BRIDGING PROGRAM AND PLACE

AN ALTERNATIVE LEARNING CENTER FOR MANDAN, ND

Mackenzie Lyseng

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A Design Thesis Submitted to the
Department of Architecture and Landscape Architecture
Of North Dakota State University

By

Mackenzie Ruth Lyseng

In Partial Fulfillment of the Requirements
for the Degree of
Master of Architecture

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Primary Thesis Advisor

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Thesis Chair

May 2015
Fargo, North Dakota

Figure 1. Fence Post.

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

All images created by Mackenzie Lyseng unless otherwise noted.

All images created by Mackenzie Lyseng unless otherwise noted.

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Figure 2. Grass.


THE PROPOSAL

Figure 3. Train.

THESIS ABSTRACT

A school is an institution designed for the teaching of students, yet so often our school buildings do little to suggest that any learning occurs inside. Our schools should be designed in a way that enhances the learning experience and encourages students to take control of their education. The Mandan Alternative Learning Center strives for a new approach to education design, one that seeks a stronger connection between the program and the place.

The Mandan Alternative Learning Center serves as one possible solution for what a school could become if specific design concepts are applied throughout the design process. Some of the concepts considered in this project include: air quality, natural lighting and lighting levels, wayfinding and circulation, connection to nature, active design, social interaction, flexible design, occupant control, site location and context, etc. Research has found many of these design concepts to have a positive influence on both student learning and productivity, as well as student wellbeing. All of which are essential for future success, however it may be defined. The goal of this project is to reshape the way in which our schools are designed and experienced to enhance student learning and wellbeing.

PROBLEM STATEMENT

How can the built environment enhance student learning and wellbeing?

Figure 4. In the Grass.

Figure 5. Bark.

THE NARRATIVE

The environment in which we engage in an activity can have a large impact upon what we do and how we do it. In this thesis project, I wanted to explore this relationship and readdress the way we go about designing for a specific activity. In a school, there are a variety of activities that the built environment needs to accomodate for. Beyond just providing a space for these activities, it should be goal for the architecture to improve or enhance these activities. In this way, we are bridging program and place to make one cohesive design.

Another aspect of this thesis is enhancing occupant wellbeing. Adolescence is a time of great personal change which can often result in poor mental or physical wellness. According to a study conducted by the National Institute of Mental Health in 2012, 9.1 percent of individuals between the ages 12 and 17 had experienced at least one major depressive episode within the past year (Substance Abuse and Mental Health Services Administration, 2010). By introducing design solutions that promote wellness into the schools, hopefully we can see a drop in this statistic.

The site for this thesis project shall be located in Mandan, North Dakota. The Morton County Comprehensive Housing Study has calculated that the population of Mandan is projected to increase by nearly 7.2% by 2018 due to the oil boom (Hanna:Keelan Associates, 2014). This population increase will also affect school populations, and equates to about a 1.8% increase per year. In 2012, the city realized that their elementary schools would soon reach capacity, so they constructed a new elementary school called Red Trail Elementary. This increased the total capacity of Mandan elementary schools to 1,887 students. This averages out to be 315 students per grade level.

The middle school and high school are now in need of expansion to ensure that there will be adequate space for these students in the future. Currently, the two schools are in good standing with their capacity, but in a few years this will not be the case. According to the district's enrollment projections, there will be approximately 305 students per class in the elementary schools by 2017. The middle school has a capacity of 266 students per class, and the high school has a capacity of 275 students per class (RSP & Associates, 2012). If we presume that the population of the city will continue to increase at a steady rate, the middle school and high school will need to be expanded by the year of 2017.

The population growth in Mandan can most likely be attributed to the oil boom. Families are moving to the state of North Dakota for the promise of financial security. According to the North Dakota Petroleum Council, the Bakken wells are likely to produce oil for the next 30 years, so it can be assumed that the population will continue to increase for about 20 years (North Dakota Petroleum Council, 2014). At a growth rate of about 1.8% per year, our current high school population of 275 students is bound to reach about 375 by the year 2035. Once the state runs out of oil, it is likely that the population will either plateau or begin to decrease. For this reason, my thesis will suggest a secondary alternative high school that serves 300 students that creates a combined total of 1,500 high school students in Mandan, ND

The location of the current high school is not ideal for the students and the athletes who must drive a mile away to reach their athletic fields. My proposal suggests that a new alternative school be located much closer to these fields. This will create a much stronger connection between academics and athletics within the school. The alternative school would share facilities and programs with the main high school so that the students may benefit from the variety of opportunities present within a larger school. My proposal will be beneficial to the students and community of Mandan, and will help solve the capacity issues that the school district will be facing within the next few years.


Figure 6. Mandan High School.

PROJECT TYPOLOGY

High School

This proposal will be applying design strategies to promote student learning and wellbeing in a high school facility. The goal is to see improved health and wellness within the occupants, but also higher productivity and greater learning within the students. The high school will house students from grades nine through twelve.

Figure 7. Radiator.

TYPOLOGICAL RESEARCH

FOSSIL RIDGE HIGH SCHOOL

Fort Collins, CO

ARCHITECT RB+B Architects, Inc.
SQUARE FOOTAGE 90,334 ft^2
OCCUPANCY 1,800 students

DISTINGUISHING CHARACTERISTIC First LEED Certified school in Colorado

PROGRAM Classrooms, Offices, Restrooms, Electrical Systems, Cafeteria, Circulation, Gymnasium, Patio, Outdoor Classrooms, Walking Path, Athletic Field, Gardens

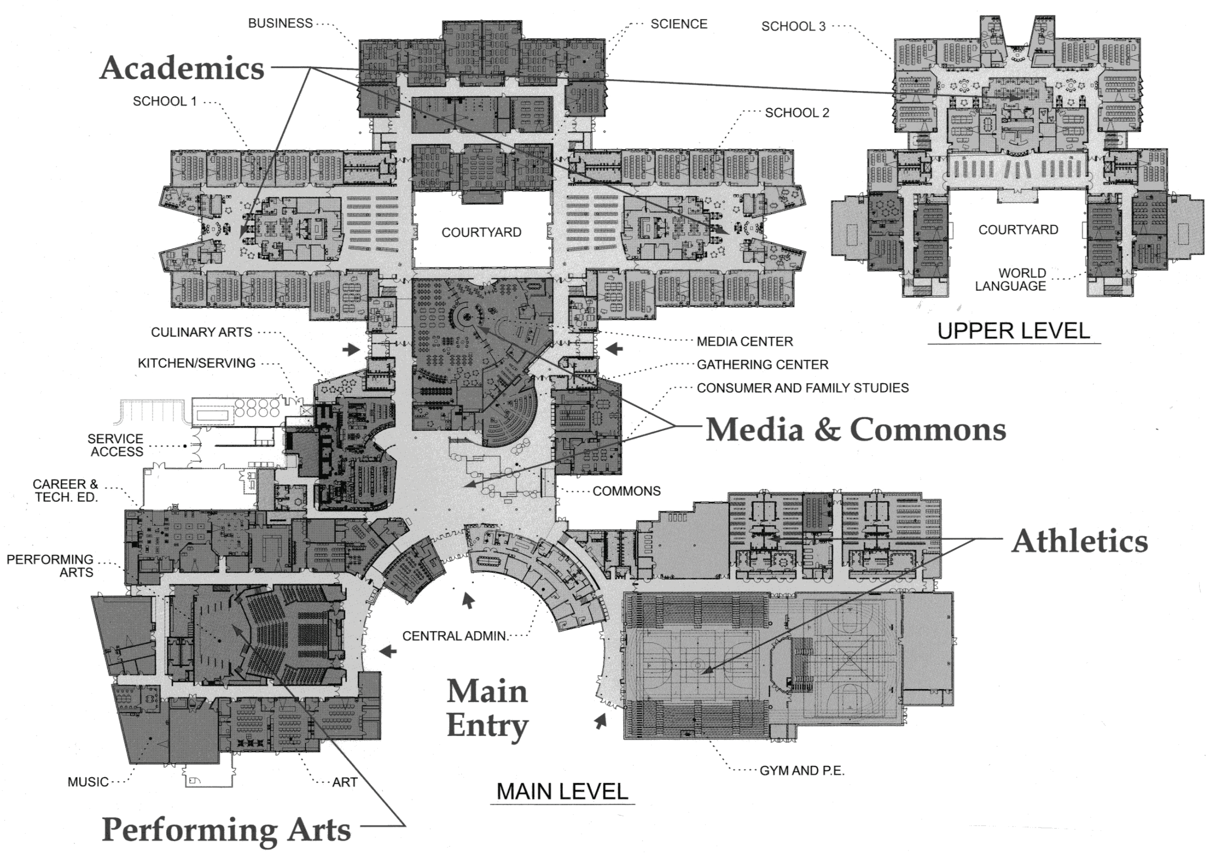


Figure 8. Fossil Ridge Floor Plans.

Figure 9. Fossil Ridge High School 3.


Figure 10. Fossil Ridge High School 1.

Fossil Ridge High School was the very first school to earn LEED certification in Colorado and has become an inspiration for other schools to go green. The main focus for the design team was the building's environmental performance. It wasn't until later that they decided to pursue LEED certification. The school utilizes the traditional classroom, but implements energy efficient elements to lower building costs, improve the indoor environmental quality, and lower the ecological footprint of the building.

The building utilizes an east-west orientation to allow natural daylight into every classroom. In order to achieve this, the building massing had to be fairly spread out which, in turn, occupies a larger square footage. Operable windows reduce the need for mechanical heating and cooling, and helps circulate fresh air throughout the building. Solar panels along the south facade of the building help generate a portion of the building's energy supply, and help shade the windows during the hot summer months.

The classrooms are divided into three wings to support a sense of community among the students and teachers. Shared spaces, such as the library, auditorium, gymnasium and cafeteria, are centrally located in the building to bring the entire school together. The overall plan of the building is fairly balanced with a hierarchy placed upon the building's core, which contains the main entrance and library space. The building's massing is fairly symmetrical across the north-south axis, but slight alterations occur to suit specific spaces.

Fossil Ridge High School is an excellent case study for this thesis project because it illustrates how architectural elements can benefit building occupants and the overall function of the building.

Figure 11. Fossil Ridge Massing.

MASSING

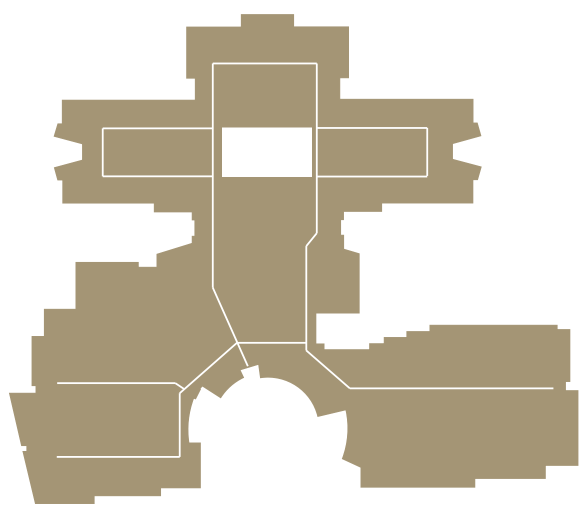


Figure 12. Fossil Ridge Circulation.

CIRCULATION

Figure 13. Fossil Ridge Main Floor.

Figure 14. Fossil Ridge Typical Floor.

SPATIAL RELATIONSHIPS

LOUD SPACES
QUIET SPACES

ANNE-MARIE EDWARD SCIENCE BUILDING

Ste-Anne-de-Bellevue, Canada

ARCHITECT Saucier + Perrotte Architectes
SQUARE FOOTAGE 34,120 ft^2
OCCUPANCY 5,000 students

DISTINGUISHING CHARACTERISTIC Grand, orange staircase

PROGRAM Student Lounge, Learning Center, Classrooms, Offices, Laboratories, Atrium, Courtyard

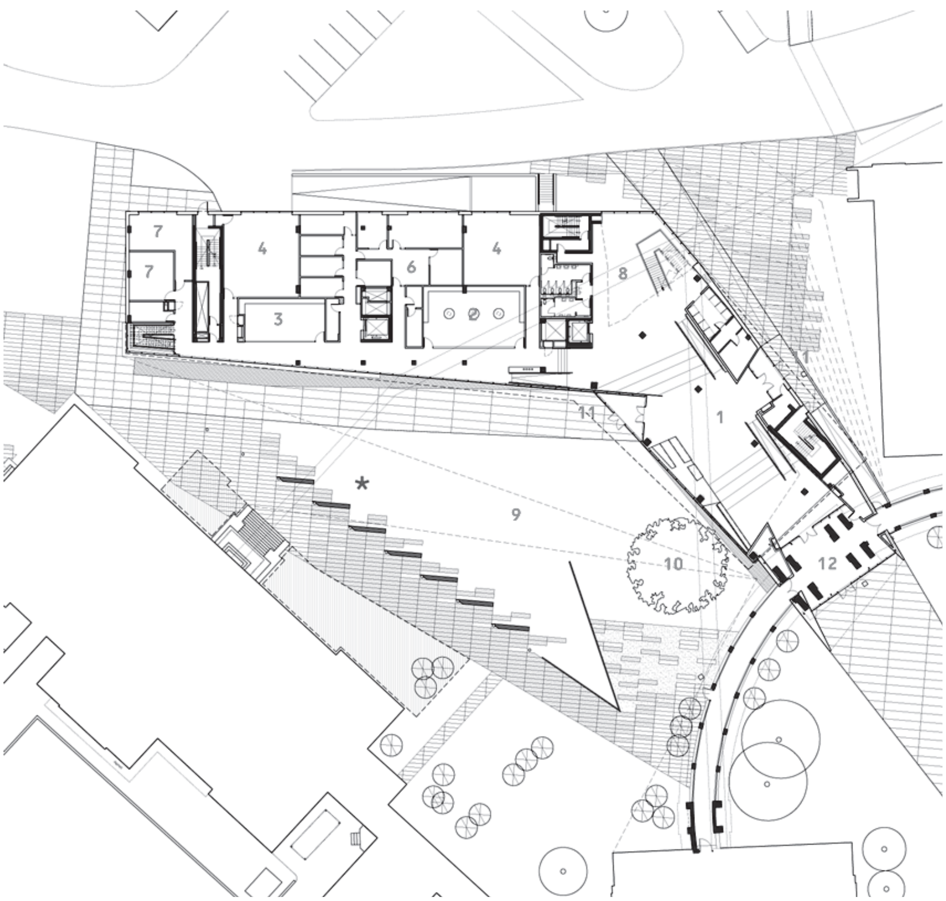


Figure 15. Anne-Marie Edward Floor Plans.

Figure 16. Orange Staircase.

The Anne-Marie Edward Science Building was completed in 2012 at John Abbott College near Montreal, Canada. The goal of the project was to provide the students with a state-of-the-art building with spaces for formal and informal, collaborative learning.

The distinguishing feature of the building is its large, orange staircase that consumes the atrium and branches out to connect the different spaces of the building. The orange is carried throughout the building for wayfinding, but also to foster communication and a sense of community between the different communities.

The facade of the building utilizes multi-tonal tints of grey glass which creates a playful variance of shading during hours of sunlight. The transparency of the glass also changes to give more or less privacy to the enclosed spaces.

The goal of the project was to create a building that promotes learning and provides a healthy environment for its students. Natural lighting and views to the outdoors help make the learning environment bright and energizing. The indoor air quality of the building is controlled through natural ventilation techniques, while the heating and cooling is provided by geothermal energy to reduce energy consumption and building costs.

Anne-Marie Edward Science Building provides a great example of how to design for user wellness. The intriguing central staircase motivates the occupants to use the stairs and implement physical activity into their daily lives. Natural daylighting and ventilation are used to create a comfortable indoor environment that encourages learning and concentration. All of these strategies promote health and wellness within the building occupants.

Figure 17. Anne-Marie Edward.

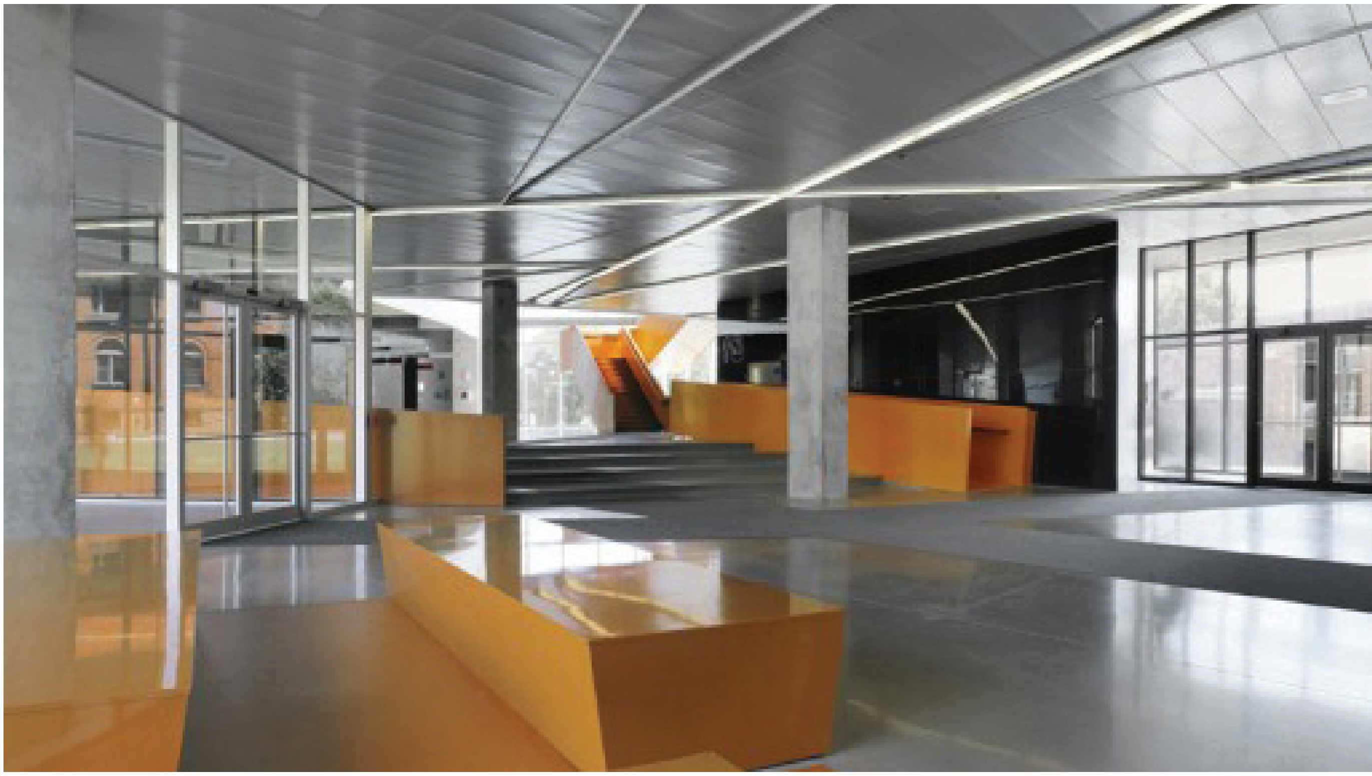


Figure 18. Anne-Marie Edward Wayfinding.

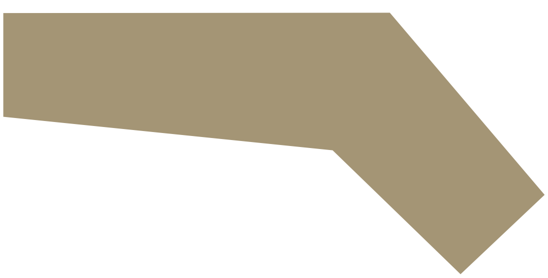


Figure 19. Anne-Marie Massing.

MASSING

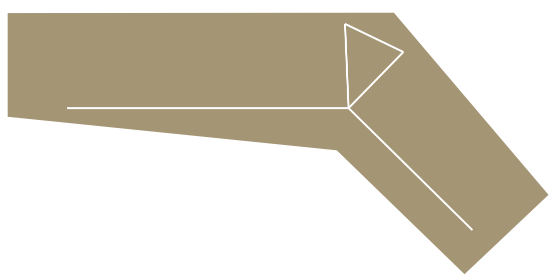


Figure 20. Anne-Marie Circulation.

CIRCULATION

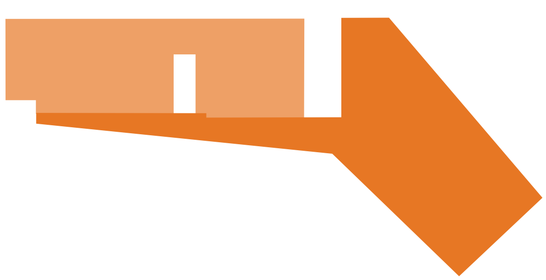


Figure 21. Anne-Marie Main Floor.

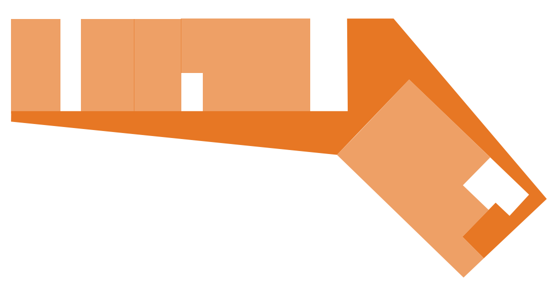


Figure 22. Anne-Marie Typical Floor.

SPATIAL RELATIONSHIPS

- LOUD SPACES
- QUIET SPACES

DUNBAR SENIOR HIGH SCHOOL

Washington, D.C.

ARCHITECT Perkins Eastman
SQUARE FOOTAGE 280,000 ft^2
OCCUPANCY 1,100 students

DISTINGUISHING CHARACTERISTICS Large, well lit atrium for social gathering

PROGRAM Classrooms,Offices, Atrium, Pool, Auditorium, Cafeteria, Museum, Gymnasium, Electrical Systems, Athletic Field

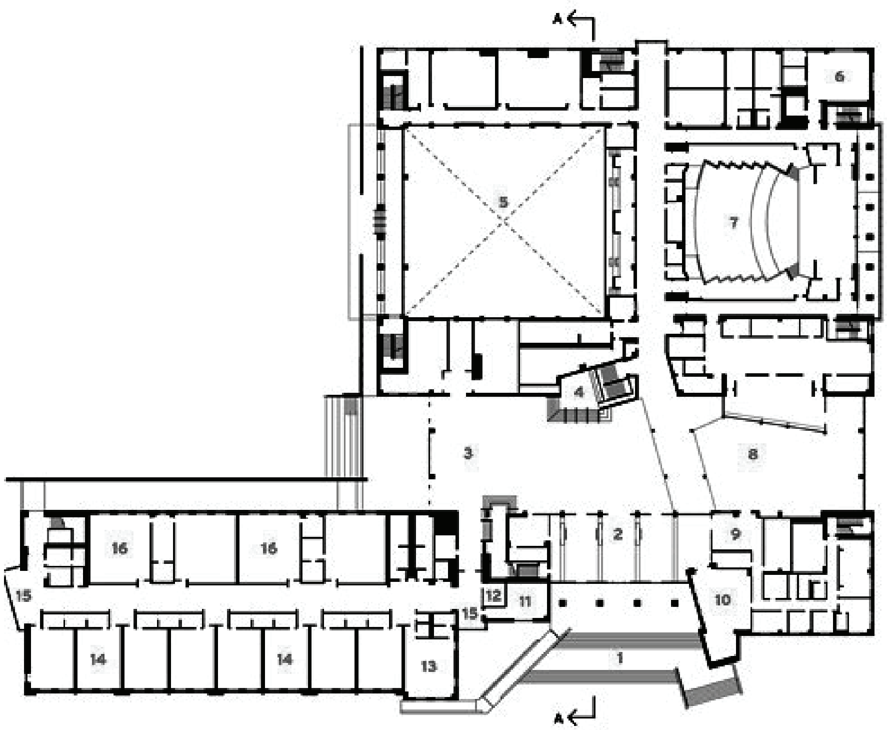


Figure 23. Dunbar Floor Plans.

Figure 24. Dunbar Senior High School.

Dunbar Senior High School was designed in response to a failed, previous facility that had made its students feel tense and aggressive due to its lack of windows and appropriate space. This problem is well addressed in the new design with its vast atrium and multitude of windows.

The building has an L-shaped plan that separates the classrooms from the shared, public spaces. This solution creates a separation between loud spaces and quiet spaces which will help maintain student productivity and concentration.

The school is split into four different academies, which helps to create a sense of community within each group. After ninth grade the students are asked to choose between education, pre-engineering or business, law and public policy. The academies are separated by floors, yet all utilize the communal spaces such as the cafeteria, gymnasium, pool, and atrium.

Several sustainable strategies have been implemented into the design such as; geothermal wells, solar panels and stormwater collection cisterns. Eventually, the school would like to seek a LEED Platinum rating.

Dunbar Senior High School demonstrates how simple architectural elements can influence the overall attitude of building occupants. By simply creating more space and access to natural light and views, the school has seen increased productivity and decreased aggression within its students. This project represents a success story for the theoretical premise of this thesis proposal.

Figure 25. Dunbar Atrium.

Figure 26. Dunbar Massing.

MASSING

Figure 27. Dunbar Circulation.

CIRCULATION

Figure 28. Dunbar Main Floor.

Figure 29. Dunbar Typical Floor.

SPATIAL RELATIONSHIPS

- LOUD SPACES
- QUIET SPACES

TOPOLOGICAL RESEARCH SUMMARY

The typological research that I have conducted for this thesis includes the analysis of three very different educational buildings. When searching for appropriate case studies, I predetermined that I wanted to find examples of educational facilities that presented a unique design decision that was user-oriented. Each of the buildings focuses upon something different.

Fossil Ridge High School focuses upon a sustainable facility paired with an educational program that focuses upon sustainability. These practices are not only beneficial to the environment, but also to the students who are able to learn about sustainability at a young age. The created design helps build a connection between the occupants and the environment which can be critical for spiritual wellness.

The Anne-Marie Edward Science Building focuses upon active design and creating connections. The large, intriguing staircase helps to persuade students to take the stairs rather than the elevator. This is a great technique to improve physical wellness in building occupants. The “branches” of the staircase, which connect all the floors, help to create connections and simplify wayfinding. This will benefit both social and emotional wellness prospectively.

Dunbar Senior High School focuses upon social and emotional wellness within its students. The project directly addresses a problem that was seen in the old facility regarding student behavior. By learning from the past, they were able to design a school which allows its students to feel comfortable and create connections with their classmates. The two main techniques they implemented were proper daylighting and proportions.

All of the educational facilities analyzed show a successful integration daylighting and views into every classroom, which is essential to student productivity and wellness. This is largely a matter of building form. Another commonality between all of the buildings is the spatial relationships. Classrooms and quieter spaces are grouped together and separated from the louder, public gathering spaces. This seems to be a good strategy for reducing distractions within learning spaces, and promoting a sense of community by grouping spaces of higher activity.

Overall, the typological research conducted was beneficial to the development of my thesis project. The case studies presented examples of how specific design solutions can directly affect the building occupants. Although these strategies may not have been used with the direct intention of improving occupant wellness, they were successful in doing so. The theoretical premise of this thesis project was strengthened by the typological research.

Figure 30. Fountain.

MAJOR PROJECT ELEMENTS

LEARNING SPACES

ACADEMIC SPACES
Learning spaces for the students

LIBRARY AND MEDIA CENTER
Media center with spaces for individual studies

ACTIVITY SPACES

VISUAL AND PERFORMING ARTS SPACES
Performance space that supports the full occupancy

FITNESS AND WELLNESS SPACES
Large space for physical education and sporting events

SUPPORT SPACES

ADMINISTRATION SPACES
Space for administration and facility support

FOOD SERVICES SPACES
Large space that provides food for the students

FACILITIES MANAGEMENT AND SUPPORT SPACES
Spaces used for building operation and maintenance

CIRCULATION SPACES
Hallways and gathering spaces for socialization

Figure 31. Children on Terrace.

USER/CLIENT DESCRIPTION

STUDENTS 300

The students are the primary client for this typology. The majority of the design decisions made will reflect the needs of this population. They will occupy the building from September until June as full-time occupants. Some parking will be required for this user group.

FACULTY 40

The secondary user group for this typology is the faculty. This includes teachers, administrators, custodians, building operators and lunch service employees. There will be approximately 20 teachers and 20 additional staff needed to support the facility. This user group will occupy the building from September until June as full-time occupants. Sufficient parking will be needed for this user group

COMMUNITY MEMBERS Variable

An alternative user group for this typology is community members. This includes parents as well as other members of the community that may be using the facility. They will occupy the building for varied amounts of time as part-time occupants. Typically this activity will occur outside of regular school hours. The student and faculty parking will double as parking for this user group. A small section of parking will be required to accommodate daytime visitors.

Users of this facility may have physical disabilities, so the school will be designed to meet ADA requirements for accessibility. Users will also be coming from a variety of cultural and economical backgrounds, so it is important that the facility is inclusive and makes all occupants feel welcomed.


Figure 32. Site.

SITE INFORMATION

Mandan, North Dakota

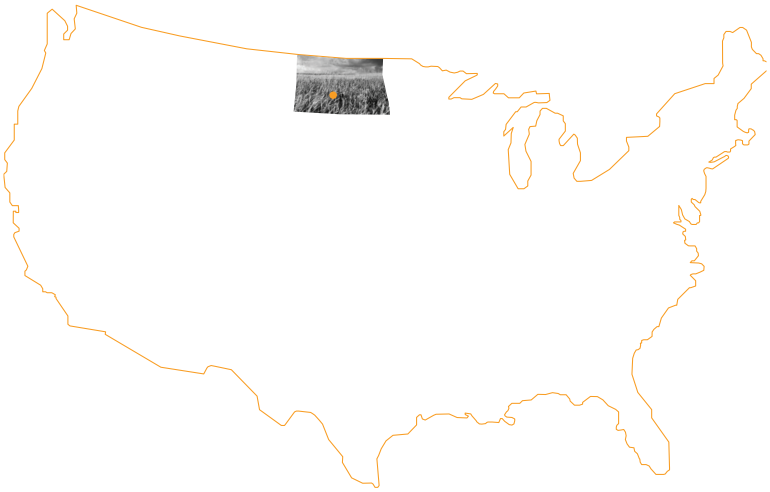


Figure 33. USA Map.

Figure 34. Site from the River.

SITE ADDRESS 205 2nd Avenue NW

LAND AREA 22.4 Acres

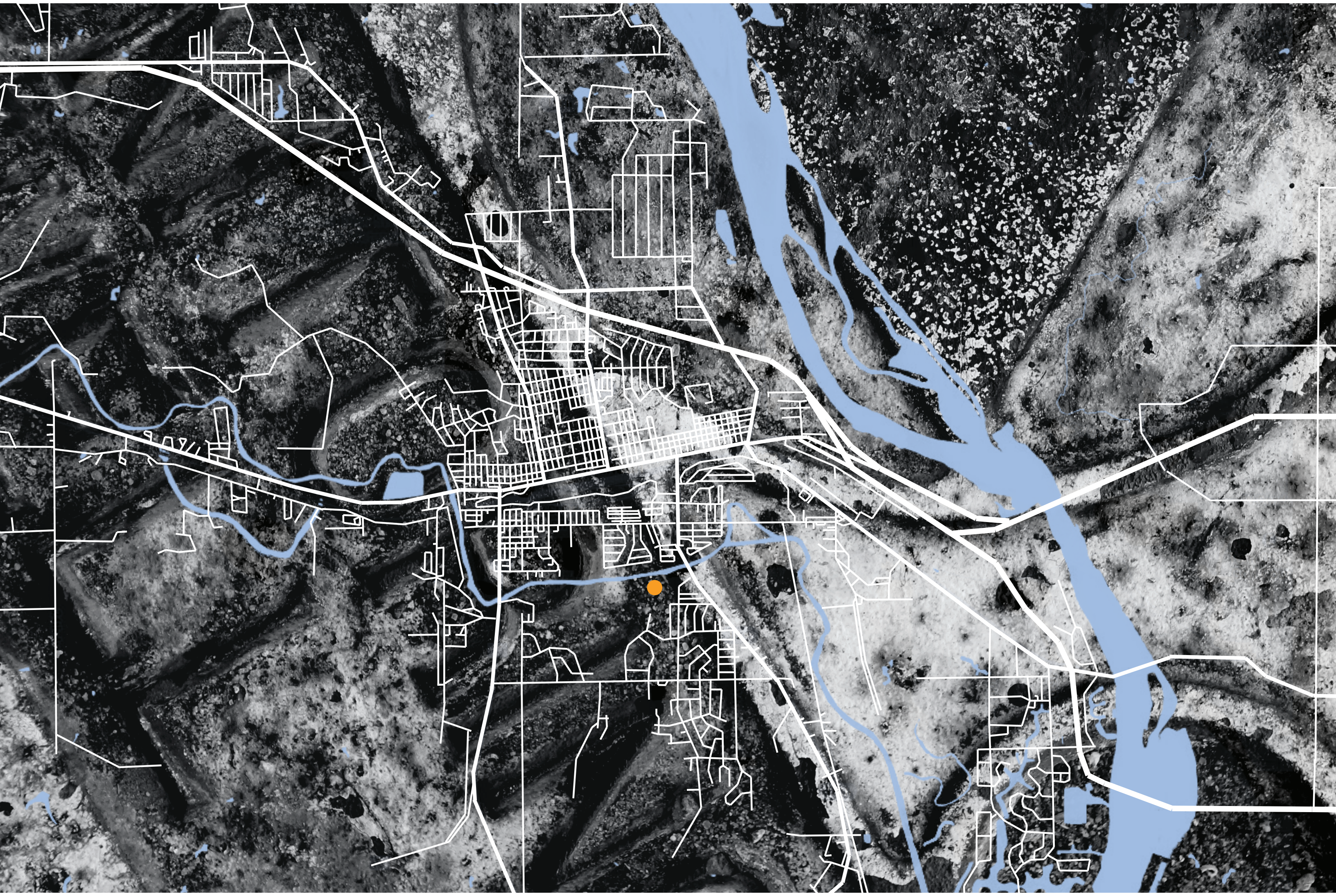


Figure 35. Mandan Map.

Figure 36. Downtown Mandan.

The specific site that I have chosen has all of the desirable characteristics associated with a high school site. It is centrally located within the town and within walking distance of several existing and developing neighborhoods. It is also located close to the athletic fields that are be used by the current high school, so these spaces can be reused for this proposal. The site presents an appropriate amount of land to accommodate a high school facility, and overlooks a beautiful landscape that could provide spectacular views for the occupants.

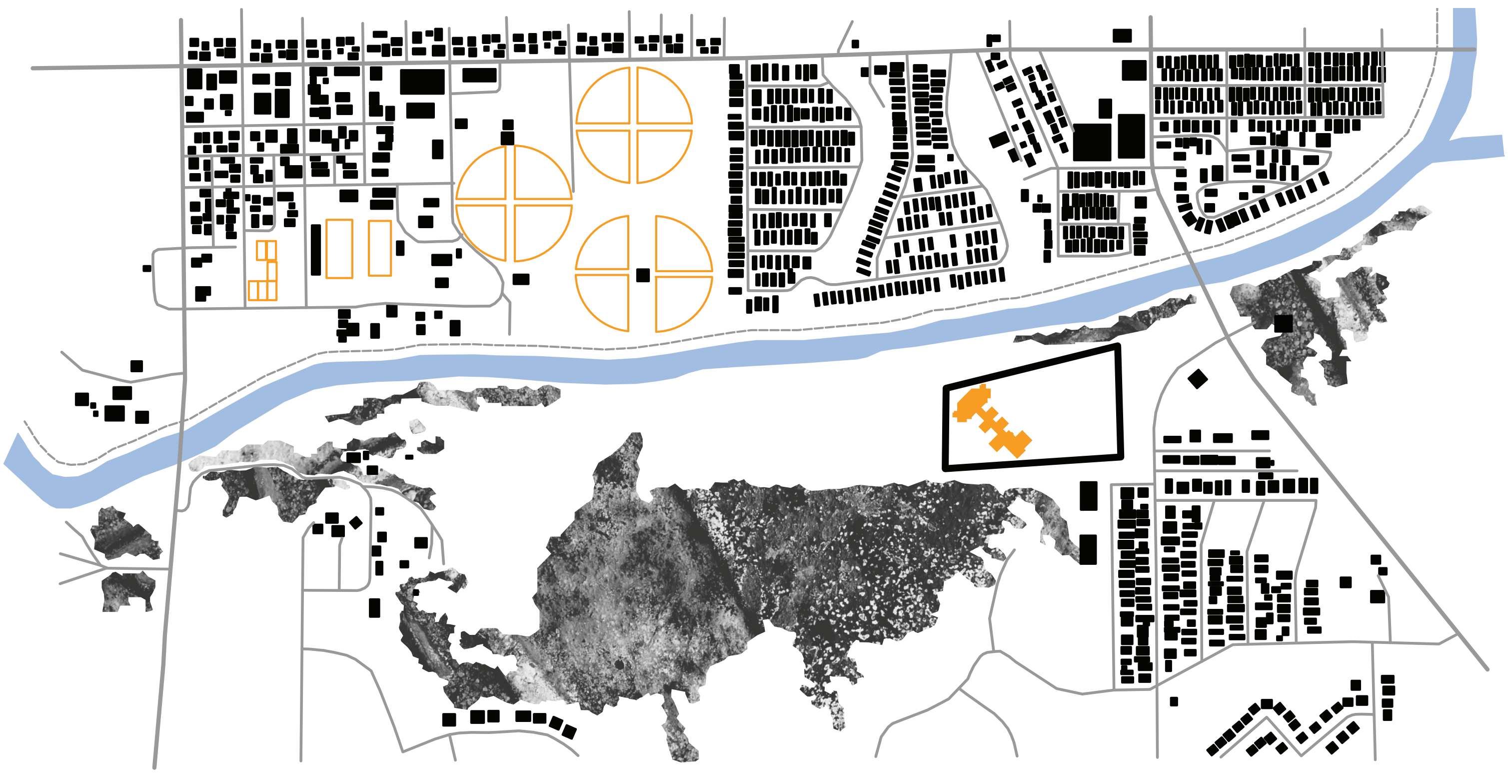


Figure 37. Site Map.

Figure 38. Neighborhood Development.

Figure 39. North View.

Figure 40. East View.

Figure 41. South View.

Figure 42. West View.


Figure 43. Tracks.

PROJECT EMPHASIS

My thesis will focus upon the specific building design aspects that have be proven to encourage learning and wellbeing within schools. Though concreate findings about this topic may be unobtainable due to the high complexity and multitude of variables associated with this topic, a large body of research already exists to support this subject. Upon completion of the research phase, I will have the knowledge required to design a building that promotes stduent learning and wellbeing.

Figure 44. Mandan Construction.

GOALS OF THE THESIS PROJECT

ACADEMIC

The design solution for this project has been in the makings since I was accepted into the architecture program. Everything that I have learned while in school has been applied to this project to create a comprehensive design that demonstrates my skill and ability. After successfully completing this thesis, I will be awarded with a Master of Architecture degree, which has been the ultimate goal of my entire college education.

PROFESSIONAL

Upon graduating, I plan to join the workforce by working for an architectural design firm that specializes in user-oriented design. My hope is that through this thesis I am able to gain a better understanding of what exactly this entails so that I can bring that knowledge into the professional setting and apply it to the projects I am assigned to. The goal is to learn how the built environment can influence its users, and then how architects can use that information to employ specific design solutions proven to improve occupant wellness.

PERSONAL

It is my personal goal that through this project I am able to impact the way in which others approach education design. I would like to show how important it is to put the user's needs first during the design process so that the final design ends up being one that is relevant and long lasting.


Figure 45. Yellow Leaves.

PLAN FOR PROCEEDING

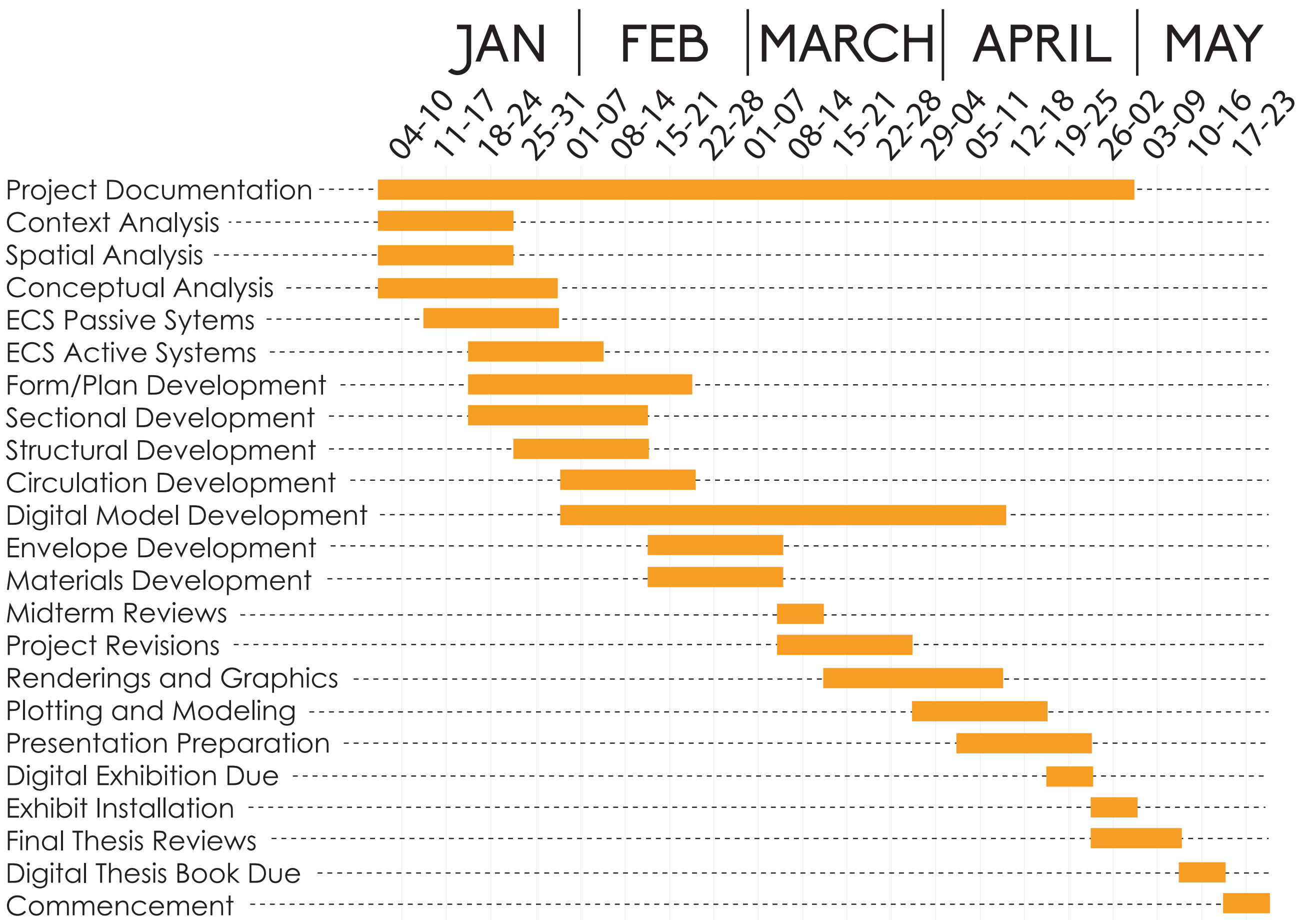


Figure 46. Thesis Schedule.

DEFINITION OF RESEARCH DIRECTION

Now that I have established the different dimensions of wellness, the next step will involve in depth research upon architectural strategies that are proven to encourage wellness within these dimensions. I will also have to conduct research upon the building typology to determine proper programming of spaces. Further analysis upon the site and historical context will be necessary to help inform specific design decisions.

A PLAN OF YOUR DESIGN METHODOLOGY

To successfully gather information, I will perform mixed-method research. I will use both qualitative and quantitative data to support my theoretical premise. Due to the long collection period required to gather accurate data, I will be utilizing post-occupancy research findings already collected by credible sources rather than collecting my own. In addition, I will be using a short survey to gather qualitative data about learning spaces from the general public.

A PLAN FOR DOCUMENTING THE DESIGN PROCESS

It will be important that I properly document all research, photography, drawings and models created during the design process. This information will be recorded in this book and will be made available through the North Dakota State University institutional repository. At the end of the design process, I will be presenting my thesis project for review, so that I may share the information gathered with other individuals.

Figure 47. Movement.

THE PROGRAM

Figure 48. Red Leaf.

UNIFYING IDEA RESEARCH

The built environment can be described as the physical, manmade elements that we encounter on a daily basis. These elements often go unperceived by the mind since their presence is a constant within our lives; though their impact upon us can be substantial. Several aspects of the built environment are known to physically and psychologically impact occupants. This thesis will analyze these different aspects to find a design solution for a public high school that will help promote student learning and wellbeing.

The importance of school and education is well recognized in the United States. School is the place where our children go to learn and build the skills they'll need to become productive members of society (National Academy of Sciences, 2007). With nearly a quarter of our population spending the majority of their days within a school building, it's clear that the effectiveness of our schools should be a top priority within society. Despite their importance; many school facilities are being designed in the same way that they were 100 years ago (Brubaker, 1998). Standardized tests can show us which areas of studies our students excel and fall behind in, yet they don't take into account how the quality of the school building may be impacting the student's health and learning abilities. It's time that we take a step back and ask ourselves, is it simply the teachers and the curriculum taught which are responsible for our student's success (Baker, 2012)?

Thankfully, a considerable amount of attention is now being placed upon green, healthy buildings. Healthcare facilities across the nation are now realizing the impacts that their facility has upon patient recovery (Ulrich, 2004), and companies are beginning to understand the ways in which their office design may be influencing worker productivity (Churchman, 1990; Kamarulzaman, 2011). These same findings can, and should, be applied to school buildings to improve the health and productivity of our students.

As research upon environmental psychology continues to expand, our knowledge about the potential hazards associated with our built environment will become more clear. We already have a general understanding of how to build and maintain a healthy school, yet much more research must be conducted before we can determine exactly how much of an impact

"Ideally, the physical setting of a school should be one that actively stimulates development of human beings as a whole - socially, intellectually, physically, as well as emotionally. Creating a "place" for learning, and not just a "space," should not be a bonus, but rather an essential requirement in providing great settings for learning." (De Chiara, J., & Crosbie, M, 2001)

the school will have on children's health (Baker, 2012). Much of the knowledge we have in this field today is based upon teacher and parent anecdote, as well as research from other building types. Of course the impact that the school building has upon a student will vary from person to person (National Research Council, 2006). Still, there are several aspects of the built environment which have been identified as probable factors in the health and learning abilities of the majority of students. In my research I have analyzed these factors with a focus upon their implications towards a design solution.

The majority of the design aspects researched in this thesis impact building occupants by triggering stress. "Prolonged stress results in prolonged depression of the immune function, which can increase the susceptibility to illness (particularly repertory infections), and increase psychological distress and depression. Other side effects include: impaired performance on complex tasks, decrease in problem-solving abilities, increase in general negativity, impatience, irritability, feelings of worthlessness, addiction, anxiety, depression and coronary heart disease" (Sassi, 2006). Even small amounts of stress have the ability to distract students and prevent them from focusing during school, though architects now have the ability to design schools which are void of environmental stressors that previously impacted student's psychological and physical well-being.

Through research, I have found a variety of different aspect regarding the built environment which have been found to have an impact upon student health and learning. There are bound to be additional factors outside of school that impact our students, yet the following categories are factors which the built environment has control over. These factors have direct design solutions which will be carried into the final design for this thesis project.

AIR QUALITY

Air quality is the most well-understood health stressor found in the built environment. Building systems and materials can have a neutral or positive impact upon building occupants, or they can cause a multitude of air quality issues such as "increased particulate matter, volatile organic compounds (VOCs) and other toxic materials, moisture intrusion that leads to mold problems and other toxins and irritants" (Baker, 2012). It has been found that poor air quality is responsible for 50,000 premature deaths in the United States annually which equates to nearly $150 billion in health-related costs (National Oceanic and Atmospheric Administration). An additional $93 billion is lost due to productivity issues that involve poor indoor air quality (Mudarri, 2010).

The building profession is now aware of the harmful toxins which many building materials may be exposing to building occupants. The most well-known toxins are VOCs, which are released from building materials as a toxic gas. VOCs have been linked to visual disorders, respiratory irritation, headaches, fatigue, memory impairment and other health concerns (Baker, 2012). Wide arrays of products are known to contain VOCs, such as: paints or lacquers, cleaning products, adhesives, wood products, carpets, furnishings, and much more (Perkins & Bordwell, 2010). My design shall utilize low or no VOC materials that will help prevent health issues from arising within the school. In turn, this will also help to improve student learning capabilities because less of their attention will be lost upon health concerns.

Health concerns can also arise with HVAC systems do a poor job of filtering out pollutants and maintaining proper ventilation. It's been found that a stationary adult will intake between 6 to 10 liters of air every minute (Holmes, 1994). If the quality of the air is poor, it's bound to have negative health impacts upon that person. Typical symptoms can include: acute discomfort, asthma, headache, nose or throat irritation, dry or itchy skin, dizziness, fatigue, sensitivity and so on. These building related illnesses can be attributed directly to the poor indoor air quality that is a result of inadequate ventilation, presence of air pollutants and unaddressed biological contaminants, such as mold (Baker, 2012). In order to avoid these issues, buildings must be designed with proper HVAC system that can control humidity levels, air flow rates and pollutant filtration. It has been found that students make significantly fewer errors and require much less time to complete simple tasks when situated in a building with suitable air quality (Fisher, 2000). Clearly, air quality has a large impact upon student health and performance.

It should also be noted that, student health can also be adversely affected by the outdoor air quality (Baker, 2012). Site selection for schools is very important so that adjacencies to pollution-causing sources are avoided. This means that schools should be placed away from factories and heavily trafficked roads. Proper site location will help to control the indoor air quality as well as allow students to take advantage of the outdoor spaces surrounding the school.

ACOUSTICS

Noise control and proper acoustics are very important in schools where productivity and concentration are required in order to be successful. According to the National Academy of Sciences, "excessive noise can interfere with learning by affecting memory and acting as a distraction that impairs a student's ability to pay attention" (National Academy of Sciences, 2007). Noise distractions can also influence a student's patience levels making it easier for them to give up when dealing with difficult tasks or puzzles (Cohen et al., 1980). If student productivity and learning is a priority, acoustics need to be firmly addressed during the design phase in order to see success.

The suggested ambient noise level for a classroom is 35 dBA (National Academy of Sciences, 2007). You can associate this noise level with the average volume of a public library. Anything above this range can prove to be problematic for speech intelligibility and concentration preservation. It's understood that people are unable to comprehend a noise unless it is at least 15 decibels louder than the background noise (Baker, 2012). Regular speech from a meter away is typically around 60-70 decibels, so it would be appropriate for ambient noise to be no louder than 35 decibels.

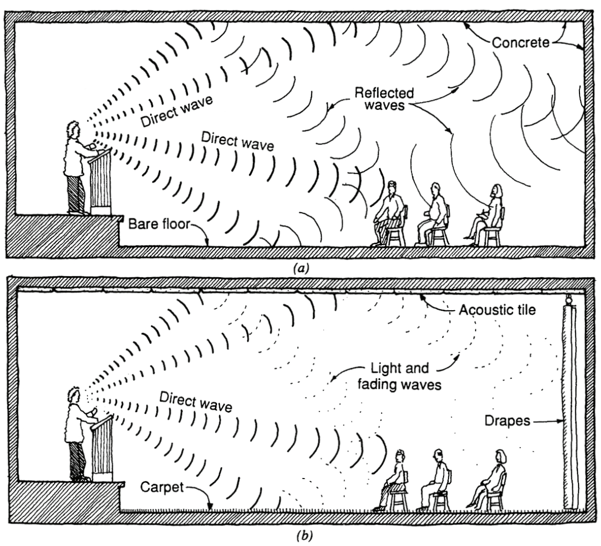


Figure 49. Reverberation Charts.

Room (a) shows an untreated classroom where speech perception may be difficult for the students. Absorptive materials in room (b) help reduce reverberant sound.

Another aspect of acoustics which needs to be addressed is reverberation time. Rooms that are constructed of hard materials can create more echoes which can increase speech ambiguity. The suggested reverberation time for a classroom is no more than .6 second (National Academy of Sciences, 2007). If a sound reverberates for any longer than this, it can be muddy and incomprehensible. In a recent study, children's performance was analyzed in the context of two different classrooms with reverberation times of .49 and 1.1 seconds. It was found that there was a significant negative impact on short-term memory and speech perception as reverberation time increased (Klatte et al, 2011). Design implications to improve the acoustic quality of a space include: carpeted floors, acoustic ceiling tile, upholstered furniture, quality wall insulation, indoor plants, artwork and sound baffles for larger spaces (Fisher, 2000).

Sound can also have psychological impacts when unwanted noises are persistent and unchanging. Fatigue can occur when noises at levels of 65 decibels interfere with mental activities. At 80-90 decibels, the average sound of a busy street, rising blood pressure and heart stress can occur (Sassi, 2006). For this reason, site selection becomes very important. It may also be beneficial to provide a variety of spaces at different noise levels so that students have the ability to choose the level of ambient noise they are exposed to.

THERMAL COMFORT

The human perception of thermal comfort is influenced by four factors: air temperature, radiant heat, relative humidity and air speed (National Academy of Sciences, 2007). Individual perception is then further modified by personal metabolic rates, physical activity and the insulation value provided by clothing choices. Thermal comfort standards will not be able to satisfy the entire general public, but should satisfy about 80% of building occupants (National Academy of Sciences, 2007). The 20% of individuals who are unsatisfied can improve their level of comfort by adding or removing layers of clothing until contented.

The recommended thermal environment for a school has humidity levels between 40-70% as well as moderate air temperatures, between 60-70 degrees Fahrenheit (Schneider, 2002). Adequate room temperature is very important for student learning. If temperatures rise above 77 degrees Fahrenheit, the students may begin to experience physiological effects such as decreased mental efficiency and performance. Inadequate humidity can also take a toll on students by requiring increased respiration rates which will in turn decrease student attention spans and comfort (Fisher, 2000). The design solution for this thesis will be able to provide thermal comfort through correct insulation values and a proper HVAC system.

This neutral environment should satisfy the majority of students, although it doesn't take into account the benefits of natural ventilation. Poor building ventilation can create a buildup of carbon dioxide due to human respiration. This buildup can cause headaches, drowsiness and inhibit the ability for students to concentrate (Myhrvold et al., 1996). In a recent study, researchers found that students who attended a naturally ventilated child care center showed less symptoms of allergies and asthma than those who attended air-conditioned child care students (Zuraimi et al., 2007). This presents the unique challenge of designing a HVAC system that can maintain thermal comfort but also allow for natural ventilation.

LIGHTING LEVELS

The visual quality of a learning environment is crucial since a large portion of the learning process for students depends upon sight. In terms of light, we must approach it from two different angles. The quantity of light needed in schools is largely agreed upon today, but much less knowledge exists upon quality of light and how it affects student health. An adequate quantity of light and appropriate quality of light must both be present in order to ensure that the highest level of student health and learning is accessible (Baker, 2012).

Sufficient illumination levels are crucial for student learning. Eyestrain, cause by inadequate lighting, can pose as a major distraction and stressor for both students and teachers (Brubaker, 1998). Classrooms generally require about 20-50 footcandles to achieve proper lighting levels (Perkins & Bordwell, 2010). The footcandle measurement refers to the amount of lumens needed per each square foot of area. Of course, proper illumination will vary depending on the space and the type of activity taking place. When the visual aspect is important (laboratory, art room, exhibits, etc.) the illumination level will need to be increased.

Quality of light typically refers to the amount of daylighting that a space acquires. If improper daylighting occurs, students will be subject to Seasonal Affective Disorder (SAD) which may cause sleepiness, fatigue, weight gain or depression (Sassi, 2006). SAD can be avoided by ensuring that every space within a building has an adequate amount of windows. Besides the positive health benefits provided from nature light, studies have found that students show greater improvement in math and reading skills on standardized tests when taught in daylit classrooms (Heschong Mahone Group, 1999). The reasoning for higher student performance may be linked to motivational effect of the natural lighting. Learning environments that have an abundance of natural light will offer a space that is easy and pleasurable to work in, encouraging students to continue their learning (JISC Development Group, 2006).

A deprivation of natural light also has the ability to disrupt student's melatonin cycles (Baker, 2012). Natural light is critical for maintaining the

Figure 50. Essen.

"It may be ridiculous to make every window different just for the sake of being different, but it's even more ridiculous to make every one the same just for the sake of being the same."
(Day, 2014)

body's circadian rhythm which control melatonin production. When individuals are exposed to inappropriate lighting levels for the time of day it signals to the body to stop or start melatonin production, the sleep hormone (Environmental Protection Agency, 1989). This may cause students to have greater fatigue during class which will disrupt the student's ability to focus and retain information (Baker, 2012). Views to the outdoors and proper lighting levels well greatly benefit a student's ability to learn by allowing their bodies to properly adjust to the time of day and the activity taking place. It is recommended that 20% of wall space be allocated to windows (Tanner, 1999), though variation should occur to avoid redundancy and to provide the proper level of lighting.

SOCIAL INTERACTION

Social interaction is crucial for child development. A strong social network can provide support for a student and give them motivation and encouragement (Zimring, 1982). Without social interaction a student may become isolated or depressed. There are a variety of ways in which interaction can be promoted within a school. One of the best ways is by separating the population into smaller houses or communities. In this situation, students can become familiar with their surroundings and peers which will help them to feel more comfortable. By creating a community space for each house, students will be provided with a space for casual conversation (Evans, 2003). These spaces should be welcoming and engaging to draw students into the space and spur conversation (Day, 2014).

School cafeterias pose a great opportunity for students to interact with one another. A variety of different sized and shaped tables should be provided to suit the needs of everybody. The inherent geometry of round tables creates a central focus which is great for starting conversations amongst students who may not know anybody (Day, 2014). In public areas, it's important to provide a variety of different spaces with different levels of interaction so that students may choose to suit their needs (Zimring, 1982). Some days the student may desire social interaction, and other days they may long for some privacy. There should be adequate space to accommodate both.

Figure 51. Marysville Getchell High School.

Casual seating areas along central hallways can spur impromptu social interaction amongst students.

FACILITY AGE AND CONDITION

Facility maintenance and cleanliness is one of the most obvious strategies for achieving student health, although there are also design-related control measures which may influence student health and learning. It has been found that students taught in new or modernized buildings scored consistently higher (7% higher) on standardized tests than those taught in older school facilities (Chan, 1979; Phillips, 1997). It was concluded that these findings were unrelated to the socio-economic status of the student populations and directly linked to the quality of the building (Fisher, 2000). Still, the research doesn't necessarily suggest that new school buildings permit greater learning, but rather that old buildings, with inadequate equipment and facilities, may provide fewer learning opportunities for the students (Stricherz, 2000). Thus, building a new school is not a solution for improving student achievement. The quality of the facility is of far greater importance.

There was a related study conducted by Earthman and Lemasters in North Dakota aimed to find a correlation between school building quality and student scores on the CSTB (National Academy of Sciences, 2007). The study, including 199 different high schools, found that students in above-standard buildings outscored students from standard buildings in all subtests except for social studies (Earthman & Lemasters, 1996). The factors used to determine building quality include: air-conditioning, illumination levels, temperature control, wall color, equipment and utility condition, roof adequacy, acoustic control, floor type, building age, and furniture condition.

Building quality can also have an impact upon student behavior. Multiple studies organized by McGuffey found that students are less likely to have disciplinary incidents in new school buildings (McGuffey, 1982; Schneider, 2000). Though, other studies have found an inverse relationship between the age of the school building and student behavior. It is speculated that this relationship may be a result of increased supervision and discipline typically associated with newer facilities (Cash, 1993; Edwards, 1992; Fisher, 2000; Ikpa, 1992). Thus, quality schools have the potential to improve student behavior, though if over-supervision is produced it may have a negative impact on the students.

OCCUPANT CONTROL

Occupant control is an aspect of building design which is just now becoming understood. Building occupants feel better and are more comfortable when they have the ability to control their environment, or the perceived ability to do so (Evans, 2003; Sassi, 2006). Constraints that limit the amount of control that occupants have over their environment may produce stress or a feeling of helplessness (Cohen et al., 1987; Evans, 1998). Prolonged stress can have detrimental impacts on the immune system which may in turn lead to larger health concerns (Baker, 2001). A multitude of uncontrollable stimulus can be a source of stress for occupants, for example: lack of thermal or lighting control, inflexible spatial arrangements, insufficient resources, lack of privacy, uncontrollable noise transmission etc. (Evans, 2003; Hedge, 1991). With prolonged exposure to these uncontrollable stimuli, students may be quicker to give up on a subsequent task, making comprehension and retention more difficult.

Another aspect of occupant control which is important to school design is the opportunity for social interaction and seclusion when needed. Children need social interaction for personal development, as well as intimate spaces for individual learning and reflection (Day, 2014). A range settings designed for different levels of interaction will allow students to choose the type of interaction they're engaged in. Spaces designed for small or no social interaction can be used by students who are looking for personal space or small group space, classrooms and breakout spaces can be used for larger group work or collaboration, and large public spaces, like the media center or cafeteria, can be designed to promote larger social interaction (Evans, 2003). It's important for the students, especially high school students, to be able to choose their social environment because it will help to promote independency (Brubaker, 1998). The design of these spaces will help to reflect the type of interaction that should be occurring there.

COLOR PSYCHOLOGY

There is yet to be solid research linking student achievement to color, yet a large amount of research upon color's physiological effects on humans does exist. In the school setting, color is believed to influence student attention span and sense of time and place (Fisher, 2000; Sinofsky & Knirck, 1981). The effects of colors are mutual to all people, regardless of personal taste (Day, 2014). The broad effects from colors are that warm colors speed up the metabolism, while cool colors slow it down (Day, 2014). From there, each color has a specific mood that it encourages. Teenagers need an environment that supports an active mind and encourages independency (Day, 2014). For this, the appropriate color is a light green, blue or gray color (Fisher, 2000).

It is recommended that a colored accent wall be placed wherever student attention should be directed (Perkins & Bordwell, 2010). Typically, this will be the primary teaching wall where the teacher and any visual learning material will be located. This will help to keep students focused and act as a visual relief (Fisher, 2000). It may also be important to note that colored paint, when too intense, has the ability to feel heavy. Colored light, rather, feels light and make us feel raised up into a particular mood (Day, 2014). The application of colored light will need to be very controlled being that too much colored light can cause visual strain to occupants. This idea will be further developed in the design phase.

Figure 52. Kaiser Wilhelm Memorial Church.

The blue stained glass windows help to crate a serene environment within this church in Berlin, Germany.

SCHOOL SIZE

School size plays a critical role in the high school experience for students. A large amount of research is being conducted that supports the idea that students may benefit from a smaller school (Schneider, 2000). Larger schools may be able to provide more opportunities for their students because they have the population to support more activities and types of classes. Still, there is an inverse relationship between population size and competition amongst students. In particular, this competition can be seen for students hoping to participate in co-curricular activities. Students in smaller schools benefit from the small population by having less competition and having the ability to presume multiple different roles (Howley, 1995). The range of activities correlates directly with school size, and student of larger schools have access to a greater variety (Barker & Gump, 1964).

Smaller schools also provide more intimate learning environments where students feel comfortable and are well-known (Wasley et al., 2000). This can create a sense of community where students are encouraged to learn. Small schools allow students to form closer bonds with teachers and fellow classmates which can lead to fewer discipline problems and higher student achievement (Nathan & Febey, 2001). In general, half of the studies reveal that students in smaller schools outperform those in larger schools. The other half finds that school size plays no role in the achievement level of students (Cotton, 1996). Nonetheless, no research was found supporting the idea that higher achievement levels can be associated with larger schools.

In terms of student health, the sense of community that is created in a small school is greatly beneficial to the development of the students. Fewer students means that there is less of a chance for anonymity and isolation (Barker & Gump, 1964). Still, larger schools can provide a greater variety of opportunities to their students which can be beneficial for career development. According to Brubaker, a small school is anything under 900 students, and a large school is anything over 2100 students (Brubaker, 1998). The design solution for this thesis will accommodate 300 students. A close relationship will be made with the existing high school so that students may benefit from their wide variety of activities.

DENSITY

School density is very important to the psychological health of students. If overcrowding occurs, students can experience psychological distress and feelings of isolation. According to American School and University, the average high school provides 167 square feet per student (Chiara & Crosbie, 2001); any area smaller than this would run the risk of overcrowding. For this thesis proposal, the school must be able to hold a maximum capacity of 300 students. This requires a minimum building footprint of 63,500 square feet, though this number will likely change to suit the needs of the school.

It is likely that the design solution for this thesis will go above the average square footage per student being that optimum student health and learning is the ultimate goal of the project. Basic area calculations can be used as a guide during the design process, for example: a cafeteria should allow 15 square feet per student, and an auditorium should allow 7-9 square feet per student (Perkins & Bordwell, 2010). The average classroom size of 35 square feet per student is likely to increase for this design solution.

CONNECTIONS TO NATURE

A connection to nature within the built environment can act as a restorative element that provides an opportunity for occupants to mitigate stress. Thus, the building can act as a preventative healing resource. Views of or direct contact with natural elements can provide restoration to building occupants (Evans, 1998). Windows within classrooms can provide the necessary cognitive relief that students need to remain focused and energized. The type of distraction that windows create is a "soft" distraction in which students can easily refocus their attention (Perkins & Bordwell, 2010). It is a far better distraction than a cellphone which can completely break the focus of a student.

Figure 53. The Sustainability Treehouse.

A direct connection to nature can help students distress and regain focus.

Indoor plants can also greatly benefit the health of the students. Their aesthetic softness can help to create a comfortable learning environment that keeps students calm (Day, 2014). Adding indoor plants to square or rigid buildings can help them to feel more welcoming to occupants. Plants also have the ability to purify the air by absorbing pollution, trapping dust and oxygenating the air. Beyond this, they can naturally adjust the humidity to be at an appropriate level which helps to make the indoor environment comfortable for the students (Day, 2014). Lastly, indoor plants can be used as a sound barrier to dampen noise transmission between open spaces.

FORM

One area of classroom design that is beginning to see major reconsideration is classroom shape and proportions. Traditional classrooms are square with all desks facing towards the teacher at the front. This design excludes students who sit in the back corners and presents little opportunity for group collaboration (Fisher, 2000; Shor, 1996). It has been found that students "learn most effectively as independent students proceeding at their own rates in both small groups (5-20 students) and large groups (60-100 students or more)" (Brubaker, 1998). In either of these situations the typical classroom shape does not exist.

In terms of shape, schools are often full of harsh 90 degree edges that allow the building to be more compact and efficient. These types of spaces have become a norm, so we don't realize how they can harden and predispose us to aggression (Day, 2014). Curved walls can be comforting and encouraging, though they must be balanced with straight lines to maintain orientation and wayfinding capabilities. Classrooms should be specifically designing for the activity they are housing. Classrooms for discussion should be rounded while teaching spaces should be trapezoidal to show hierarchy (Day, 2014). Collaboration spaces should have a variety of differently shaped spaces to suit the work that is being done.

SECURITY

Security is important for all building types, but it becomes extremely important when it comes to the place where we send our children every day. School security ensures that our students are in a safe environment where their only concern needs to be upon their academics. There are two different types of strategies that can be used to address building security, "active and passive" systems (De Chiara & Crosbie, 2001). Passive strategies for building security focus upon the design and program of the building. One way to do this is by grouping the school into separate houses (De Chiara & Crosbie, 2001). This will help to keep student movement between classes within a certain area of the school.

It is also important to keep a single entry point into the school for visitors, so that strangers are unable to wander freely about the school (Perkins & Bordwell, 2010). A reception desk, or portion of the administration offices, should be located at this entry point to greet and register all guests (De Chiara & Crosbie, 2001). By locating all community spaces together and close to parking, you can close off learning spaces during afterhours to avoid security issues. Typically these spaces are grouped together anyways due to their higher noise level that may be distracting to learning students. Active security should only need to be employed in the case that passive security fails (De Chiara & Crosbie, 2001).

Figure 54. IDEA Commons, Chicago Daley Library.

Semi-transparent barriers, such as steel-mesh curtains, can provide private spaces without compromising security.

"People's health and well-being affect their sense of happiness. Equally, a sense of happiness affects people's well-being." (Martin, 1997).

ACTIVE DESIGN

Active design is a new design technique that uses architectural elements to increase the amount of physical activity occupants engage in during a regular day routine. Inactivity is becoming one the world's biggest threats, attributing to 9.4% of all deaths worldwide (Hallal, 2012). This trend is also being seen in children. In 1969, it was recorded that approximately 50% of all American students walked to school; today this percentage has dropped down to a mere 5% of students (Baker, 2012). This drop in number may be largely attributed to school location and safety concerns from parents. Site selection is very important in this regard. Schools should be centrally located near neighborhoods and away from potential threats.

Building design can be a great way to incorporate physical activity into our daily routine. The best way to do this is by focusing

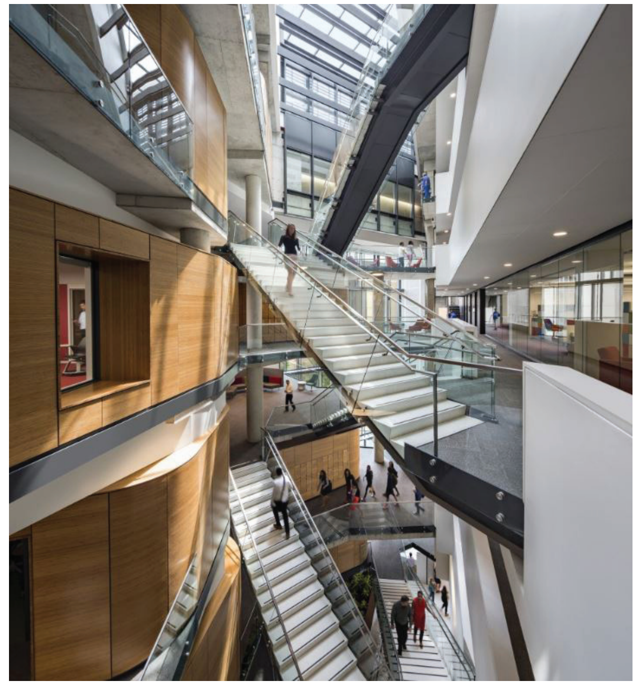


Figure 55. Milken Institute School of Public Health, Washington, D.C.

The playful, zig-zag staircase found in the Milken Institute School of Public Health was designed to encourage physical activity.

Figure 56. Untitled Photograph of Alpert Medical Center Atrium..

The atrium of the Alpert Medical Center has a warm feel due to the wood ceilings and neutral tones.

on the building's circulation system - corridors, stairs, lobbies, elevators. These spaces can either promote or deter physical activity based upon their "availability, convenience, desirability, safety and comfort" (New York City Departments of Design and Construction, 2010). If these spaces are designed to be fun and engaging, occupants will want to spend their time there. These spaces can further entice occupants into physical activity by providing elements of intrigue or convenience, such as natural elements, drinking fountains, or bathrooms (New York City Departments of Design and Construction, 2010). Though this won't fulfill a child's recommended amount of exercise per week, it will provide a space for students to get their bodies in motion in an otherwise inactive day.

AESTHETICS

The aesthetics of a school can be surprisingly important for school design. Though the function of the space is of primary importance, the design needs to motivate students to learn and make them feel comfortable in their learning environment. Unfortunately, studies show that many of our high schools are failing to provide spaces that engage and inspire their students (McNeely et al., 2002; National Research Council and Institute of Medicine, 2002). To do this, our students need to be stimulated by their environment. Human beings function best when moderately stimulated by their surroundings (Day, 2014; Evans, 1998). Too little stimulation can be joyless and boring; yet too much can be stressful and distracting. The key is to design spaces with the concept of "difference within sameness" (Day, 2014). That is, elements which are predictable and constant, yet dynamic, like the sound of babbling water.

Material choice is another aspect of aesthetics which can largely impact the indoor environment that is created. It is important to consider the thermal and acoustic insulation values when selecting materials (Perkins & Bordwell, 2010), but it is also important to consider the feeling that a material may suggest (Day, 2014). For schools, it's best to use "soft" materials within the classroom which can absorb sound to prevent reverberation (Perkins & Bordwell, 2010). Incorporating natural elements (wood, brick, stone, etc.) into the design can help to promote a space which focuses the mind and reduces stress (Chang & Chen, 2005; Day 2014). Further consideration should include regional materials which reflect the context of the building.

WAYFINDING

Wayfinding is the ability to navigate throughout a built environment with minimal confusion. There are 5 different aspects of design that should be addressed to promote wayfinding – paths, edges, districts, nodes, landmarks (Perkins & Bordwell, 2010). Paths refer to the corridors which take us from space to space, edges are the boundaries between spaces, districts are areas with a distinct identity, nodes are places of intense activity where paths may intersect and landmarks are points of reference within the design (Perkins & Bordwell, 2010). In all of these aspects, the key is cohesion (Evans, 1998). Paths should be consistent in their method and different districts should be easily recognizable.

For this thesis, districts shall be used to separate the students into different communities to help promote a sense of community. Each district shall have a unique identity, which makes wayfinding less complex. Communal spaces, such as the cafeteria or library, shall serve as a landmark to help students and guests navigate throughout the building. For security reasons, a distinct edge will separate the learning spaces from the public spaces that may be used after hours. All of these design aspects should help to make the school more navigable.

Figure 57. Lassonde Studios.

The stylish yet functional furnishings of this space create a mature environment that will encourage students to learn.

FURNISHINGS

Furniture can have a large impact upon satisfaction and productivity. Unsuitable furniture can have a large impact upon the learning capabilities of students. It's been found that uncomfortable seating can "causes problems including backache, poor concentration spans and writing difficulties, thus reducing learning opportunities" (Fisher, 2000). It's important that chairs are ergonomically designed so that students can focus upon learning rather than making themselves comfortable.

Typical classrooms use arm desks which are highly uncomfortable, restrictive and childish. They are no longer appropriate for high schools where students desire to be in a mature setting. Tables and chairs allow for maximum flexibility and create an environment which feels like a "workplace for learning" (Perkins & Bordwell, 2010). They should be functional, durable and comfortable to promote learning. Furnishings in public areas should be more comfortable and plush to promote social interaction and recreation (Perkins & Bordwell, 2010). Furnishings play a major role in informing the activity, mood and noise level of a space, so their application should be deliberate and thoughtful.

SUMMARY

Through the previous research, I have identified several factors of student health and learning which can be influenced by the built environment. Though external factors such as family life, socio-economics, and so on may also play a role in determining a student's health and learning abilities, these identified design aspects are things in which the school can provide for the student. By understanding their importance and impact, we can then use these factors to create better design solutions for our schools.

In discovering the ways in which the built environment may influence students, it became clear that student health and student learning are largely dependent upon one another. If a student's health is suffering, then so too will their learning capabilities. It's impossible to separate the design factors that impact student health from the ones that impact student learning. These two aspects of a student's life must be analyzed together.

In total, I have identified 17 different factors of the built environment which have been found to be influential upon student health and learning. These factors can be further broken down into two separate groupings. The first group of factors concerns whole-building design; this includes: air quality, social interaction, facility age and condition, occupant control, school size, connections to nature, form, security, active design, aesthetics and wayfinding. These factors should be considered during the pre-design phase and should be applied to the school as a whole. The second group of factors are space-specific, they include: acoustics, thermal comfort, lighting levels, color psychology, density and furnishings. These factors should be analyzed and designed per each individual programmed space to suit the needs of the activities associated with that space.

The following chart analyzes the major programmed spaces in terms of the space-specific design factors previously identified.

	ACOUSTICS	THERMAL	LIGHTING
Academic Spaces	35 dB / .6 seconds	68 degrees F	50 FC
Atrium	45 dB / 1 second	64 degrees F	40 FC
Administration Offices	30 dB / .6 seconds	68 degrees F	50 FC
Library	30 dB / .5 seconds	68 degrees F	60 FC
Cafeteria	40 dB / 1 second	66 degrees F	25 FC
Gymnasium	45 dB / 1.4 seconds	60 degrees F	50 FC
Theater	20 Db / 1.6 seconds	64 degrees F	10 FC

	COLOR	DENSITY	FURNISHINGS
Academic Spaces	Light Green/Blue	35 SF/Student	Tables and Chairs
Atrium	Neutrals	I SF/Student	Comfortable Seating
Administration Offices	Green	15 SF/Student	Tables and Chairs
Library	Green	25 SF/Student	Variety of Seating
Cafeteria	Orange	15 SF/Student	Round Tables
Gymnasium	Orange	1/500 Students	--
Theater	Dark, Warm Colors	8 SF/Student	Comfortable Seating

Figure 58. Design Aspects Chart.

Figure 59. Brick Facade.

PROJECT JUSTIFICATION

"We shape our buildings, thereafter they shape us" - Winston Churchill

Adolescence is a particularly difficult time in a child's life. It represents the bridge that connects childhood to adulthood. With this comes multiple different stressors that can have a heavy impact upon a teenager's well-being. Puberty can cause rapid changes in a teen's body composition which is often accompanied by feelings of self-consciousness or curiosity (Rogol A. et al., 2002). Some teens may also experience additional responsibilities being that they can acquire a job at age 16. Adolescence is also a time when teens will begin to search for self-identity. Quite often this involves "trying on" different roles in pursuit of something that feels right to the individual. This type of behavior is to be expected, and is perfectly acceptable. Unfortunately for some teens, this process may be paired with risky behavior involving experimentation with drugs, alcohol, or sexual intimacy (Hallfors, D. et al., 2005). In a study conducted by the National Longitudinal Study of Adolescent Health, it was found that teens, especially girls, who were engaged in sex and drug behaviors were more likely to experience depression later on (ibid). According to the National Institute of Mental Health, 9% of American teens will show prevalent signs of depression during high school; this equates to 2.2 million teens each year (National Institute of Mental Health, 2012). With all of these stressors manipulating the well-being of our teens, it's important that they are provided a place of refuge.

School buildings have the opportunity to provide students with a safe and supportive environment where they are able to find comfort. For some, this may be the only safe place for them to be. Fortunately, we have the ability to design our schools with intention. We can implement strategic design elements that have been proven to encourage student health and learning, to see a direct, positive influence upon the lives of our students.

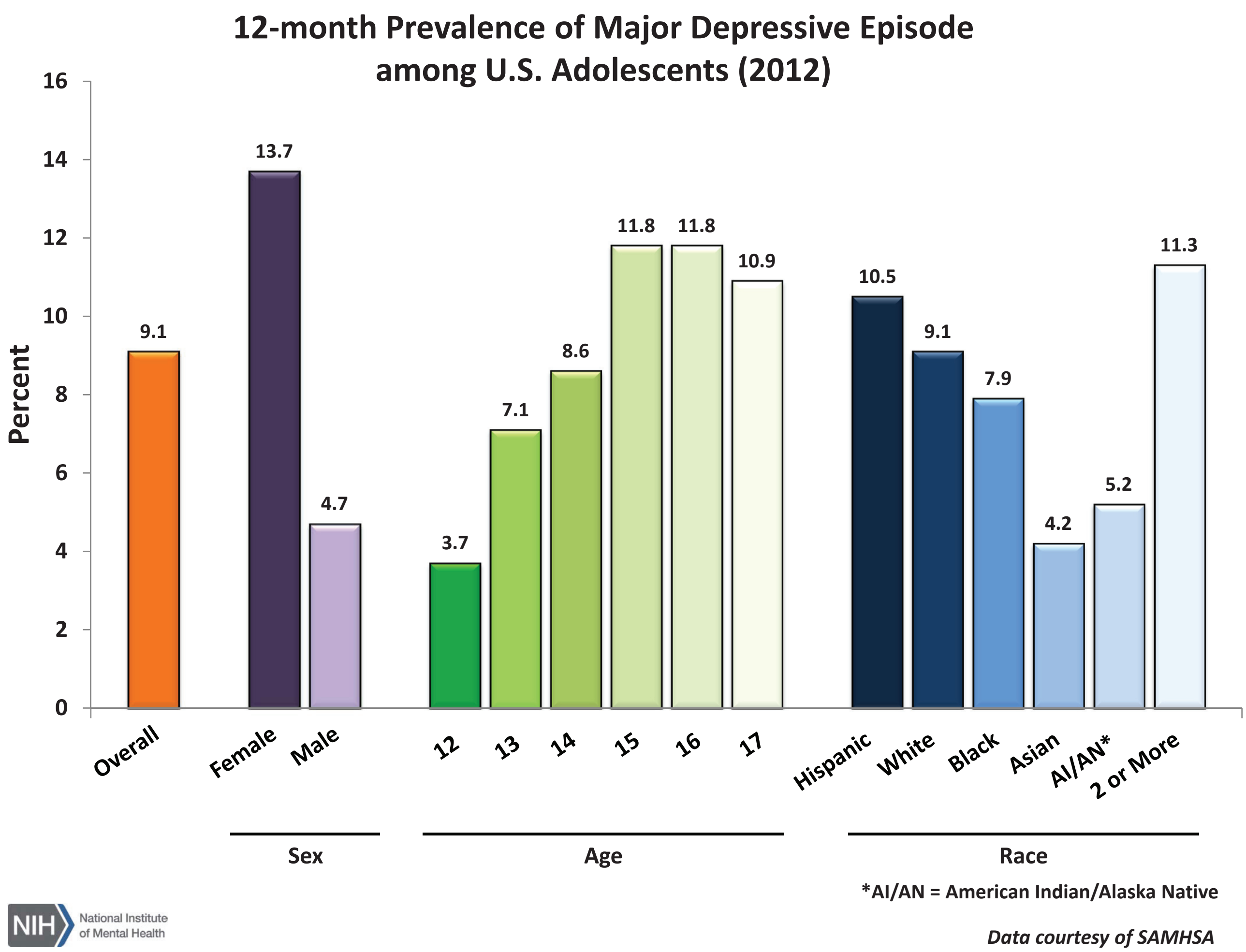


Figure 60. Depression Statistics.

Figure 61. Mandan Hall.

HISTORICAL CONTEXT

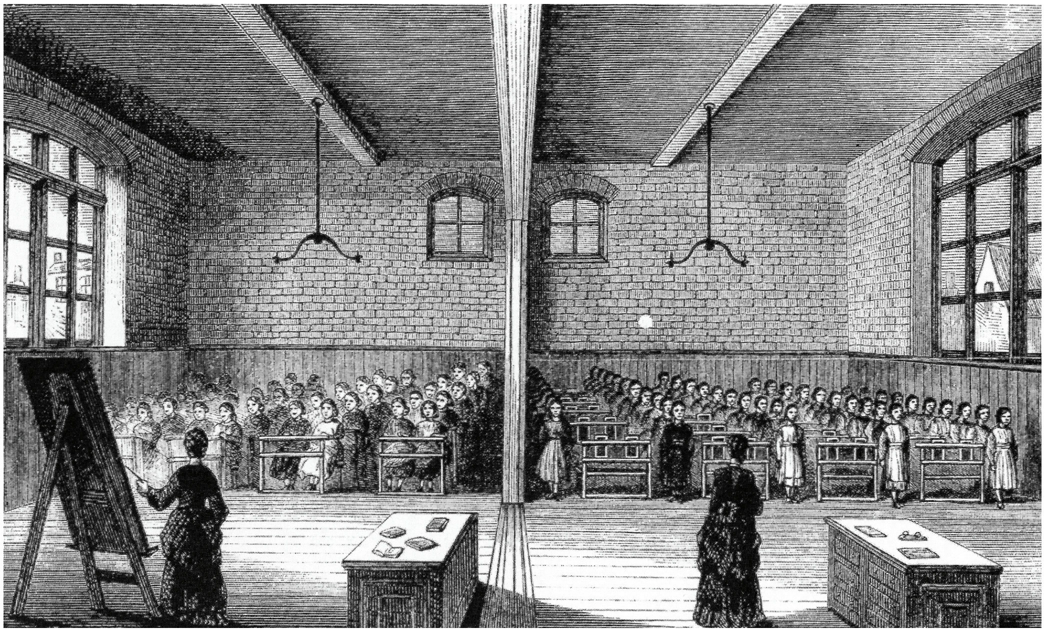


Figure 62. One-Room Schoolhouse.

With schools being the place where our children learn how to become functional members of society, it is to no surprise that school buildings are constantly being scrutinized and reinvented. School design over the past century has seen dramatic changes. Society is constantly changing, and so too has the way we design and construct our schools. Researchers are constantly revealing new information and technology that can enhance our schools and better prepare our students.

It's important to understand where we came from in order to know if we're headed I the right direction. When approaching school design it may be beneficial to reflect upon the trends seen throughout the past, and to evaluate the strategies that may or may not have been successful (Baker, 2012). By looking into the history of school design, we can uncover information about how and why our school buildings have changed over time. This will allow us to make better informed decisions about our schools today.

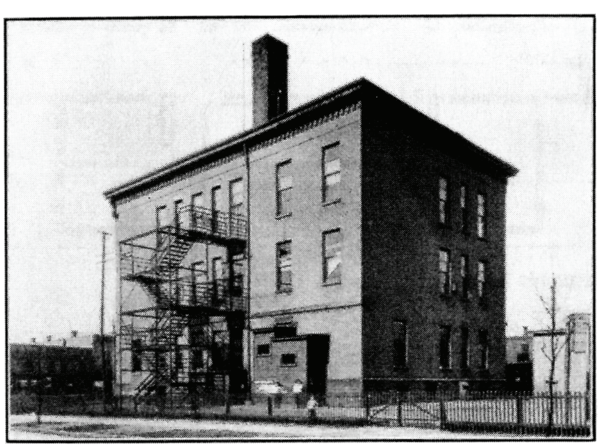
Perhaps the best place to start is with the schoolhouse. Many of us can imagine the one-room schoolhouse that is classically portrayed in American movies about the nineteenth century. These buildings were designed to fit as may students as possible, sometimes hundreds, into one large classroom for efficient learning (Dudek, 2000). This required fewer teachers, but didn't provide an adequate learning environment for the students. Horace Mann, an educational reformer, was the first person to reanalyze the one room school-house. He created set standards for desk arrangements, window placement, and a variety of other aspects of the classroom (Baker, 2012). His attempts at standardization would soon become a necessity with the Kalamazoo Decision. The Kalamazoo Decision of 1874 determined that all public schools, kindergarten through 12th grade, were to be funded by local property tax and supported by the government. This made schooling free for all students and caused a large shift in school enrollment.

During the last few decades of the nineteenth century schools were in high demand. A large amount of schools were popping up across the country to accommodate the new influx of students. These schools were highly standardized and very practical in design (Baker, 2012). There was little attention paid to the quality of the spaces being built. Their goal was to fit as many students as possible onto the smallest site possible in response to increasing land costs (Brubaker, 1998). Typically these schools had very traditional facades reflecting the neo-classical styles of the time.

Cleveland's Alabama School was built in the 1850s. It was a three story building with 3 classrooms on each floor. Each room was designed to house 100 students, though increased enrollment demanded that nearly 200 students be squeezed into each room.

Into the twentieth century, researchers began to reevaluate the quality of the learning environments that had been created. Strict standards began to be published that informed room temperature, ventilation rates, and lighting levels (Baker, 2012). Daylight was very important at the time, due to the lack of electricity, and though HVAC systems were new to the market it wasn't long before they were being installed into schools across the country (ibid). Once electrical lighting was introduced, the Illumination Engineering Society published code that called for a minimum of 3 footcandles of artificial light in all classrooms (Osterhaus, 1993). Of course, all of these standards were subject to change with development in technology.

In the 1930s, attitudes began to shift regarding the learning environment of students. A new set of educational reformers were introduced, and with them came the idea of child-centered learning (Hille, 2011). Schools began to focus upon natural ventilation, daylighting, physical wellness and a connection to the outdoors, and so the "open air school" movement was born (Baker, 2012). Many scholars began to recognize the need for a reform in school design, and so research began upon the psychological effects of school buildings upon users. Following this period, little advancement occurred due to the unexpected Great Depression and the start of World War II (ibid).



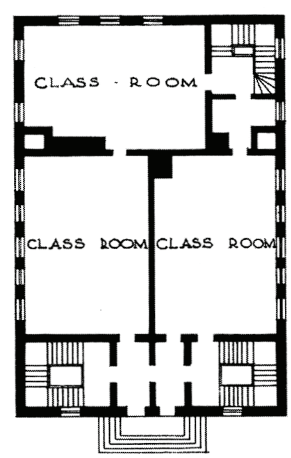


Figure 63. Alabama School.

"In practical terms, the modern school as it developed in the United States at this time, was determined to have a number of practical and functional advantages over the traditional two- or three-story brick schoolhouse. To begin with, its lightweight construction, which utilized new building technologies, was less expensive and easier to build, and although its life expectancy was shorter, it was argued that schools needed to be rebuilt periodically anyway." (Hille, 2011).

A good example of the "open air school" style can be seen in the Impington Village College designed by Walter Gropius and Maxwell Fry in 1936. The school features floor to ceiling windows that allow for ample daylighting and views to the outdoors.

The post-war baby boom produced massive growth within the education department for several years to follow. School populations rose by nearly 2.3 million students in just 10 years (Baker, 2012). According to report by the National Council of Schoolhouse Construction, "$20 billion was spent on new educational facilities from the end of World War II through 1964 (National Council on Schoolhouse Construction, 1964). With this growth came a new wave of innovation. Schools of the 1950s can be characterized as large, one story buildings with sweeping curtain walls and flat roofs (Brubaker, 1998). Unfortunately many of these buildings were poorly constructed and demanded continual maintenance for proper upkeep.

Figure 64. Impington Village College.

The Crow Island School, designed in 1940 by Perkins and Will, is possibly the best example of a finger-plan school from this time. It has been noted as the school building that "defined modern education architecture in the United States" (Tanner & LacIney, 2005).

In the 1960s, demand shifted over to high school buildings as the baby boomer generation graduated from middle school. This era saw the development of environmental psychology, where researchers were beginning to find links between the built environment and student achievement (Baker, 2012). The decade soon became dominated by research and innovation. One of the most influential research organizations was the Educational Facilities Laboratory (EFL) (Baker, 2012; Brubaker, 1998). They brought about several new ideas within school design, one of their most well-known being the open floor plan (Brubaker, 1998). This type of layout allowed for flexibility, and eliminated

Figure 65. Crow Island School.

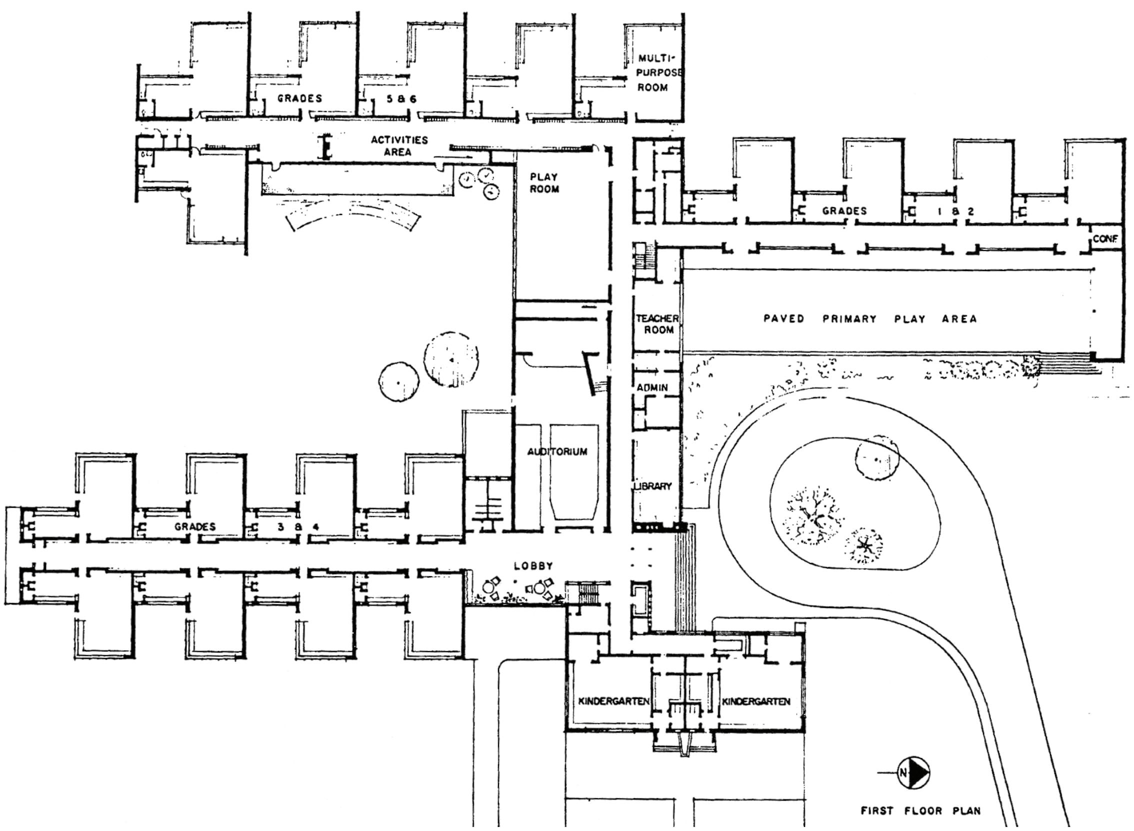
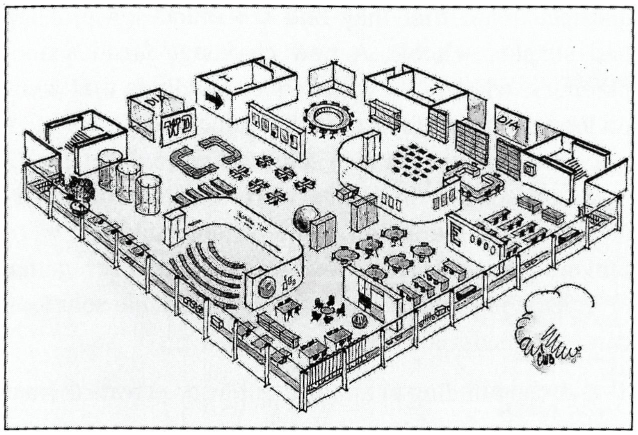


Figure 66. Crow Island Floor Plan.



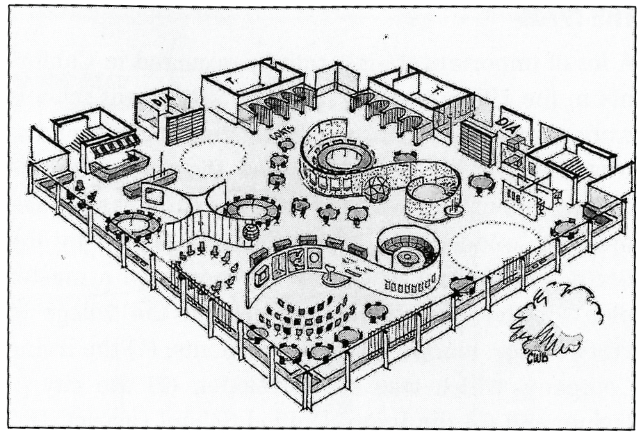


Figure 67. Disney Magnet School.

The Disney Magnet School was designed by Perkins and Will and completed in the 1960s. The floor plans above illustrate a few ways in which the 90' by 90' space could be arranged. This type of floor plan faced scrutiny for insufficient daylighting and poor acoustics.

the idea of a traditional 30' by 30' classroom. Unfortunately, many people disagreed with this radical change, so most open floor plan schools only lasted for a short while. The Disney Magnet School is Chicago is one of the only open floor plan schools from the 1960s which is still in existence.

The energy crisis of 1973 drove many schools towards energy consumption efforts (Baker, 2012). Declining enrollment rates gave schools an opportunity to retrofit their facility with energy-efficient design elements. The energy crisis also brought about the Institutional Conservation Program, which was a federal retrofit program that gave grants out to schools and hospitals that updated their facilities to be more energy efficient (ibid). For a short period of time, standard ventilation rates for classrooms dropped down to 5 cfm to help preserve energy (Janssen, 1999). The idea of the windowless classroom was also created during the 1970s. The innovation was introduced as a strategy for gaining more control over indoor environmental factors. Researchers found no apparent negative impacts upon student health or learning, and teacher and student complaints weren't enough reason for architects to avoid this type of construction (Baker, 2012).

The 1980s found very little advancement for educational facilities. Research that had been conducted in the 70s was being reconsidered, and schools began to refocus their attention upon traditional classroom designs (Hille, 2011). New construction and renovation slowed down, and many schools began to see their decline. In 1995, the Government Accountability Office released a report that stated that U.S. schools were in poor condition, and that an estimated $112 billion was needed just to bring the nation's schools back up to an acceptable overall condition (Baker, 2012). A few of the problems addressed included the presence of lead and asbestos, and defiance of ADA requirements. Though these issues were brought to light, no federal assistance was provided to help address the problem.

Green design and high-performance buildings became a new trend in the 1990s fueled by the introduction of a new building rating system called LEED (Leadership in Energy and Environmental Design) in 1998. This green movement continued into the 21st century and is now one of the most influential forces in school design (Taylor, 2008; US Green Building Council, 2007). LEED not only promotes sustainable design measures that help to protect natural resources, but also healthy indoor environment conditions to encourage wellness within building occupants. The program has returned a focus back onto the importance of the indoor environmental quality of our buildings.

Recent research reveals new topics in regards to the relationship between school facilities and student health and learning. Significant problems have been found involving the air filtration systems in U.S. schools. It has been suggested that increasing rates of asthma within children may be linked to the poor air quality of their school (Ribéron et al., 2002; Smedje & Norbäck, 2000; Zuraimi et al., 2007). It has also been acknowledged that low levels of natural light within schools can have a negative impact upon student cortisol levels (Kuller and Lindsten, 1992). These two findings have influenced architects into finding new strategies that incorporate natural ventilation and lighting to improve student health and learning.

With the momentum that we currently have within school architecture and the technology that we have available for advancements, it will be interesting to see where the future takes us. Many schools have already switched over to a project-based learning curriculum and increasing amounts of technology are now being introduced into school facilities. As we continue to imagine new possibilities, it's important that we always look back upon the history of school design, as to not replicate any of the mistakes made in our past. We already possess the information needed to create better schools for the future.

Figure 68. Fossil Ridge High School.

Figure 69. Mandan Field.

SITE ANALYSIS

VIEWS AND VISTAS

The site is located in south Mandan, which is an older part of town that recently began to see new construction. Its close proximity to Heart River presents great opportunities for fantastic views from the building. The site sits up on a plateau which overlooks woods to the South, farmland to the West, and the river to the North. Although there are several new houses being built in the area, none shall impact or obstruct these views. The building should be designed to take advantage of these views by proper space arrangement and orientation. It would be beneficial to the students to have study areas on the West side of the building with large windows oriented towards these views. The site is bare of shadows throughout the day due to its high elevation in coparison to its surroundings.

VEGETATION AND HUMAN INTERVENTION

The site shows very little sign of human intervention besides a few pieces of scrap metal and wood that look as though they had been stripped from an old barn. The rest of the site is covered in wild grasses that look as though they have been untouched for several years. Due to the horizontal quality of the land, I would assume that the site was previously used for farmland.

Figure 70. New Construction.

Figure 71. Heart River.

Figure 72. Farmland.

Figure 73. Existing Neighborhood.

Figure 74. Human Intervention.

Figure 75. Open Field.

LIGHT QUALITY

The site receives ample sunlight all year round. Only a small sliver of the south edge receives shading during the winter months. The site possesses great opportunity for natural daylighting for the building. It will be important to consider how the design will cast shadows on surrounding sites. In particular, it's imperative that the design does not cast any shadows on the farmland to the west.

WIND QUALITY

Wind velocity is very high in Mandan due to the character of the Great Plains. The site is particularly windy thanks to its high elevation and adjacency to the Heart River. Winds typically approach the site from the west. Outdoor spaces should be located on the east side so that the building may provide wind coverage. The picture above looks at the site from the northwest corner, and demonstrates the site elevation and river adjacency.

Figure 76. Light Quality.

Figure 77. Wind Quality.

SURROUNDING BUILT FEATURES

The surrounding built environment consists primarily of housing developments. The neighborhood to the north is a trailer park that looks to be several years old. To the west of this neighborhood lies the existing high school athletic fields, which shall still remain. Further west is a middle-income neighborhood that surrounds Mary Starck Elementary School. There are a few warehouses belonging to the Mandan Parks and Recreation department within this neighborhood. A small population of commercial buildings exists at the major intersection north of the site. Adjacent to the site is a small church. Several new neighborhoods are being built south of the site.

The site is in a good location due to the large amount of surrounding neighborhoods. Several students will have the ability to walk to school due to the close proximity. The neighborhoods are quiet and safe which is also beneficial to the school.

Figure 78. Brick Building.

Figure 79. New Neighborhood.

Figure 80. Built Environment.

SOIL STUDY

The soil of the site is primarily gravel and sand, which classifies it as not prime farmland for the city of Mandan. This type of soil structure works well as a foundation material for buildings and has excellent drainage capabilities. The dominant soil order is Mollisols which is a rich soil favorable for agriculture, though it only accounts for 15% of the land area. The surrounding sites have much higher percentages of Mollisols. The soil suborder is Ustolls, which is the common suborder of semiarid climates.

Dominant Soil Order: Mollisols (15%)
Dominant Soil Suborder: Ustolls (15%)
Farmland Class: Not Prime Farmland

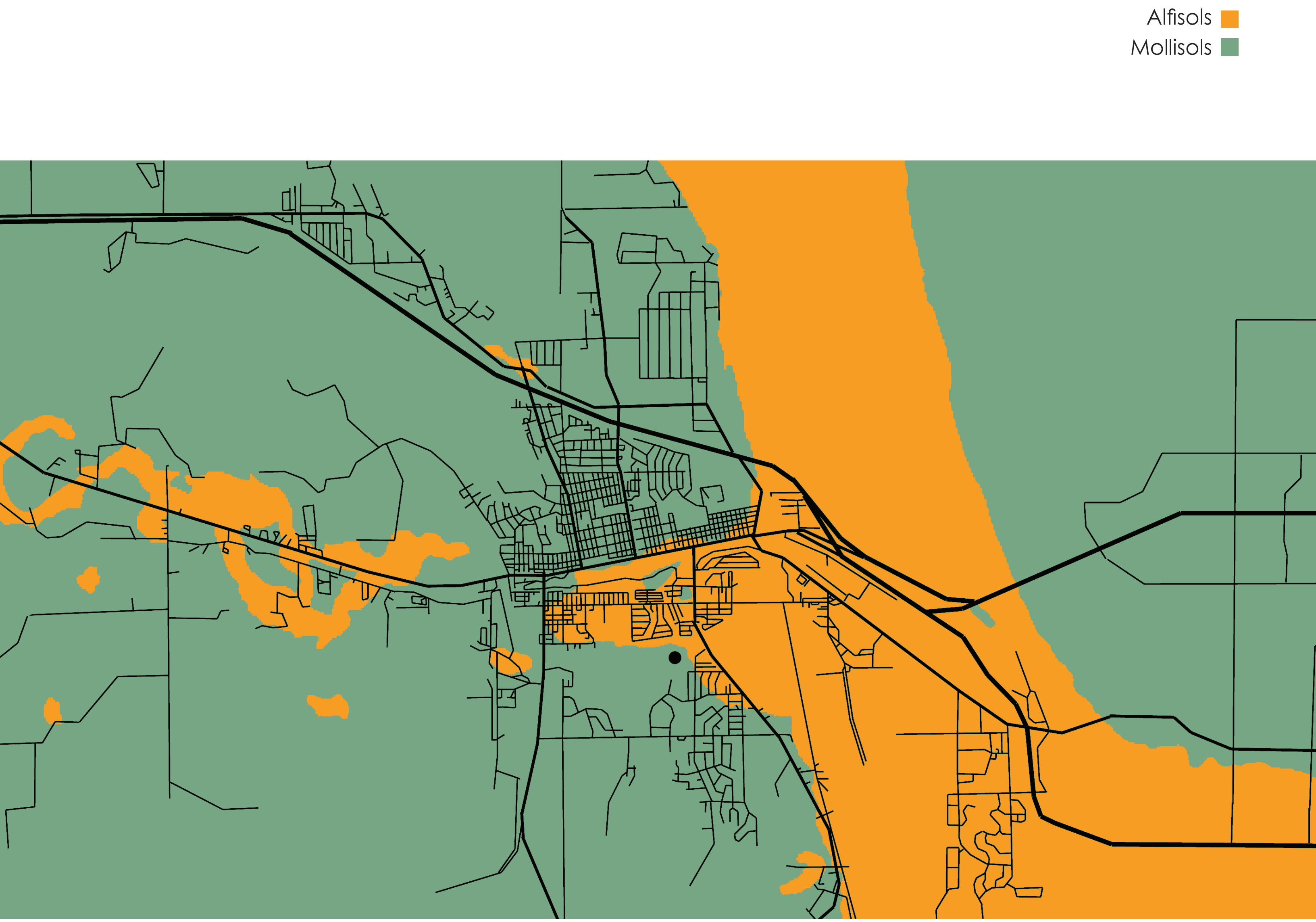


Figure 81. Soils Analysis.

TOPOGRAPHY

The topography of the site is fairly flat, with steep slopes down to the river on both the north and west sides. This particular landform works very well for this project. The school will have a large, flat foundation to build upon, while being up on a hill will help with drainage and creates great views of the river. The slope on the north side is about 6% which is suitable grade for both pedestrian and car. The slope on the west side is about 20% which would require stairs if access is required. Neither slope is at danger from erosion.

Figure 82. Site Section A.

Figure 83. Site Section B.

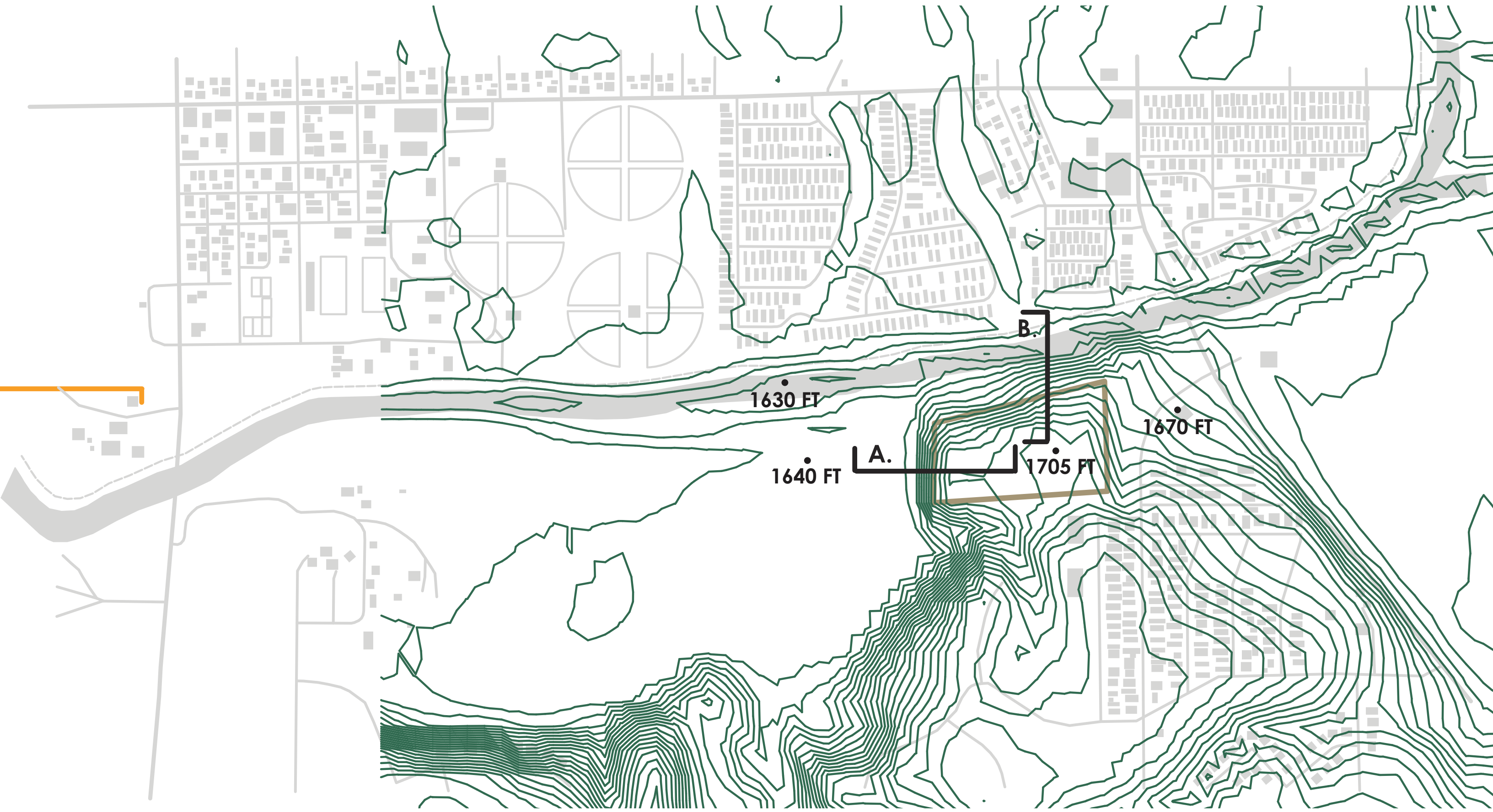


Figure 84. Topography Map.

WATER STUDY

Flooding is not unusual for Mandan, though this is not an issue for my particular site. Its lowest elevation of 1680 ft. is still well above the flood plain. A recent levee was built on the north side of Heart River which will prevent flooding in the neighborhoods north of the site.

The portion of Heart River adjacent to the site is approximately 26,500 ft. above confluence with the Missouri River. According to a chart produced by the Federal Emergency Management Agency of Mandan, The stream bed near the site sits at 1626 ft. in elevation.

10% Annual Chance of Flooding: 1650 ft. or less
1% Annual Chance of Flooding: 1654 ft. or less

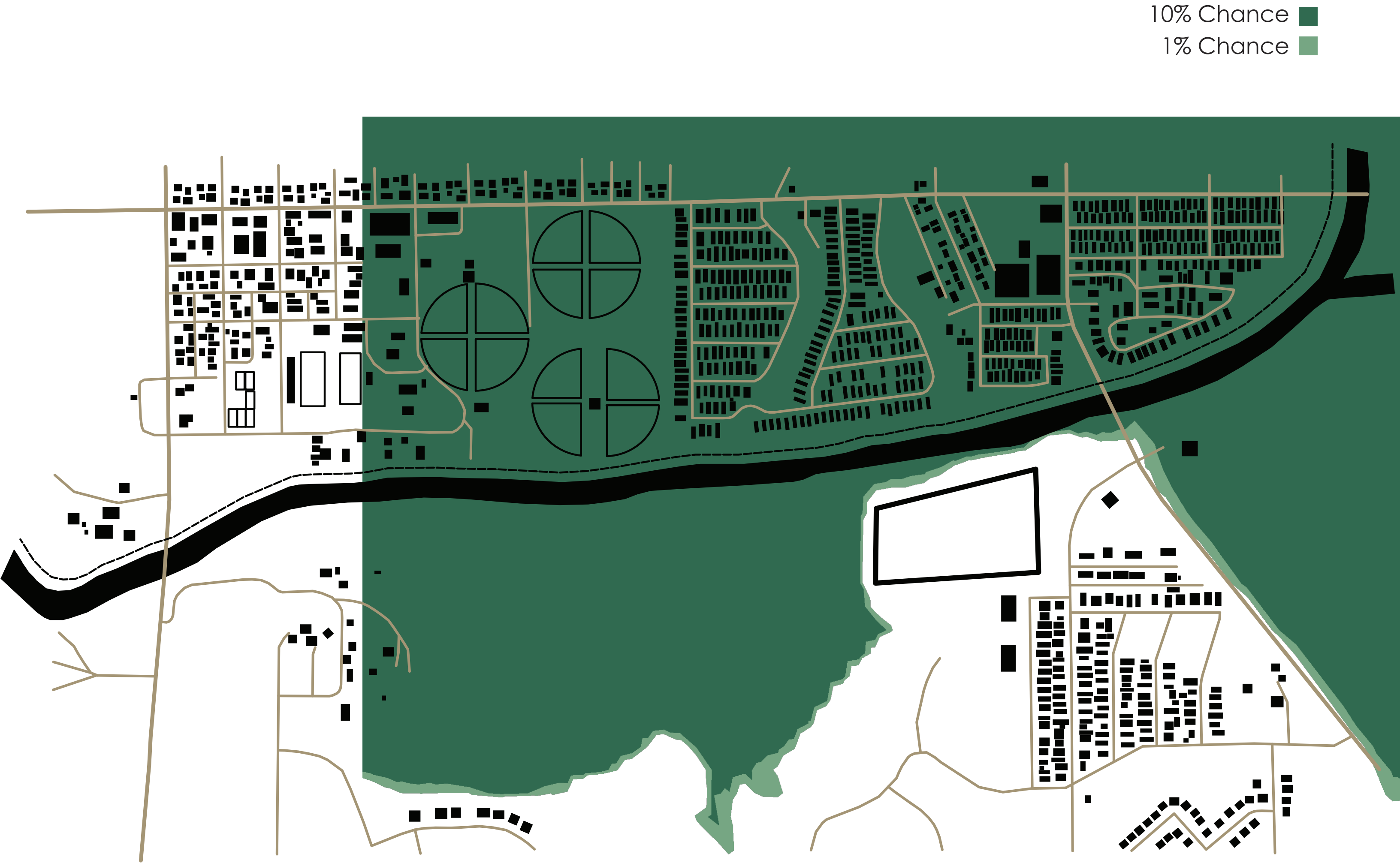


Figure 85. Annual Chance of Flooding.

VEHICULAR TRAFFIC

Vehicular traffic is fairly light around the site due to location between neighborhoods. Fort McKeen Road is an arterial road that leads to downtown Mandan, so its traffic is a bit heavier. The site's location to this road is ideal. It's close enough to the road that the school is easily accessible, but not too close where school traffic will be backed up onto the arterial road.

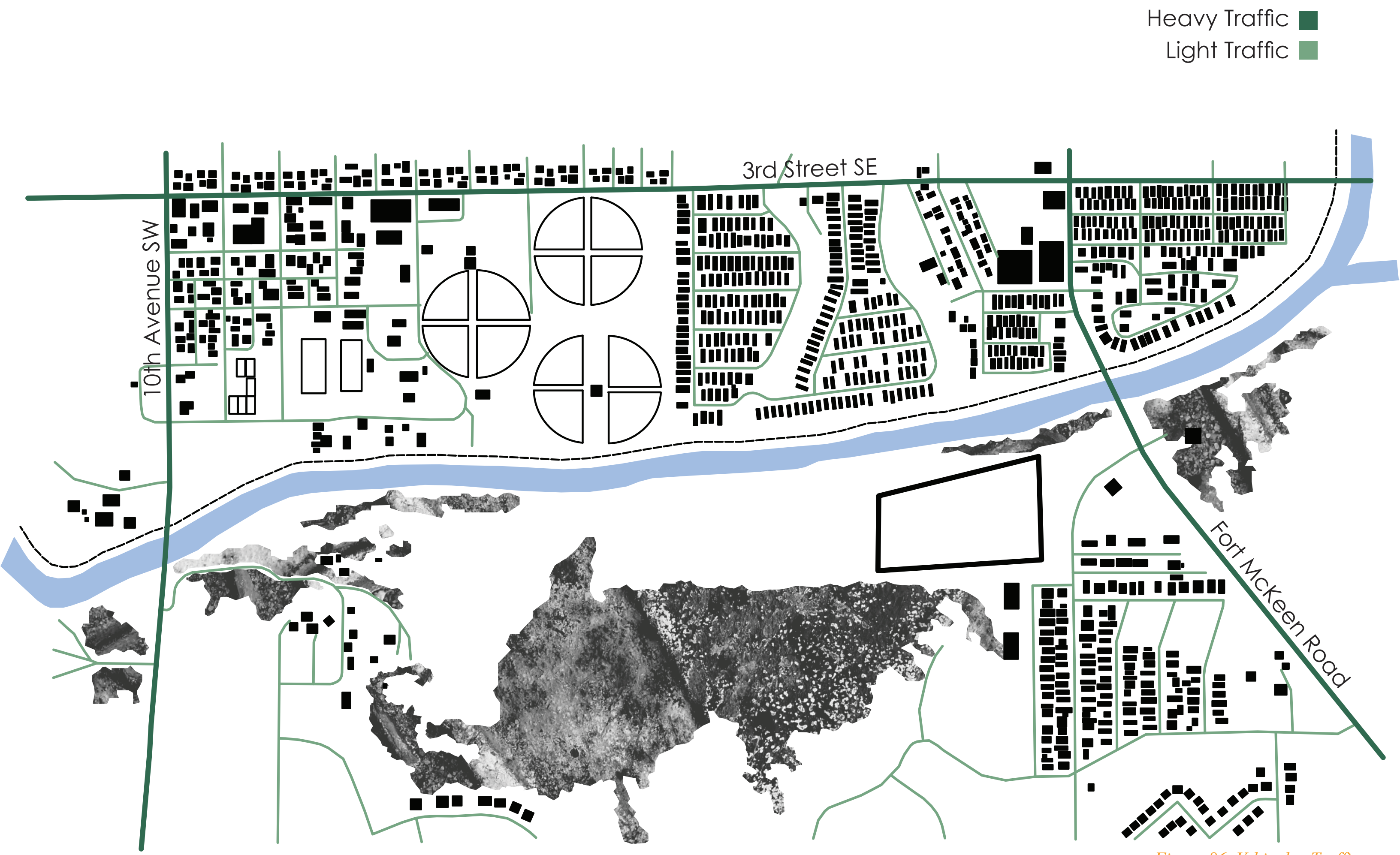


Figure 86. Vehicular Traffic

PEDESTRIAN TRAFFIC

Pedestrian traffic is fairly light in this part of town. Fort McKeen Road and 3rd Street SE see a moderate level of pedestrian traffic due to the amenities along their path. There is a walking path that was created on top of the levee just north of Heart River. This receives a good amount of pedestrian traffic from the adjacent neighborhood. This could potentially be transformed into a sidewalk that connects the school to the opposite side of the river. This would also be beneficial to student athletes who must cross the river to access their playing fields. In this scenario, a pedestrian bridge would need to be created between the site and the levee. Its elevation would need to be above 1650 ft. in order to avoid the risk of flooding.

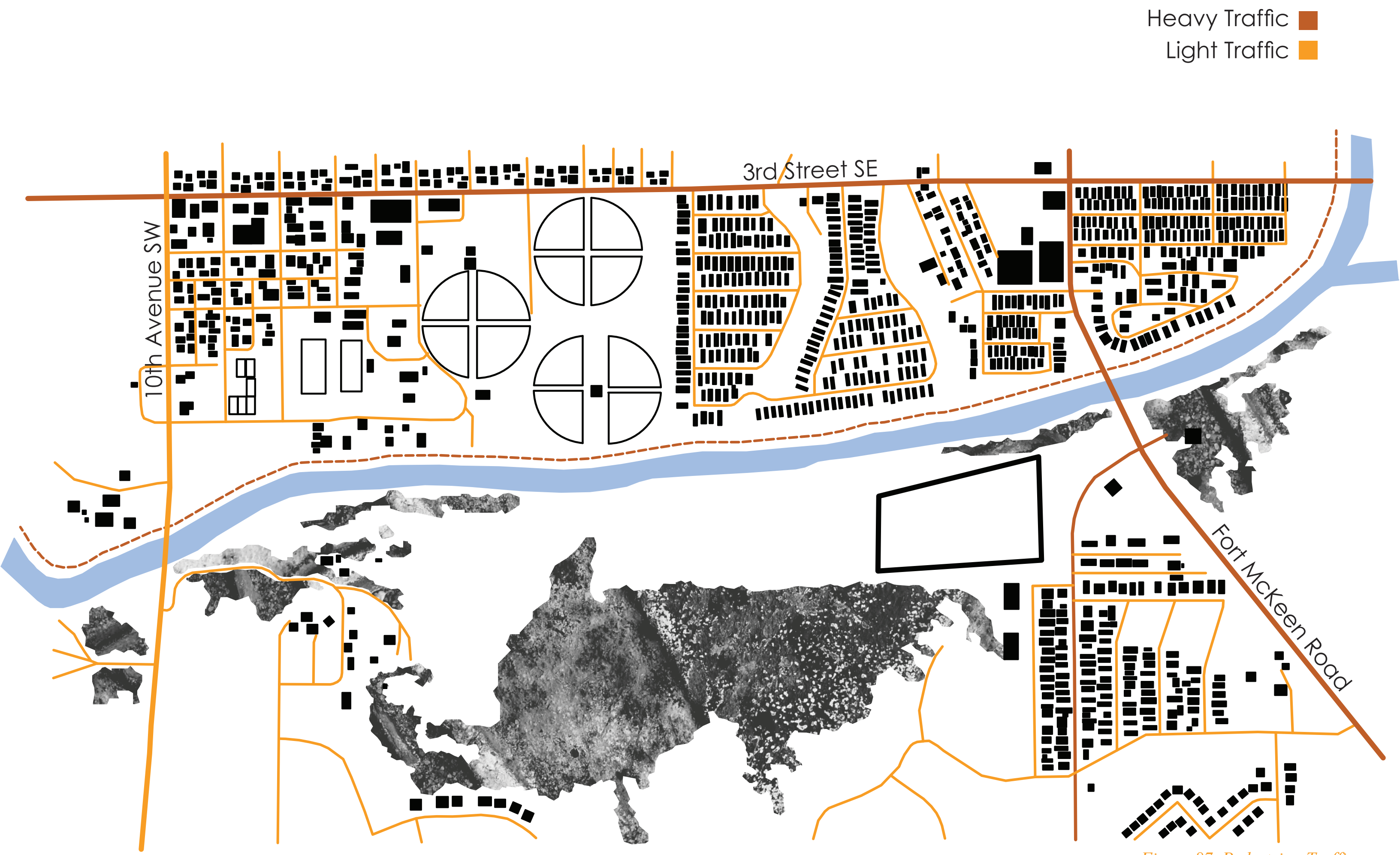


Figure 87. Pedestrian Traffic.

PARCEL INFORMATION

The site is zoned in the agricultural district, which also permits select building types that can help encourage diversification. It is discouraged to use the land for anything which may negatively impact the environment or disturb surrounding agricultural and residential areas. A public high school is permitted for this zone. This includes any accessory building to a school. The setbacks for this project include a 60 ft. setback from the front boundary, 25 ft. setbacks from the side boundaries, and a 50 ft. from the rear boundary. The building can be no more than 35 ft. tall, yet there are no restrictions upon lot coverage or floor area ratios. There are no existing utilities on the site.

Fortunately, the site lies on a parcel of land that is already owned by the City of Mandan, so land costs would not need to be considered. The only costs associated with the project would be construction costs.

PARCEL NUMBER 655798000
ADDRESS 205 2nd Avenue NW
SIZE 22.4 Acres / 976,900 SF
ZONING DISTRICT Agricultural

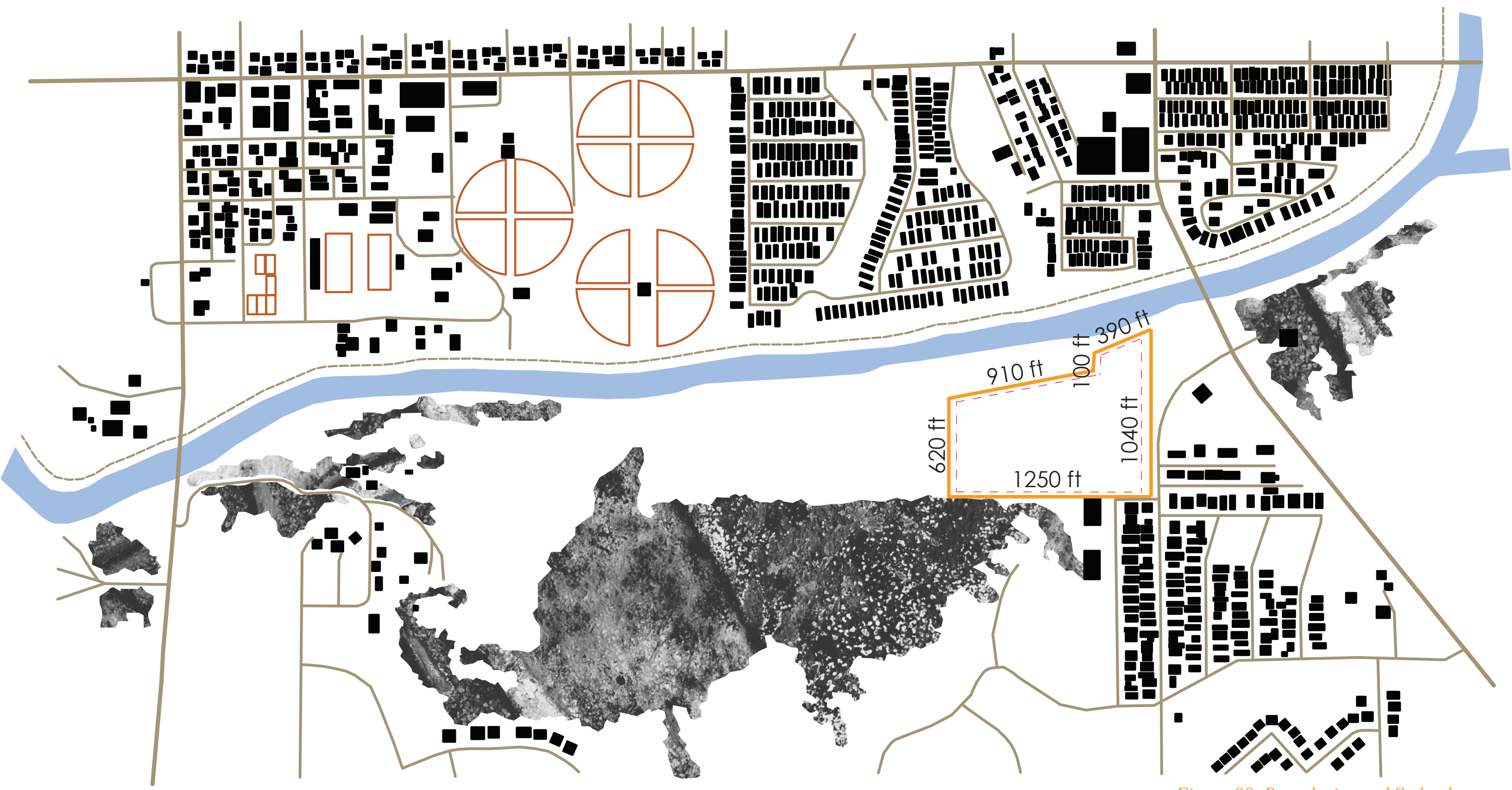


Figure 88. Boundaries and Setbacks.

CLIMATE DATA

Mandan is in the humid continental climate region. This type of climate is characterized by four distinct seasons. Humidity levels are fairly high, yet still comfortable. The city is fairly dry, averaging about 16.5 inches of rain and 49 inches of snow annually. The area is sunny 62.5% of the time, which equates to about 2,740 hours of sunshine annually. The wind on the site comes primarily from the NW, though slight breezes can be felt in the summer from the SE. Wind speeds in the winter can reach over 20 mph, so it will be important that all entrances and outdoor spaces are well protected. It would be ideal for the entrances to be placed on the SE corner so that summer breezes are allowed to enter the building.

TEMPERATURE

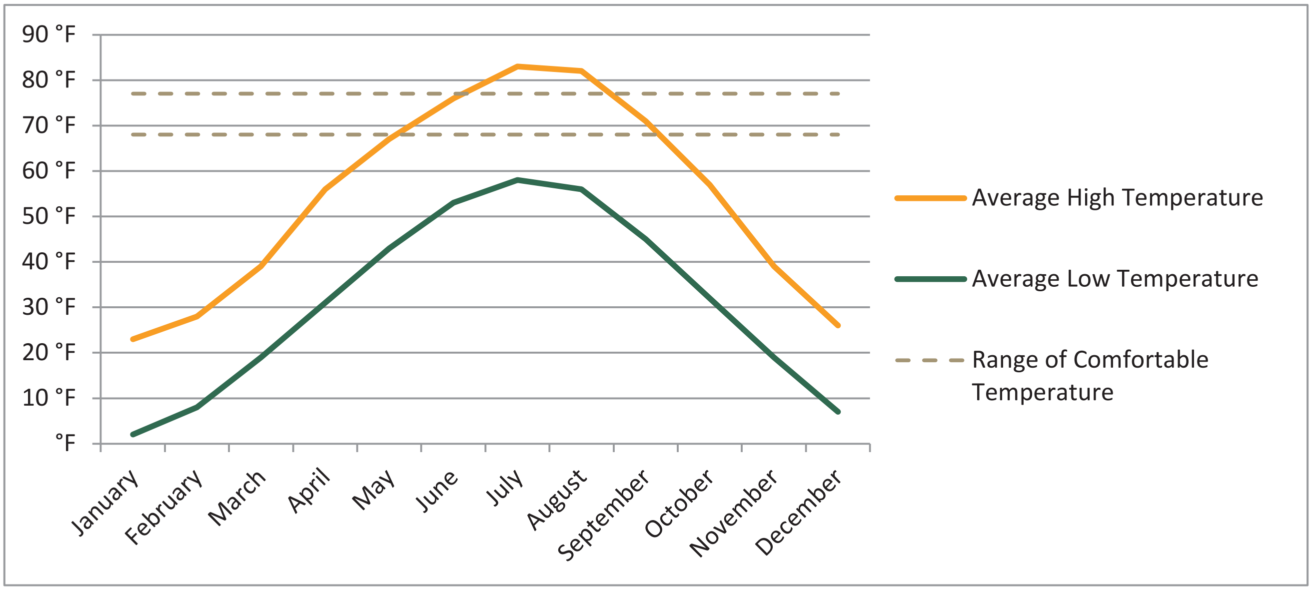


Figure 89. Temperature Graph.

RELATIVE HUMIDITY

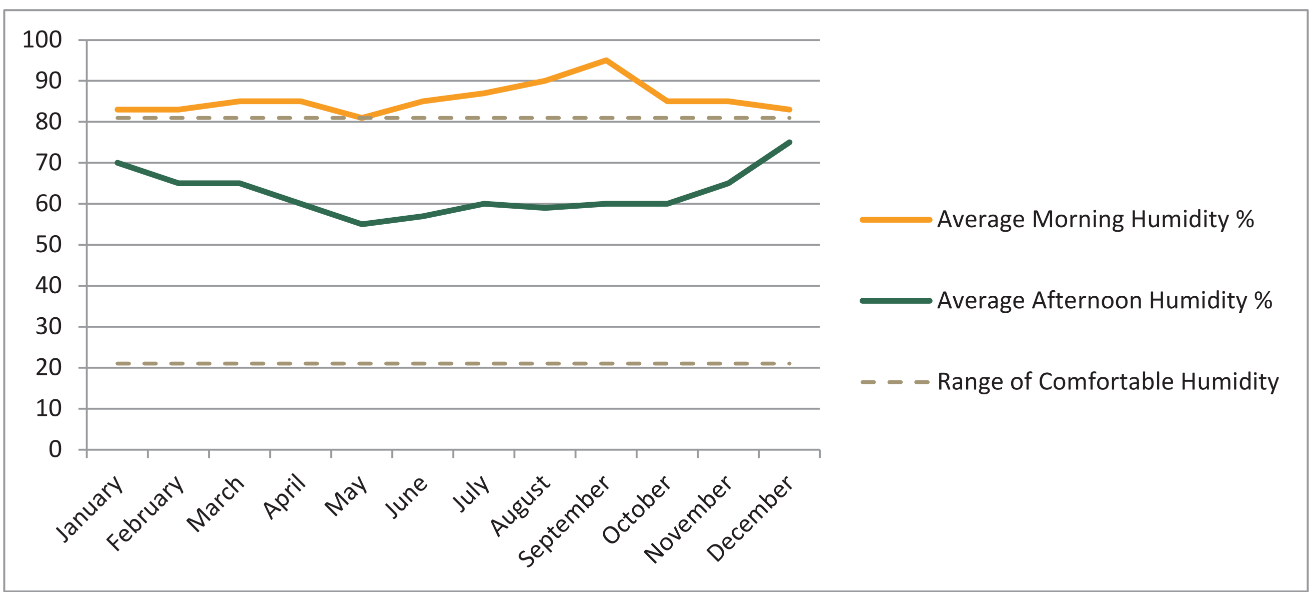


Figure 90. Relative Humidity Graph.

PERCIPITATION

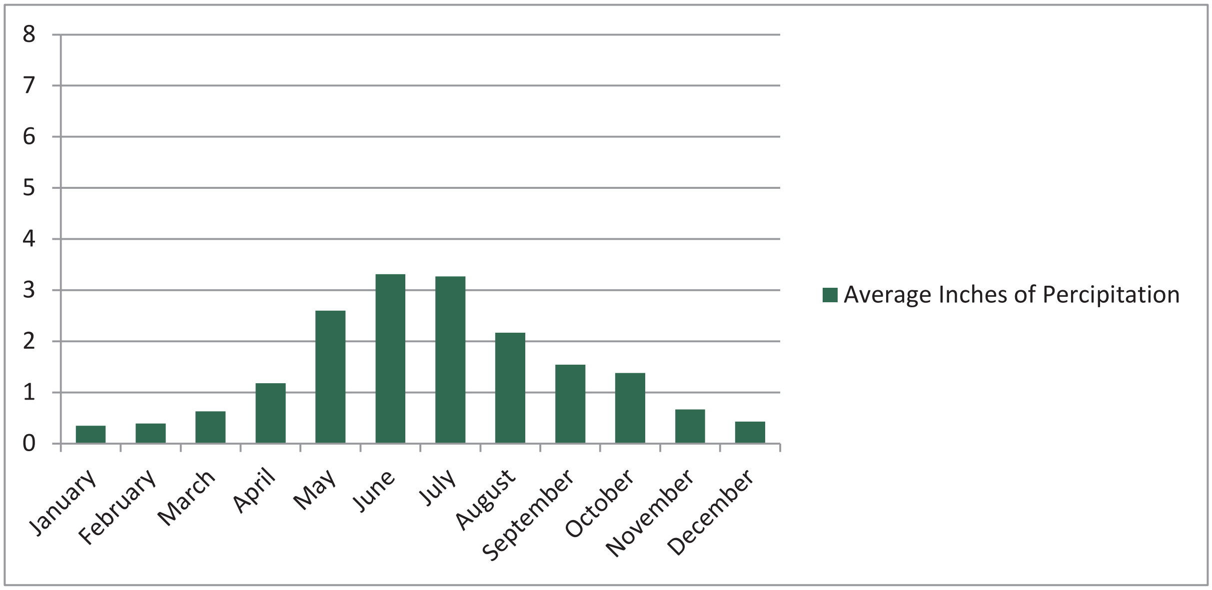


Figure 91. Percipitation Graph.

SUNSHINE

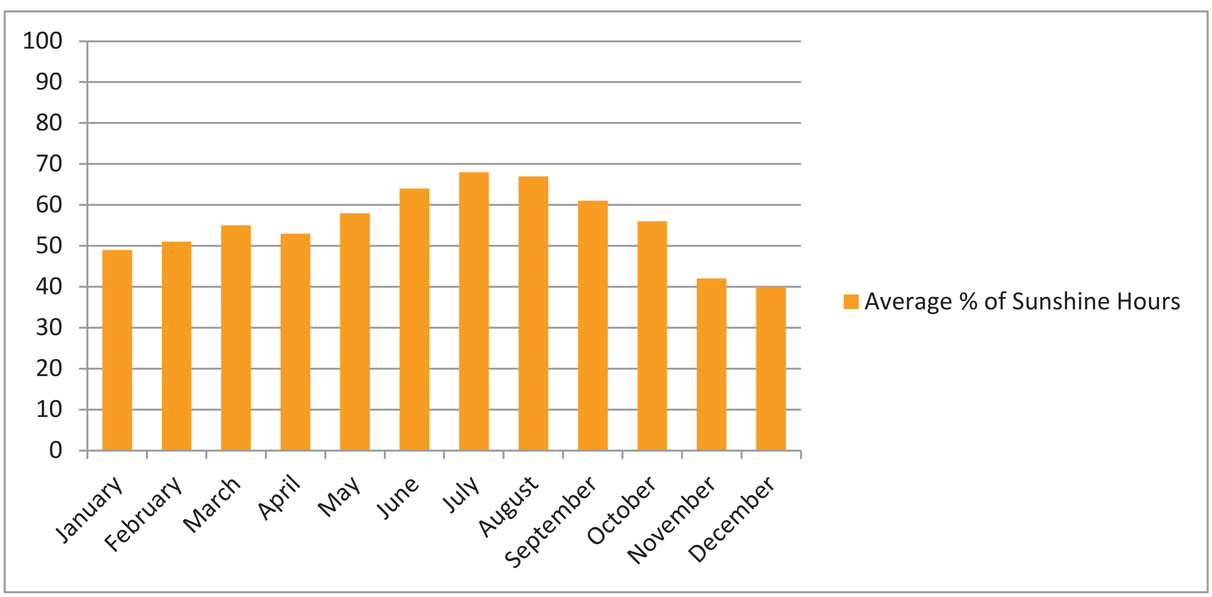


Figure 92. Sunshine Graph.

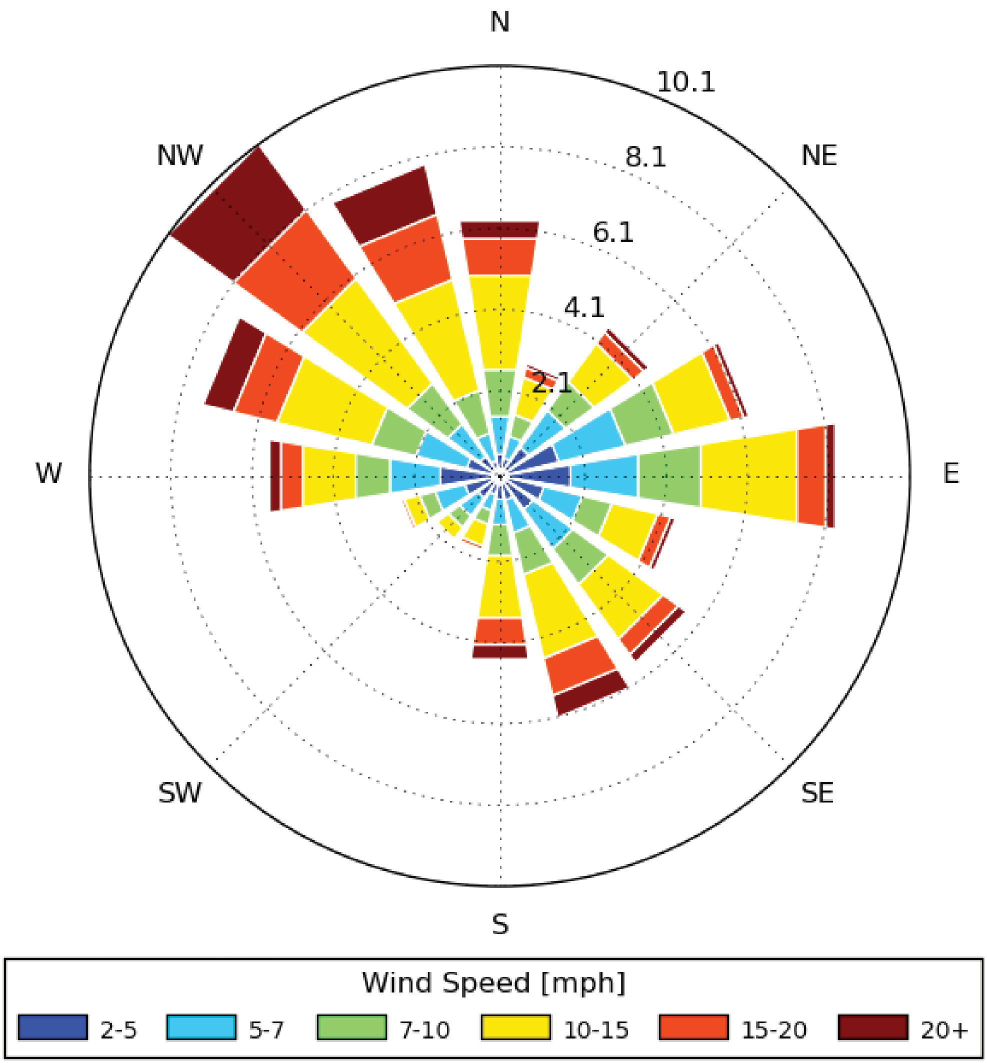


Figure 93. Mandan Wind Rose.

SUN ANGLES

LATITUDE 46.5°

By analyzing the sun angles of a region, you can design a building that passively heats its interiors. For Mandan's climate, it's important that winter sun is allowed into the building to passively heat spaces. Summer sun should be avoided as it provides excessive heat that must be removed. The sun is at an angle of 20° at winter solstice at this latitude. At summer solstice, the sun sits at an angle of 66° above the horizon. Shading devices should either sit perpendicular to the incident angle, or extend far enough to provide full coverage of the shading area.

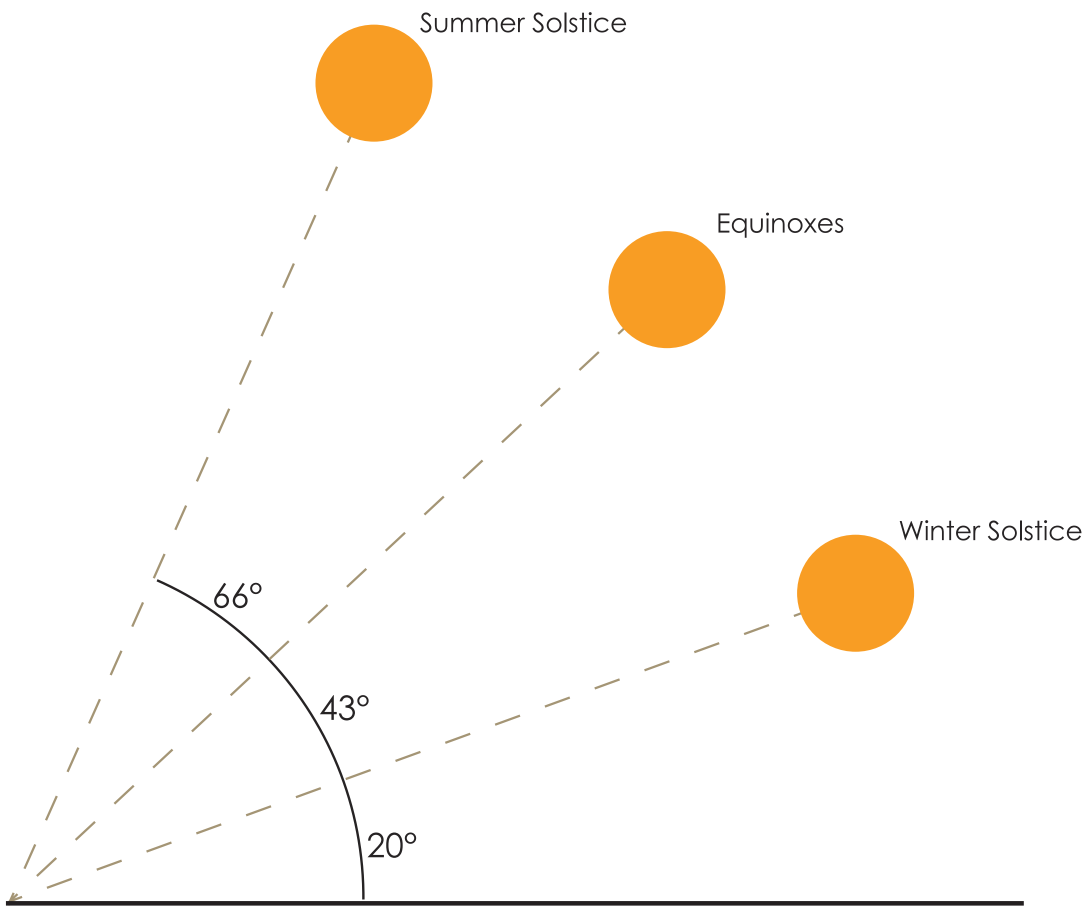


Figure 94. Sun Angle Diagram.

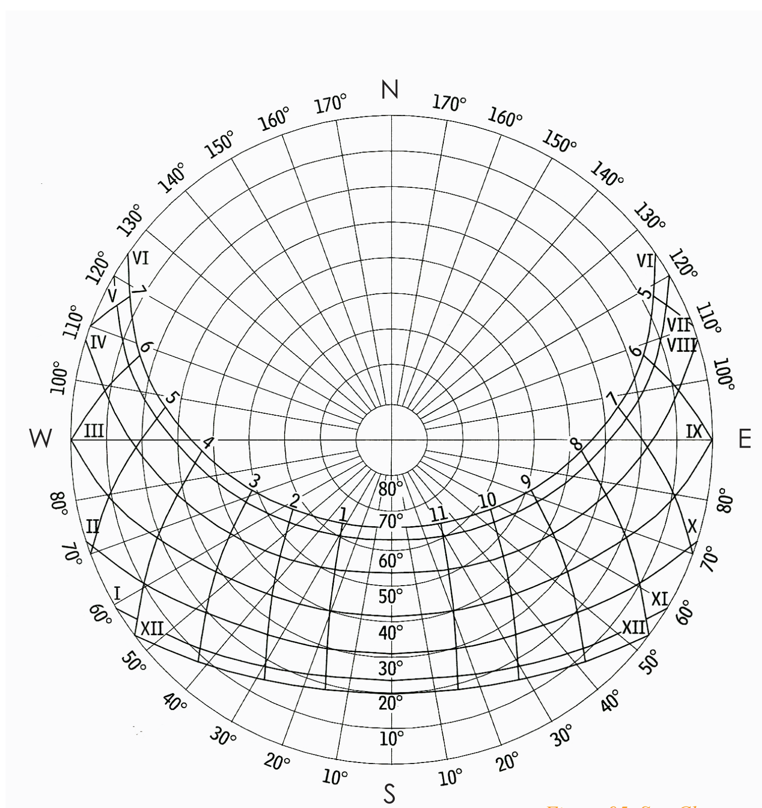


Figure 95. Sun Chart.

SITE ANALYSIS SUMMARY

Mandan, like most cities in North Dakota, is currently seeing an influx in population due to the rich oil fields located in the state. Because of this, the city has begun to expand its limits to accommodate all of the new residents. My site lies between the original neighborhoods and one of the areas that is currently seeing massive growth. This will be a good location to gather a large amount of students that live in close proximity. The adjacency to multiple neighborhoods not only promotes walkability, but also security. There are no sources of pollution or loud noises nearby that could disrupt or inhibit student health and productivity. The only potential threat by the site is Heart River, which runs along the north side of the site. Fortunately, the age group of the students attending the school is old enough that close supervision over this area shouldn't be necessary.

Flooding is a common issue in Mandan, but shouldn't be an issue for the site. The lowest elevation on the site is 1680 ft., which is still 25 ft. above the 1% flood plain. In fact, the landform which the site sits upon is quite unique and well-suited for a school. The site is a large plateau that slopes quite dramatically on the north, west, and east sides. This will help with drainage on the site, and will direct all surface runoff to the river. The plateau sites up above the river as well as a beautiful expanse of farmland. The school can benefit from this great location by framing views of the surrounding landscape.

Just across the river and to the west a bit lays the existing high school athletic fields. Their current location, away from the school, is very inconvenient to both students and families who must drive between the two. By locating the new school right next to the fields, there will be a larger connection between academics and athletics, which are both important for student development. The design will most likely include a bridge that crosses Heart River and connects the school to the embankment. There is an unofficial path along the bank that leads straight to the athletic fields. This path will need to become better established with stairs that connect to the neighboring community. This can also be used by students who now that the ability to walk to school.

The site shows no signs of human intervention besides its unusually flat form and a short fence along the southeast corner. I would assume that the plot was previously used as farmland, but abandoned this use because of poor soil composition. The soil is primarily gravel and sand, which is inadequate for farming, but excellent for building upon. The city currently owns this site, so I would assume that they already have something planned or are saving the location for future use. A public school could be a great use of the site, especially since it is already owned by the city.

A school would help liven up the older neighborhood, create interest in the new neighborhood, and help promote walkability in the area. As of now, the area is fairly walkable, yet there are few destinations for people to walk to. A small population of commercial stores exists just north of the site, but they are fairly run-down and could use updating. The addition of a high school would give people a reason to walk around the neighborhood, especially if a community garden is included in the plan.

The site is approximately 22.4 acres which is plenty of space for a high school and supporting amenities. Because it is on elevated land, there are few shadows that are cast upon the site. This will be excellent for the school since natural lighting will be one of the key design aspects. Still, shading devices should be considered to lower cooling costs in the summer months. Wind speeds are fairly high in the area and come primarily from the northwest. The building design and orientation should be sensitive to this issue so that cold air is not allowed into the building, and so that outdoor spaces have a bit of protection from the harsh wind.

There are several aspects of the site which work in favor of a public high school. Most importantly is its close location to several different neighborhoods; old and new. By locating the school close to the students, it will help to create a sense of community in the area which is vital for creating a successful school. The school will be easily accessible and will serve as a connection point between the old neighborhood and new neighborhoods to the south.


Figure 96. Rainbow Vine.

BUILDING PROGRAM

ACADEMIC SPACES	QUANTITY	STUDENTS	NET STUDENTS	AREA	NET AREA
Studios	4	75	300	4500	18000
Classrooms	8	30	240	900	3600
Small Group Rooms	4			150	600
Special Education Classrooms	1	15	15	900	900
Conference Room	1			600	600
Special Education Office Space	2			200	400
Special Education Storage	1			200	200
Restroom	1			50	50
Science Laboratory	2	30	60	1200	2400
				SUBTOTAL	**26750**

ADMINISTRATION	QUANTITY	STUDENTS	NET STUDENTS	AREA	NET AREA
Reception	1			300	300
Secretary	1			150	150
Principal	1			200	200
Vice Principal	1			150	150
Conference Rooms	1			350	350
Mail/Copy Rooms	1			300	300
Administration Storage	1			450	450
Nurse	1			150	150
Waiting Room	1			150	150
Cot Room	1			120	120
Restroom	1			50	50
Guidance Counselor	1			150	150
Reception	1			300	300
Workroom	1			150	150
Counselor Storage	1			150	150
				SUBTOTAL	**3120**

Figure 97. Space Allocation Chart A.

LIBRARY AND MEDIA CENTER	QUANTITY	STUDENTS	NET STUDENTS	AREA	NET AREA
Circulation Desk	1			200	200
Book Stacks	1			1800	1800
Reading Spaces	1			3000	3000
Library Storage	1			150	150
Interactive Media Spaces	2			200	400
				SUBTOTAL	**5550**

STUDENT DINING	QUANTITY	STUDENTS	NET STUDENTS	AREA	NET AREA
Cafeteria	1			1500	1500
Kitchen				900	900
Serving Station	1			900	900
				SUBTOTAL	**3300**

FITNESS AND WELLNESS	QUANTITY	STUDENTS	NET STUDENTS	AREA	NET AREA
Gymnasium	1	40	40	8840	8840
Fitness Storage	1			900	900
Fitness Offices	1			150	150
Locker Rooms	2			900	900
Weight Room	1	24	24	900	900
Dance Studio	1	20	20	900	900
				SUBTOTAL	**12590**

Figure 98. Space Allocation Chart B.

VISUAL AND PERFORMING ARTS	QUANTITY	STUDENTS	NET STUDENTS	AREA	NET AREA
House	1	300	300	3600	3600
Stage	1			2000	2000
Art Classrooms	1	30	30	900	900
Photography Lab	1			150	150
Kiln Room	1			150	150
Art Office Space	1			200	200
Art Storage Space	1			200	200
Music Classroom	1	40	40	1200	1200
Practice Rooms	3			50	150
Music Office Space	1			150	150
Music Storage Space	1			300	300
				SUBTOTAL	**9000**

FACILITY SUPPORT SPACES	QUANTITY	STUDENTS	NET STUDENTS	AREA	NET AREA
Restrooms	3			900	2700
Mechanical Room	1			3600	3600
Receiving	1			900	900
Storage	1			1800	1800
Facility Management Office	1			150	150
				SUBTOTAL	**9150**

SITE PROGRAM
Staff Parking
Student Parking
Bus Drop-Off
Pedestrian Circulation
Community Garden
Outdoor Courtyards
Outdoor Ampitheater
Sporting Field

Figure 99. Space Allocation Chart C.

AREA SUMMARY	VALUE
Net Internal Area	69,460 SF
Circulation Multipler (33%)	x 1.5
Gross Internal Area	83,580 SF

CAPACITY SUMMARY	
Effective Student Capacity	300 Students
Utilization Factor	85%
Maximum Capacity	354 Students

AREA ANALYSIS	
Square Foot per Student	278 SF

AREA COMPARISON	
Academic Space	32%
Administration Space	4%
Library and Media Center Space	6%
Food Service Space	4%
Fitness and Wellness Space	15%
Visual and Performing Arts Space	11%
Facilities Management and Support Space	11%
Circulation Space	17%

Figure 100. Area Analysis Chart.

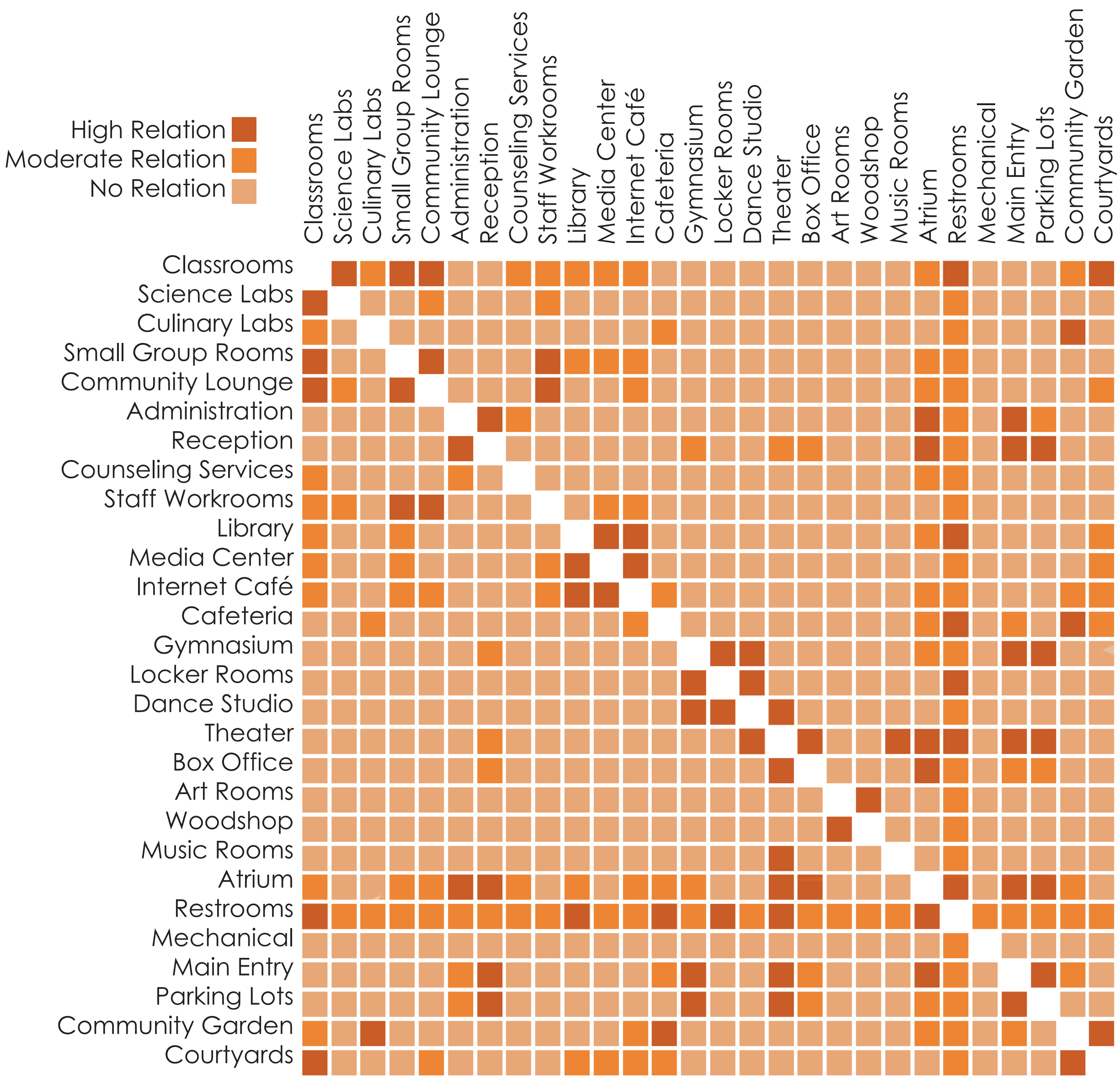


Figure 101. Interaction Matrix.

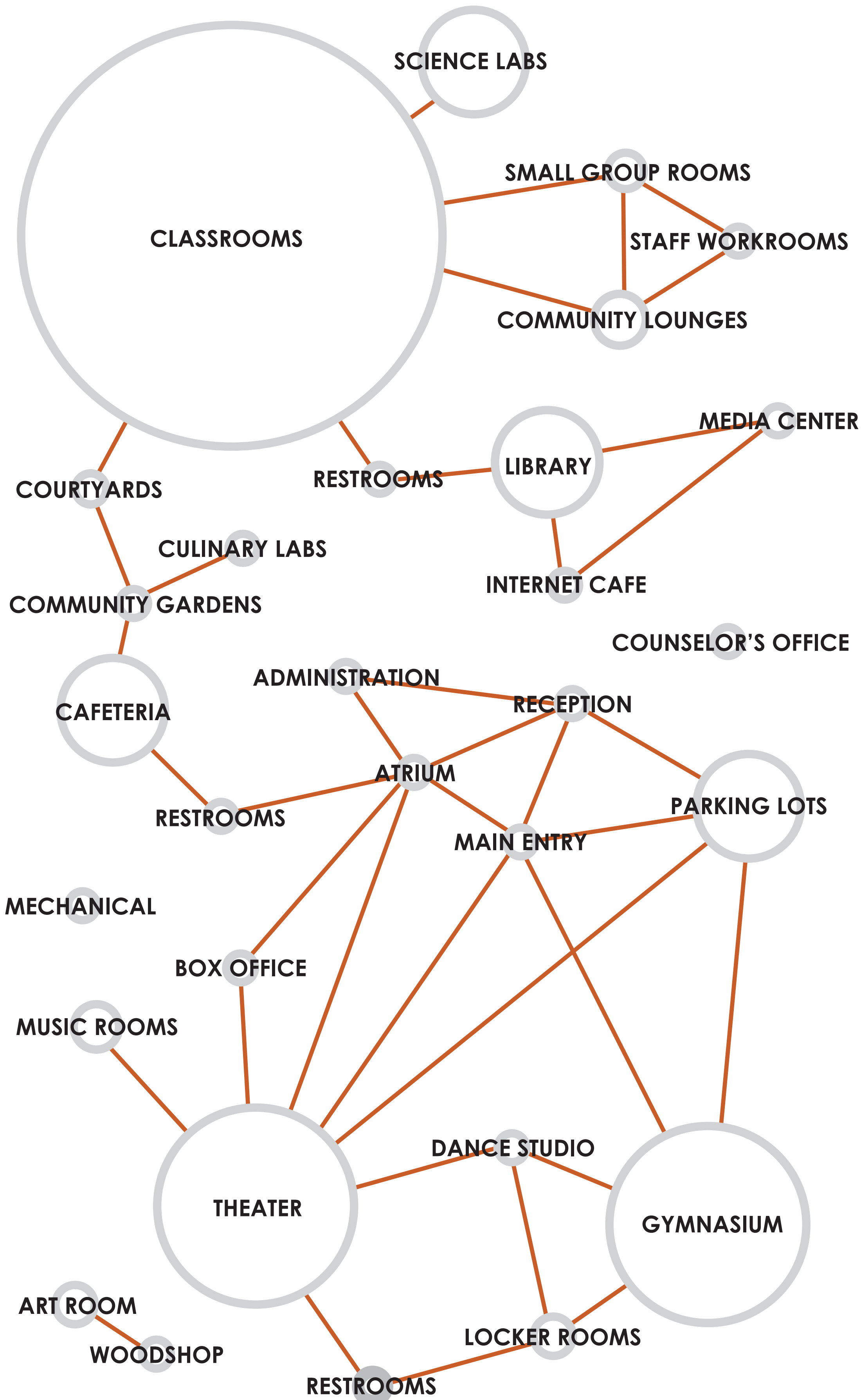


Figure 102. Spatial Arrangement Diagram.

Figure 103. NW View.

DESIGN SOLUTION

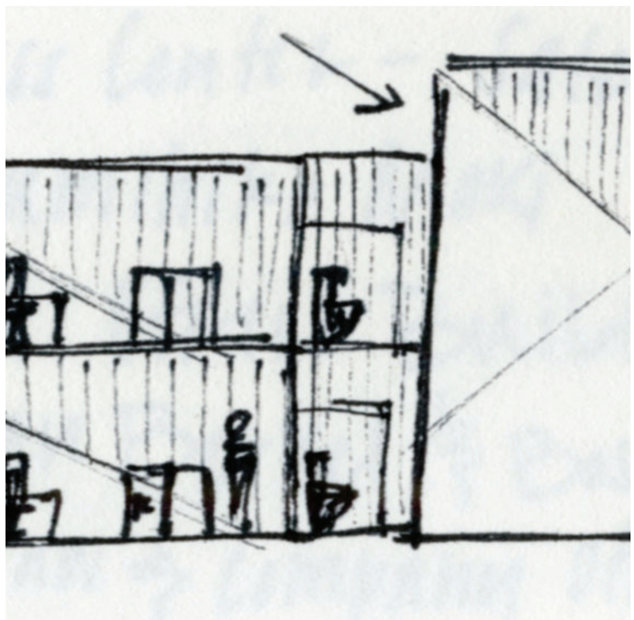


Figure 104. Process Documentation.

PROCESS DOCUMENTATION

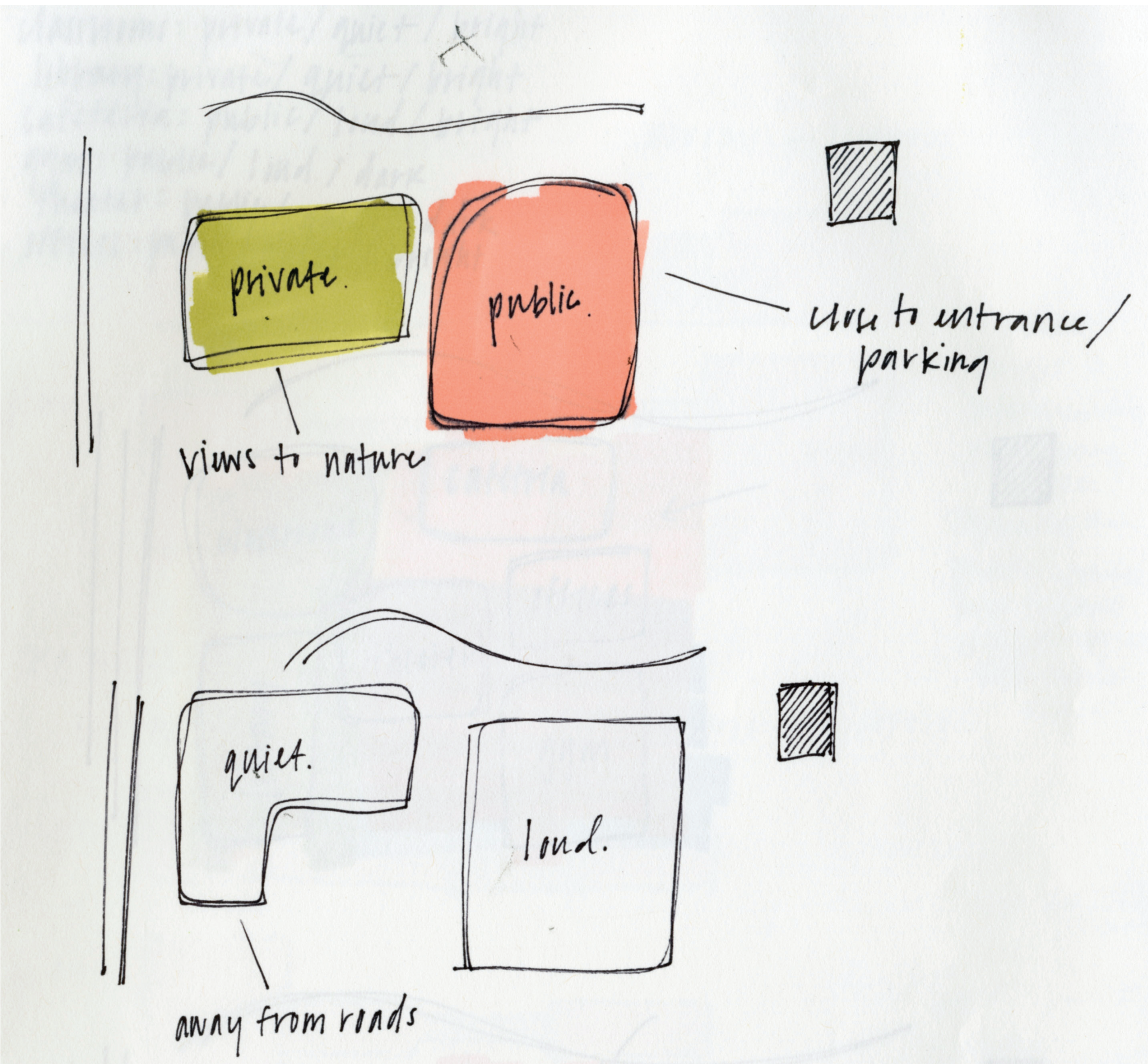


Figure 105. Process 1.

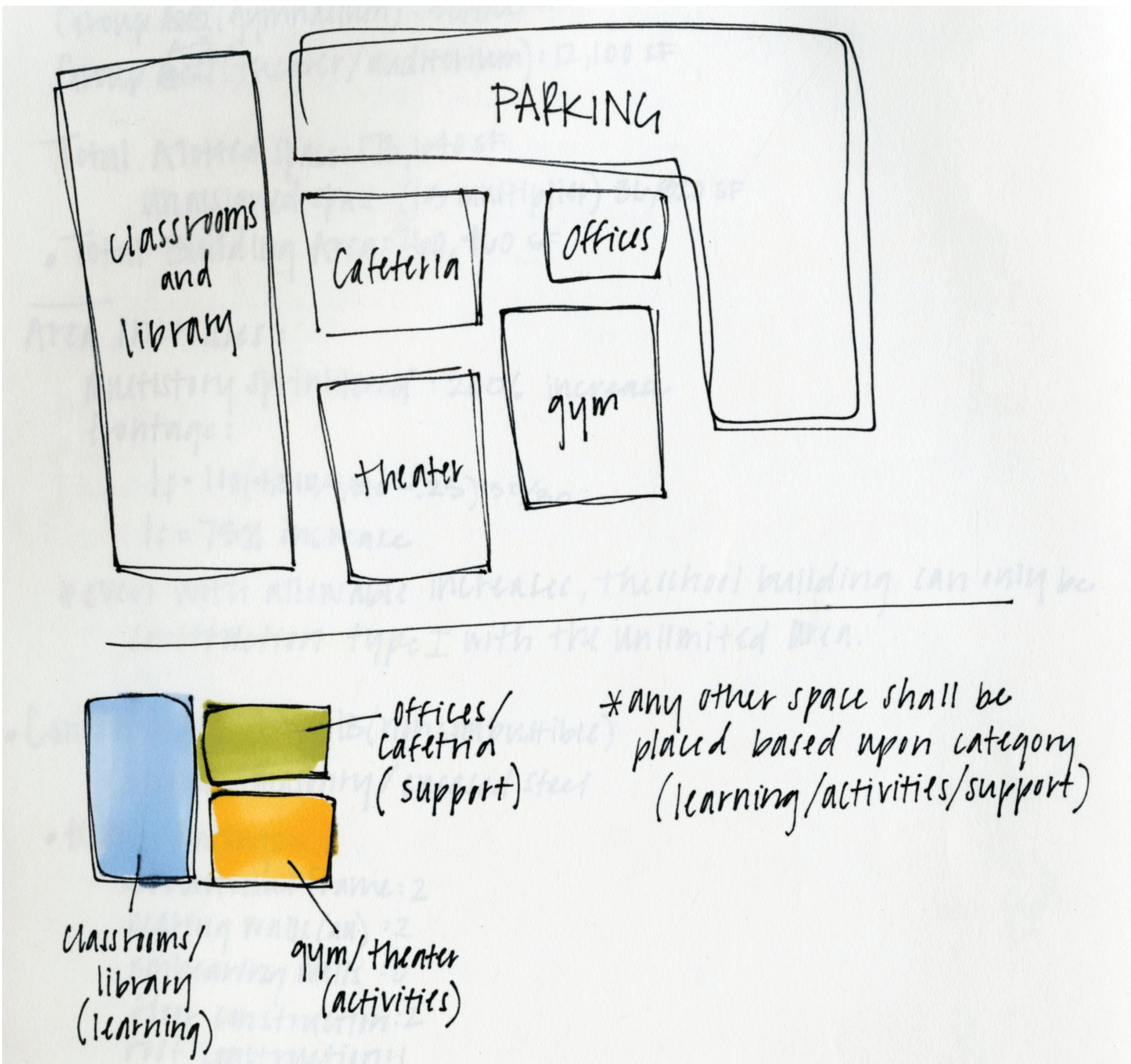


Figure 106. Process 2.

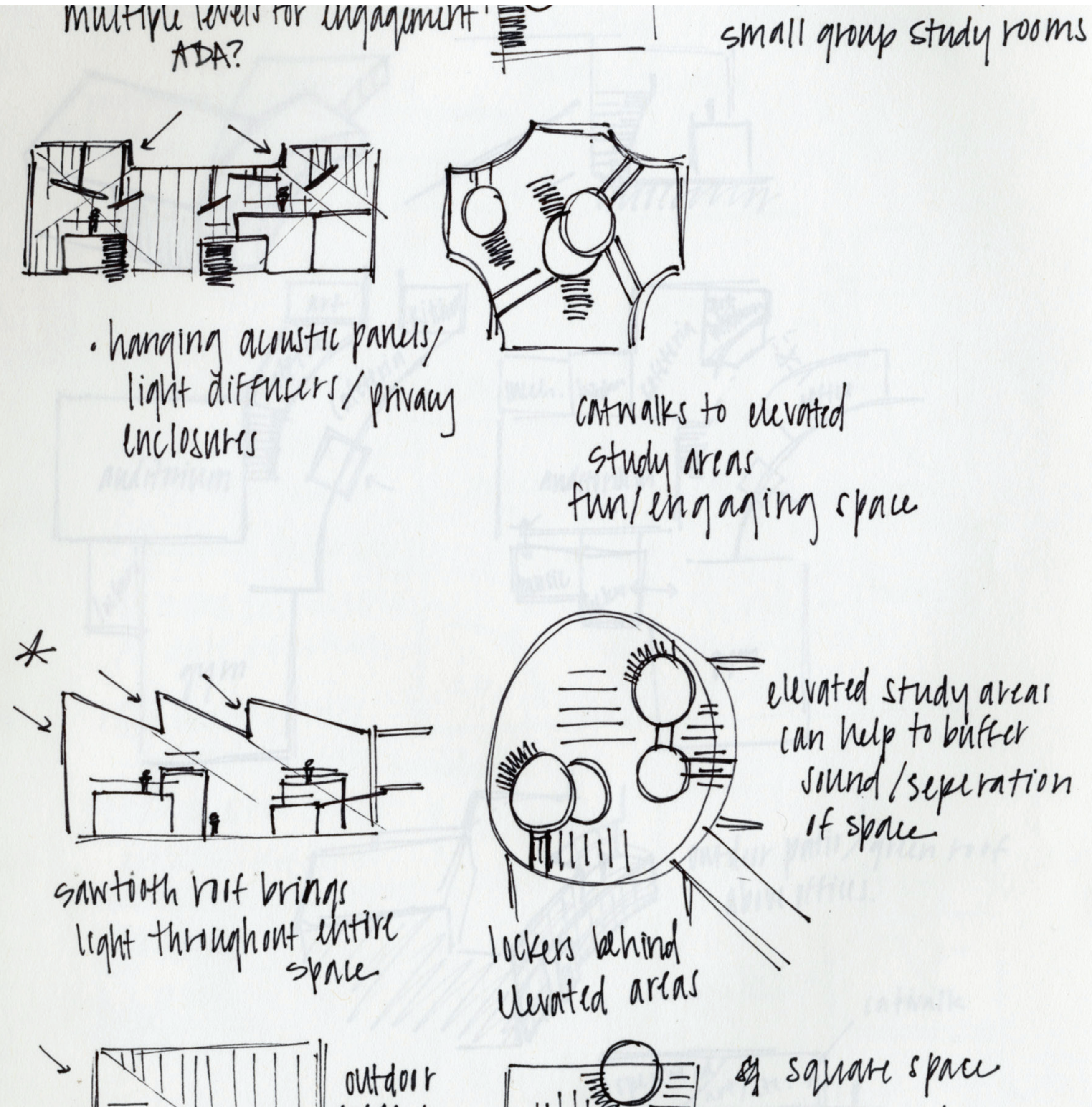


Figure 107. Process 3

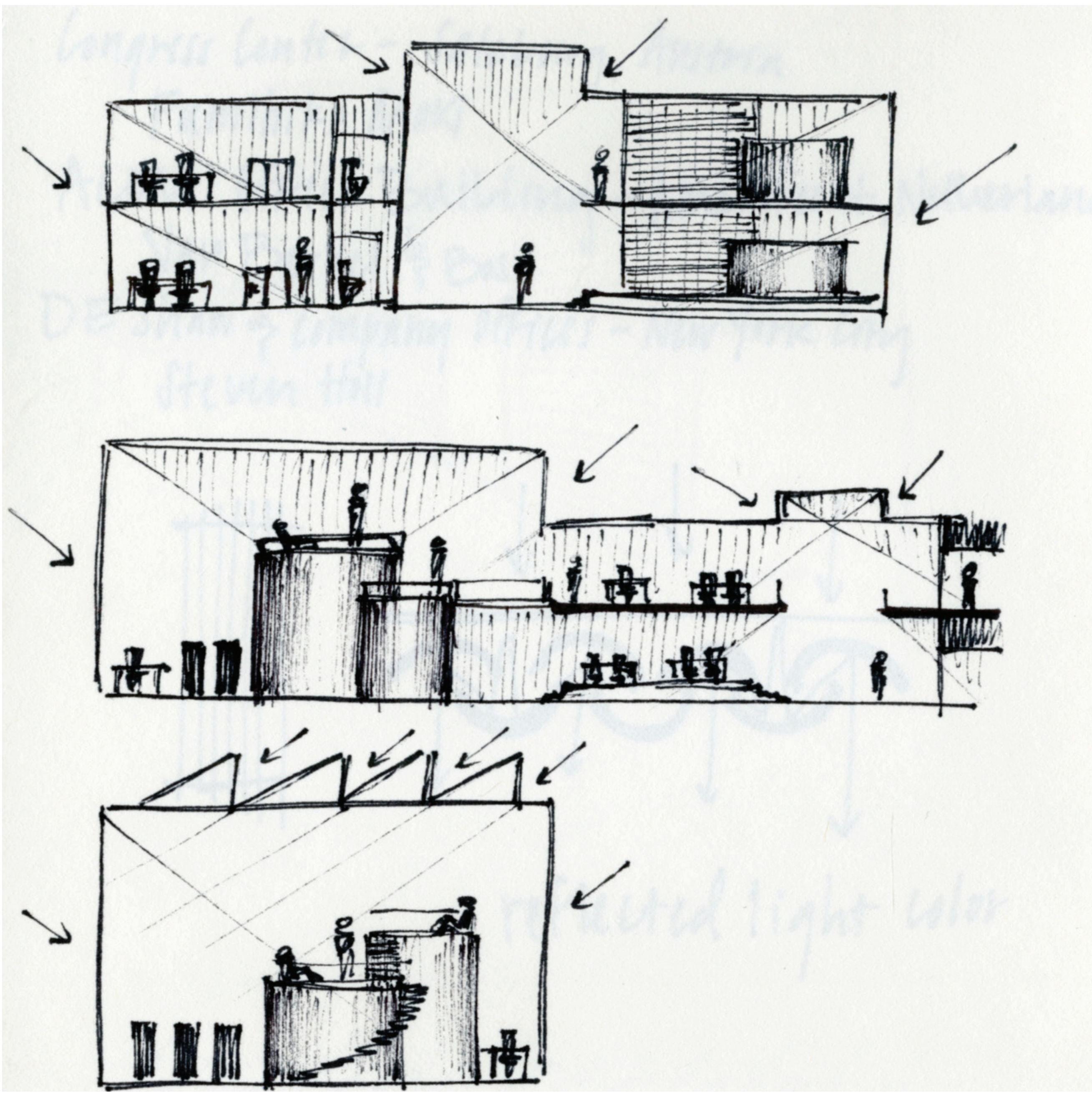


Figure 108. Process 4.

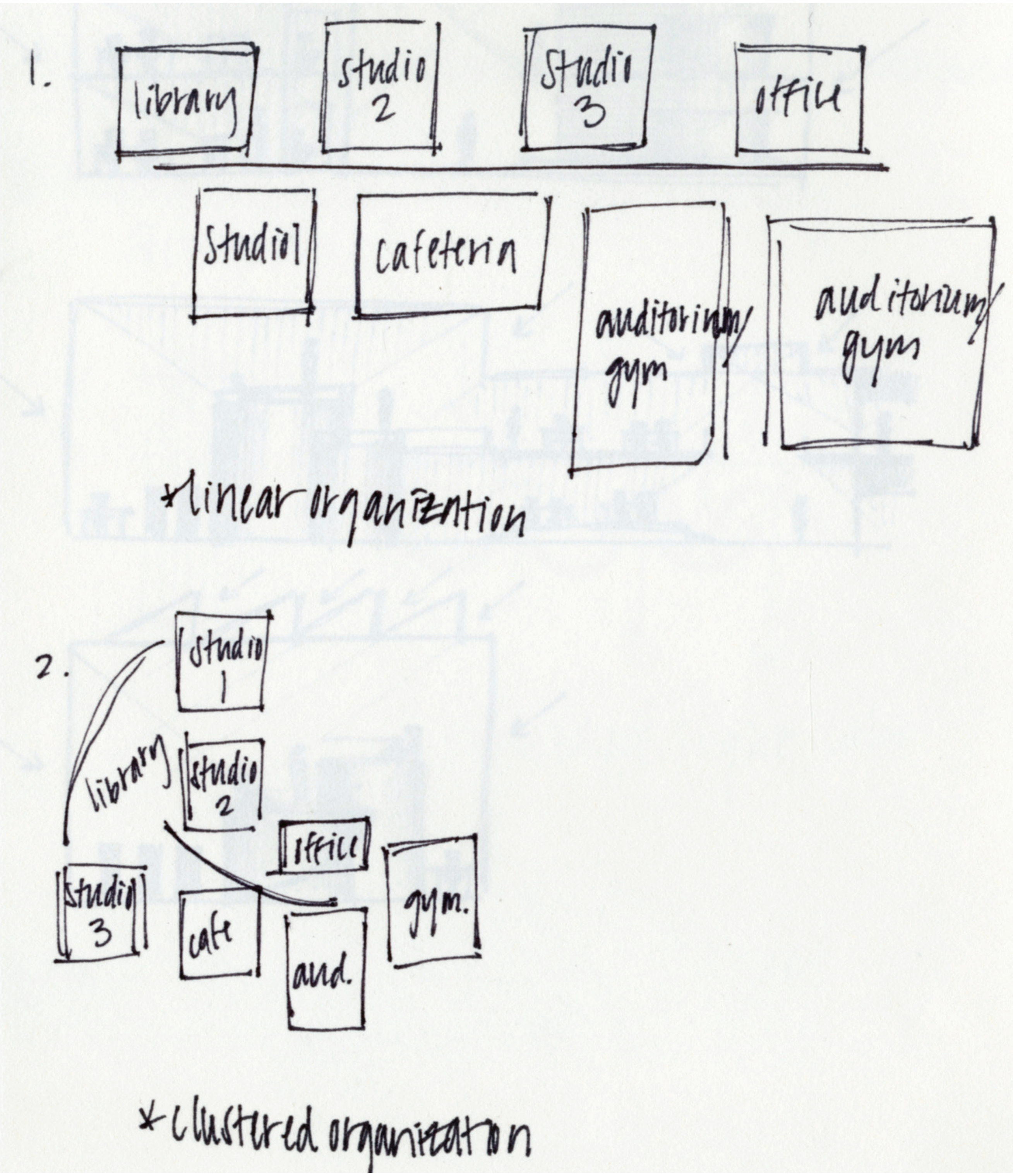


Figure 109. Process 5.

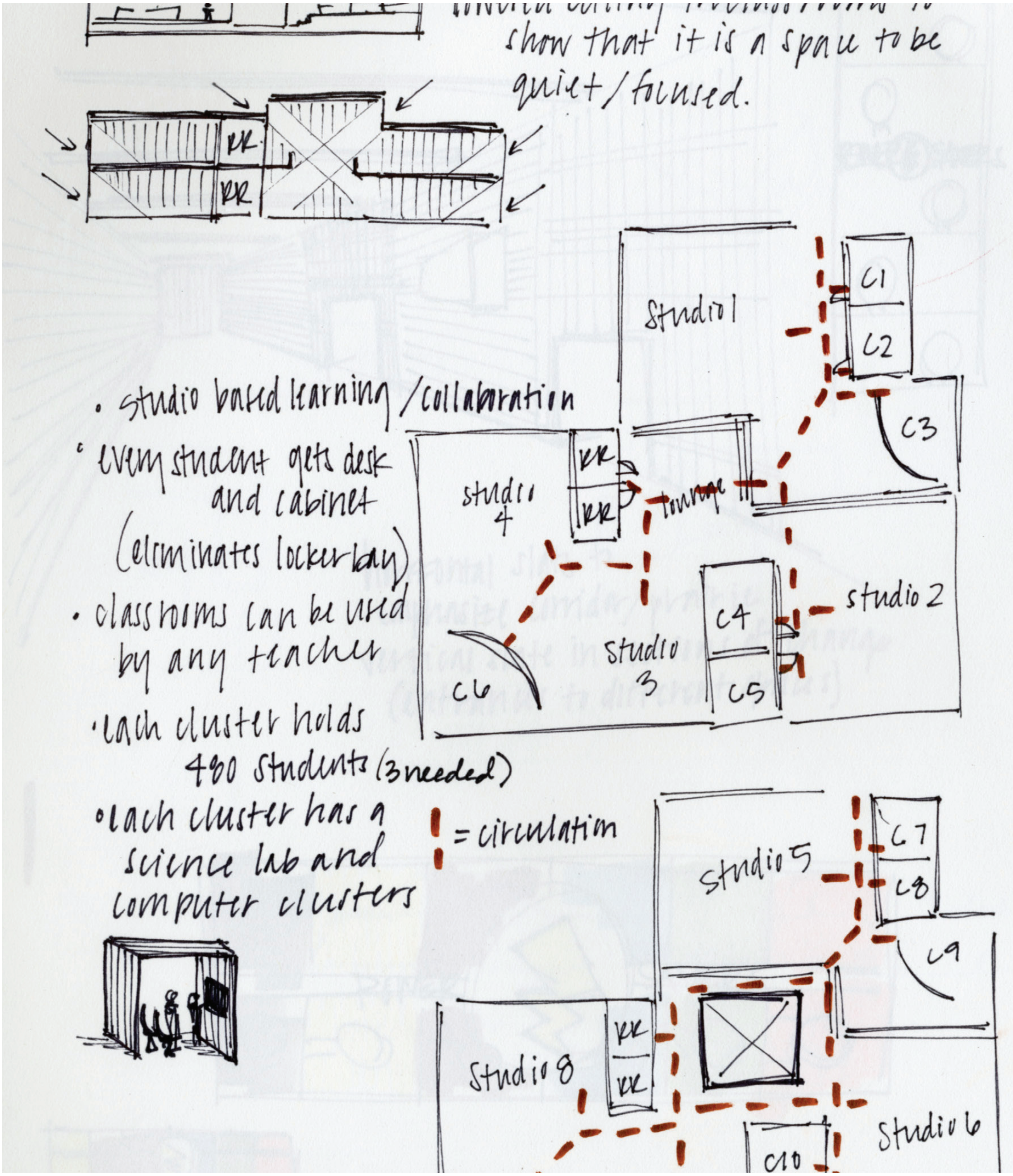


Figure 110. Process 6.

Figure 111. Commons Money Shot.

FINAL DESIGN

The building sits up on a high plateau overlooking Heart River and the agricultural fields down below. Right across the river are the athletic fields which will be shared by both high schools. This is the view you would see while walking along the dyke.

Figure 112. Building Perspective.

Figure 113. Floor Plans.

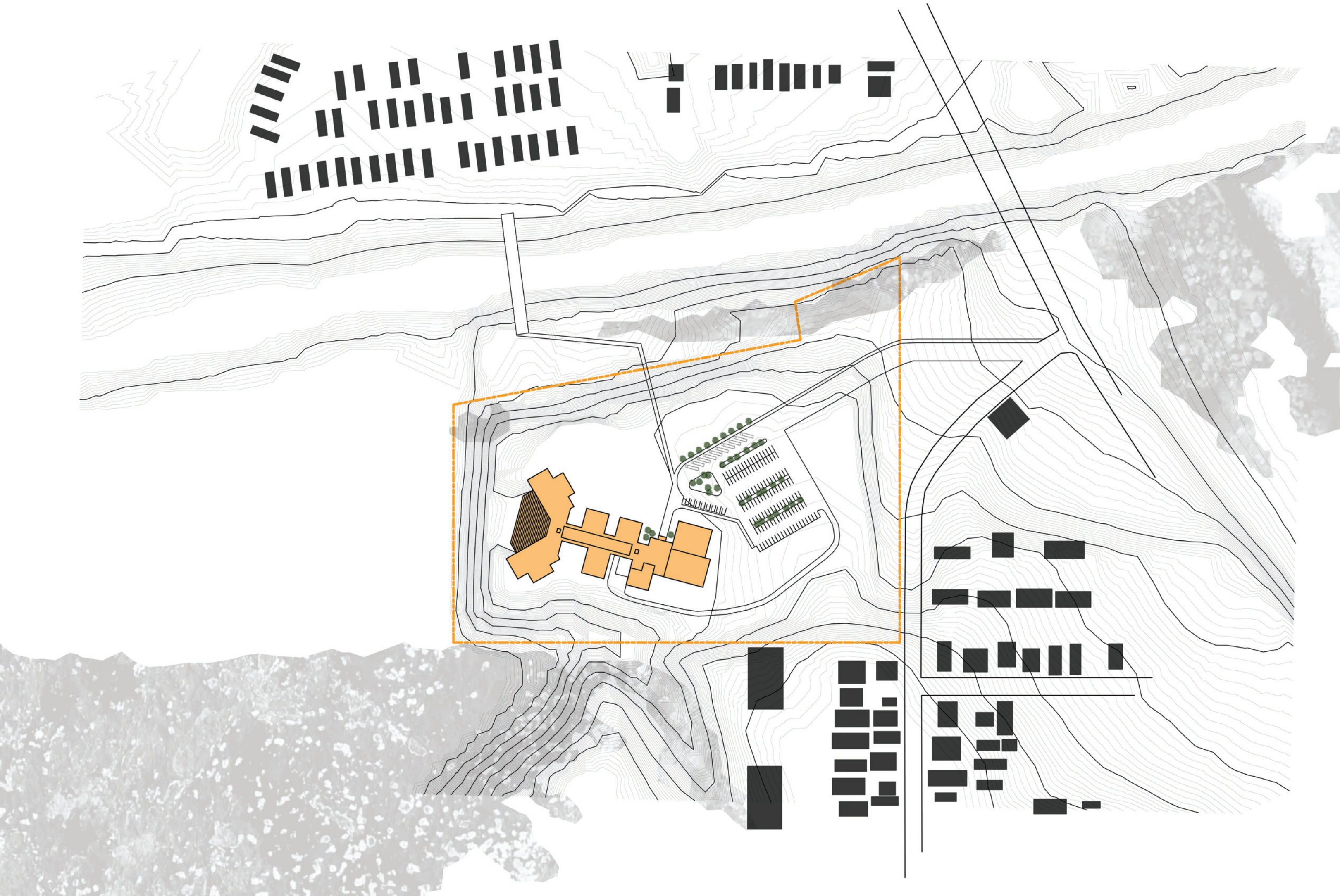


Figure 114.Final Site Plan.

1. THE COMMONS
2. STUDIOS
3. THE HUB
4. SCIENCE LABS
5. CAFETERIA
6. MUSIC DEPT
7. ADMINISTRATION
8. GYMNASIUM
9. LOCKER ROOMS
10. ATHLETIC OFFICE
11. DANCE STUDIO
12. WEIGHT ROOM
13. SPECIAL EDUCATION
14. CULINARY LAB
15. ART DEPT
16. OUTDOOR PATIO
17. MECHANICAL ROOM
18. TELECOM ROOM
19. ELECTRICAL ROOM

- COLLABORATION SPACE
- CLASSROOM/STUDIO
- DINING SERVICES
- ADMINISTRATION
- ATHLETICS
- SUPPORT

Figure 115. Floor Plan Key.

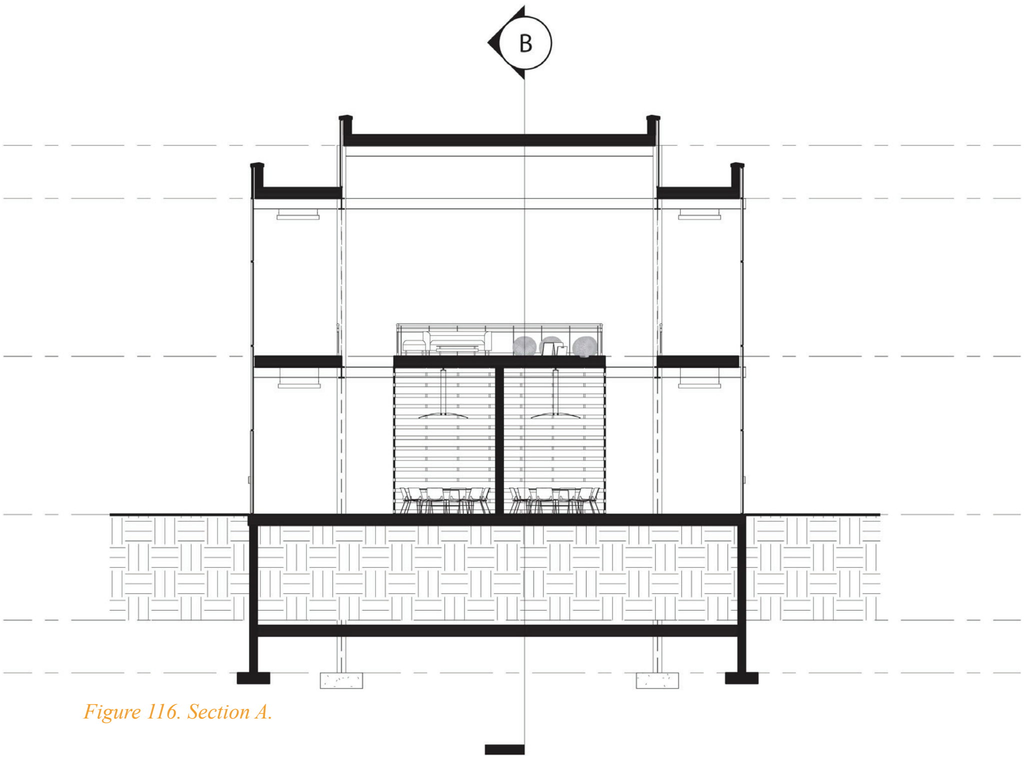


Figure 116. Section A.

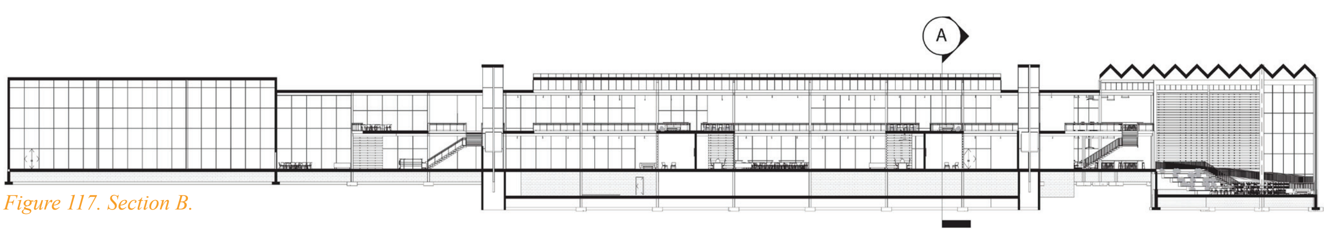


Figure 117. Section B.

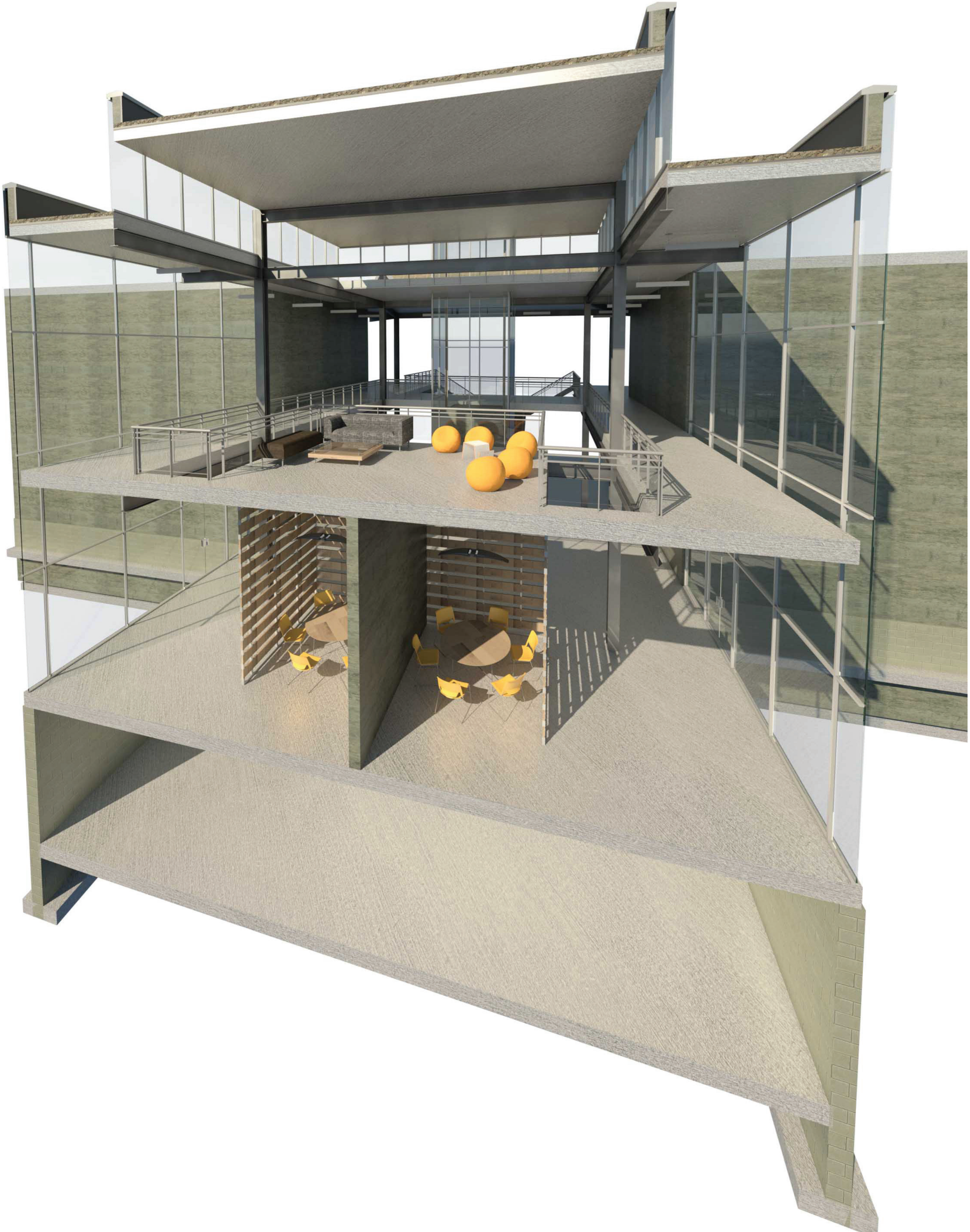


Figure 118. Section A Perspective.

Most of the site is left untouched to allow the site to return to its natural wild grasses.

Figure 119. Main Entry.

Figure 120. Entry Lobby.

Upon entering the building, you are welcomed into a large atrium space. Administration sits across fromt he lobby to help welcome guests and keep the school secure.

The Hub is a high activity space within the building. It serves as the main corridor that connects all other spaces, and has a variety of collaboration and social interaction spaces for students to use during and in between classes.

Figure 121. The Hub.

Figure 122. The Hub from Below.

Collaboration spaces within the Hub are equipped with state of the art technology for students to use.

Figure 123. Collaboration Spaces.

Social gathering spaces within the hub provide opportunities for students to engage with one another, which is crucial for development and providing a sense of community in the school.

Figure 124. Social Gathering Space.

The Commons stems directly from the end of the Hub and serves as a large community gathering space for the school. It's wide, expansive windows frame the beautiful view that exists off the Northwest corner of the site.

Figure 125. The Commons.

Figure 126. The Commons Looking Back.

The Commons' open layout allows it to be used for a variety of different activities throughout the day. Students can use the space during the day as a library, media center, or collaboration space. The enlarged stairs allow the space to also be used as an auditorium for lectures or performances.

The studios are located adjacent to the Commons. Community spaces and social gathering spaces are placed throughout the studios to create an intimate learning environment

Figure 127. Studio Space.

Each student is given their very own studio desk and cabinet to store their belongings. Typical projects will be project-based to encourage collaboration. Breakout classrooms are provided for when classes need a more structured space for learning.

Figure 128. Studio Workspaces.

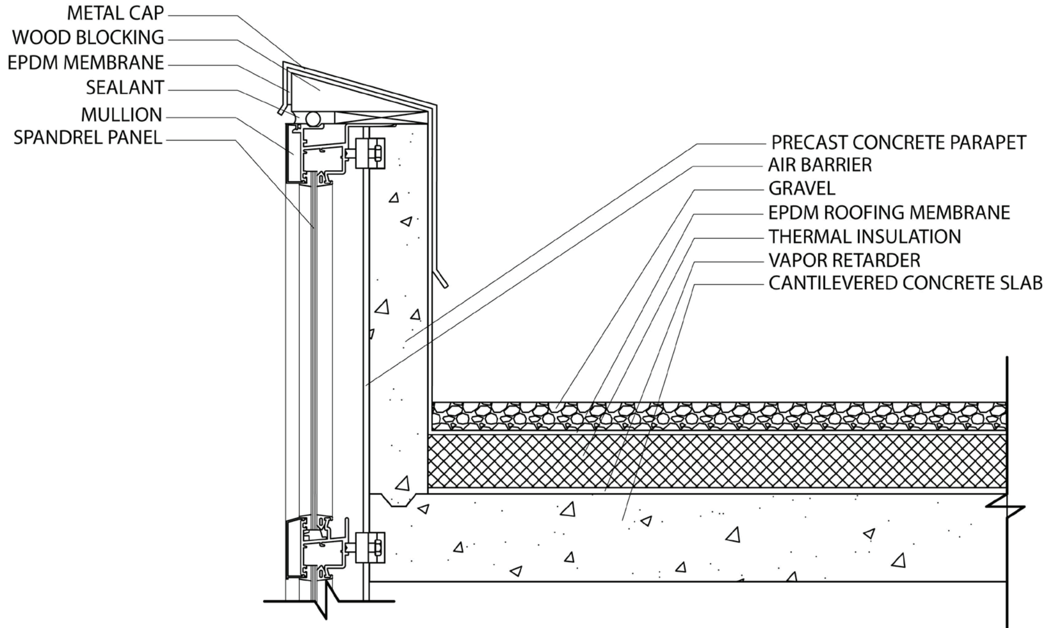


Figure 129. Parapet Detail.

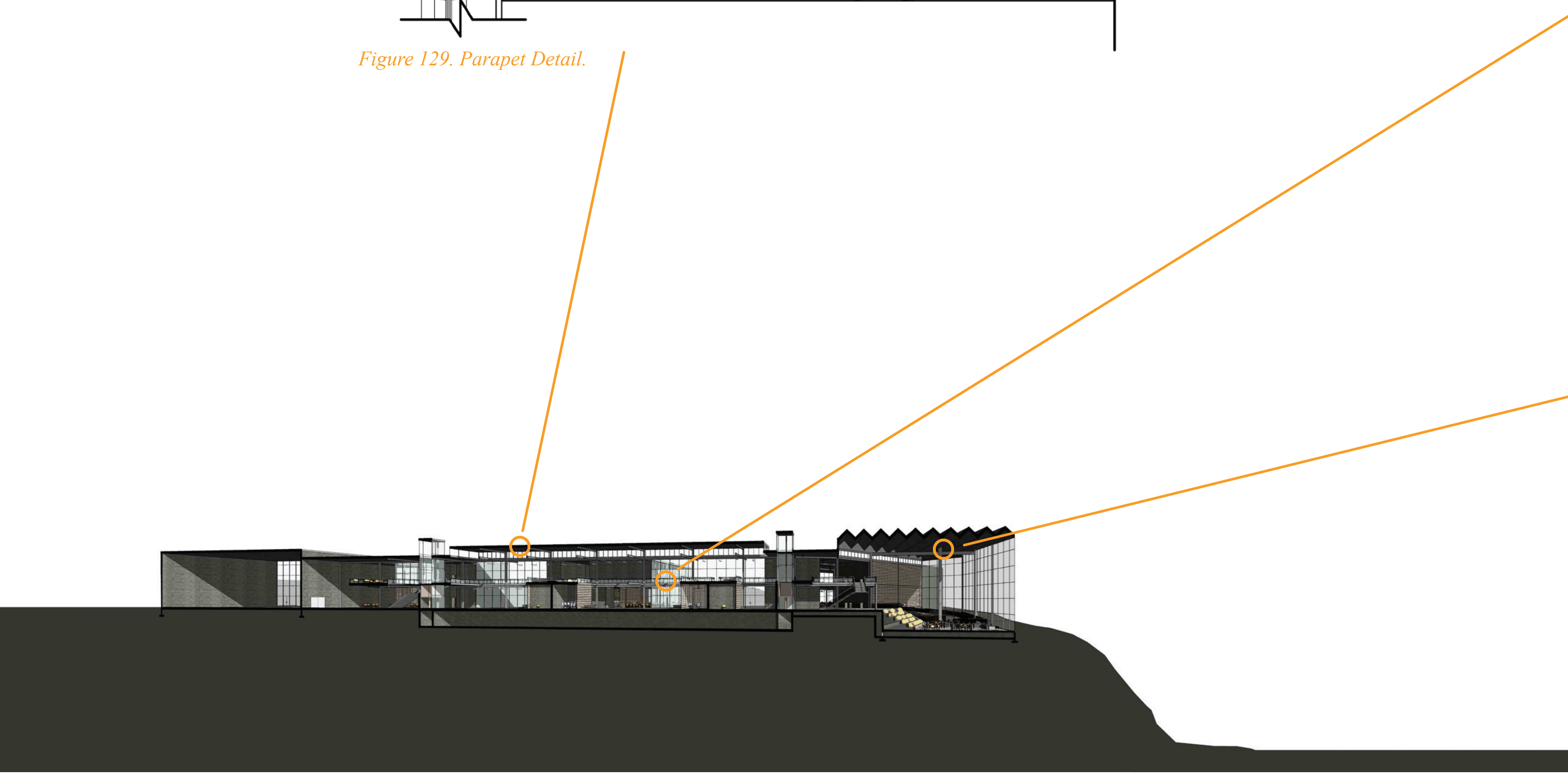


Figure 130. Section B Perspective.

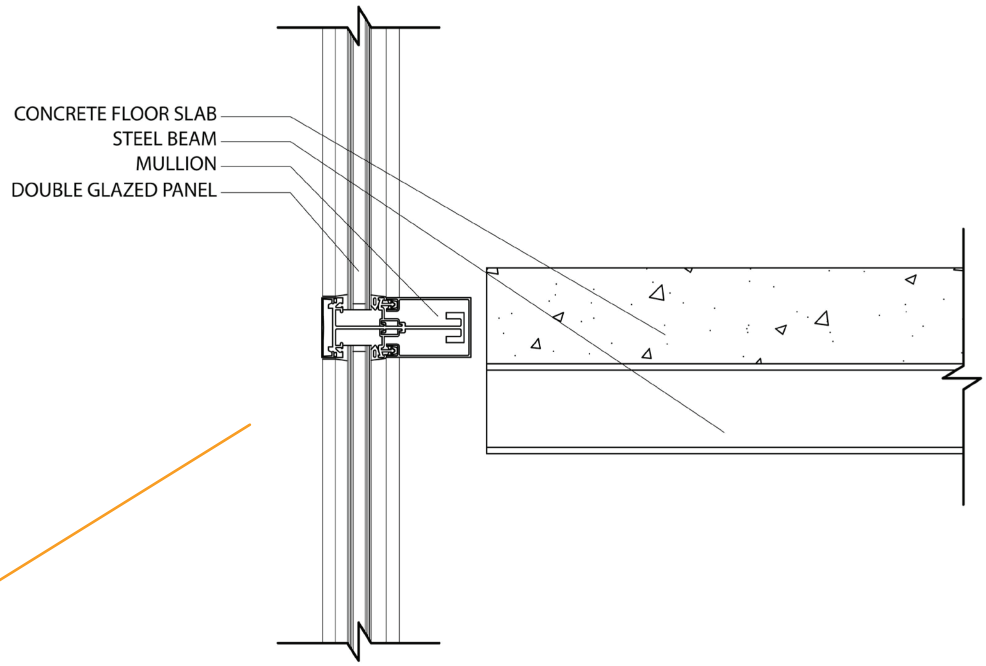


Figure 131. Curtain Wall Detail.

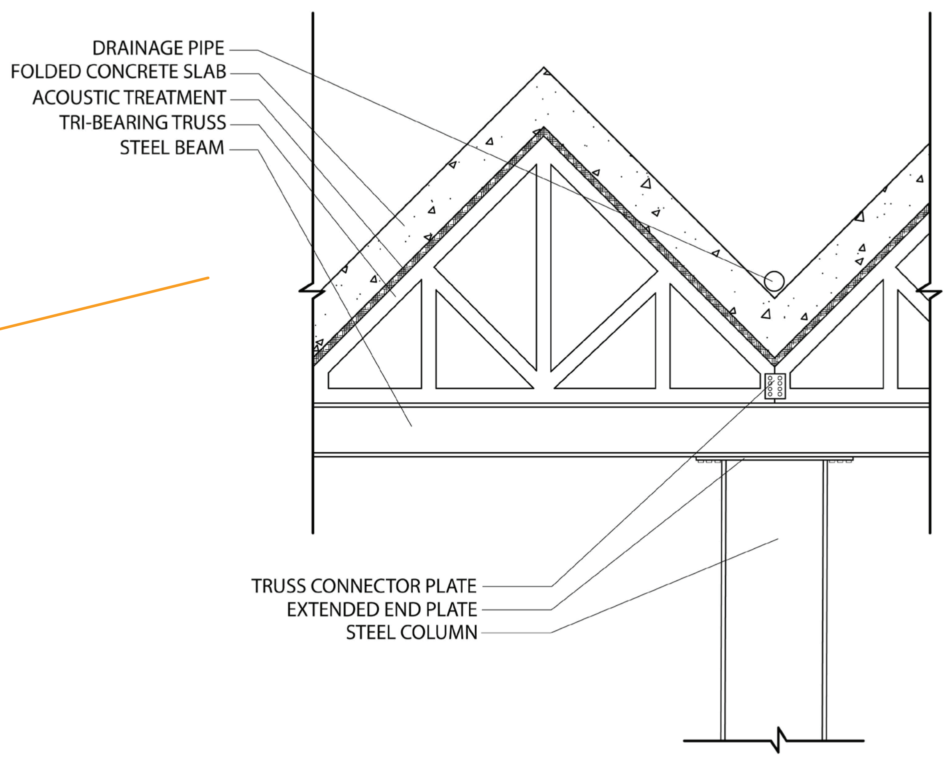


Figure 132. Folded Slab Roof Detail.

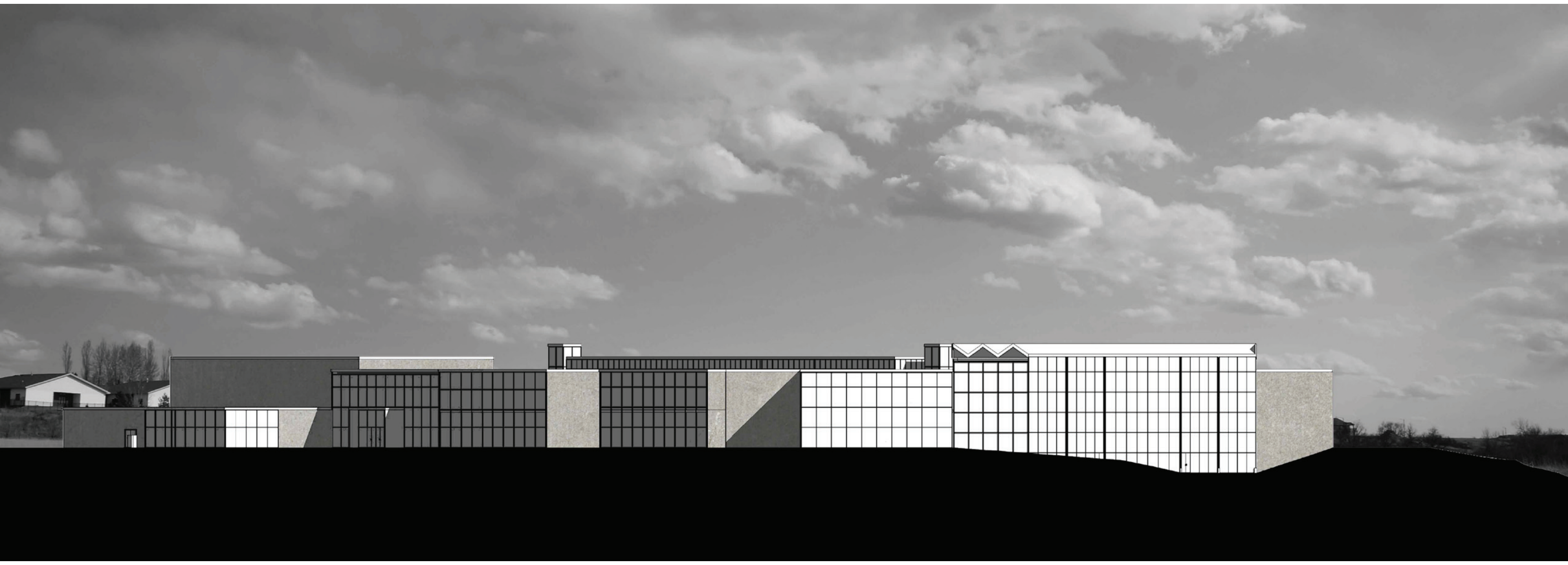


Figure 133. North Elevation.

Figure 134. East Elevation.

Figure 135. South Elevation.

Figure 136. West Elevation.

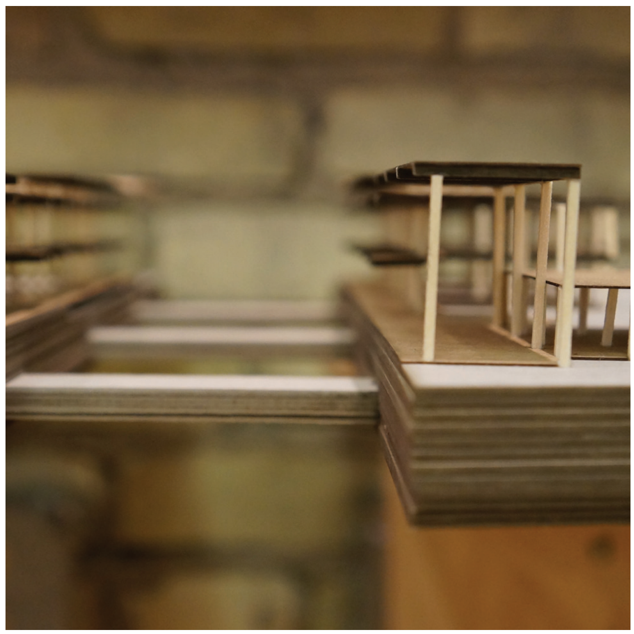


Figure 137. Structural Model 1.

PROJECT INSTALLATION

Figure 138. Project Installation.

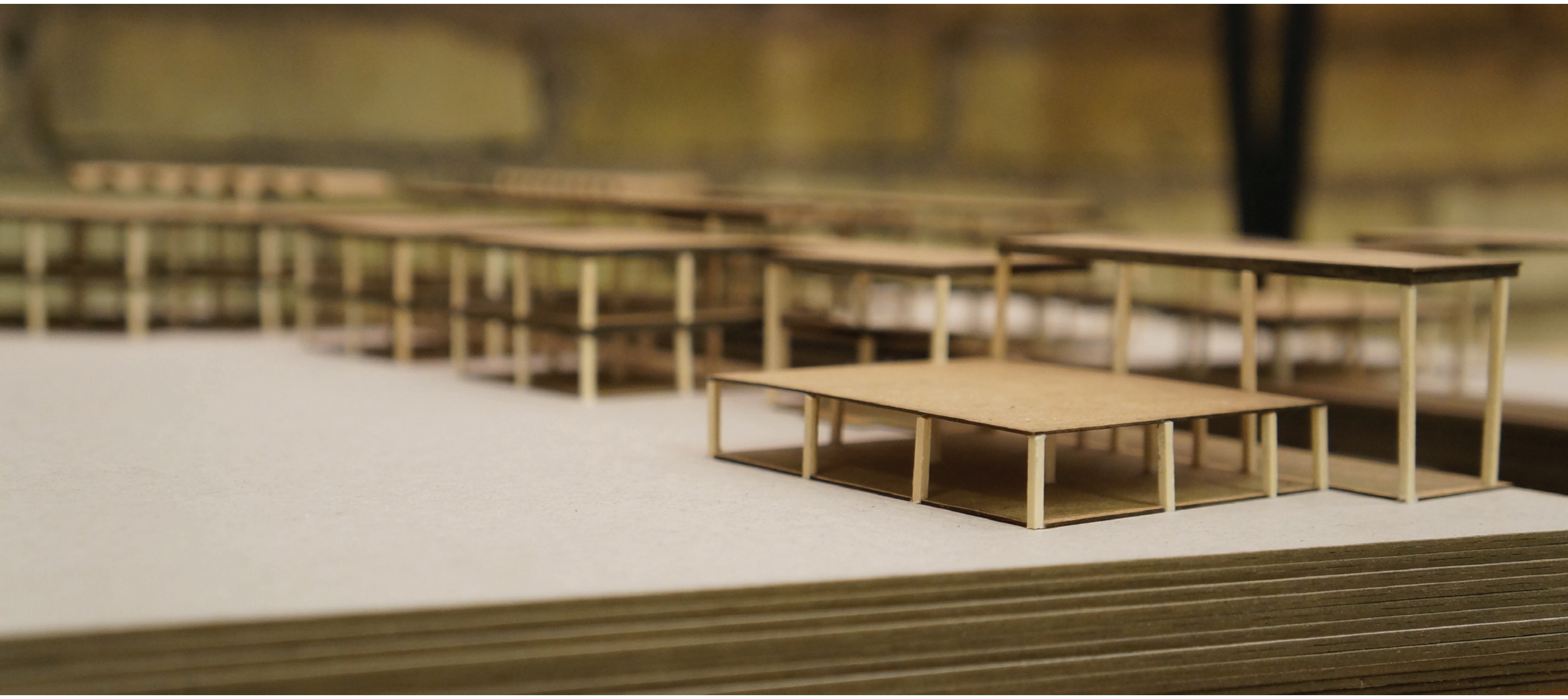


Figure 139. Structural Model 2.

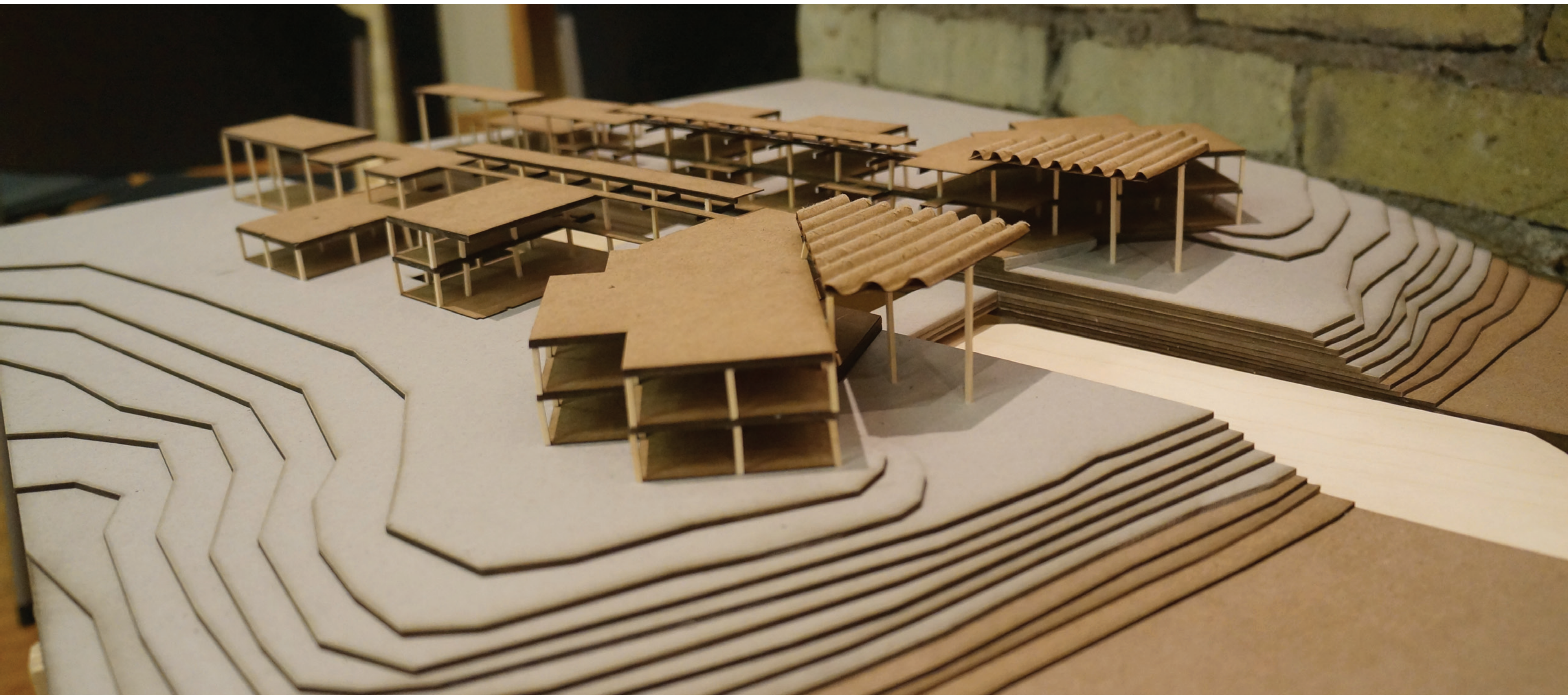


Figure 140. Structural Model 3.

Figure 141. Rock.

THE ABSTRACT

REFERENCE LIST

Alabama School, Cleaveland [Photograph and Floor Plan]. From Planning and Designing Schools (pg. 3) edited by Brubaker, C., 1998, New York: McGraw-Hill.

Arnold, D. (2004). Airy Offices Create 15% Work Boost, o Design. July 2004.

Anne-Marie Edward Science Building at John Abbott College / Saucier + Perrotte Architectes [Photograph], Retrieved October 2, 2014, from: http://www.archdaily.com/?p=452306>

ASHRAE. (2010). ANSI/ASHRAE Standard 62.1-2010: Ventilation for Acceptable Indoor Air Quality. Atlanta, GA: American Society of Heating, Refrigerating and
Air-Conditioning Engineers, Inc.

[Floor Plan of Fossil Ridge High School], Retrieved October 1, 2014, from: http://archrecord.construction.com/schools/071213-SCH_FOS.asp

[Untitled Photograph of Fossil Ridge High School], Retrieved October 1, 2014, from: http://www.rbbarchitects.com/portfolio/fossil-ridge-high-school/

Baker, L. (2012). The Impact of School Buildings on Student Health and Performance. The McGraw-Hill Research Foundation & the Center for Green Schools

Baker, N. (2001). Designing for Comfort: Recognizing the adaptive urge, Keynote Presentation, Cooling Frontiers Symposium, College of Architecture and Environmental Design. Arizona State University. Tempe, AZ. October 2001.

Barker, R. G., & P. V. Gump. (1964). Big school, small school: High school size and student behavior. Stanford, California: Stanford University Press.

Bell, P. A. et al. (1978). Environmental Psychology. Philidelphia, PA: W.B. Saunders Company

Benson, R. (Photographer). (2014). [Untitled Image of Milken Institute School of Public Health], Retrieved December 4, 2012 from: http://www.archdaily.com/568447/milken-institute-school-of-public-health-payette/

Berand, B. (1992). Fostering resiliency in kids: Protective factors in the family, school, and community. Prevention Forum, 12(3).

Bowers, J. H., & Burkett, G.W. (1987). The Relationship of Student Achievement and Characteristics in Two Selected School Facility Environmental Settings. 64th Conference of the Council for Educational Facility Planning International (CEFPI), Alberta, Canada.

Brubaker, C. (1998). Planning and designing schools. New York: McGraw-Hill.

Carter, P. (Photographer). [Photograph of School Terrace]. From Architecture of Schools (pg. 198) edited by Dudek, M., 2000, Boston: Architectural Press.

Cash, C. (1993). A Study of the Relationship Between School Building Condition and Student Achievement and Behaviour. D.Ed. Dissertation, Blacksburg, Virginia: Polytechnic Institute and State University

Chan, T. (1979). The Impact of School Building Age on Pupil Achievement. Greenville County: US Department of Health Education and Welfare & National Institute of Education

Chang, C., Chen P. (2005). Human Response to Window Views and Indoor Plants in the Workplace. HortScience, 2005, Vol. 40

Churchman, A., Stokols, D., Scharf, A., Nishimoto, K., & Wright, R. (1990). Effects of Physical Environmental Conditions in Offices on Employee Stress and Well Being. Paper presented at 22nd International Congress of Applied Psychology, Kyoto, Japan.

Cocking, R., Brown, A., Bransford, J, National Research Council, & Committee on Developments in the Science of Learning. (1999). How people learn : Brain, mind, experience, and school. Washington, D.C.: National Academy Press.

Cohen, S, Evans, G, Krantz, DS, & Stokols, D. (1986). Behaviour, Health and Environmental Stress. New York, Plenum.

Connell, J.P., Spencer, M.B., & Aber, J.L. (1994). Educational risk and resilience in African American youth: Context, self, action, and outcomes in school. Child Development, 65, 493-506.

Cotton, K. (1996). School size, school climate, and student performance. Portland, Ore.: Northwest Regional Educational Laboratory.

Cramer (Photographer). (2014). [Untitled Image of Annie-Marie Edward Science Building], Retrieved October 2, 2014, from: http://www.dezeen.com/2014/02/18/grand-orange-staircase-john-abbott-college-saucier-perrotte/

Curwell, S. et al (ed) (1990). Buildings and Health: The Rosehaugh Guide. London: RIBA Publications

D'Acci, L. (2011). Measuring Well-Being and Progress. Social Indicators Research, (1), 47-65.

Day, C. (2014). Places of the soul : Architecture and environmental design as healing art (3rd ed.).

De Chiara, J., & Crosbie, M. (2001). Time-saver Standards for Building Types (4th ed.). New York: McGraw-Hill.

DHHS (Department of Health and Human Services). (2001). Healthy People 2010: Understanding and Improving Health. Washington, DC: US Government Printing Office

Doll, C. (1992). School Library Media Centres: The Human Environment. School Library Media Quarterly Summer: 225–229.

Dudek, M. (2000). Architecture of schools : The new learning environments. Oxford [England] ; Boston: Architectural Press.

Earthman, G. & Lemasters, L. (1996). Review of Research on the Relationship between School Buildings, Student Achievement, and Student Behaviour. Paper presented at the Annual Meeting of the Council of Educational Facility Planners.

Eccles, J., Midgley, C., Wigfield, A., Buchanan, C., Reuman, D., Flanagan, C., & MacIver, D. (1993). Development During Adolescence. American Psychologist, 48(2), 90-101.

Edwards, M. (1992.) Building conditions, parental involvement and student achievement in the D.C. public schools. Master's thesis, Georgetown University. (ED338743)

Environmental Protection Agency. (1989). Indoor Air Quality and Work Environment Survey: EPA Headquarters' Buildings. Vol. 1-4. Employee Survey. [Online]Volume 1-4. Final Rep., EPA Contract #68-01-7359. Washington, DC: US EPA

Evans, G. (1998). When Buildings Don't Work: The Role of Architecture in Human Health. Journal of Environmental Psychology, 18(1), 85-94

Evans, G. (2003). The Built Environment and Mental Health. Journal of Urban Health, 80(4), 536-555.

Evans GW, Saegert S, Harris R. (2001). Residential density and psychological health among children in low-income families. Environmental Behavior. 33:165–180.

Fearson, A. (2014). Grand Orange Staircase Ascends through Science Faculty by Saucier + Parrotte. Dezeen Magazine. Retrieved from http://www.dezeen.com/2014/02/18/grand-orange-staircase-john-abbott-college-saucier-perrotte/

Federal Emergency Management Agency. (2005). Flood Insurance Study: Morton County, North Dakota and Incorporated Areas. Retrieved December 7, 2014 from: http://www.swc.state.nd.us/4dlink9/4dcgi/getsubcontentpdf/pb-2231/38059cv000a.pdf

Finn, J., & Rock, D. (1997). Academic success among students at risk for school failure. Journal of Applied Psychology, 82, 221-234.

Fisher, K. (2000). Building Better Outcomes: The Impact of School Infrastructure on Student: Department of Education, Training and Youth Affairs.

Fletcher, J. (Photographer). (2013). The Sustainability Treehouse [Photograph]. Retrieved December 7, 2014 from: http://www.archdaily.com/484334/the-sustainability-treehouse-mithun/

Ford, A. (2007). Designing the sustainable school. Mulgrave, Victoria: Images Pub.

Hallal, Pedro C. (2012). Global physical activity levels: surveillance progress, pitfalls, and prospects. The Lancet, Vol. 380, pp. 247-257.

Hallfors, D., Waller, M. W., Bauer, D., Ford, C. A., & Halpern, C. T. (2005). Which Comes First in Adolescence—Sex and Drugs or Depression? American Journal of Preventive Medicine, 29(3), 163-170.

Hanna:Keelan Associates. (2014). Morton County, North Dakota Comprehensive Housing Study. Lincoln, Nebraska: Hanna, & Keelan.

Hedge, A. (1991). Design innovation in office environments. In W. Preiser, J. Visher & E. White, Eds, Design Intervention. New York: van Nostrand Reinhold, pp. 301–322.

Heschong Mahone Group. (1999). Daylighting in schools: An investigation into the relationship between daylighting and human performance. San Francisco, California: Pacific Gas and Electric Company

Hille, T. (2011). Modern Schools: A Century of Design for Education: John Wiley & Sons.

Holmes, J. (1994). How Much Air Do We Breath? s.l. : California Environmental Protection Agency

Howley, C. (1995). The Matthew Principle: AWest Virginian Replication. Educational Policy Analysis Archives 3(18).

Ikpa, V. (1992). The Norfolk Decision: The Effects of Converting from a Unitary Educational System to a Dual System on Academic Achievement. Norfolk, Virginia.

Institute of Medicine. (1997). Schools and health: Our nation's investment. D. Allensworth, E. Lawson, L. Nicholson, and J. Wyche (Eds.). Committee on Comprehensive School Health Programs in Grades K-12. Division of Health Sciences Policy. Washington, DC: National Academy Press.

Janssen, J. E. (1999). The history of ventilation and temperature control. ASHRAE Journal, 41(10), 48-70.

Jessor, R., Turbin, M.S., and Costa, F.M. (1998). Protection in successful outcomes among disadvantaged adolescents. Applied Developmental Science, 2, 198-208.

JISC Development Group. (2006). Designing Spaces for Effective Learning: A Guide to 21st Century Learning Space Design. University of Bristol.

Kamarulzaman, N., Saleh, A. A., Hashim, S .Z., Hashim, H., & Abdul-Ghani, A. A. (2011). An Overview of the Influence of Physical Office Environments Towards Employee. Procedia Engineering, 20, 262-268.

Kaplan, S. (1995). The restorative benefits of nature: Toward an integrative framework. Journal of Environmental Psychology, (3), 169-182.

Kaplan, S. (2009). Creating a larger role for environmental psychology: The Reasonable Person Model as an integrative framework. Journal of Environmental Psychology, (3), 329-339.

Kopec, D. (2006). Environmental Psychology for Design. New York: Fairchild.

Kuller, R., & Lindsten, C. (1992). Health and behavior of children in classrooms with and without windows. Journal of Environmental Psychology, 12, 305-317.

Lackney, J. (2001). The State of Post-Occupancy Evaluation in the Practice of Educational Design, Paper presented to Environmental Design Research Association, EDRA 32, Edinburgh, Scotland, 5 July 2001.

Largo-Wight, E. (2011). Cultivating healthy places and communities: Evidenced-based nature contact recommendations. International Journal of Environmental Health Research, 21(1), 41-61.

Lassonde Entrepreneur Institute (Client). (2014). The Garage [Rendering]. Retrieved December 7, 2014 from: http://www.archdaily.com/556051/eda-breaks-ground-on-the-university-of-utah-s-newest-place-to-live-work-and-create/

Lawrence R, Hartig T. (2001). Health, housing, and urban environments: Updating the agenda for research and practice. Open House Int. 26:3–7.

Lawson, B. (1990). How Designers Think. London: Butterworth Architecture

Leather, P.M. et al. (1997). Windows in the Work Place: Sunlight, Views and Occupational Stress, Environment and Behavior. 30.

Lechner, N. (2008). Heating, Cooling, Lighting: Sustainable Design Methods for Architects (3rd Ed.): Wiley

Matthews, S., & Yang, A. (2010). Exploring the Role of the Built and Social Neighborhood Environment in Moderating Stress and Health. Annals of Behavioral Medicine, 39(2), 170-183.

Martin, P. (1997). The Sickening Mind: Brain, Behaviour, Immunity and Disease. London: Flamingo

McCardle, R. (1966). Thermal Environment and Learning. Missouri, University of Missouri.

McGraw Hill Construction. (2014) SmartMarket Report - The Drive Toward Healthier Buildings: The Market Drivers and Impact of Building Design and Construction on Occupant Health, Well-Being and Productivity.

McGuffey, C. (1982). Facilities. Improving educational standards and productivity: The research basis for policy. ed. H. Walberg. Berkeley, California: McCutchan Pub. Co

McNeely, C.A., Nonnemaker, J.M., and Blum, R.W. (2002). Promoting school connectedness: Evidence from the National Longitudinal Study of Adolescent Health. Journal of School Health, 72(4), 138-146.

Mudarri, D. (2010). Public Health Consequences and Cost of Climate Change Impacts on Indoor Environments. Washington, DC : Environmental Protection Agency

Myhrvold, A. N., Olsen E., &Lauridsen, O. (1996). Indoor environment in schools: Pupils' health and performance in regard to CO2 concentrations. Indoor Air '96, vol. 4, pp. 369–71. The Seventh International Conference on Indoor Air Quality and Climate. International Academy of Indoor Air Sciences

Nair, P., & Fielding, R. (2005). The language of school design : Design patterns for 21st century schools. Minneapolis, Minnesota: DesignShare.

Nathan, J., and K. Febey. (2001). Smaller, safer, saner, successful schools. Washington, D.C.: National Clearinghouse for Educational Facilities, and Minneapolis, Minnesota: Center for School Change, Humphrey Institute of
the University of Minnesota

National Academy of Sciences. (2007). Green Schools: Attributes for Health and Learning. Washington DC: National Academies Press

National Council on Schoolhouse Construction (Ed.). (1964). NCSC Guide for Planning School Plants.

National Institute of Mental Health (Research Entity) (2012). 12-month Prevalence of Major Depressive Episode among U.S. Adolescents (Chart) Retrieved October 17, 2014 from: http://www.nimh.nih.gov/health/statistics/prevalence/major-depression-among-adolescents.shtml

National Oceanic and Atmospheric Administration. Air Quality. United States Department of Commerce. Retrieved October 17, 2014 from: http://www.noaawatch.gov/themes/air_quality.php.

National Research Council. (2004). Board on Children, Youth, Families. Committee on Increasing High School Students' Engagement Motivation to Learn, National Research Council . Committee on Increasing High School Students' Engagement Motivation to Learn, Institute of Medicine, & NetLibrary, Inc. Engaging schools : Fostering high school students' motivation to learn. Washington, D.C.: National Academies Press.

National Research Council. (2006). Committee to Review Assess the Health Productivity Benefits of Green Schools. Review and assessment of the health and productivity benefits of green schools an interim report. Washington, D.C.: National Academies Press.

National Research Council and Institute of Medicine. (2002). Community programs to promote youth development. Committee on Community Level Programs to Promote Youth Development. J.S. Eccles, and J. Gootman (Eds.), Board on Children, Youth, and Families, Division of Behavioral and Social Sciences and Education, Washington, DC: National Academy Press.

Natural Resources Conservation Service. Web Soil Survey: United States Department of Agriculture. Retrieved December 10, 2014 from: http://websoilsurvey.nrcs.usda.gov/

New York City Departments of Design and Construction (2010). Active Design Guidelines: Promoting Physical Activity and Health in Design. City of New York.

North Dakota Petroleum Council. (2012). Bakken Basics. Retrieved December 7, 2014 from: https://www.ndoil.org/?id=78&advancedmode=1&category=Bakken+Basics

Northridge ME, Sclar ED, Biswas P. (2003). Sorting out the connections between the built environment and health: A conceptual framework for navigating pathways and planning healthy cities. J Urban Health. 80:556–568.

Novitski, B. J. (2014). Building as a Teaching Tool. Schools of the 21st Century. Retrieved on October 17, 2014 from: http://archrecord.construction.com/schools/071213-SCH_FOS.asp

OECD (2013). OECD Guidelines on Measuring Subjective Well-being, OECD Publishing. http://dx.doi.org/10.1787/9789264191655-en

Osterhaus, W. K. E. (1993). Office lighting: a review of 80 years of standards and recommendations.

Pearlman, Bob. (2010). Designing New Learning Environments to Support 21st Century Skills. In J. A. Bellanca & R. Brandt (eds.), 21st Century Skills (116-147). Solution Tree

Perkins Eastman (Architects). [Floor Plan of Dunbar Senior High School]. Retrieved October 2, 2014, from: http://archrecord.construction.com/projects/Building_types_study/K-12/2014/1401-Dunbar-Senior-High-School-Perkins-Eastman-and-Moody-Nolan.asp

Perkins, L., & Bordwell, R. (2010). Building type basics for elementary and secondary schools (2nd ed., Building type basics series). Hoboken, N.J.: John Wiley & Sons.

Perkins, Wheeler and Will (Architects). (1940). Crow Island School Floor Plan [Floor Plan]. From Planning and Designing Schools (pg. 12) edited by Brubaker, C., 1998, New York: McGraw-Hill.

Perkins, Wheeler and Will (Architects). (1940). Crow Island School [Photograph]. From Planning and Designing Schools (pg. 11) edited by Brubaker, C., 1998, New York: McGraw-Hill.

Phillips, R. (1997). Educational Facility Age and the Academic Achievement of Upper Elementary School Students. D.Ed. Dissertation. Athens, University of Georgia: 1–128.

Prensky, M. (2008). The role of technology in teaching and the classroom. Educational Technology, 48(6), 64.

Roberts, C. J. (2014). Students meet in the Construction and Engineering lobby [Photograph]. Retrieved December 6, 2014 from: http://archrecord.construction.com/projects/Building_types_study/K-12/2012/Marysville-Getchell-High-School-Campus.asp?bts=K12

Ribéron, J., O'Kelly, P., Maupetit, F., & Robine, E. (2002). Indoor air quality in schools: The impact of ventilation conditions and indoor activities. Proceedings of Indoor Air, 109–114.

Rittelmeyer, P. C. (1990). Contributions to an Empirical Phenomenology of School Architecture. Zeitschrift-fur-Padagogik 36(4): 495–522.

Rogol, A., Roemmich, J., & Clark, P. (2002). Growth at Puberty. Journal of Adolescent Health, 31(6), 192-200.

Romeo, J. (Photographer). [Untitled Photograph of Dunbar Senior High School Atrium]. Retrieved October 2, 2014, from: http://archrecord.construction.com/projects/Building_types_study/K-12/2014/1401-Dunbar-Senior-High-School-Perkins-Eastman-and-Moody-Nolan.asp

Rosenfeld, L.B., Richman, J.M., and Bowen, G.L. (2000). Social support networks and school outcomes: The centrality of the teacher. Child and Adolescent Social Work Journal, 17(3), 205-225.

RSP & Associates. (2012). Enrollment Projections District from 2012/13 through 2016/17 [Enrollment Projections].

RSP & Associates. (2012). Mandan Public Schools - Elementary Boundaries [Site Map].

Sassi, P. (2006). Strategies for sustainable architecture. London; New York: Taylor & Francis.

Saucier + Perrotte Architectes (Architects). (2014). [Floor Plan of Annie-Marie Edward Science Building], Retrieved October 2, 2014, from: http://www.dezeen.com/2014/02/18/grand-orange-staircase-john-abbott-college-saucier-perrotte/

Schnieder, M. (2002). Do School Facilities Affect Academic Outcomes? Washington D.C.: National Clearinghouse for Educational Facilities

Shor, I. (1996). When Students Have Power: Negotiating Authority in a Critical Pedagogy, Chicago and London: University of Chicago Press.

Sinofsky, E. and Knirck, FG (1981). Choose the Right Colour for Your Learning Style. Instructional Innovator 26(3): 17–19.

Smedje, G., & Norbäck, D. (2000). New ventilation systems at select schools in Sweden–effects on asthma and exposure. Archives of Environmental Health, 55(1).

Srinivasan, S. et al. (2003). Creating Healthy Communities, Healthy Homes, Healthy People: Initiating a Research Agenda on the Built Environment and Public Health. American Journal of Public health, 93(9).

Stricherz, M. (2000). Bricks and mortarboards. Education Week. 20 (14): 30–32. Retrieved December 1, 2014 from: http://www.edweek.org/ew/newstory.cfm?slug=14facilities.h20

Tanner, K., Jago, E. (1999). The Influence of the School Facility on Student Achievement. Washington D.C.: University of Georgia.

Tanner, C. K., & Lackney, J. A. (2005). Educational Facilities Planning: Pearson Allyn and Bacon

Taylor, A. (2008). Linking Architecture and Education: Sustainable Design of Learning Environments: University of New Mexico Press

Thomas Jefferson Center for Educational Design. (2002). Learning Environments Designed for the Occupants: Three Case Studies of Innovative Elementary School Designs. Charlottesville, Virginia: E. Shrader-Hervey & M. Droge

Tinucci, A. (Photographer). (2011). [Untitled Photograph of Chicago Daley Library IDEA Commons], Retrieved December 4, 2012 from: http://www.archdaily.com/568667/university-of-illinois-at-chicago-daley-library-idea-commons-woodhouse-tinucci-architects/

Ulrich R., Zimring C., et al. (2004). The Role of the Physical Environment in the 21st Century Hospital. Princeton, N.J.: Robert Wood Johnson Foundation.

[Untitled Photograph of Alpert Medical Center Atrium]. (2011). Retrieved December 4, 2014 from: http://med.brown.edu//newbuilding/naming-atrium

US Green Building Council. (2007). LEED (Leadership in Energy and Environmental Design) for Schools, version 2.0. Washington, D.C.

Wasley, P. M., Fine M., Gladden N. E., Holland S. P., King E., Mosak E., & Powell, L.C. (2000). Small schools: Great Strides. A study of new small schools in Chicago. Retrieved December 1, 2014 from: http://www.bnkst.edu/html/news/SmallSchools.pdf

Yang, T. C., & Matthews, S. A. (2010). The role of social and built environments in predicting self-rated stress: A multilevel analysis in Philadelphia. Health and Place, 16(5), 803-810.

Zimring, Craig. (1982). The Built Environment as a Source of Psychological Stress: Impacts of Buildings and Cities on Satisfaction and Behavior, Environmental Stress (151 -217). New York: Cambridge University Press.

Zuraimi, M. S., Tham, K. W., Chew, F. T., & Ooi, P. L. (2007). The effect of ventilation strategies of child care centers on indoor air quality and respiratory health of children in Singapore. Indoor Air, 17(4), 317-327.

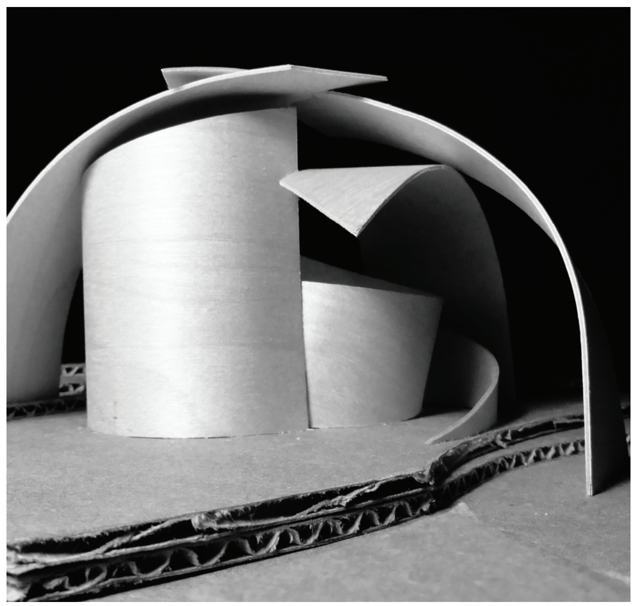


Figure 142. Tea House.

PREVIOUS STUDIO EXPERIENCE

2ND YEAR

Tea House Project | Vorderbruggen
Fall 2011

The Tea House project was my very first project in the architecture program, so I learned a lot about who I am as a designer. This project was very user-oriented similar to my thesis project.

Boat House | Vorderbruggen
Fall 2011

The Boat House project was not the most successful project, but it taught me a valuable lesson. It showed me that both form and function must be addressed during the design process in order to derive a successful design.

Dance Studio | Booker
Spring 2012

The Dance Studio was a enjoyable project because it allowed us a lot of design freedom. This was the first project to challenge us to recreate a moment or movement within our architecture.

Unconventional Dwelling | Booker
Spring 2012

The Unconventional Dwelling was one of my favorite projects in my undergraduate career. It forced us to redefine the spaces within a home and work with them in an efficient manner. This is the project that sparked my interest in sustainable design.

3RD YEAR

Church Remodel Project | Kratky
Fall 2012

The Church Remodel project gave us insight into what a project might be like in the real world. We met with the client and evaluated the facility to develop a responsive design within certain limits.

Visitors Center | Yergens
Spring 2013

The Visitors Center was the very first project I designed within Revit. Although it was a struggle, I'm very glad that I took on the challenge of learning this valuable program early in my educational career.

Restaurant and Studio Apartments | Yergens
Spring 2013

The Restaurant project was fun because we were able to design a building for our own community. This project taught me how to design with the context which is a valuable skill I carried into my later projects.

4TH YEAR

High Rise | Crutchfied
Fall 2013

The High Rise project was a challenging project that taught me how to approach comprehensive design. I also learned how to work with others being that it was a partner project. Collaborative skills are very important in our field.

Urban Redevelopment Project | Gleye
Spring 2014

The Urban Redevelopment project was designed during our semester abroad. It asked us to reimagine an entire neighborhood through a redevelopment project. This project made me realize the impact that architecture can have upon a community.

5TH YEAR

Hello Nature | Schwein
Fall 2014

The Hello Nature was a really enjoyable project that allowed us to explore our creativity. Rather than focusing upon the details of a building, we focused our attention upon the design process.

Figure 143. Portrait.

PERSONAL IDENTIFICATION