will be used as bedrooms. The new windows on the east side of the building are also found on this floor. No commercial space is found on this floor. The basic floor plan and sample developed floor plan can be seen in sheets A-10 and A-13.

Recommendations

It is important to note that structural repairs have been made by the owner which allowed us to design the floor plans assuming that the most pressing structural concerns were taken care of. As stated before, a roof inspection is recommended to check for any leaks before ay work is done .A hazard mitigation contract must be put in place to remove all of the hazards such as lead, asbestos, as well as bird droppings which can be harmful to the workers as well as the residents. The exterior

masonry wall is currently in good condition, however, tuckpointing should be put on the radar for future maintenance. Another note on the masonry wall is that the wall on the Brown Building where the tile façade is located probably will have damage after the tiles are removed. This is something that will need to be fixed to restore the original wall of the building. A final note is that all of the recommendations made are for the upper floors, however, in the final design it would be good to check for any deficiencies in the lower floors that can be fixed during the renovations.

Section VII

Engineer's Cost Estimate

Table 1. Cost estimate for project

Description	Quantitiy	Units	Unit Price	Total Cost
Pre-Construction				
Hazard Mitigation	1	Each	$ 15,000.00	$ 15,000.00
Building Envelope				
Repair Connection on Brown Building	2270	sq-ft	$ 2.60	$ 5,902
Roof	17940	sq-ft	$ 3.45	$ 61,893
Façade Demolition for Brown Building	2436	sq-ft	$ 6.00	$ 14,616
Window Replacement & Installation	90	Each	$ 2,600.00	$ 234,000
ADA Ramp for Main Apartment Access	18	ft	$ 175.00	$ 3,150
Structural Modifications				
New Window Openings	820	sq-ft	$ 2.26	$ 1,853
Cut Openings between Buildings	576	sq-ft	$ 5.00	$ 2,880
Elevator and Staircase Structure (Brick Veneer)	1525	sq-ft	$ 165.00	$ 251,625
Stairwell Construction	2140	sq-ft	$ 3.22	$ 6,891
Mechanical Systems				
Elevator (3,500 lb) 9'-0" x 7'-2" Hoistway	1	Each	$ 81,350	$ 81,350
Interior				
Interior Remodel (including mechanical systems)	45310	sq-ft	$ 120.00	$ 5,437,200
			Sum:	$ 6,116,360
			15% Contingency:	$ 917,454
			10% Engineering & Administration:	$ 611,636
			Total Project Cost:	**$ 7,645,000**

The cost estimate was done using cost per square foot information from the RSMeans book. Since the building is old, a lot of material removal has to be done to remove the harmful material which is accounted for in the Hazard Mitigation cost. It is important to note that the interior remodel is all inclusive which accounts for the ductwork, wiring, HVAC, plumbing, and sprinkler. A 15% contingency was added as there are a lot of unknowns with this project so this would help prevent the client from unexpected expenses that would lead to being overbudget. With 27 units, the cost per unit is $283 thousand which may be a bit steep. It is important to note that this cost only includes the apartments and does not take into account any revenue that can be produced by renting out the mixed use spaces. Due to this cost, this project may not be financially viable without grants or other financial incentives.

Appendix A

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Appendix B

Tables

Table B-1. Clinton IA Code of Ordinances Section 159.065 Off-street parking requirements

Residential	
Rooming and boarding house	1 space/sleeping room
One- and two-family dwelling	2 spaces/dwelling unit
Apartment dwelling	
Efficiency apartment	1 space/dwelling unit
One bedroom apartment	1 space/dwelling unit
Two or more bedroom apartment	2 spaces/dwelling unit
Mobile home	2 spaces/home space
Elderly and handicap apartment	1 space/dwelling unit

Table B-2. ADA parking requirements for the total number of parking spots

Total Number of Parking Spaces in Parking Facility (Lot or Garage)	Minimum Total Number of Accessible Parking Spaces Required	Minimum Number of Van Accessible Parking Spaces
1 - 25	1	1
26 - 50	2	1
51 - 75	3	1
76 - 100	4	1
101 - 150	5	1
151 - 200	6	1
201 - 300	7	2
301 - 400	8	2
401 - 500	9	2
501 - 1000	2% of total	
1001 and over	20, plus 1 for each 100, or fraction thereof, over 1000	

Table B-3. The declining population on Clinton, Iowa over the past decade
http://worldpopulationreview.com/us-cities/clinton-ia-population/

Year ▾	Population	Growth	Annual Growth Rate
2017	25,480	-174	-0.68%
2016	25,654	-202	-0.78%
2015	25,856	-248	-0.95%
2014	26,104	-244	-0.93%
2013	26,348	-257	-0.97%
2012	26,605	-272	-1.01%
2011	26,877	17	0.06%
2010	26,860	-912	-0.33%
2000	27,772	-1,429	-0.50%

Appendix C

Figures

Figure C-1. Public City Lot Chosen as the First Alternative for the Apartments

Figure C-2. Exterior Elevator as the Primary Alternative for the Apartments

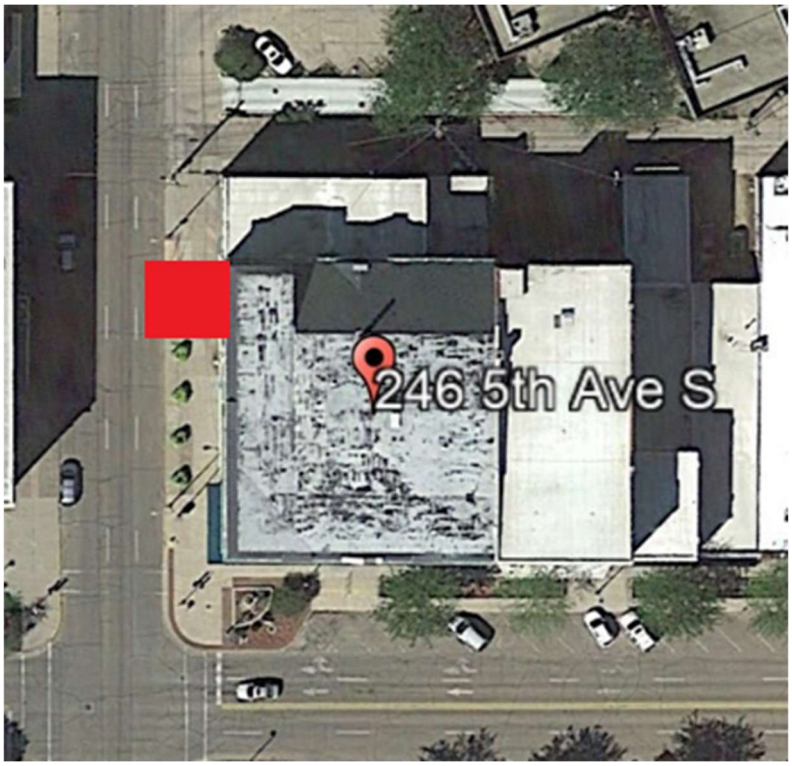


Figure C-3. Main Entrance Near Exterior Elevator

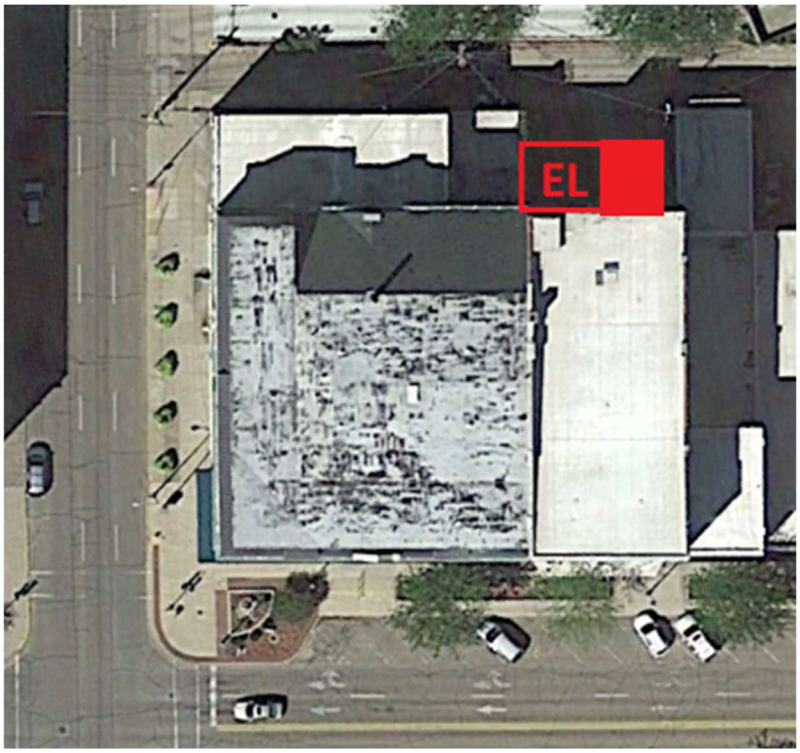


Figure C-4. Secondary Entrance on the West of Jacobsen Building

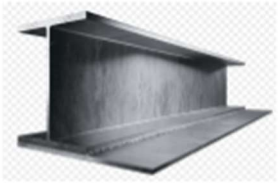
Figure C-5. Existing Ballroom Condition on the Third Floor of the Jacobsen Building

Figure C-6. Images of the Fourth Floor of the Jacobsen Building that Show the Limited Usable Space

Appendix D

Hand Calculations & Specifications

Structural Steel Lintel Design



Steel Beam/Plate Lintel:
In solid walls with large superimposed loads, or in walls where the openings are greater that 8 ft.

Known:

- Solid masonry wall (1886)
- Opening through 2 bearing walls
- 8 ft corridor
- $\Delta_d < \frac{L}{600}$

Assumptions:

- Design is for opening on 1st floor
- Use a steel beam/plate lintel
- 8" extension on both sides of the lintel
- $q_{d.floor} = 25\ psf$
- 8" height of clay brick
- ASD Load combinations
- Designing for 1st floor (total of 4 floors)
-

$H_{wall} := 52.75\ ft$ $H_{door} := 8\ ft$

$$w_T := \frac{(27\ ft + 24.75\ ft)}{2}$$

ASCE 7-16

Ch. C3 Dead Loads

Assumed

$q_{d.floor} := 25\ psf$

Clay brick wythe: 8in (2 bearing walls)

$q_{d.walls} := 79\ psf$

Ch. 4 Live Loads

Residential: Corridors servicing public rooms

$q_{l.floor} := 100\ psf$

$W_{d.floor} := q_{d.floor} \cdot w_T = 646.875\ plf$

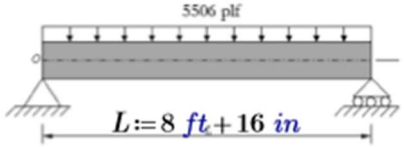
$W_{d.walls} := q_{d.walls} \cdot \left(H_{wall} - \left(H_{door} \cdot 3\right)\right) = \left(2.271 \cdot 10^3\right)\ plf$

$W_{l.floor} := q_{l.floor} \cdot w_T = \left(2.588 \cdot 10^3\right)\ plf$

Ch. 2 Load Combinations: ASD

2.) D+L

$W := \left(W_{d.floor} + W_{d.walls}\right) + W_{l.floor} = \left(5.506 \cdot 10^3\right)\ plf$



$$V := \frac{W \cdot L}{2} = (2.569 \cdot 10^4)\ lbf \qquad M := \frac{W \cdot L^2}{8} = (5.995 \cdot 10^4)\ lbf \cdot ft$$

$$\Delta_{max} := \frac{L}{600} = 0.187\ in \qquad \Delta_{max} := 0.187$$

Steel Construction Manual

Table 3-2 (Z_x), Table 1-1 (I_{xx})

$E := 29 \cdot 10^6\ psi$

Choose W8x, W12x or W16x for a brick height of 4 in

W12x26

$M_R := 92.8\ kip \cdot ft$

$V_R := 56.1\ kip$

$I_x := 204\ in^4$

$$\Delta_d := \frac{5 \cdot W \cdot L^4 \cdot 1728}{384 \cdot E \cdot I_x} = 0.159$$

$$DCR := \frac{\Delta_d}{\Delta_{max}} \cdot 100 = 84.964\ \%$$

W8x58

$M_R := 149\ kip \cdot ft$

$V_R := 89.3\ kip$

$I_x := 228\ in^4$

$$\Delta_d := \frac{5 \cdot W \cdot L^4 \cdot 1728}{384 \cdot E \cdot I_x} = 0.142$$

$$DCR := \frac{\Delta_d}{\Delta_{max}} \cdot 100 = 76.02\%$$

W16x26

$M_R := 110\ kip \cdot ft$

$V_R := 70.5\ kip$

$I_x := 301\ in^4$

$$\Delta_d := \frac{5 \cdot W \cdot L^4 \cdot 1728}{384 \cdot E \cdot I_x} = 0.108$$

$$DCR := \frac{\Delta_d}{\Delta_{max}} \cdot 100 = 57.583\ \%$$

From the selected beams, the **W12x26** was chosen as it is one of the lighter options ** (less expensive) and it is the least overdesigned beam based on the assumptions.

Technical Notes on Brick Construction: Bearing Area

Grouted solid masonry (4500 plus psi): Type N Mortar

$f_m := 200\ psi$

$$A_b := \frac{V}{f_m} = 0.892\ ft^2 \qquad L_b := \frac{A_b}{16\ in} = 8.029\ in$$

ADA Ramp Requirements [§405]:

405.2 Slope & 405.3 Cross Slope.

Slope represents the proportion of vertical rise to horizontal length and is specified in the Standards as a ratio (e.g., 1:12). It also can be expressed as a percentage, pitch, or in degrees. The running slope is to be uniform along a run, although slight variations may occur with certain materials such as concrete. No other changes in level other than the running slope (1:12 max.) and cross slope (1:48 max.) are permitted. Variations in slope, such as grade breaks within runs, can disrupt wheelchair travel.

405.5 Clear Width.

The clear width of a ramp run and, where handrails are provided, the clear width between handrails shall be 36 inches (915 mm) minimum.

405.7 Landings.

Ramps that do not have level landings at changes in direction can create a compound slope that will not meet the requirements of this document. Level landings are required at the top and bottom of each run. Changes in level greater than 1:48 are not permitted at landings. Landings must be designed to prevent the accumulation of water. Circular or curved ramps continually change direction. Curvilinear ramps with small radii also can create compound cross slopes and cannot, by their nature, meet the requirements for accessible routes. A level landing is needed at the accessible door to permit maneuvering and simultaneously door operation.

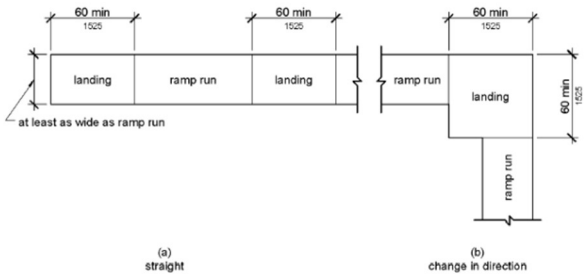
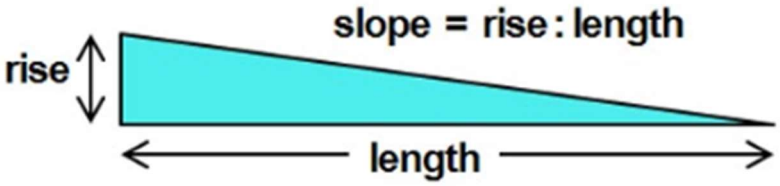


Figure 405.7 Ramp Landings

Known:

- Current rise (y) to main entrance 1 ft
- Slope = rise (y, ft) : length (L, ft)
- Width (w) > 36”



Equation:

$$\frac{1}{12} = \frac{y}{L}$$

- Solve for length (L):

$$L = 12(y) = 12(1) = 12\ ft$$

ADA Handrail & Stairway Requirements [§504.6, §505]:

- 504.2 Treads and Risers. All steps on a flight of stairs shall have uniform riser heights and uniform tread depths. Risers shall be 4 inches (100 mm) high minimum and 7 inches (180 mm) high maximum. Treads shall be 11 inches (280 mm) deep minimum.
- 504.5 Nosings. The radius of curvature at the leading edge of the tread shall be ½ inch (13 mm) maximum. Nosings that project beyond risers shall have the underside of the leading edge curved or beveled. Risers shall be permitted to slope under the tread at an angle of 30 degrees maximum from vertical. The permitted projection of the nosing shall extend 1½ (38 mm) maximum over the tread below.
- 505.4 Height. Top of gripping surfaces of handrails shall be 34 inches (865 mm) minimum and 38 inches (965 mm) maximum vertically above walking surfaces, stair nosings, and ramp surfaces. Handrails shall be at a consistent height above walking surfaces, stair nosings, and ramp surfaces.
- 505.5 Clearance. Clearance between handrail gripping surfaces and adjacent surfaces shall be 1½ (38 mm) minimum.

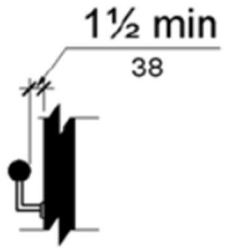


Figure 505.5 Handrail Clearance

- 505.6 Gripping Surface. Handrail gripping surfaces shall be continuous along their length and shall not be obstructed along their tops or sides. The bottoms of handrail gripping surfaces shall not be obstructed for more than 20 percent of their length. Where provided, horizontal projections shall occur 1½ (38 mm) minimum below the bottom of the handrail gripping surface.

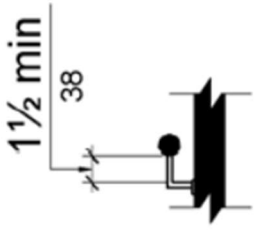


Figure 505.6 Horizontal Projections Below Gripping Surface

- 505.7.1 Circular Cross Section. Handrail gripping surfaces with a circular cross section shall have an outside diameter of 1¼ inches (32 mm) minimum and 2 inches (51 mm) maximum.

- 505.7.2 Non-Circular Cross Sections. Handrail gripping surfaces with a non-circular cross section shall have a perimeter dimension of 4 inches (100 mm) minimum and 6¼ inches (160 mm) maximum, and a cross-section dimension of 2¼ inches (57 mm) maximum.

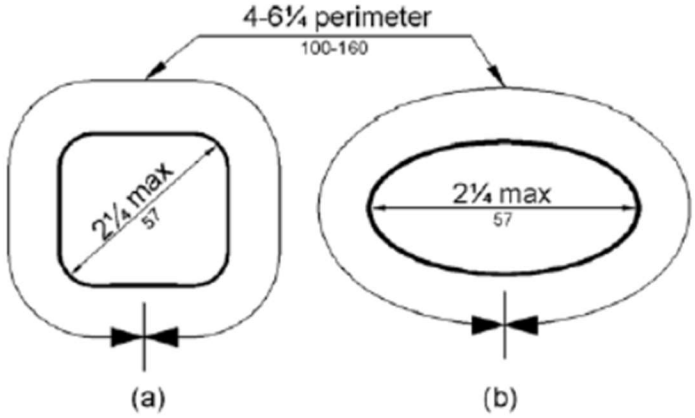


Figure 505.7.2 Handrail Non-Circular Cross Section

- 505.10.1 Top and Bottom Extension at Ramps. Ramp handrails shall extend horizontally above the landing for 12 inches (305 mm) minimum beyond the top and bottom of ramp runs. Extensions shall return to a wall, guard, or the landing surface, or shall be continuous to the handrail of an adjacent ramp run.

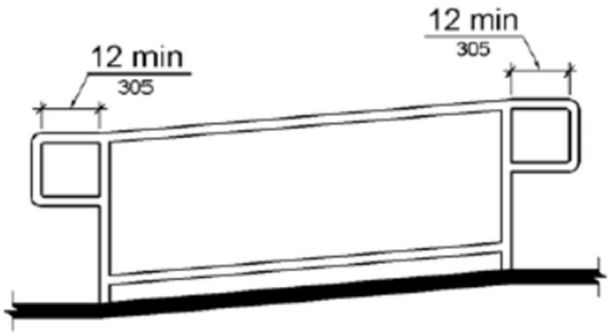


Figure 505.10.1 Top and Bottom Handrail Extension at Ramps

Elevator specifications from Schumacher Elevator Co. that were used to layout design of shaft.