



LIGHT &
LEARNING

AN ELEMENTARY SCHOOL DESIGN BY LUKE DIEKMAN



Figure 4 - *sunrise*, Google

And God said,
"Let there be light," and
there was light. And God
saw that the light was good.



Figure 6 - *child staring*, Luke Dickman

"Tell me and I forget,
teach me and I may
remember, involve me
and I learn."

- Benjamin Franklin

P
PART 1
INTENT

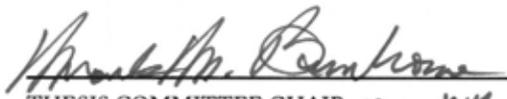
SIGNATURE PAGE

LIGHT & LEARNING

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


PRIMARY THESIS ADVISOR *May 16th, 2013*

By


THESIS COMMITTEE CHAIR *May 16th, 2013*

LUKE DIEKMAN

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for the Degree of
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ABSTRACT

My thesis investigates the question: how does exposure to natural light enhance academic performance in an elementary school?

My claim is that exposure to natural light enhances academic performance in elementary schools. The actors being the natural elements; light. The action being exposure to natural elements in the academic setting. The object being students in elementary schools.

The exploration of this thesis will be done by means of an elementary school Bismarck ND.

My premises are as follows: light is a biological need that stimulates brain activity and influences mood; exposure to natural light positively influences the learning environment and psychological well-being of those who inhabit it; students in elementary schools learn better, and enjoy the spaces more when natural light is integrated with their experiences.

The justification for my thesis is that learning/education is very important to our society as a whole, as well as individually. The learning environment shapes our thoughts and influences our passions. I have experienced the power of light on an environment, and I want to pursue this topic so that others can learn, enjoy and explore that experience as well.

Title: Light & Learning

Keywords: School, Light, Sight, Learning, Children

THESIS PROBLEM STATEMENT

How does exposure to natural light enhance academic performance in an elementary school?

STATEMENT OF INTENT

- T**YPOLOGY Elementary School
- C**LAIM Exposure to natural light enhances academic performance in elementary schools. The actors are the natural elements; light. The action is exposure to natural elements in the academic setting. The objects are students in elementary schools.
- P**REMISES **Actor:** Light is a biological need that stimulates brain activity and influences mood.
Action: Exposure to natural light positively influences the learning environment and psychological well-being of those who inhabit it.
Object: Students in elementary schools learn better, and enjoy the spaces more when natural light is integrated with their experiences.
- U**NIFYING IDEA Not only is light a biological need, but a catalyst in motivation and mood. The experience of a space is directly correlated with our developmental process and learning motivation. A well lit space, inviting the natural light to enter, gives its inhabitants the ability to grow and enjoy learning.
- J**USTIFICATION Learning/education is very important to our society as a whole as well as individuals. The learning environment shapes our thoughts and influences our passions. I've experienced the power of light on an environment, and I want to pursue this topic so that others can learn, enjoy and explore that experience as well.

P
ART 2
PROPOSAL

NARRATIVE

LIGHT IS ESSENTIAL. With only a little natural light we would suffer; too much we would feel discomfort; without it we would die. Light is integrated into every area of our lives. In the presence of light we are stimulated and awakened, and in its absence we are drowsy and still. Our bodies require light for growth, our minds require light for perception, our eyes need light to decipher color, and our circadian rhythms need light to cycle. Light has the power and ability to set a mood, track the passage of time, nourish living organisms, and inspire us to learn and explore the world we live in.



Figure 23 - *angel of hope*, Luke Diekman

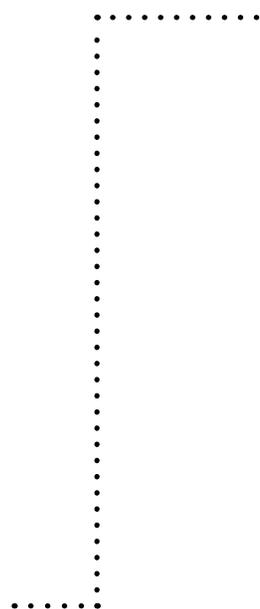
..... Because light is so essential to our daily lives, it has to be considered a high priority in architectural designs; especially learning environments. In the past, windows were seen as unnecessary. Windows were merely distractions for the children, heating/cooling expenses, as well as inferior in ventilation to air-conditioning systems. One thing they did not consider was that windows provide light, and light is a biological necessity - not just light from a distant fixture hanging from the ceiling, but natural light that streams through windows and dances on the floors and walls as time elapses throughout the day. Natural light provides more than just the rising and the setting of the sun, but the story of seasons and day-to-day occurrences; such as the lengthening of days as summer approaches, or the short number of hours the sun appears during the cold winter months, or the monotonous dull-grey skies that accompany a storm. The world is a canvas, light is the medium, and time is the artist.

Education is very important to our society on an individual scale, as well as nationally. Learning gives us opportunities to succeed - achieve our dreams and whatever we put our mind to accomplishing. A primary factor to improving learning is the quality of light and its association with its environment. Light sets the mood, focuses attention, diminishes drowsiness, and creates spaces of enjoyment.

LIGHT IS EXPERIENTIAL. Learning environments beckon architects to discover the affects of light it has on the minds of children - to create spaces that integrate children who are required to be indoors to experience the world around them from the inside-out. A school is more than just a place to learn, it's a place to learn well.

CLIENT DESCRIPTION

THE STUDENTS: Elementary schools consist of grades kindergarten to fifth grade. The city of Bismarck has about five hundred elementary school age children that need a school to be placed in. There will be two new elementary schools built that will share responsibility for enrolling these students, averaging two hundred fifty children per school. Usage for this school will peak from August when the school year begins, until May when summer break arrives. Summer months offer summer school, in which case the facility will be occupied but at a much lower usage. Because the children are too young to drive, parking for the students won't be necessary, only for teachers, faculty and visitors. Students will need playgrounds for recess, cafeteria's for lunch, a library to study, a gymnasium to exercise, classrooms to learn, and an environment that is enjoyable and experiential to be in. There are many extra-curriculum activities that happen after normal school hours such as sporting events, plays/musical/drama performances, and various weekend activities that the students and parents are involved in. As the student's progress through the school year, parent-teacher meetings will take place, as well as visitation tours for new students.





..... **THE FACULTY:** The recommended teacher to student ratio for Bismarck's elementary schools is one-to-eighteen. Since there will be close to two hundred and fifty students, the school will need at least fourteen teachers. The rest of the faculty consists of principles, janitors, secretaries, cafeteria assistants, school nurses, etc. Most of these faculty members will need a space to work in, a place to store their belongings, as well as parking spots. Some faculty members, such as the school nurse or secretaries, will need rooms that are designed specifically for them. Peaks and declines in usage of the school for the faculty/staff will be determined by the activities of the students that are present. As the number of students enrolled in the school climb, the need for more teachers and faculty members to accommodate them will also increase.

PROJECT ELEMENTS

CLASSROOMS: Most of the students learning will be done here. The classrooms will accommodate about eighteen children at its max capacity, and will be flexible for many different teaching activities.

ENTRY: This will be where kids are greeted when they first arrive in the morning, and the last space they exit as they return home. The entry will be an inviting space - easily accommodating traffic flow and connectivity to the rest of the school.

DISPLAY SPACES: These will be areas in which children can showcase their work or what they have been learning that week. Display spaces are also very engaging for parent's to see and experience as well.

HOME BASE AND INDIVIDUAL STORAGE: Students will need space to store things for school and personal use. Lockers, cubby holes, storage nooks will be present for students.

CLASSROOM LABS: In addition to class room space, lab space will be used for more creative, messy experiments and demonstrations.

PERFORMANCE SPACES: This encompasses art, music, festive recitals and concerts.

GYMNASIUMS: Spaces to accommodate indoor activity and exercise.

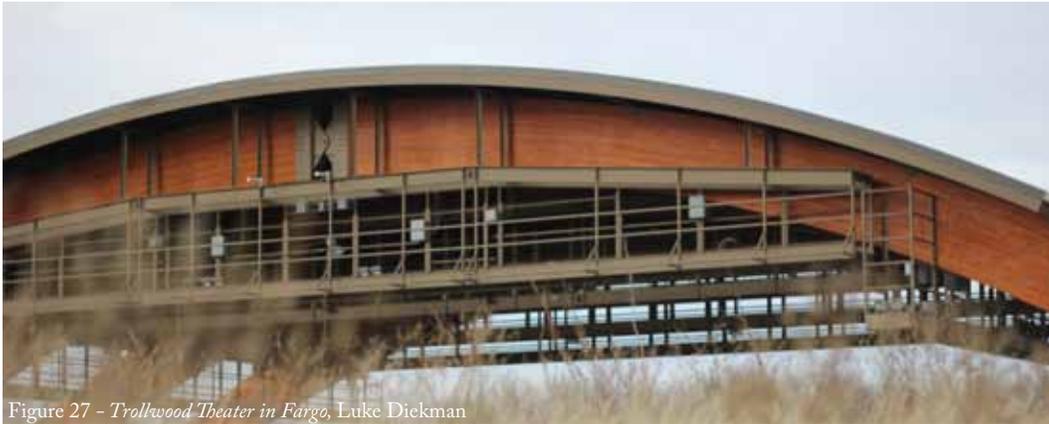


Figure 27 - Trollwood Theater in Fargo, Luke Diekman

.....

CAFETERIAS: To create a friendlier environment for kids to eat in, the cafeteria will be more like a casual eating area. These will be spaces where children can socialize, eat, and take a break from their studies.

INDOOR/OUTDOOR CONNECTIONS: This includes atriums, glazing, courtyards, clerestories, and landscape architecture. The enfilade is what will be experienced here - the connection and the journey between the inside and outside.

FLEXIBLE SPACES: Throughout the school year, there will be many special activities that will need space for a temporary time. As the city grows, flexible spaces to accommodate overflow spaces will need to be present.

PARKING LOTS: The main uses for these lots will be for faculty and special events. The most useful way to accommodate transportation is the use of a wrap-around drop-off site, so that parent's can easily leave and take their children.

FACULTY SPACES: Principal's office, secretary space, janitor's room, teacher's lounge, and other spaces to accommodate and assist the faculty.

TOILETS: These are essential, but should not be typical.

PLAYGROUNDS: A playground is anywhere outside that elicits learning, fun, and interaction among the students.

SITE INFORMATION

REGION: Mid-West, United States

As the recession in America persists, the Midwest has proven to have a stable economy, showing growth in jobs and a surplus in budget in the state of North Dakota. As a result of the state's success, many people are flocking to this North Dakota for jobs and homes.

CITY: Bismarck, North Dakota

Lately, North Dakota has experienced an oil boom which has brought even more people over to the Midwest, specifically Williston ND. Because of Bismarck's proximity to Williston, the city's population has grown significantly. Over eighty percent of Bismarck's schools are over capacity. The city is in need of two elementary schools, a middle school, and a high school to accommodate the spike in population.

SITE: East of North Washington Street & South of 57th Avenue

The Bismarck Public Schools own lots of land towards the north-west corner of its borders. This site on North Washington Street is North of where the city's growth is rapidly expanding. In addition to the elementary school, many new residential neighborhoods are planned for the near future. The site is a good choice for the school because it is easy to access; it is located where the city is expanding, the neighborhoods are safe, and the land is readily available.



Figure 29.1 - united states, Google Maps



Figure 29.2 - Bismarck ND, Google Maps



Figure 29.3 - East of N. Washington St. & South of 57th Ave., Google Maps

PROJECT EMPHASIS

THE AFFECTS OF NATURAL LIGHT

MOOD

Mood can either have a positive or negative effect on how we accomplish tasks or carry ourselves throughout the day. In the learning environment, light can influence mood to help or hinder students learning.

ATTITUDE

Attitude is more long lasting than mood - attitude is correlated with mental state. Light deprivation can cause Seasonal Affective Disorder (SAD), in which the attitude or mental state of an individual unbalanced from lack of natural light.

BIOLOGICAL NEED

Our body's function in correlation to the amount of natural light we receive. The amount of light entering our eyes can either stimulate or relax our bodies. Our Circadian Rhythms and sense of time/seasons are both correlated to the passing of natural light.

LEARNING

The affects of light on our mood, attitude and biological needs all in turn affect the way we learn. The environment is a powerful factor, in which natural light is extremely influential.



Figure 31 - *light painting*, Luke Diekman

PLAN FOR PROCEEDING

RESEARCH DIRECTION

The research that will be done in order to solve the design problem is the completions of a theoretical premise/unifying idea, a design typology, historical context, site analysis as well as a list of programmatic requirements. An understanding of the school typology, the effects of natural light on learning, and the city of Bismarck will prepare me for the design problems.

DESIGN METHODOLOGY

The design methodology will be carried out through a combination of methods; qualitative, quantitative, graphical, and digitally as part of a concurrent transformative strategy. The purpose of this strategy is to gather information that is relevant to my theoretical premise/unifying idea through qualitative and quantitative analysis. The goal is to compile the research into a logical, understandable manor through text and graphics that will help me progress into the designing phase.

DOCUMENTATION PLAN

All physical works created will be documented through scanning or photography. Physical works will be kept even after documentation. Digital images and models will be saved in three places at all times: in folders on my laptop, on an external hard drive, and in an online drop-box. Documentation of physical works will be done immediately, while digital archiving will be done weekly. The process will be laid out in an orderly fashion in the Thesis book to show the progression of research and design.

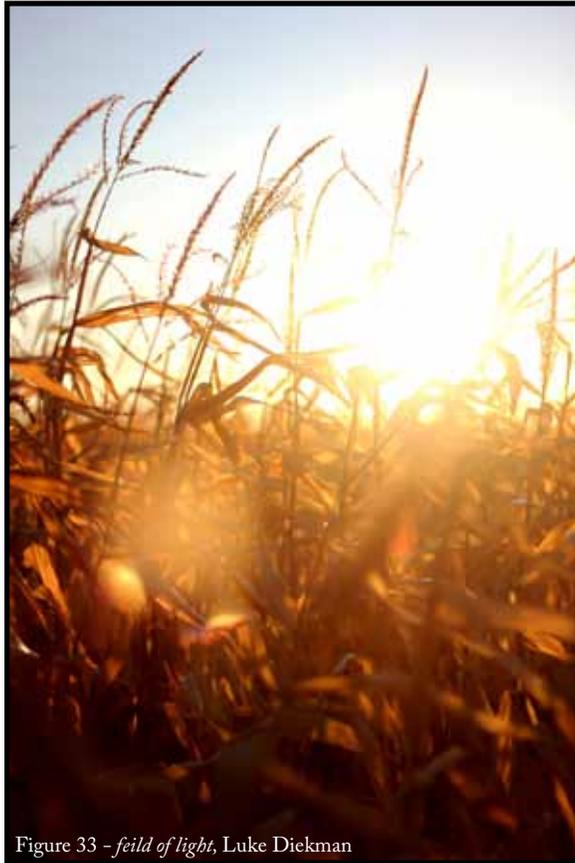


Figure 33 - *feild of light*, Luke Dickman

SCHEDULE

Task Name	Duration	Start	Finish
Conceptual Analysis	2 wks	Mon 1/7/13	Fri 1/18/13
Context Analysis	5 days	Mon 1/14/13	Fri 1/18/13
Spatial Analysis	5 days	Mon 1/21/13	Fri 1/25/13
ECS Passive Analysis	2 wks	Mon 1/28/13	Fri 2/8/13
ECS Active Analysis	2 wks	Mon 1/28/13	Fri 2/8/13
Floor Plan Development	5 days	Mon 2/11/13	Fri 2/15/13
Structural Development	5 days	Mon 2/18/13	Fri 2/22/13
Section Development	5 days	Mon 2/25/13	Fri 3/1/13
Envelope Development	1 wk	Mon 3/4/13	Fri 3/8/13
Material Development	1 wk	Mon 3/4/13	Fri 3/8/13
Midterm Review	5 days	Mon 3/4/13	Fri 3/8/13
Project Revisions	2 wks	Mon 3/11/13	Fri 3/22/13
Context Redevelopment	2 days	Mon 3/25/13	Tue 3/26/13
Structural Redevelopment	3 days	Wed 3/27/13	Fri 3/29/13
Project Documentation	5 days	Mon 4/1/13	Fri 4/5/13
Presentation Layout	1 wk	Tue 4/2/13	Sat 4/6/13
Plotting/Model Building	1 wk	Tue 4/9/13	Mon 4/15/13
Thesis CD Due	1 day	Mon 4/15/13	Mon 4/15/13
Exhibit Installation	1 day	Mon 4/22/13	Mon 4/22/13
Presentation Preparation	4 days	Mon 4/22/13	Thu 4/25/13
Thesis Exhibit	6 days	Thu 4/25/13	Thu 5/2/13

Table 34 - *task list*, Microsoft

STUDIO EXPERIENCE

SECOND YEAR

Fall 2009 - Heather Fischer
Tea House
Minneapolis Boat House
Spring 2010 - Stephen Wischer
House for Twins
Airport Terminal

THIRD YEAR

Fall 2010 - Cindy Urness
Downtown Food Coop
Downtown Wellness Center
Spring 2011 - Steve Martins
Children's Museum
Archeology Museum

FOURTH YEAR

Fall 2011 - David Crutchfeild
San Francisco Highrise
Spring 2012 - Ron Ramsay
1850's Millerite Chautauqua

FIFTH YEAR

Fall 2012 - Paul Gleye
New Downtown Center for Fargo



San Francisco Highrise



Archeology Museum



Airport Terminal



1850's Chautauqua



Children's Museum



Boat House



Downtown Food Coop



P
ART 3
PROGRAM

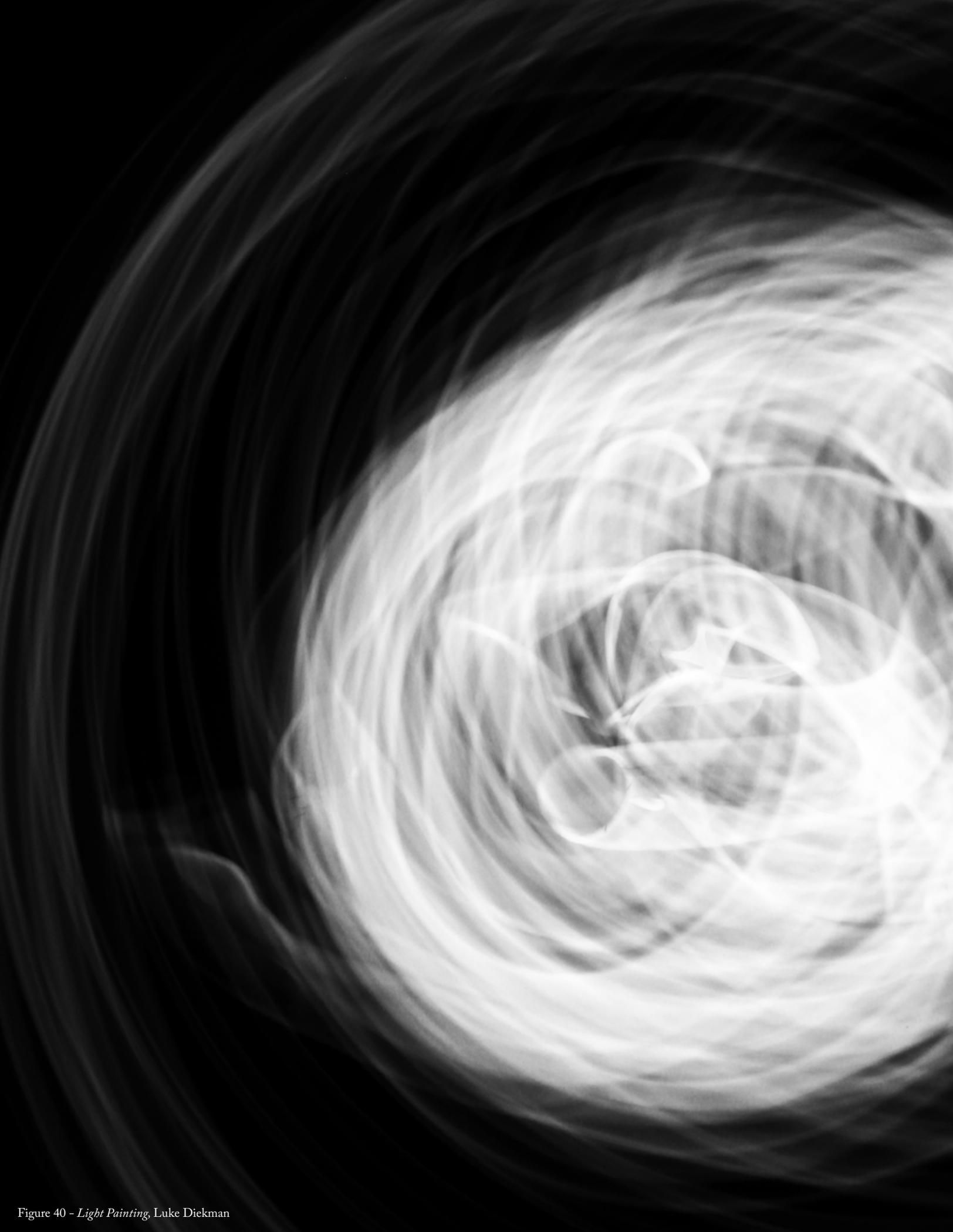


Figure 40 - *Light Painting*, Luke Dickman



RESEARCH

LIGHT & LEARNING

Thesis Emphasis

Light and Learning

“In the beginning God created the heaven and the earth.

2 And the earth was without form, and void; and darkness was upon the face of the deep. And the Spirit of God moved upon the face of the waters.

3 And God said, Let there be light: and there was light.

4 And God saw the light, that it was good.”

Genesis 1:1-4
Bible, King James Version

Daylight has been in existence since the beginning of time. To ask the question, “what is light?” seems simplistic; for we have been exposed to light our entire lives. We know of light, but the real question is, do we really know light? When our eyes perceive daylight, do we realize it is more than merely the absence of darkness? To know of something, is to have knowledge of it – to really know something is to understand the interconnected influence it has on your life.

Daylight is complex, it is more than the absence of darkness; it is the sustainer of life. To call daylight, “the sustainer of life”, isn’t an overdramatized statement at all; humans, plants, even our planet all depend upon daylight to sustain them. We are all interconnected, that is, dependent upon each other. A world without daylight is dead, literally.

Daylight brings the world to life. “Light, that first phenomenon of the world, reveals to us the spirit and living soul of the world through colors.” (Itten, *The Elements of Color*, 1970) According to Itten, light is life. Daylight not only illuminates the world around us, but paints the earth’s canvas with lively color. “Color is life; for a world without colors appears to us as dead. Colors are primordial ideas, children of the aboriginal colorless light and its counterpart, colorless darkness.”

LIGHT

“Consider the word pupil. It can have two meanings: the round aperture in the iris of the eye and a student in school or in the charge of a tutor or instructor. How are these meanings similar? Both deal with learning.” (Brubaker, Planning and Designing Schools, 1998)

Learning is something we will never outgrow; from the moment we are born, our brains have been absorbing the world through the senses. As we grow older, we prepare ourselves for the next stage of life through education. We spend nine years of schooling to prepare us for high school; four years of high school to prepare us for college; four-five years of college to prepare us for the working world; and the next forty-plus years we continue learning in our profession.

Learning will never cease, but the environment in which learning takes place matters - this is where light and learning converge. “Of all the elements that make a high performance learning environment, none has greater impact on the quality of learning than daylight.” (Brubaker, Planning and Designing Schools, 1998)

Natural Light & The Body

The Greeks compartmentalized a human being into three categories: mind, body, and spirit. As a person experiences daylight, all three aspects of life are affected. Whether daylight affects a person positively or negatively is circumstantial.

There are two primary ways that daylight affects the mind; either by being exposed to too much light, or by being deprived of light.

Too much light causes discomfort. “An efficient method of mental torture is the use of constantly high level of illumination that leaves no space for mental withdrawal or privacy, even the dark interiority of the self is exposed and violated.” (Pallasmaa, *Eyes of the Skin*, 2005) On the other hand, not enough light or poor quality of light has negative consequences.

Seasonal Affective Disorder (SAD) has affected many people during the winter months when the daylight hours are the shortest. This mental disorder produces sadness, irritability, anxiety, lack of concentration, and social withdrawal. (Hyman, *The Light Book*, 1990) Statistically, five percent of the United States population is diagnosed with this disorder, and twenty percent have symptoms that are similar. (Dryden-Edwards, *Seasonal Affective Disorder*, 2012)

THE MIND

The body is often overlooked when it comes to its need for daylight. The mind and body are closely linked, so the things that affect the mind in turn end up affecting the body as well. Deprivation from daylight affects the body's Circadian Rhythms; that is, your body's daily cycles. According to Hyman (1990), "rhythms of body chemicals influence mood, alertness, and manual dexterity." She later states, "Without light, your body's rhythms might desynchronize. To run correctly, the circadian system must have cues from the environment."

The superiority of daylight compared to artificial light is that it is synchronized with nature. It is nature! The rise and setting of the sun have a cycle that our biological systems need, and are often deprived of. Hyman reports that, "The eye is exquisitely sensitive to the length of twilight and registers the current and approaching seasons accordingly." (Hyman, *The Light Book*, 1990)

In working environments, a common physical ailment directly linked with light is eye-strain. When light directly shines into the eyes, or when the light quality is low and it's hard to focus on the task at hand, eye-strain develops. According to Brubaker, a firm owner who was known for his work in Elementary schools, states, "Eyestrain can be a major distraction." (Brubaker, *Planning and Designing Schools*, 1998) There is a light intensity comfort zone that the body needs in order to run at its best potential; anything outside that comfort zone leads to physiological discomfort.

Daylight intensity is important to keep in mind, but the most important issue is that daylight is present. Brubaker states, "Daylight is important because there are direct connections between our physiological well-being as humans and the amount of daylight we get." (Brubaker, *Planning and Designing Schools*, 1998)

THE BODY

THE SOUL

The soul has often been referred to as the “seat of all human emotion”. My personal interest is in phenomenology – the way in which we understand the world through our senses. Great spaces make you feel, and natural light elicits those feelings. Louis Kahn once said, “A room without natural light is not a room”; artificial light alone is not sufficient. (Buttiker, *Light and Space*, 1994) This statement is more easily explained by Pallamsa (2005), in which he states, “In our time, light has turned into a mere quantitative matter and the window has lost its significance as a mediator between two worlds.” (Pallasmaa, *Eyes of the Skin*, 2005) Natural light is more than an alternative source of illumination, it is connection we have to the world around us that we need.

Natural light is a clock – a way for us to feel the passage of time. Architect Bradford Perkins said concerning natural light, “Children can begin to understand the passage of time, the changing of seasons, and the environment.” (Perkins, *Building Type Basics*, 2001) Why is this all important? The answer to this question comes down to a static vs. dynamic world. Louis Kahn talked about the beauty of natural light’s dynamic nature, stating, “The blues would be one thing one day; the blues would be another thing another day. Nothing static, nothing static as an electric blub, which can only give you one iota of the character of light.” (Kahn, *Light is the Theme*, 1975)

The dynamic character of natural light gives us a sense of place – helps us feel the time of day, place, mood, and season. According to Kahn, “Natural light has all the moods of the time of the day, the seasons of the year, which year for year and day for day are different from the day preceding.” (Kahn, *Light is the Theme*, 1975)

Natural light brings the world to life. Light energizes a space through two primary ways: color and shadow. All color comes from light, and according to Itten, “Colors are forces, radiant energies that affect us positively or negatively, whether we are aware of it or not.” (Itten, *The Elements of Color*, 1970) Shadows on the other hand are more subtle, but just as powerful experience. Pallasmaa writes in his book, “Dim light and shadows are essential, because they dim the sharpness of vision, make depth and distance ambiguous, and invite unconscious peripheral vision and tactile fantasy.” (Pallasmaa, *Eyes of the Skin*, 2005) Pallasmaa is speaking about the emotional connection we have with shadow, however there is a very practical side to shadow; it brings out texture. Kahn is not overstating this fact when he says, “Material lives by light.” (Buttiker, *Light and Space*, 1994)

Natural Light & Architectural Practice

Newton's Third Law states, "For every action there is an equal and opposite reaction." In the world of architectural practices involving natural light, there has been great debate over the topic of daylight – more like contradictions.

In the 1960's, windows were thought to be useless. "Air conditioning engineers and lighting specialists were contending that windows are not only an unnecessary building expense but an operational nuisance as well." (Hatcher, *The Effects of Windowless Classrooms*, 1965) In New Mexico at that time, there were many elementary schools that also served as fallout shelters; they were built with thick walls and no windows. The Hoover School case study concluded, "No pattern of class behavior can be detected which would indicate that a view of the outdoors has been essential in the learning process." Later they concluded, "Windows are useless." (Hatcher, *The Effect of Windowless Classrooms*, 1965) This mindset of the 1960's was only a reflection of the architectural advancements at that time. Artificial light and air conditioning seemed superior to a window, and replaced windows for functional reasons.

THE GREAT DEBATE

In the 1980's, windows that let light in were not seen as a bad idea, but consistent even illumination was the desired outcome. Frederick G. Knirk, author of *Designing Productive learning environments*, states, "The quality of light has an impact on the learner". Most of Knirk's ideas about lighting were centered on varying intensity around tasks, using color to create mood, and reducing light reflections from materials. He concludes, "Classroom lighting is important because of the relative number of hours students spend indoors as opposed to outdoors in the sunlight." At this point in time, daylight was seen as a positive asset; however, the relationship daylight had to human beings was not fully understood or explored.

Current architectural practices should be rooted in facts rather than speculation. The research advancements in psychology, sociology, construction practices, and medical knowledge have strengthened our views towards natural light and its importance in building designs. A few ways we have progressed are as follows:

Psychologically: “Of all the elements that make a high performance school, none has greater impact on the quality of learning than daylight.” (Nair & Fielding, *The Language of School Design*, 2007) Daylight inhibits our natural rhythmic cycles, influences our mood, and connects us with nature.

Sociologically: “Full spectrum lighting takes into account a variety of learning styles and modalities.” (Nair & Fielding, *The Language of School Design*, 2007) The great advancement in this field concerning lighting is that we learn differently and best at different times. To keep a uniform lighting system, void of the dynamic nature of daylight, does not meet the needs of every individual; or any individual at all for that matter!

MODERN UNDERSTANDING

Construction Practices: “Daylighting can sustainably reduce the energy load on buildings.” (Nair & Fielding, *The Language of School Design*, 2007) One of the great advantages of daylight is that it is a form of energy and can be used as a resource. The sustainability movement has given us insights into cost reducing day lighting strategies and implementations have been developed.

Medical: “Daylight is important because there are direct connections between our physiological well-being as humans and the amount of daylight we get.” (Nair & Fielding, *The Language of School Design*, 2007) The brain and the body are connected, and Seasonal Affective Disorder is one example of a mental deficiency producing physical ailments. The greater medical understanding we attain the greater effectiveness our day lighting architectural designs will be in the learning/educational realm.

Louis Kahn was an architect who was considered, “One of the most influential architects of the mid-20th century.” (Design Museum, Louis Kahn,) Even though he died almost forty years ago, his design philosophies regarding daylight continue to offer inspiration.

Louis Kahn knew the power of natural light, and designed his buildings for others to enjoy the same experience. According to Kahn, “A plan of a building should read like a harmony of spaces in light.” (Buttiker, Light and Space, 1994) To Kahn, there was not a separation of space and natural light, natural light creates the space. He states, “No space, architecturally, is a space unless it has natural light.” (Kahn, Light is the Theme, 1975) Was he obsessed? If he was, it was because he understood the importance of natural light – leaving a great legacy for us all to follow.

LOUIS KAHN

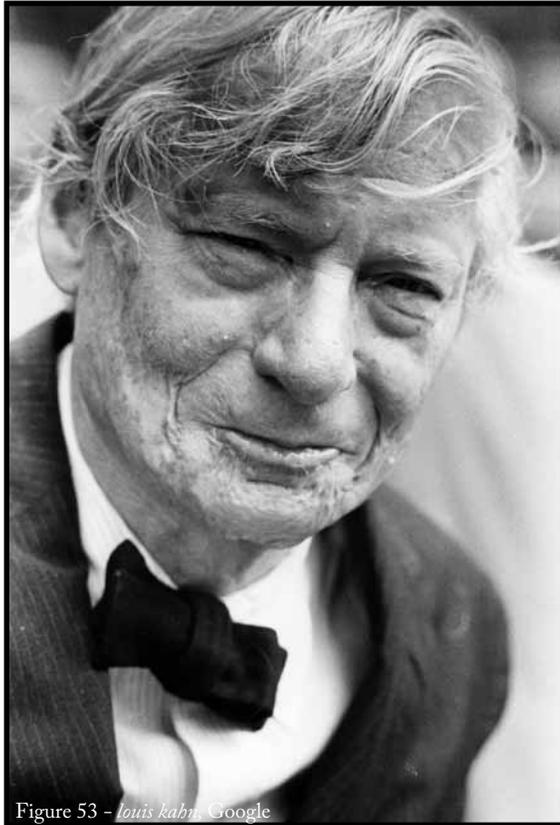


Figure 53 - *louis kahn*, Google

SUMMARY

After researching for months, gaining knowledge from several fields, I have come to a few conclusions about natural daylight and its implementations.

Learn about learning. To design spaces for those to learn well in, one has to understand how learning works. This sounds obvious, but what I'm speaking of is the raw facts – delving into the realms of psychology, sociology, etc. The building shouldn't inform the student, but the student and how he/she operates should inform the building. To clarify, instead of creating a building and then filling it with students, understand the students and then design a building to accommodate their needs. History is filled with changing ideas and new advances; few things are static. "Effective design is grounded in a firm knowledge of how we do learn." (Nair & Fielding, *The Language of School Design*, 2007) To settle for a basic understanding does the designer a misfortune as well as everyone else who interacts with their work. Learning is a continuous process.

Experience is subjective. Everything comes down to an individual experience. We all have different ways and preferences of learning – one method might suit the needs of one person, and to another it will not. To make a design uniform is inconsiderate of everyone's needs. This thought leads to my next point.

5 POINTS

Know your Demographics. This number one speech writing point is also very important in the architectural world. Experience is analyzing design at a micro standpoint, while demographics is taking a step out and seeing the broader picture. For example, people farther away from the equator suffer more from SAD and need more sunlight to penetrate their buildings; for people near the equator that is not an issue.

Dynamic vs. Static. This idea challenged me the most. I always considered static to mean “consistent”, but as I researched more, static is more clearly defined as “stagnant”. A space that is uniformly lit by artificial lights feels dead, while a space that incorporates daylight comes to life. Why is that? Because that is the beautiful thing about nature – day and night cycle, weather has seasons, new things replace the old ones dying, and our bodies are no different. Daylight is a great way to create dynamic spaces for educational environments. “Great learning environments exhibit similar characteristics to great cities and great landscapes.” (Nair & Fielding, *The Language of School Design*, 2007) This quote from Nair is a powerful metaphor for designers to bear in mind when considering daylight for learning facilities.

Consult health Professionals. Free masons have a motto that goes, “know thyself”, and that is applicable in the architectural realm as well. Know your body! To have an understanding of people’s biological needs for daylight is a good start, to consult health professionals about daylight is even better. Styles come and go, but designing for people’s needs won’t change. A quote from Nair sums up everything I have learned by stating, “Whatever the answers may prove to be, it seems that we and the health professionals who care for us can benefit from a greater awareness of the possible effects of light.” (Nair & Fielding, *The Language of School Design*, 2007)



Figure 56 - church rendering, Luke Dickman

CASE STUDIES

LIGHT & LEARNING

Typological Research



Figure 58 - *sunrise elementary*, Luke Dickman

SUNRISE

ELEMENTARY SCHOOL

Bismarck, North Dakota

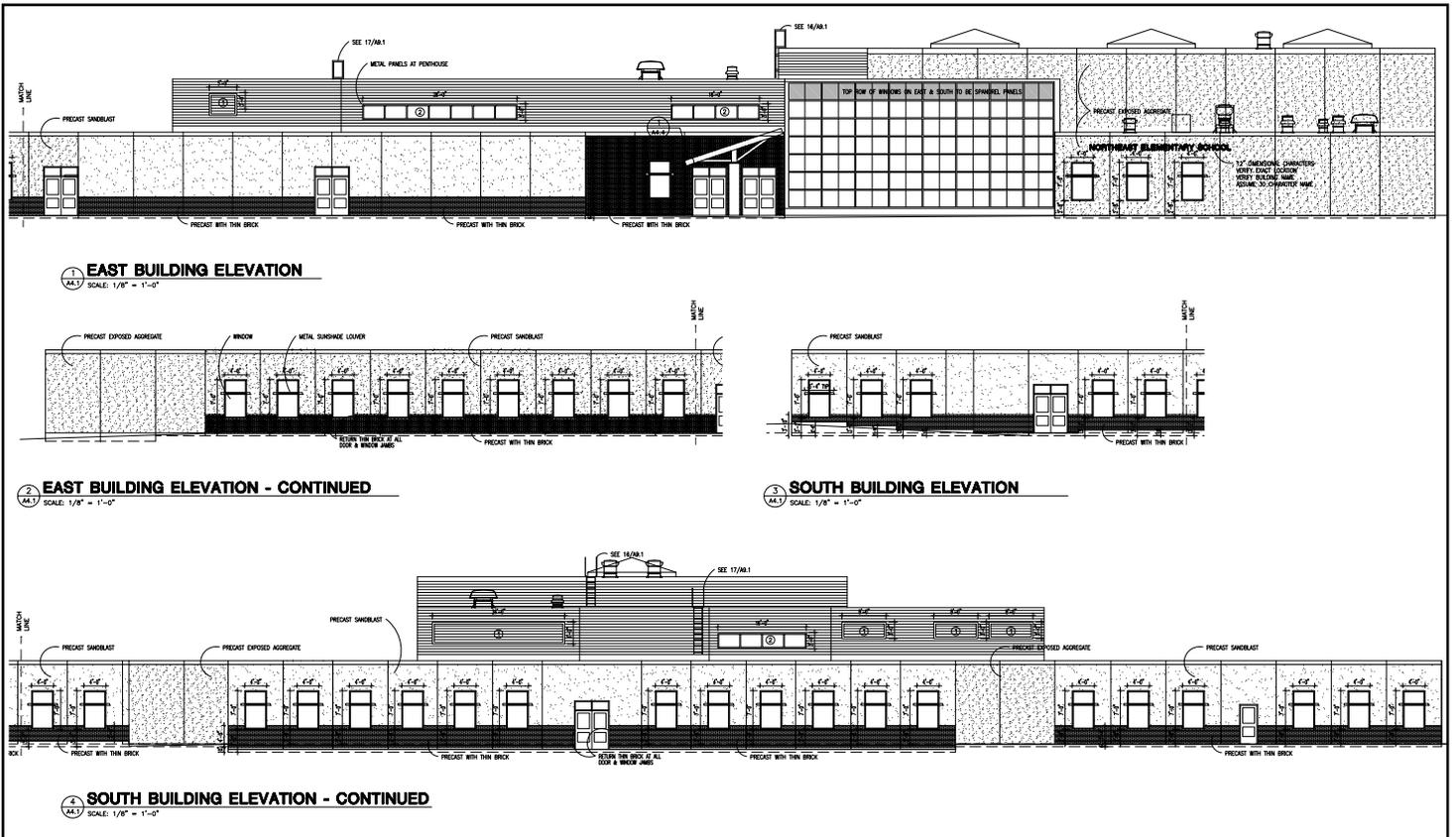
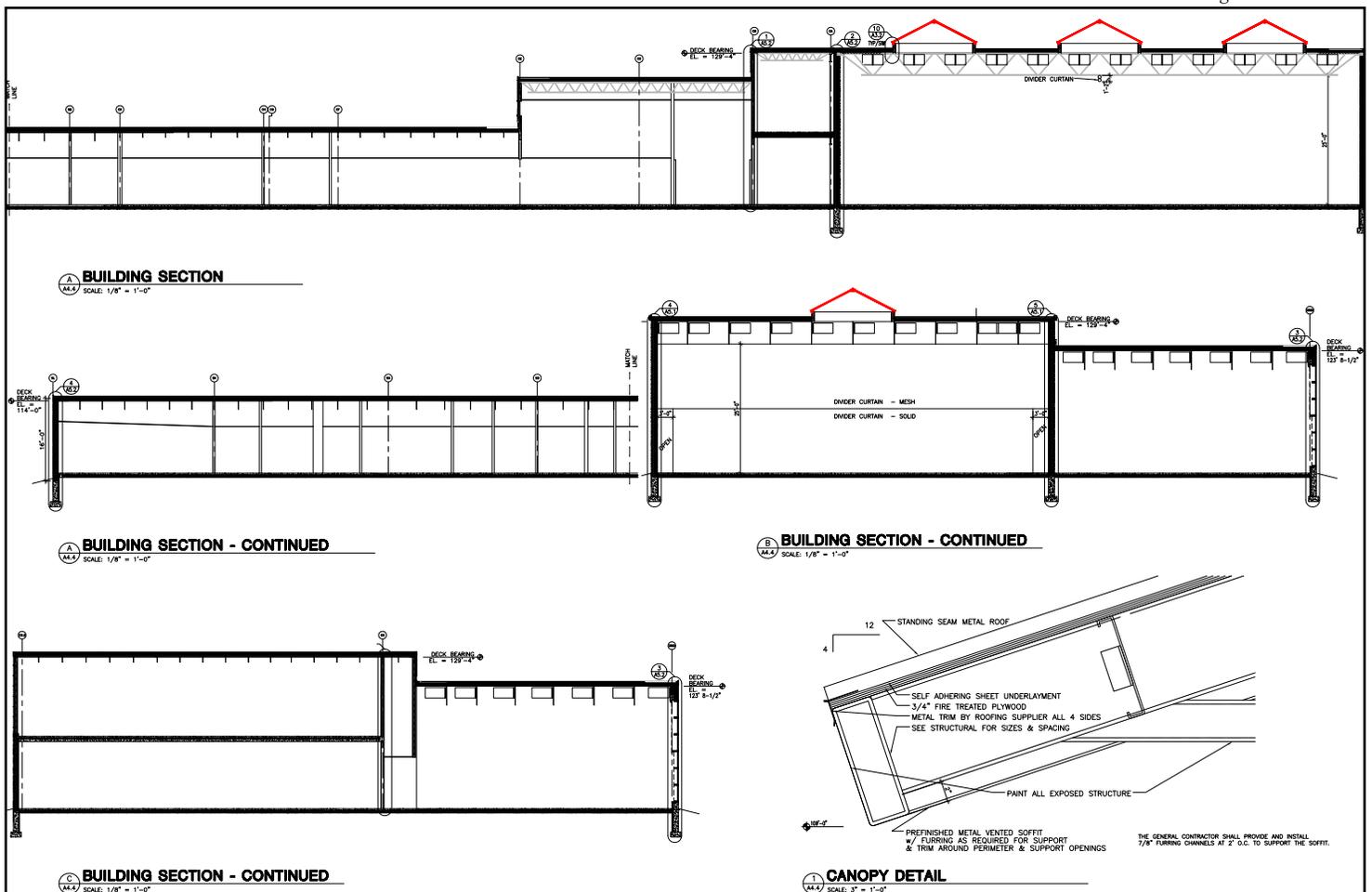


Figure 60.1 - elevations

Figure 60.2 - sections



SUNRISE

Designed by a local architect, Jim Nelson, from REH Architects, Sunrise Elementary School was completed in 2010. Located in North-East Bismarck, the school was built to accommodate a rise in the city's population.

I chose to discuss this building for several reasons: 1) It fits the typology that I am researching. 2) Its location is very close to the site I am using for my thesis; it's in the same city. 3) It is the newest elementary school in Bismarck. 4) I was able to visit this school, so I have experienced the building 5) Lastly, its design exhibited a lot of attention to natural light.

THE BUILDING

Driving up to the school, the first thing that caught my attention was the amount of glazing that surrounded the exterior facades. There were many windows, and almost every window had a sun shading louver. The interior of the school was very pleasant; every portion of the school was architecturally designed to allow daylight in. The atrium had a huge curtain wall that allowed connections to the outdoors for lunch period, band practice and concerts, and hosted events. The gymnasium had a large natural daylight opening that lit the entire space without artificial lights. Each hallway had a sky-room or clerestory window arrangement that lit the walkways and gave the school a pleasant feeling. When I talked with the school's principle, Lynn Wolf, he said that teachers and students enjoy the increased exposure to natural light - it's just a good feeling. With all the natural daylight entering the school, the architect did a great job at controlling the light with overhangs on the outside windows, frosted glass to diffuse the sky-roof light, and high clerestory windows to reduce sunlight disturbing tasks or activities.

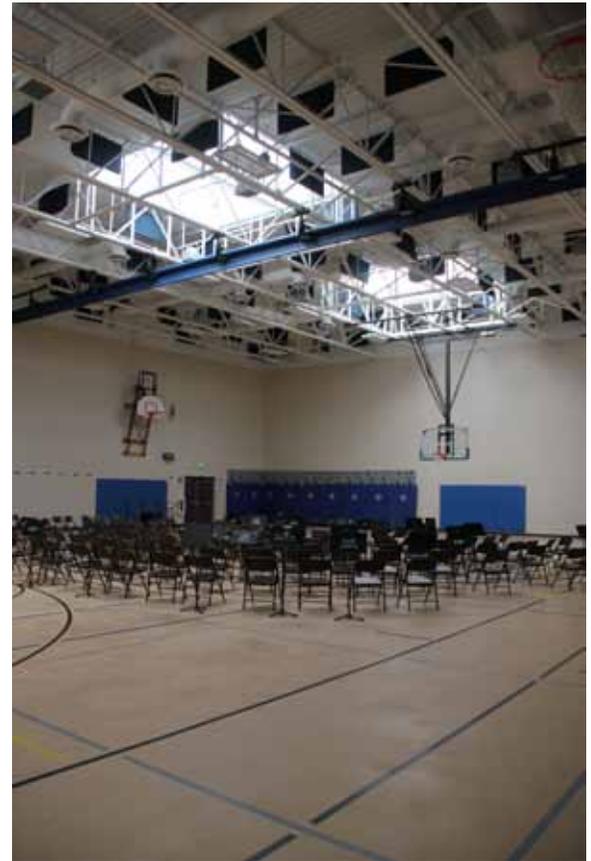


Figure 62.1 - *gymnasium*, Luke Diekman



Figure 62.2 - *corridor*, Luke Diekman



Figure 63 - atrium, Luke Dickman

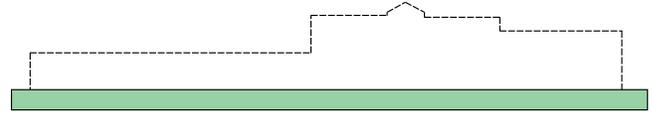
THE PROGRAM

Right as you enter the building, offices are to your left, the multi-purpose atrium is to your right, and the gymnasium is just around the corner. They designed all the event spaces easily accessible for practical and function reasons. The school's grades are divided into clusters, all connected by hallways with a library in the center. Each cluster of spaces contains classrooms around the outside to gain access to natural light, while bathrooms and storage spaces remain on the inside. Besides a gymnasium, a multi-purpose room, and offices, Sunrise also contains coat rooms, break-out spaces, custodial rooms, reading rooms, work rooms, bathrooms for students and faculty, staff rooms, computer labs, a music hall, music practice rooms, electrical rooms, and cafeteria kitchen and spaces.

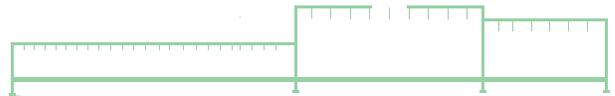
LOCAL CASE



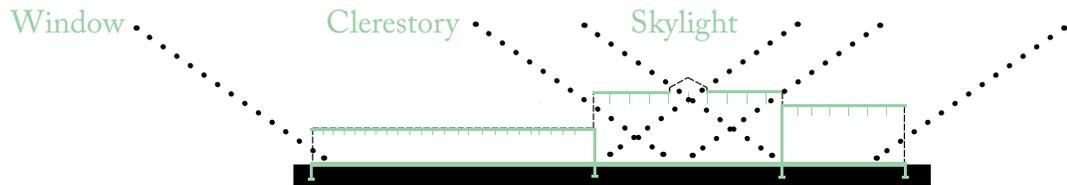
Massing



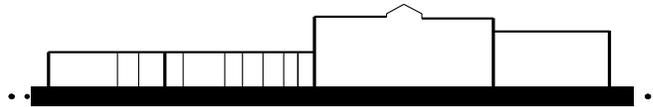
Heirarchy



Structure



Natural Light



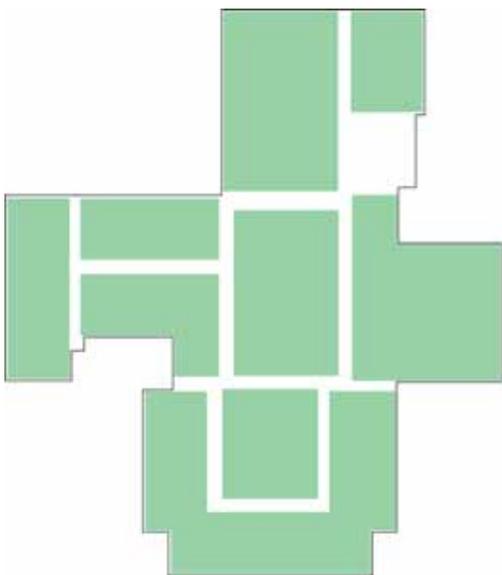
Plan to Section

STRENGTHS

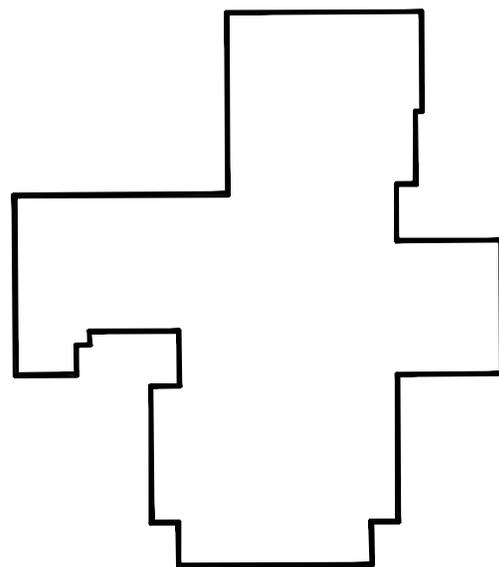
According to the City of Bismarck, Sunrise Elementary School ranked at the top in all categories of design compared to all the other schools within the city. The schools were critiqued on site, exterior, structure, roofing, interior, ADA, electrical, HVAC, plumbing, technology and safety, in which case Sunrise only missed a few points. I think their strongest aspect was their creativity with natural light. With each space it seems as though they asked the question, "how can we allow natural light in?" Quantity of natural light was obvious, but more interesting was the quality and intentionality. Natural light was present to accommodate tasks, or direct movement, or draw attention to a specific area; every use of natural light had a reason or task assigned to it.

UNIFYING IDEA

After talking to the principle, a teacher, and reading several reviews, I concluded that the use of natural light in the design was the most important aspect of the design. Daylight affects the overall mood of the spaces, which in turn positively affects productivity of student's work. Teachers are more satisfied with their environments too, which in turn positively affects their productivity. In the midst of the enclosed hallways, or daily activities within the school, there was a connection to the natural world. The daylight gave a sense of place, time, and season - I was always aware of the environment as I toured and documented my visit. This school was an inspiration to experience my topic of study.



Circulation to Space



Geometry



Bellevue Arts Museum

Bellevue Arts Museum

510

Figure 66 - *bellevue art museum*, Google

BELLEVUE
STEVEN HOLL ART MUSEUM
Bellevue Washington

BELLEVUE

The Bellevue Museum was designed by world renowned architect Steven Holl for the city of Bellevue, WA. Its exact location is at the intersection of Bellevue Way NE and the NE 6th pedestrian corridor.

The reasons I chose this as a case study was because of Holl's reputation for using natural light, and the Bellevue Museum's powerful display of his work. When it comes to implementing natural light into a design we think very functionally; Steven Holl starts with a design by thinking of natural light as not only functional, but art. Like an artist using paints, Holl explores painting his buildings with natural light as his medium.

"Throughout the building different types of light are utilized to correspond to different concepts of time. The design also focuses on how light comes into the building and how it emanates out to create an interactive beacon of light at night." (Bellevue Art Museum, 2012)

It is a very comprehensive design, taking into account the passage of natural light throughout the day, and throughout the year as seasons change.

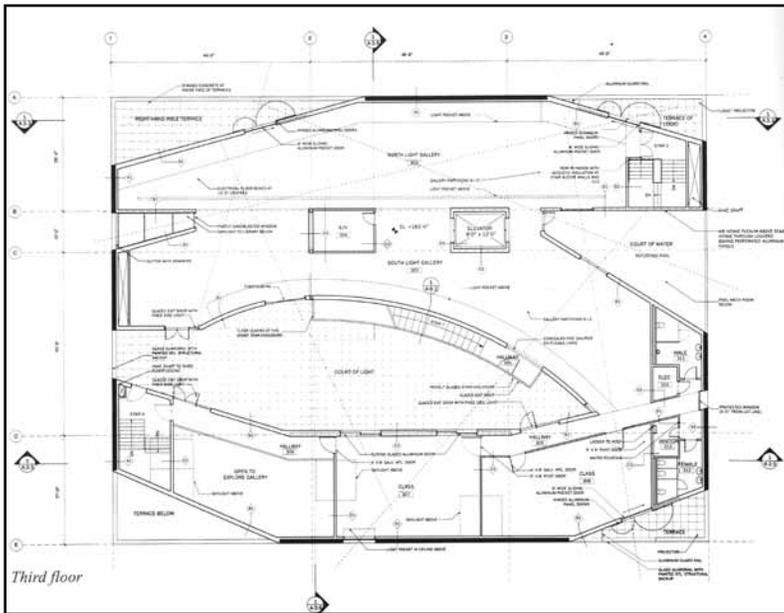


Figure 68.1 - *third floor plan*

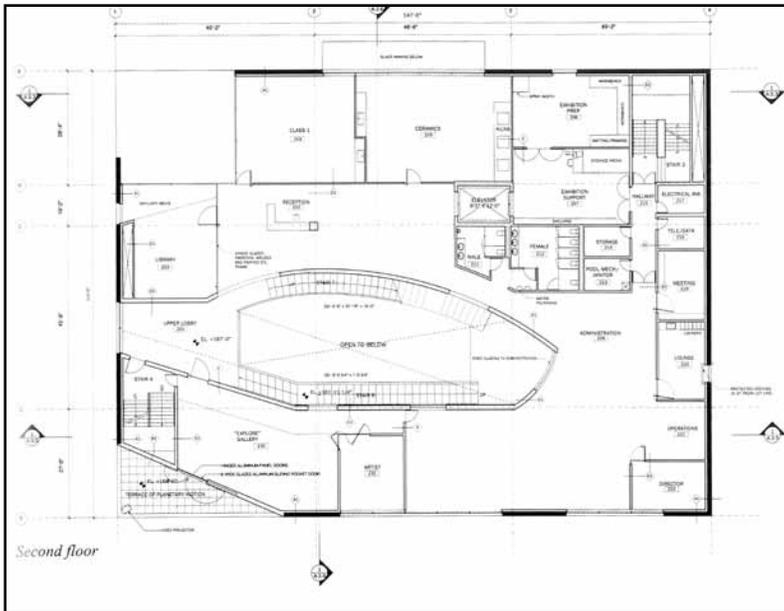


Figure 68.2 - *second floor plan*

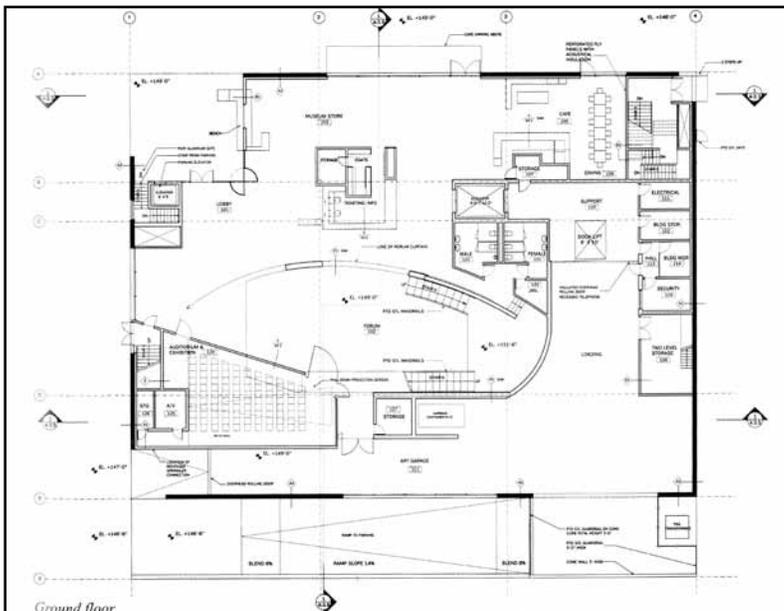


Figure 68.3 - *ground floor plan*

THE BUILDING

The building was designed to meet the spatial requirements of the growing museum, but to accommodate the display of art pieces as well as to be an art installation itself. "They wanted a more touchable art museum, one that encouraged participation and embraced a diverse menu of science, art and technology." (The Seattle Times, 2000)

The building's concept started with Holl painting with water colors. The Seattle Times stated, "Holl uses watercolor to explore critical elements such as light, space and volume."

Most of the buildings elements had a correlation to natural light. The geometry was formed to catch or prohibit light, the masses were designed to control the movement of light, and the materials and colors were determined based on the feel of natural light in the space and how well natural light interacted with the materials.

When Holl entered the project with eagerness to explore the effects of natural light, he stated, "There will also be three tiers, three distinct uses (to create, explore and learn about art), and three types of natural light." (The Seattle Times, 2000) Natural light to Holl was a way to express the spirit of emotion; art.

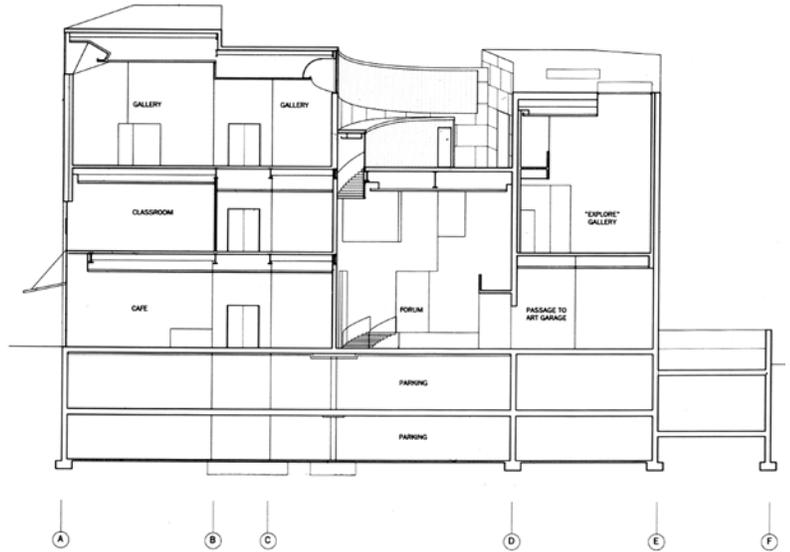
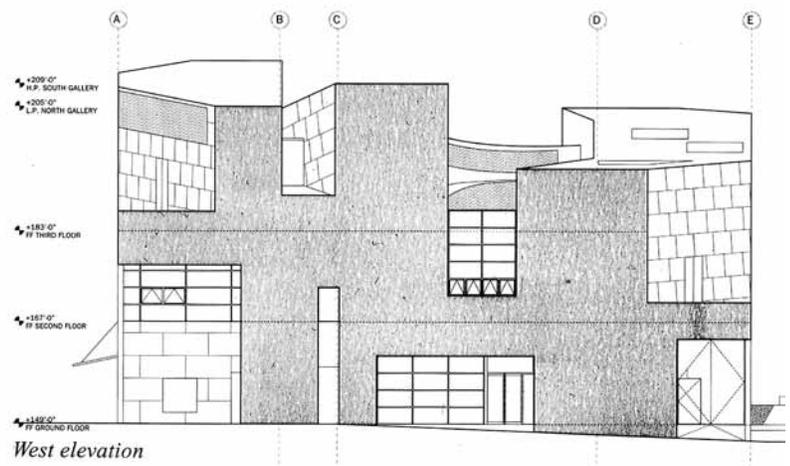
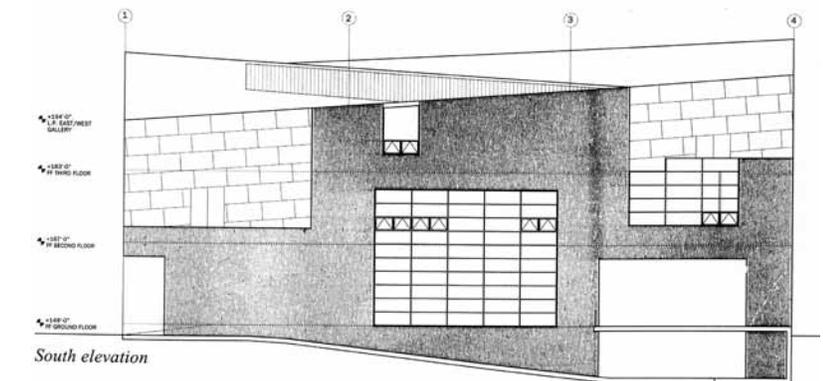


Figure 69.1 - section



West elevation

Figure 69.2 - west elevation



South elevation

Figure 69.3 - south elevation



Figure 70 - *steven hall interior*, Google

THE PROGRAM

The ground floor was designed to be open to the public, easily accessible for anyone that is curious. The Program on the ground floor consists of an exhibition hall, a museum store, a cafe, storage units and loading docks, two entrances, and a grand stair case in the center. The second floor contains gallery, exhibition, and library spaces. For the faculty there are meeting rooms, storage units, lounges, preparation spaces, storage and mechanical spaces. The center of the second floor is graced with a spacious reception area, and the grand stair case that leads up and down. The Third floor is a mixture of galleries and hallways; a beautiful connection between nature and enclosed spaces.



Figure 71.1 - *steven holl interior 2*, Google



Figure 71.2 - *steven holl interior 3*, Google

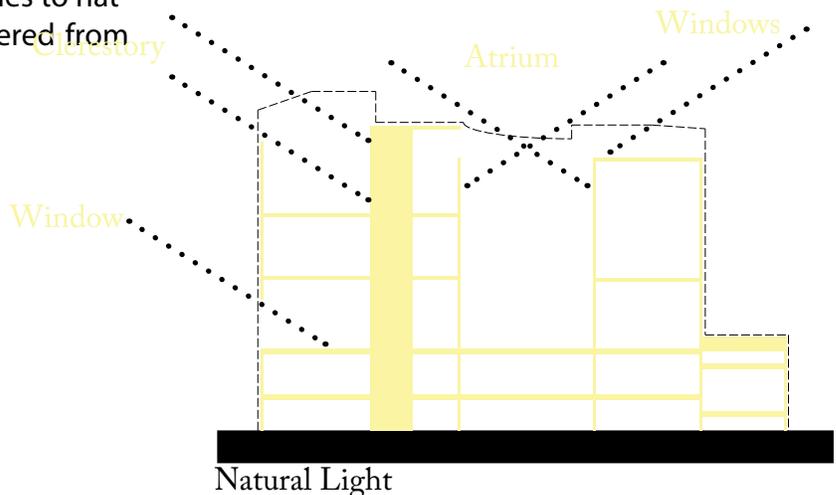
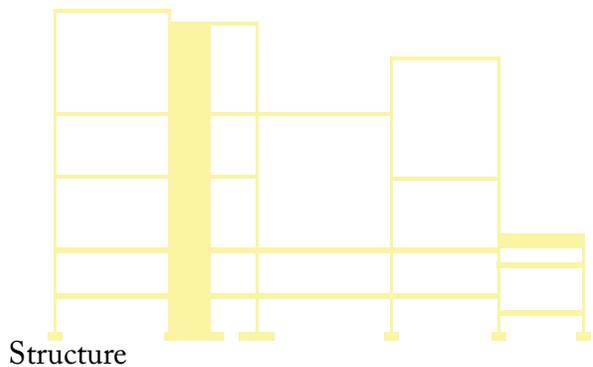
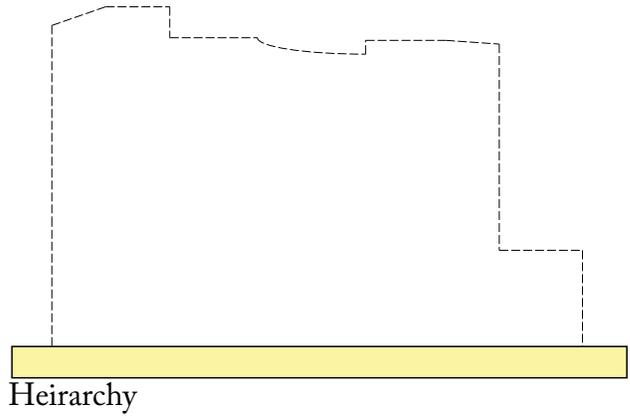
ABSTRACT CASE

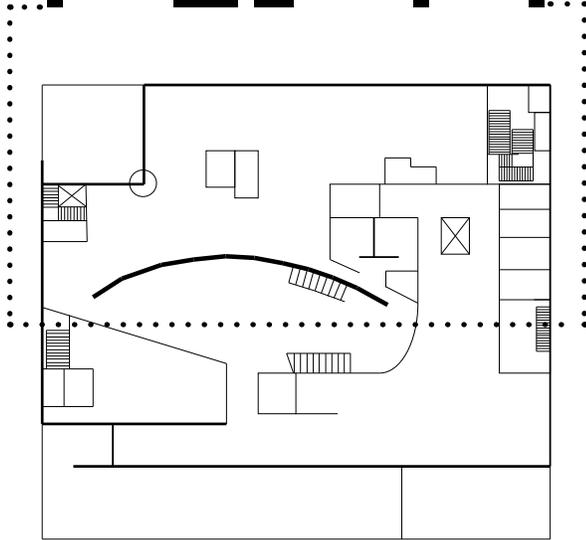
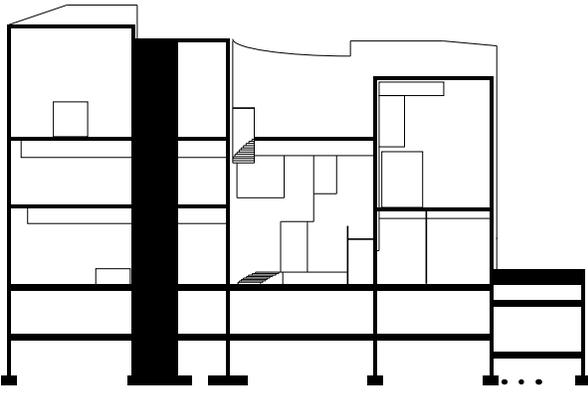
STRENGTHS

The greatest strength that the Bellevue Art Museum displays is natural light. It is a great example of designing with natural light at the conception stages of design and seeing the quality it produces, compared to designing a building and then trying to find ways to incorporate natural light to fit in. "Each of the three rooftop galleries that curl across the length of the building were designed with different types of natural light in mind. The northern gallery has high windows facing north. The center one, shaped like a crescent, contains a long, high window oriented to roughly track the sun's path across the sky. The southern gallery gets fragmented light through a series of skylights." (The Seattle Times, 2000)

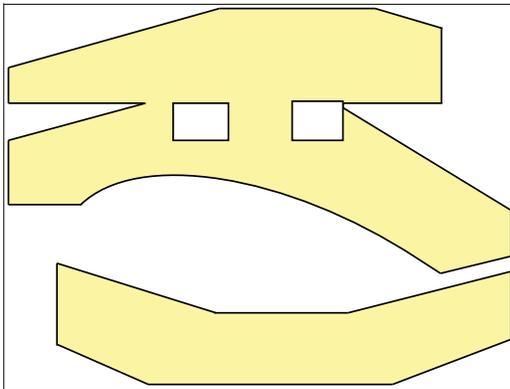
The other strength that really stuck out to me in this case study was the holistic mentality Holl explored with natural light. Natural light is more than openings in a wall, but the dialogue natural light has when it hits a color or a texture. "Color was important because the museum needed a strong presence. Bellevue's downtown palette is full of gray, brown and beige. Holl wanted something warmer and considered yellow and greens before finding red. The aluminum panels have a cool blue tint that plays with natural light." (The Seattle Times, 2000)

Forethought and holistic approaches to natural light are the strengths I gathered from this case study.

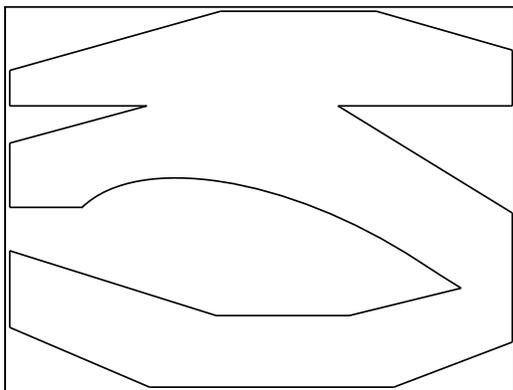




Plan to Section



Circulation to Space



Geometry

UNIFYING IDEA

Learning is tied together with motivation and mood, the spirit of the human being. Natural light has the ability to set the mood; it is a catalyst in motivation. Holl used natural light to inform movement, feeling, knowledge and connection to nature in a way that elicited enjoyment and participation. To clarify, elementary schools do not need to be art museums, I hope they never do; however, art museums, such as Holl's, inspire us to look past traditional, purely functional, uses of light and see daylight as something more; an art.



Figure 74 - barcelona elementary school, Google

BARCELONA

ELEMENTARY SCHOOL

Albuquerque, New Mexico

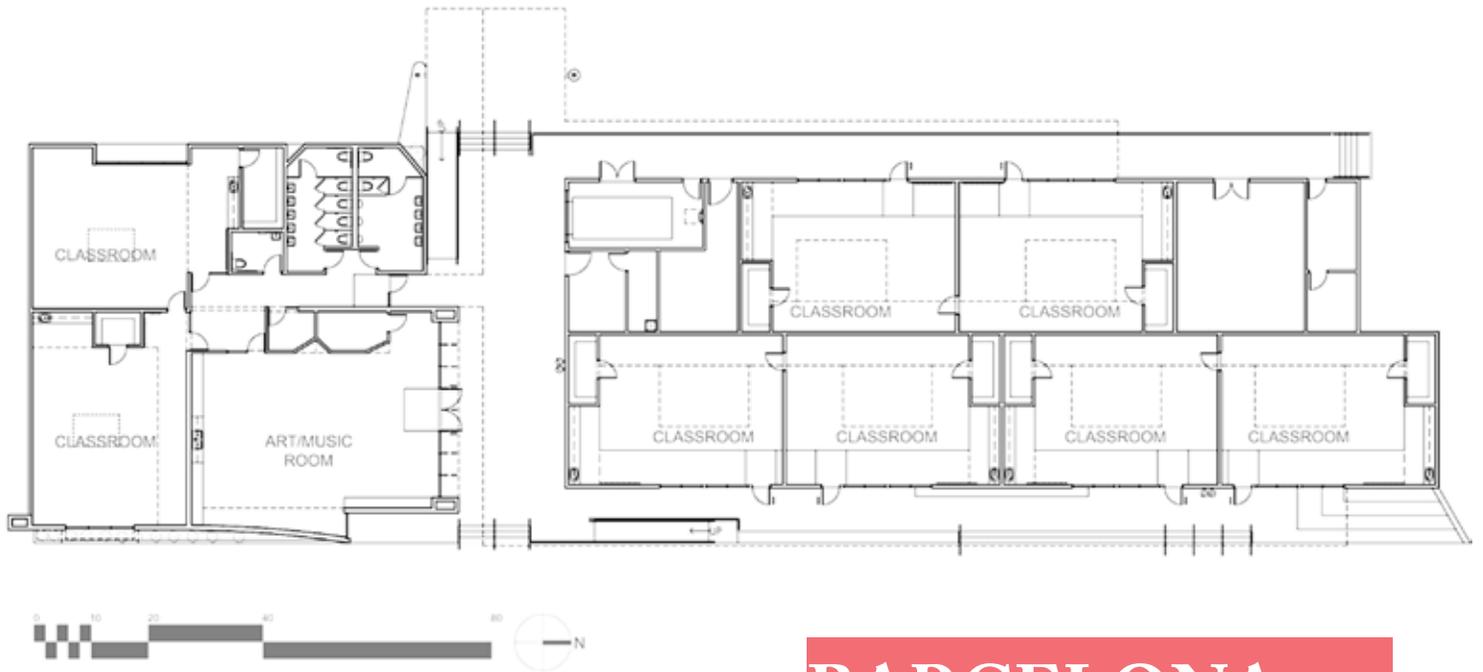


Figure 76 - plan

BARCELONA

The Barcelona Elementary School was designed by Baker Architecture+Design for the city of Albuquerque, NM. The elementary school was completed in 2009.

The reason I chose this building as a case study is for several reasons: 1) It has the same typology that I am researching. 2) The school is newer and contains modern design practices. 3) It is a national case so I can understand both local practices as well as national. 4) It had a strong focus on natural daylight. 5) It was awarded a LEED gold certificate for its design.

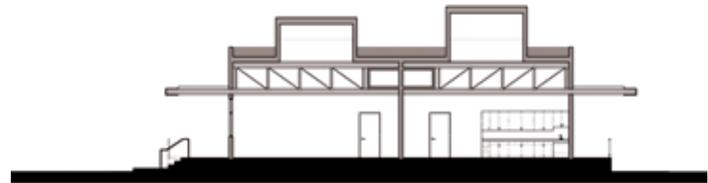
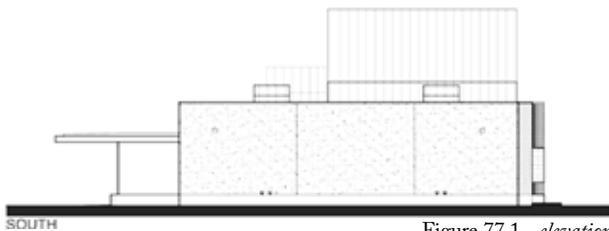
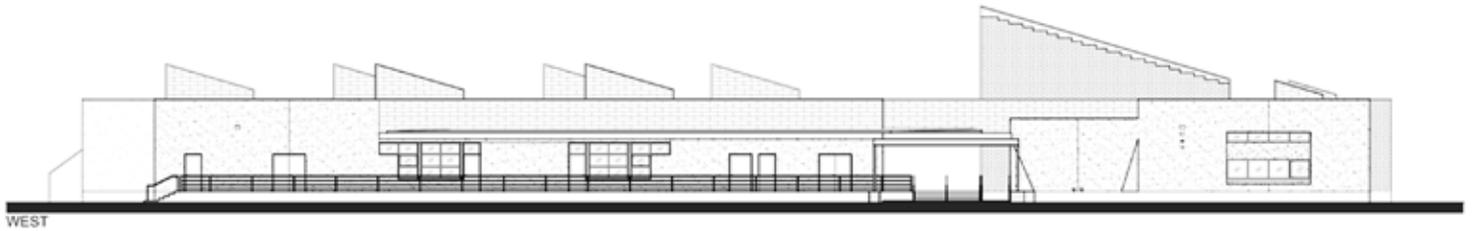
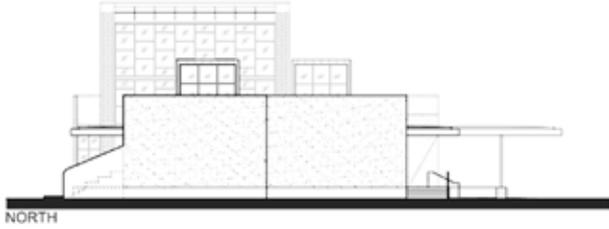
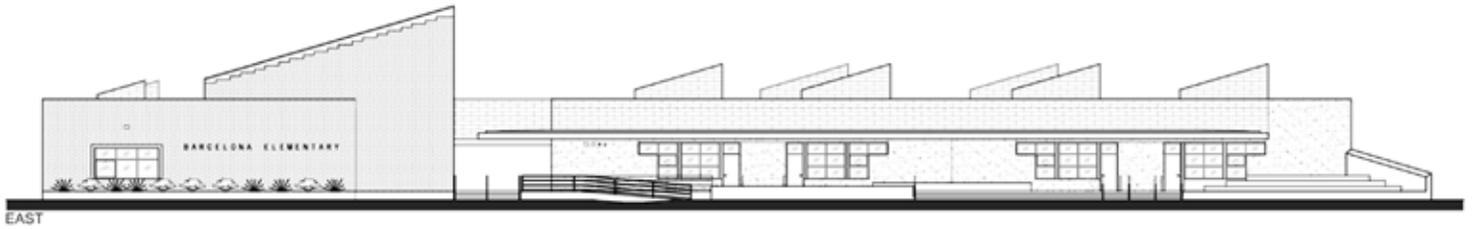


Figure 77.1 - elevations

Figure 77.2 - section



Figure 78.1 - *barcelona interior*, Google



Figure 78.2 - *barcelona interior 2*, Google



Figure 78.3 - *barcelona interior 3*, Google

THE BUILDING

As mentioned earlier, the Barcelona Elementary School obtained a USGBC LEED gold standing, and was the first school in New Mexico to do so. The school achieved its gold by implementing several sustainable design solutions. According to Arch Daily, “passive solar lighting in all rooms plus multiple lighting levels to work in harmony with natural day-lighting.” (Arch Daily, 2011) I really appreciate the fact the building doesn’t separate natural and artificial, but that good design makes them sing in unison.

Like Steven Holl’s design methods, the Barcelona Elementary School was created with daylight as a forethought, which was carried through the rest of the design. “The solar orientation and natural day lighting strategies had the most profound effect on the building’s design.” (Arch Daily, 2011)

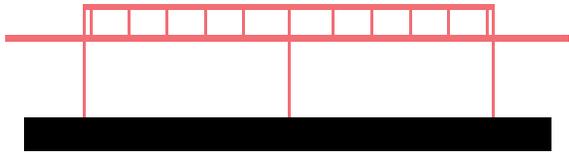
The day lighting strategies implemented into the design were huge clerestory windows, light monitors in every classroom, deep sidewalks covered by overhangs, shading louvers covering the north facade, and a color palate that corresponded well to daylight.

The best part of this case study was seeing the images of its spaces interacting with the daylight, and how friendly and inviting those spaces are.

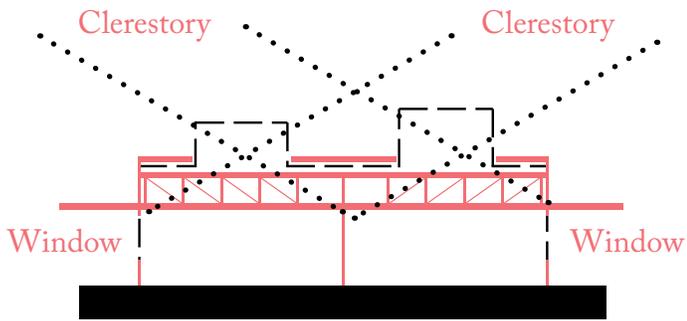
THE PROGRAM

The school is quite small and is only comprised of one floor. The school is made up of eight classrooms, an art/music room, a set of bathrooms, and a couple offices and storage spaces. Hallways sound the exterior, shading the classrooms from the East/West sunlight. In the center of the school is a wide hallway that connects the two exterior hallways, and acts as a wind tunnel.

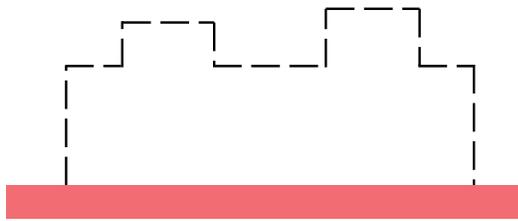
NATIONAL CASE



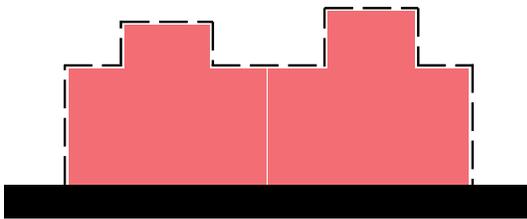
Structure



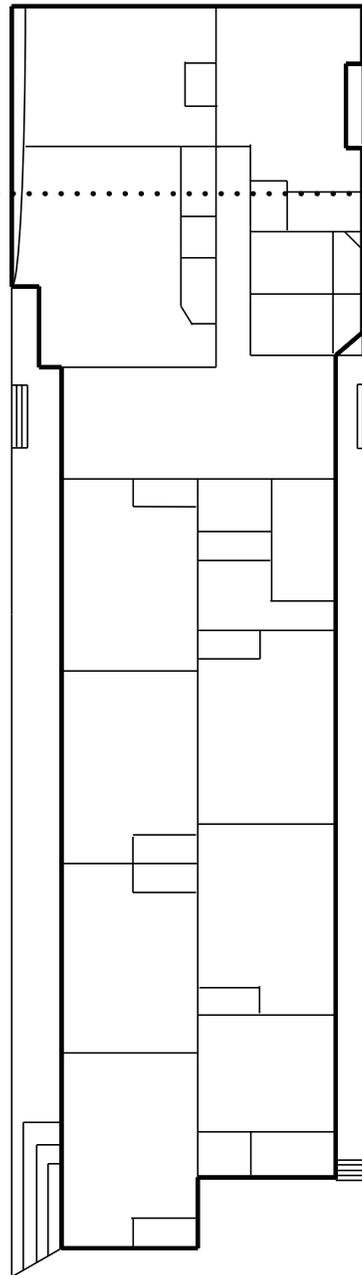
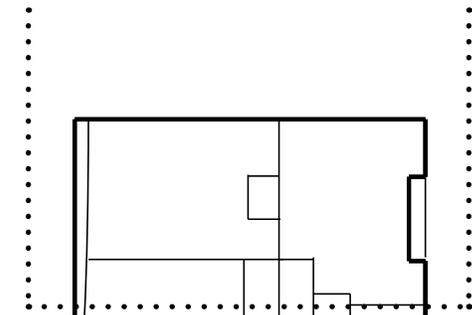
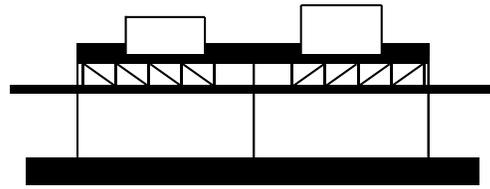
Natural Light



Heirarchy



Massing



Plan to Section

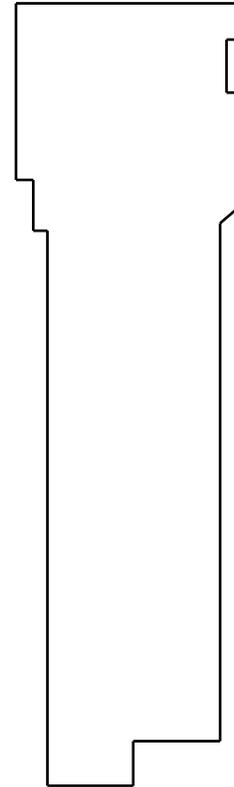
STRENGTHS

The greatest strength that I see in this case study is its design decisions through a body of knowledge. Similar to Fargo, New Mexico can sport extreme weather conditions. During the summer months, it gets to be very hot, with temperatures well over one hundred degrees Fahrenheit. Attaining a LEED gold certificate wasn't for show, it was very practical to implement those design solutions. With sustainable solutions in mind, Barcelona was able to not see daylight as something to avoid, but something to use to their advantage. Sunlight gives off a great amount of heat, and this case study was a great example of a school shedding the energy of the sun and harnessing its energy as a resource.

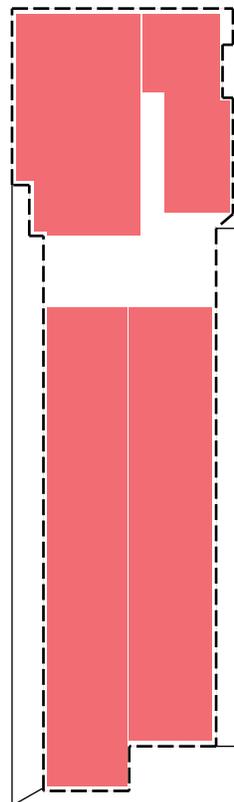
This case study is a good example of practical decisions. According to Arch Daily, some of those practical decisions were, "Natural light / views. Our site necessitated a north / south orientation, so primary windows are to the east and the west. The sun has been controlled with large overhangs and orientation to limit glare and overheating. Large "light monitors" have been provided in the middle of the rooms to bring the natural light into the back of the room." (Arch Daily, 2011)

UNIFYING IDEA

My unifying idea is that the experience of a space is directly correlated with our developmental process and learning motivation. Not enough sunlight will lead to depression, glare produces eyestrain, and too much sun can produce considerable heat gain. All these circumstances produce distractions for learning to take place, so intentional architectural solutions must be undertaken when designing an elementary school. Similar to New Mexico, North Dakota has daylight issues. During the winter months in North Dakota there is limited access to daylight, in which case practical architectural solutions concerning natural light are necessary.



Geometry



Circulation to Space

SUMMARY

UNIFYING IDEA

Not only is light a biological need, but a catalyst in motivation and mood. The experience of a space is directly correlated with our developmental process and learning motivation. A well lit space, inviting the natural light to enter, gives its inhabitants the ability to grow and enjoy learning.

After reviewing many case studies, and exploring these last three in depth, I've realized that each case brings something unique to the discussion table. Going into this portion of the program document, I wanted to use a variety of case studies to gain a more comprehensive understanding of natural light and architectural practices. I decided to use a case that was close to the site, one that was nationally acclaimed, and one that was abstract or philosophical (the case would deal with natural light, but would not correspond to the same typology). With each case being different geographically, I also decided to have each case directly relate to one of the three categories: mind, body and spirit.

The Bismarck elementary school spoke about the dialogue between natural light and the mind. The school was built where the climate loses daylight during the winter and daylight is important for mental health (Seasonal Affective Disorder) and mood/motivation. The entire school allowed daylight to enter using different openings in the facades and roofs.

The Barcelona elementary school clearly defined how natural light affects the body. The climate in New Mexico is very different from North Dakota's climate – protection from overexposure to sunlight is more important than prolonged exposure. The architectural decisions for this elementary school were based on reducing heat gain from sunlight, glare, and overexposure. All these precautions in the use of natural light can either positively or negatively affect the body, which in turn affects the student's ability to learn and perform tasks.

The art museum in Bellevue catered to the spirit of natural light. The architect, Steven Holl, used natural light to draw inspiration for the building's form, movement, and feeling. The art museum acted as an art piece itself, in which case natural light was on display. The dialogue of daylight speaking to the building's function and materials creates a phenomenological experience that is enjoyable and aesthetic.

When I look back at my unifying idea after all the research and case study analysis, I feel as though it reaffirmed it through greater detail. The only negative reaction I have towards my unifying idea was that I felt it was too simplistic, but then again, the purpose of a unifying idea is to condense everything into a sentence. Besides the feeling of simplicity (which could be the result of in-depth understanding), I was reassured of my vision for this thesis as each case study reiterated the benefits of natural daylight in education.

The common thread in each case study was the use of natural light throughout the design, but what made the case studies interesting to me were their differences. As mentioned earlier, each case study correlated with a specific area of the human being (mind, body, soul), and they also differed geographically, demographically, contextually, and functionally. The museum case study was of a different typology, but I still felt that inspiration was gained through the exploration of natural light and its correlation to environmental mood and motivation. The spaces within the museum were designed for other's enjoyment and enfilade through the exhibits. Even though the Barcelona Elementary School had the same typology as my field of interest, its geographic location brought demographic and climate differences. My views are shaped by my experiences, and in my mind increased exposure to daylight is an absolutely necessary, but in New Mexico where daylight is very consistent, that is not an issue. The Barcelona case study convinced me that the daylight needs of people groups change from place to place.

As mentioned with the Barcelona case study, the site had a huge impact on each building's design and natural light needs. The Barcelona Elementary School had primary site conditions: limited space and climate. The Bellevue Art Museum had quite different site conditions. The hardest obstacle for Steven Holl were the adjacent buildings, its context. For natural light to interact with his building, he had to be mindful of the surrounding buildings, the seasonal sun patterns, and orientation.

The core functional issues of both elementary schools were to create the best learning environment for their students. The functional differences between the two schools were their approaches to regulating daylight. Protecting its exhibitions from harm and eliciting emotion through natural light, were the two main functional characteristics the Bellevue Art Museum achieved.

Form follows function is a common architecture canon, and each case study's spatial relationships were largely influenced by their functional relationships. The basic design of an elementary school is to have hallways with classrooms around the perimeter. Because of the cold weather, Sunrise has fully enclosed hallways with classrooms around the perimeter for daylight access. Barcelona on the other hand has hallways around the perimeter with classrooms on the inside. Spatially the school is designed to meet the functional needs of reducing heat gain from direct sunlight. The only oddity I found in the spatial layout of spaces was from the Bellevue Arts Museum. Steven Holl Started with a form (a gesture he created with his hand) and proceeded to design the spatial layout of the building. He used that form however, to gain inspiration for the passage of natural light and people throughout the spaces.

All the technical issues come from the philosophical idea of light and shadow. The question posed, where should there be light and where should there be shadow? This simple question has a very intricate answer that is circumstantial to each individual case. The case studies I have discussed have helped me gain a greater understanding of architectural practices concerning natural light and its effects on the learning environment.

CONCLUSION

All the technical issues come from the philosophical idea of light and shadow. The question posed, where should there be light and where should there be shadow?



Figure 86 - *bismarck state capital building*, Google

HISTORICAL

CONTEXT

Bismarck, ND

The historical context is broken down into three categories: historical, social, and physical. The Thesis has three requirements: 1) a specific question must be posed for further research and exploration. 2) A building typology must be chosen to explore the question. 3) A site must be selected. I will discuss the requirements (Question, typology, and site) further in-depth with each category (Historical, social, and physical). I will begin by briefly covering the history and social context of Bismarck where my site is located, next I will discuss the history of elementary schools, and then lastly I will write about the social trends of natural light in architectural practices.

PHYSICAL

The site in which my thesis resides is the capitol of North Dakota; Bismarck. The city of Bismarck progressed as a state through a series of industrial movements and national events. The first big industrial movement that brought attention to Bismarck was the Northern Pacific Railroad. The railroad company built a terminal along the Missouri River in Bismarck and it was used for transportation. ("Bismarck city portrait", 2013)

The second big event that brought people to the Bismarck area was the Gold Rush. In 1871, Camps were set up in Bismarck and the city turned into a haven for saloons and prostitutes. The camps in the city were very detestable, and only lasted a few years. (Hoffman)

The city was not always named Bismarck; it received its name in 1873 in honor of a famous German statesman in hopes of attaining financial support for its future growth from him. Even though support was not given, the city's name remained. Soon after the city's name was established, a church was built, as well as a tabloid and a school! ("Bismarck city portrait", 2013)

The majority of the city's growth came through the establishment of the railroad. Bismarck became a city of trading and transportation. The city thrived in business and became North Dakota's state capitol in 1889. ("Bismarck city portrait", 2013)

Bismarck's History

The city's current population is 61,272 people and steadily increasing. The city is still thriving in business, boasting a low unemployment rate that is under three percent. ("City-data: Bismarck north Dakota) The city is experiencing tremendous growth in the last few years due to oil drilling in cities nearby. Today, Bismarck is faced with a housing crisis due to its rapidly increasing population. Increased population means an increase in the number of schools needed to accommodate children's educational needs.

The ideal situation for the Bismarck public school district is to have eighteen students-to-one-teacher ratios, but that has been compromised to accommodate the increasing number of children enrolling. Currently, sixteen out the nineteen schools in Bismarck are over-capacity. ("Community forum meeting #1) The teacher-to-student ratio has been stretched, as well as the spaces within each school. Teacher's offices and multi-purpose rooms are now being reused as class rooms.

The city has stated it's in need of three new schools immediately; two new elementary schools and one new high school. ("Community forum meeting #1) The site that I have chosen for one of the elementary schools is located in the North-West sector of Bismarck. The land is already owned by the city's board of education and is ready to be used. The areas surrounding the site are comprised mostly of residential suburbs that have plans to expand as the city continues to grow. The site is a proper place for a new elementary school that will serve its community well.

HISTORICAL

This next section on historical context I'm going to discuss my typology: elementary schools. There are two topics I want to touch on regarding the history of elementary schools: 1) a brief history of the development of elementary schools over the last couple centuries. 2) A glance at the development of the local elementary schools in Bismarck.

The design of schools in the urban setting around the 1850's was pretty basic in their form and function. "Brick walls, axial plans, pitched roofs, historical styles, two to four stories, and very small sites characterize these structures." (Brubaker, Planning and Designing Schools, 1998) Most of these early urban schools were reduced to classrooms, hallways, and stair cases. Even though the function of these schools was very basic, the facades of some of these schools were very ornate. The Classical, Gothic, and Victorian styles in architecture produced some very beautiful schools that were preserved well and are still used today.

Around the 1900's, a new form of schools started being designed called "Prairie Schools". According to Brubaker, "Prairie School style included long horizontal lines of brick, wood, and stucco; continuous bands of windows sheltered by large roof overhangs; and new nontraditional forms and details." (Brubaker, Planning and Designing Schools, 1998) The one element that really characterized these schools is their attention to landscape. Before, schools were built on small lots with just enough room to build a functional facility, now schools were being designed with spacious exteriors.

History of School Design

The next great leap in school design came from the firm Perkins & Will. One of their schools designed in the 1940's, Crow Island School, was created with three goals: 1) Create a significant example of modern architecture. 2) Perform a restudy of Winnetka's educational system. 3) Redirect the learning process and the architecture it generated, recognizing the importance of how to teach and where to teach. (Brubaker, Planning and Designing Schools, 1998) To build a school intentionally, seeking to be more efficient and striving to be more effective with the educational environment was a new mindset when designing schools. Perkins & Will started a new standard in designing schools, in which all new schools being designed began to implement this new way of thinking.

The 1950's brought a wave of cheap, easily constructed, mass produced schools due to the baby-boom that was happening at the time. The 1970's were filled with schools that would serve other functions when they were no longer used as educational facilities. These schools were designed to fit various functions such as shopping centers, bomb shelters, private companies, etc., when they no longer served their educational purpose. (Brubaker, Planning and Designing Schools, 1998)

Today, schools are being designed sustainably. Sustainability takes into account several key factors such as the needs of the environment, the psychology of learning, and the subjectivity of context. The greatest asset throughout the history of designing schools is the application of knowledge. As we become more aware of the learning process, the environment, the practical uses of schools, and previous successes and failures in designing schools we progress towards smarter and more efficient designs.

Currently in Bismarck there are seventeen elementary schools. The completion date of these elementary schools range from the 1950's, Will-Moore Elementary, to their newest elementary school, Sunrise, which was completed in 2010. ("Community forum meeting #1 & 2)

The schools all have very different layouts ranging from radial, cluster, and linear configurations. All of the elementary schools contain no more than two floors and have very similar material palettes consisting of various types of Brick. The older schools have been known to lack functionality in their spatial layouts, as well as a lack in sensitivity to the learning environment.

The city's newest elementary school, Sunrise, displays a good understanding of modern practices. All the schools were assessed by the school board on eleven factors: site, exterior, structure, roofing, interior, ADA, electrical, HVAC, plumbing, technology, fire safety. Sunrise scored the highest, achieving a ninety-eight percent overall grade. ("Community forum meeting #1) The school was designed with the student's needs in mind, not merely creating space to house students. Sunrise was praised for its holistic design and pleasant atmosphere.

Bismarck Schools

SOCIAL

In earlier school designs, a window was seen as practical for two reasons: 1) it provided light for tasks. 2) When the window was opened it provided air circulation. These very basic concepts helped students perform their tasks the best they could in their environment; however, it was very dependent on the natural environment.

As technology progressed, windows were accompanied by artificial lights and air conditioning units to prolong working hours with more consistent lighting and temperatures. In the mid 1950's, there was a period in time when windows were considered useless. (Hatcher) Artificial lights were more consistent and reliable, and air conditioning units regulated the temperature better and faster than windows, so both apparatuses became more functional and practical in the general public's opinion.

The idea that windows were useless didn't last very long. As studies in psychology and sociology developed, so did our understanding of natural light. Even though natural light and cooling could not outperform a light bulb or an air conditioning unit, it offered us something those apparatuses could not; a biological need. Natural light at this point in time was seen as a good thing, but the understanding of it was still developing as well as its architectural implications.

This last section I will discuss the social trends and developments within our society concerning natural light. The progression of natural light used in school design, and the effects natural light has on education are what I want to focus on here.

Within the last two decades we have progressed in our knowledge of natural light. Realizing the effects of natural light on mood, behavior, productivity, mental and physical well being has changed the way we practice architecture. Creative uses of inviting natural light into spaces is commonly practiced by architects and widely enjoyed by their clients.

Currently with the sustainability movement at hand, light is not only seen as a biological need, but an energy resource. Buildings now use overhang devices that shield against direct sunlight during the hot times of the day; some use solar panels to convert energy from the sun into electricity; some use sunlight to reduce the reliance upon artificial lights to illuminate spaces, thus reducing energy costs. The benefits of natural light have greatly developed within our society and have become a social trend that will be exciting to watch progress into the future.

PROJECT GOALS

When I was a young boy, I made up my mind I wanted to make buildings when I grew up. I would play with my Lego sets dreaming one day I would make real buildings. As I went through my High school years, that dream stayed with me, and I remember telling everyone that when I graduate I was going to pursue architecture. Now, I am a fifth year architecture student at North Dakota State University, and the dreams I had when I was a young boy are slowly becoming a reality.

As old dreams are coming to pass, I'm at a stage where new dreams are arising. With my last year in school I ask myself questions: what are my dreams academically? What are my dreams professionally? How about personally? My dreams are my goals, and to have them brings passion, excitement, and adventure to work as well as life. I will briefly talk about my goals academically, professionally, and personally.

INTRODUCTION

I am a graduate student here at North Dakota State University, and am completing my thesis in hopes of attaining a Master's in Architecture. Throughout my education here at NDSU, I have come to enjoy the emotions that architecture elicits, and the ability to create those experiences for others. I have always been drawn to churches; seeing their ornate beauty and experiencing the light play with the interior elements amazes me. Churches inspired me to design spaces with feeling and intentionality. As I pondered my favorite element in architecture, I concluded it was daylight. The reason churches were so experiential to me was because they incorporated daylight. The more I learned about daylight, the more I realized how important it is to everything we do; emotionally, physically, spiritually, socially, and my topic of research, educationally.

My goals academically are to understand all I can about natural light, and to create a thesis that is clear and professional for others to learn and enjoy. Thesis is the capstone project of my five year experience in the program, and my goal is to push my limits and capabilities to create a thesis I am proud of, as well as a thesis that employers will see my skills and abilities and desire me to work for them. My ultimate goal academically is to graduate with a Master's in Architecture by completing a standout thesis project.

Professionally I have two main desires; to achieve the best that I can do, and to be accepted wherever I work. I have started the Intern Development Program and would like to complete that, and then become a licensed architect. I have worked in a firm, and I know what is expected. My goal is to work as hard as I can and to experience as much as I can in hopes of doing my best wherever I go. My desire for affiliation has given me a passion for people and relationships. My goal is to work for a firm that treats its employees as family and where there is a thriving community. I would also like to work for a firm that is knowledgeable and is always striving to achieve better work and good relationships. Achievement and relationships with people has given me a passion to one day own a firm.

PROFESSIONAL

My personal goals in life are to never suffocate creativity, limit exploration, or merely coast through life. I want to create, I want to explore, and I want to live life with passion! Architecture has always appealed to me in those areas, and I want to maximize those opportunities. Architecture is universal, so I would like to travel someday and work in places I never thought I could. Architects are considered “masters of all trades”, and I would like to understand the world and be able to learn new skills. Most architects retire many years past the typical forty, and I would like to be so excited about my profession that it doesn’t seem like work anymore. My ultimate personal goal is to leave a legacy. I want to do good work, bless those who work with me, live life with integrity, spend time with my family, and give God all the credit.



Figure 100 - *site path*, Luke Dickman

SITE ANALYSIS

QUALITATIVE ASPECTS

Bismarck, ND



Figure 102 - *needle grass*, Luke Dickman



NARRATIVE

I remember researching throughout the summer months, trying to find an appropriate site that fit the criteria for my elementary school in Bismarck. After many hours of research and balancing the needs of the Bismarck Public School System, I located a very practical lot of land in the North-West sector of Bismarck.

There were a few key reasons as to why I chose this site: 1) the site was in a district that needed a new elementary school. 2) Surrounding the site was a mixture of undeveloped land and developing neighborhoods. 3) The land was currently owned by the Bismarck Public School System. 4) The site is easily accessed by one of the city's main roads: Washington St.

With these very practical and functional reasons, I chose this piece of land to be my site. The first site visit I made was on September 27th, 2012. The trip was made in the morning hours to avoid the heat from the warm summer days that were occurring. The site was absolutely beautiful – much better looking than Google Maps portrayed it to be.

It was very quiet. I felt connected to the natural world as I closed my eyes and listened to the nature's sounds around me. The music of grasshoppers hiding and the wind moving over the long grass filled the air. In the midst of my documentation, I had to put down my tools and just enjoy everything that the site was offering.

The only noise that occurred was the occasional passing of a car on the nearby road. As I journeyed throughout the site, I really enjoyed the views, smells, sounds, and textures that were there. The colors of the vegetation were a pleasant palate of greens, reds, and yellows all kissed by golden rays of the overhead sun.

The site really captured the essence of Bismarck – very plain and simple, and at the same time very peaceful and delicate. There was a dichotomy arising within my mind; part of me was excited to see this land develop, and part of me wanted nothing to disturb it. The further I walked away from the main road, the more it felt like I was in the middle of the country. The land was flat so a person could see distant townscapes in the horizon.

A neighborhood formed the southern boundary of the site. To the west was a beautiful modern church with more residential neighborhoods hiding behind it. The East went on forever; hazy outlines of commercial buildings interrupted its vast natural landscape. The northern view from the site remains untouched by development.

The site is generally flat. There are a few indentations in the land, but they were very subtle. When I was present, there weren't any pools of water – Bismarck had experienced a very warm summer this year, so the lack of water on the site could be explained by drought. Apart from a few clusters of trees wrapping around the northern boundary of the site, there was nothing obstructing the sun from the site. This nakedness to the natural elements make the summer months very hot from the sun, and the winter months very cold from the dominant North-West winds.



Figure 106 - *site path 2*, Luke Dickman





Figure 108 - soil, Google

SOIL SURVEY

NORTH-WEST BISMARCK, ND
Burleigh County



The soils that comprise my site are Williams Association. The Williams soils are very common in the central and northwest areas of North Dakota. The Missouri river is an underlying geological cause of these soils. "Surface drainage is partially developed and considerable surface runoff drains into the depressions." (Patterson, Soil survey report, 1968)

The Williams soils are found in landforms that contain slopes, hills, ridges, and convex crests. The slopes of these landforms range from 1 to 8 per cent, and can be as steep as 12 per cent. According to the Soil survey report, "Williams soils are well-drained Chestnut soils developed from calcareous, loam glacial till." (Patterson, Soil survey report, 1968)

The composition of Williams soils change at four different levels: A, B, Cca, and C. The surface soil, A, which is about 3-6 inches is a dark brown loam that contains a moderate granular structure. The level underneath the surface soil, B, (4-16") is a dark grayish brown clay loam that contains a moderate prismatic and blocky structure. The third level of the Williams soil, Cca, which is 16-26 inches below the surface is a light olive brown loam and contains a prismatic and blocky structure that is strongly calcareous. (Calcareous means it is very chalky because it is composed of calcium carbonate) The bottom level of the soil, C, (26-60") is simply a light olive brown loam that is calcareous. (Patterson, Soil survey report, 1968)

This type of soil has a high water-holding capacity, which makes it prized as cropland. The depth of the Williams soils to the water table is around 80 inches. (United States Department of Agriculture, 2011)

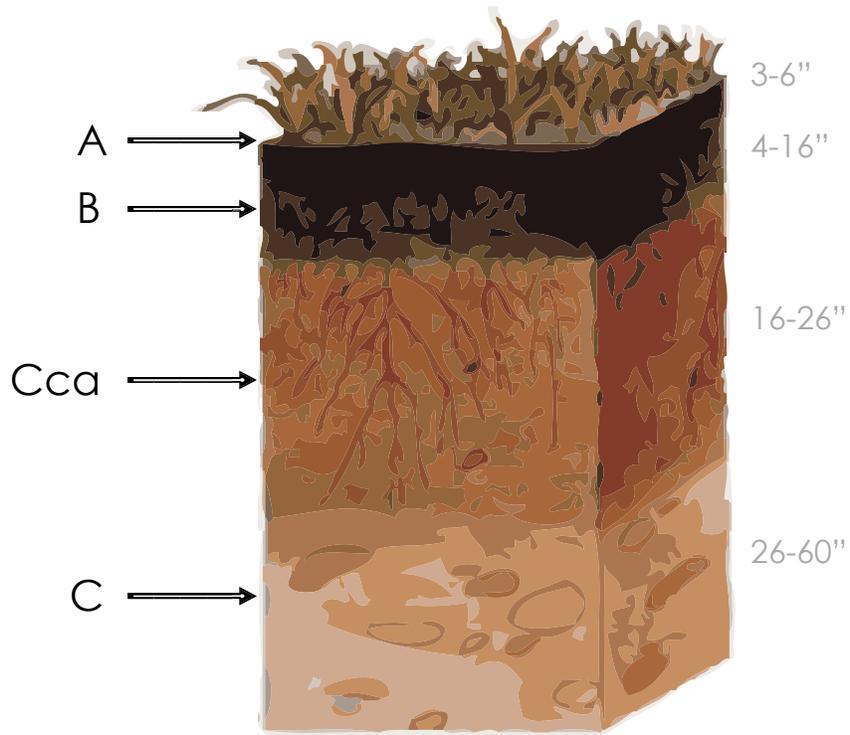


Figure 111 - soil figure, Google

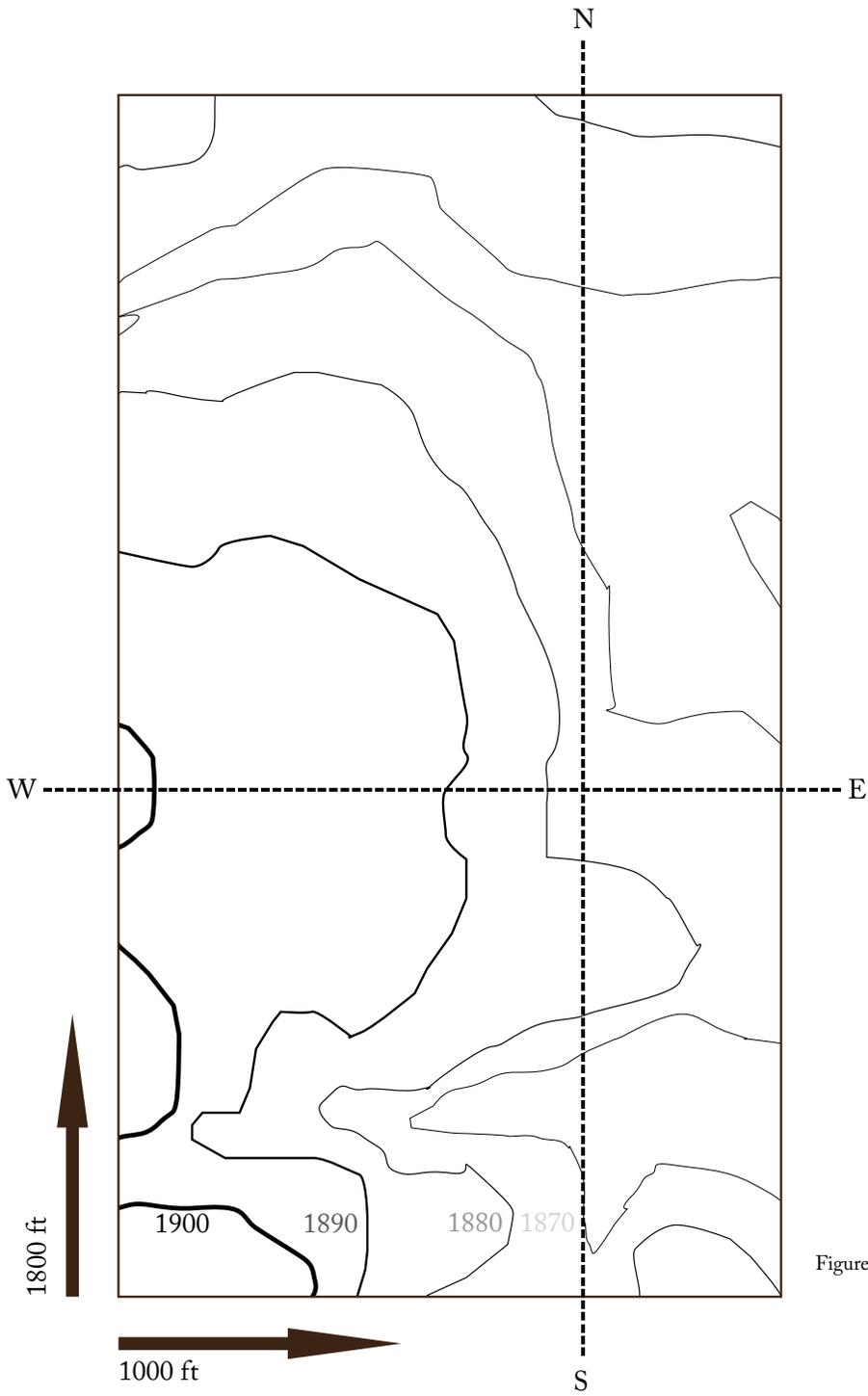
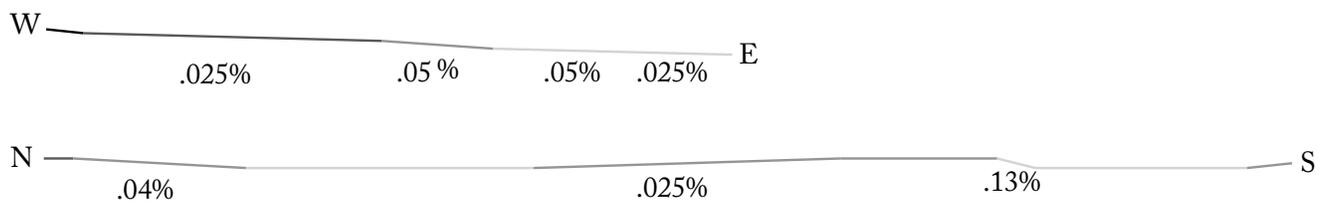
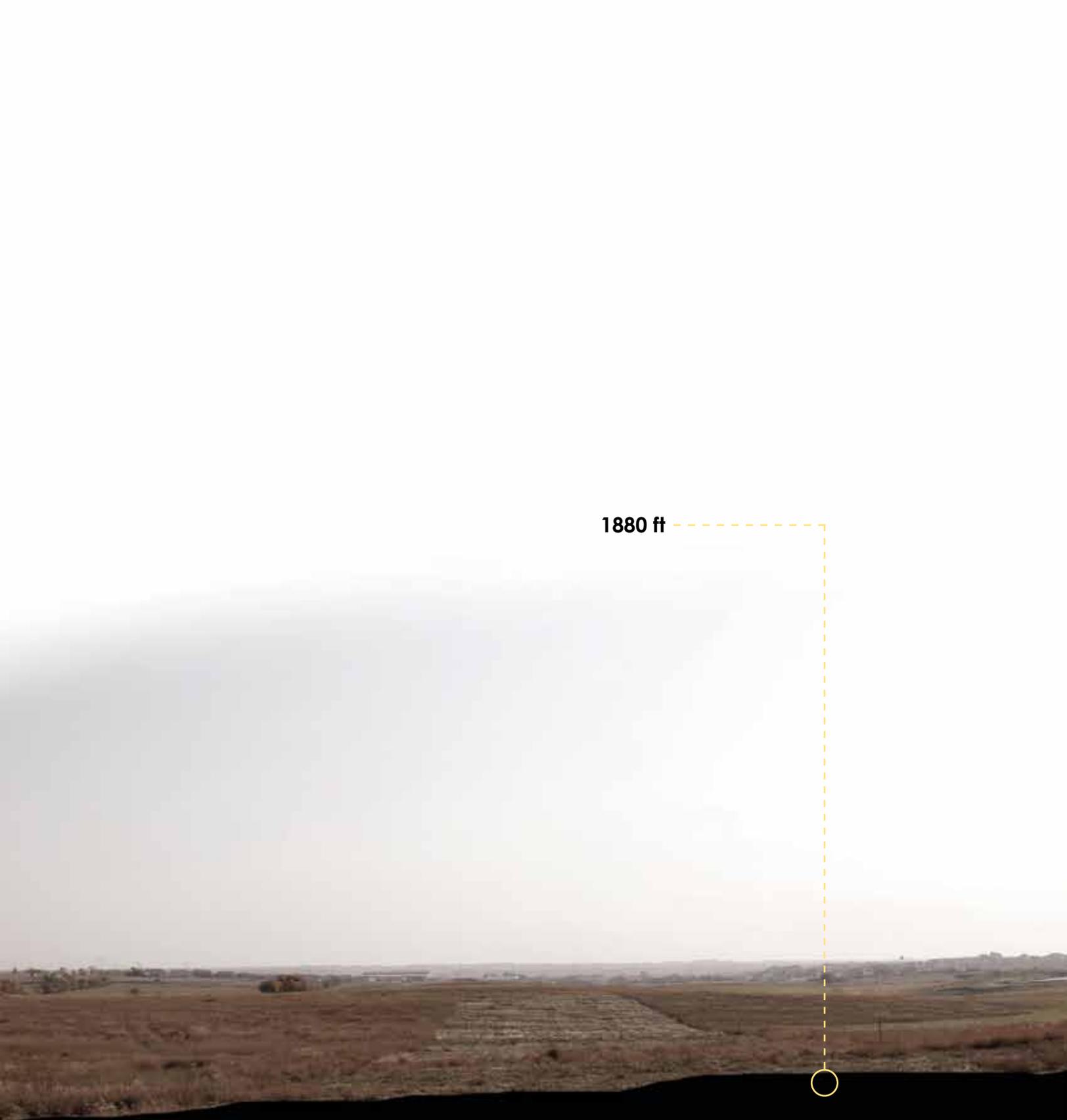


Figure 112 - *Slope analysis*, Illustrator



SLOPE ANALYSIS



1880 ft

Figure 113 - *site section*, Luke Dickman

SECTION & ELEVATION

E



Figure 114.1 - *site view*, Luke Dickman

N



Figure 114.2 - *site view 2*, Luke Dickman

W



Figure 114.3 - *site view 3*, Luke Dickman



Figure 115 - site view 4, Luke Dickman



Figure 116 - street view, Luke Dickman

TRAFFIC

3RD ST./N. WASHINGTON

South Street View.



Figure 118.1 - *south street view*, Luke Dickman



Figure 118.2 - *west street view*, Luke Dickman

S W
N E



Figure 118.3 - *north street view*, Luke Dickman



Figure 118.4 - *east street view*, Luke Dickman

The organization of traffic ways in Bismarck is a combination of grids and winding developments. The densely populated portions of the city, such as downtown, are formed in grids, while the suburbs around the perimeter of the city deviate from the orthogonal grid. The North-West sector of Bismarck where my site is located has orthogonal streets with winding developments.

Washington Street is the only road that leads to the site. Two suburban developments connect at the south end of Washington Street, while the north end is connected to one development as well. The City of Bismarck has plans to fill the vacant land surrounding my site with more suburban developments. The winding nature of the current suburban designs will be replicated with these future developments; the city's grid in this North-West sector will not be orthogonal like the rest of the city.

The two Avenues that connect Washington Street to the rest of Bismarck are 71st Avenue at the North end of the site and 43rd Avenue which is at the South end of the site. These two avenues span the entire city which makes the site easily accessible.

The roads surrounding the site have low vehicular traffic; they are primarily used for local home owners to commute back and forth from work, and congregational members of Good Shepherd Lutheran Church on Sunday Mornings. There is a bike path on the west side of Washington Street that gives rise to pedestrian activity. A runner or biker will occasionally be seen traveling along the path. Due to the cropland that surrounds the outskirts of the city, Washington Street and 71st Avenue occasionally are used by farmers for transportation.



Figure 120 - *good shepherd lutheran church*, Luke Dickman

SURROUNDINGS

GOOD SHEPARD LUTHERAN CHURCH

Taken From the Site Accross Washington Street



GOOD SHEPHERD: Good Shepherd is a Lutheran Church that affiliated with the ELCA. The church is located South-West of my proposed elementary school site. The church’s congregation is around five thousand members. The church claims its congregation has doubled over the last six years.

BOULDER RIDGE: Boulder Ridge is a residential community that is a recent addition to the city of Bismarck. This development contains over 150 lots with nearly all of them inhabited. The community has plans for a commercial center at its southern border which has not yet been established.

HORIZON MIDDLE SCHOOL: Horizon is a middle school for grades 7 through 9 that was finished in 2001. It is located west of Washington Street and South of Medora Ave. The projected enrollment of the middle school is going to reach over 1000 students in the next couple years.

57 Ave. NW



Utility Lines



Farmland



Vegetation



Water



Tractor



Horizon Middle School



Good Shepherd Church



Districts



Medora Ave.



N. Washington St.

SITE

1

Figure 123 - site map, Photoshop & Illustrator



Figure 124 - site view 5, Luke Dickman



Site Photographed From the 3rd Street



Figure 126 - *boulder ridge*, Luke Dickman

DEMOGRAPHICS

BISMARCK NORTH DAKOTA

Capital City of North Dakota



ORIGINS: Bismarck was founded in 1872, and became North Dakota’s State Capitol in 1889.

POPULATION: The population of Bismarck was determined to be at 61,272 in 2010. The population of Bismarck is predicted to climb steadily over the next couple years. The male population is less than females, standing at 48.6%.

RACE: Out of the 61, 272 people in Bismarck, 92% are Caucasian. The Caucasian population is comprised mostly of Germans (57.9%), followed by Norwegian (18.2%).

AVERAGE HOUSEHOLD INCOME: Bismarck is considered a commercial city where the unemployment rate is 3.2% and the average household income is \$48,956.

MEDIAN HOUSE OR CONDO VALUE: The median house/condo value is around \$154,201. This value has risen considerably over the last decade.

RELIGION: The predominant religion in Bismarck is Catholicism at 47%, followed by Lutherans at 26%.

SCHOOLS: Bismarck has sixteen elementary schools, five middle schools, four high schools, and three colleges. The city has many private schools as well. (City-data.com)



Figure 128 - *tree of life*, Luke Dickman

CLIMATE

NORTHWESTERN CONTINENTAL

Extremes: Hot and Cold

The climate for Bismarck ND is considered continental. Continental climates are located predominantly in the Midwest, north western coasts, and east coast states. There are two specific areas that make up a continental climate: weather and vegetation.

WEATHER: Everyone that visits the Dakotas mentions the weather, and most people that live in the Dakotas talk about it all the time. According to Maps of the World, it states about continental climates, "It is generally hot in summers and gray and dreary in winters." (mapsofworld.com) The temperatures in Bismarck can reach 90 degrees in the summer, and below zero in the winter. The harsh dominating North-West winds that run 10 mph on average throughout the winter months make the temperatures even more extreme. During the summer months, the heat is amplified by the amount of moisture in the air. The Missouri River that runs along the city's West border reduces extreme temperatures to its surroundings due to its water temperatures. The city averages around 2-3 inches of rain throughout the summer time, and around 8-9 inches of snow throughout the winter months.

VEGETATION: The continental weather produces a specific type of vegetation comprised of tall-grass prairies or forests. When I visited my site in Bismarck, the main observable vegetation was prairie with scattered groves of trees. The vegetation is naturally selected by its ability to survive extreme climate conditions. The vegetation of Bismarck will be discussed further in the next section.



Figure 130 - *site path 2*, Luke Dickman

VEGETATION

THE NORTHERN PLAINS

Bushes, Grasses and Trees

As I researched the vegetation in North Dakota, I compiled a list of the species of plants that are most common in the city of Bismarck; they are as follows:

- Eastern Ponderosa Forest
- Wheatgrass-Needle grass
- Wheatgrass-Bluestem-Needle grass
- Bluestem Prairie
- Sand hills Prairie
- Oak Savanna
- Northern Floodplain Forest
(U.S. Department of Transportation)

From this vegetation list, I have decided to talk about three of the plants listed that I found most common on my site as well as throughout the entire city. According to my observation, Needle Grass, Blue-stem Prairie, and Oak Savanna were the most common.

OAK SAVANNA: Savanna Oaks are primarily found in regions that contain low tree densities and other species of vegetation are dominant. These trees form in clusters on the open landscapes in the midst of other plants, specifically grasses. Because of the competitive nature of these Oaks, the open prairies are a suitable place for this species so that it can grow peacefully with a lot of space. The nature of Oak Savannas gives growth to many grasses and forbs; depending on the density of the tree's canopy.

NEEDLE GRASS: Needle Grass is the long grass that most young children assume is wheat. It grows very fast and reaches heights between two and three feet tall. This type of grass can be used for feeding livestock. Needle grass grows well with the other native species, which makes the landscape very scenic holistically. I have to admit that I did not like it when grasshoppers flew into me when I was walking through the needle grass on my site; apart from my preferences, needle grass is a prime habitat for grasshoppers. The nature of the needle grass root is deep and fibrous. This plant's survivability in continental climates comes from its roots' ability to reach depths close to ten feet. Because of Needle Grass's resistance to disease and high dormancy, this plant is perfect for Midwestern prairies.

BLUE-STEM PRAIRIE: Blue-stem Prairie grass is differentiated from Needle Grass by its clumping nature and color. This species of vegetation grows up to two feet tall and consists of blue-green colors during the summer months and rosy-rust colors throughout the winter months. Similar to Needle Grass, Blue-stem Prairie Grass is very suitable for the weather conditions of Continental climates. This type of grass is very stable; adding structure to its neighboring plant species. Not only is it very beautiful on the prairie landscapes, but Blue-stem Prairie grasses are currently used in many suburban and city landscapes as well.



Figure 134 - *Blue-stem*, Luke Diekman



Figure 135 - *needle grass 2*, Luke Dickman



Figure 136 - tractor field, Luke Dickman

LIFESTYLE

MIDWESTERN COUNTRY

People & Places

In this section of the program document, I would like to reveal the lifestyle of Bismarck to help understand the people I will be designing a school for. There are five categories I will discuss: people, culture, shopping/dining, festivals and sightseeing.

PEOPLE: As mentioned previously in the section, the people of Bismarck are predominantly white, Catholic, and German; if you fit in those three categories, chances are you were born in the Midwest. When I lived in Bismarck for three months, I noticed that the town loved being country – pickup trucks, farmers, country music and close-knit families made up the general population. The typical mindset of Bismarck is to work hard and enjoy family.

CULTURE: The Belle Mehus Auditorium provides the city with performing art entertainment, and is also a historic place in Bismarck. Sleepy Hollow is a small outdoor acting company that provides entertainment during the summer months. The acting company is currently in the process of renovating their stage for a more permanent presence and grander facility.

FESTIVALS: Typical festivals that occur throughout the year in Bismarck are Rodeos, art displays, sport shows and cultural/heritage events. In September, the city hosts the annual United Tribes International Pow Wow. The month of October is filled with the Edge of the West PRCA Rodeo. In August, The Art & Galleries Association hosts their annual art fair at the state capital. There are many craft fairs, art displays, and symphonies that the people of Bismarck enjoy.

SHOPPING & DINING: The main center for shopping in Bismarck ND is the Kirkwood mall which is located at the heart of the city. It has been stated that, "Bismarck-Mandan is the retail hub for south-central North Dakota; a retail trade that includes nearly 170,000 people." (City-data.com) Third Street South and State Street North in Bismarck provide the city with many options for dining. Like most typical Midwestern cities, the dining facilities are comprised of sit-down restaurants, buffets, fast-food, coffee shops and bars.

SIGHTSEEING: The most famous tourist attraction in Bismarck is the skyscraper capital building. The skyscraper stands out amidst the prairie and low-rise buildings that surround it. There is an old fashioned Lewis and Clark steam ship that gives rides along the Missouri River. Bismarck displays replicated Indian villages and military forts at the Fort Lincoln Museum. Lastly, the city has a Lewis & Clark interpretive Center that documents the adventurers' exploration of the local lands.



Figure 140 - *grass head*, Luke Dickman



DIAGRAMS

BISMARCK'S CLIMATE

Quantitative Analysis

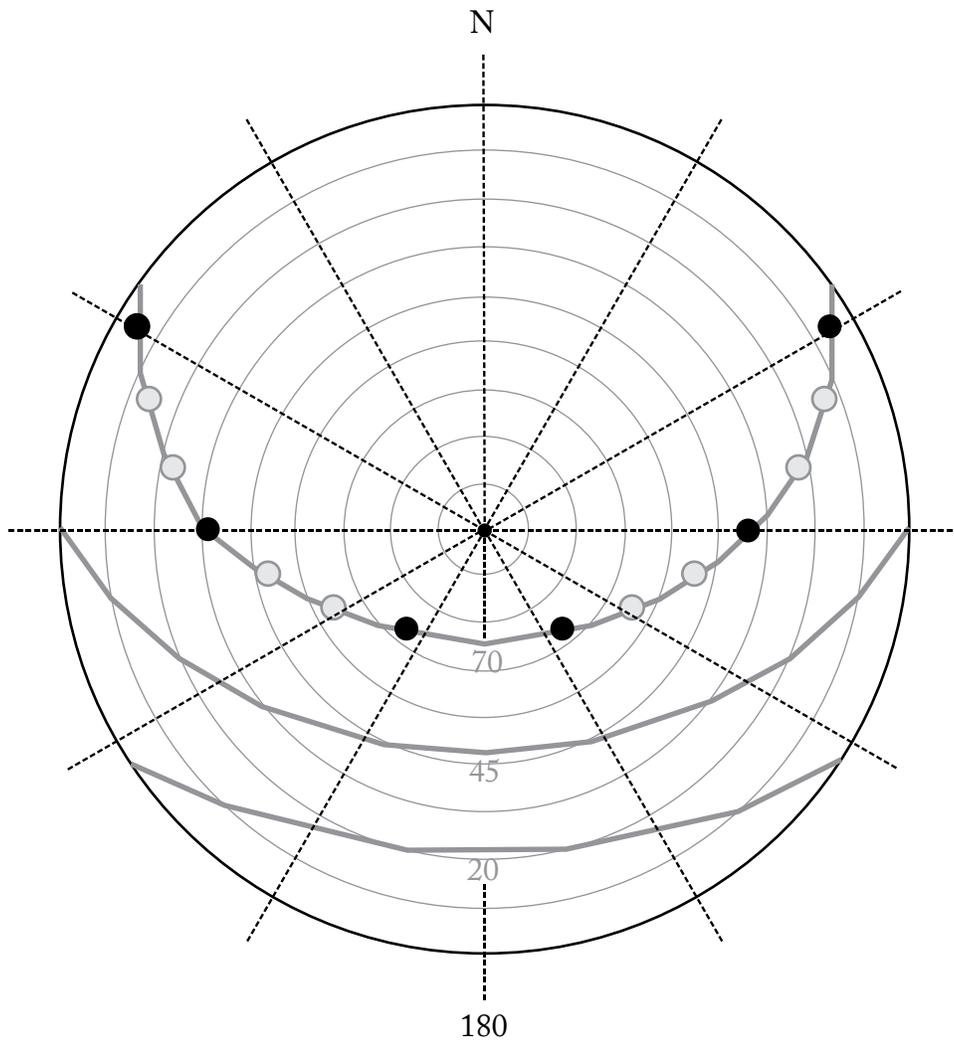


Figure 142 - *sun path diagram*, Illustrator

SUN PATH

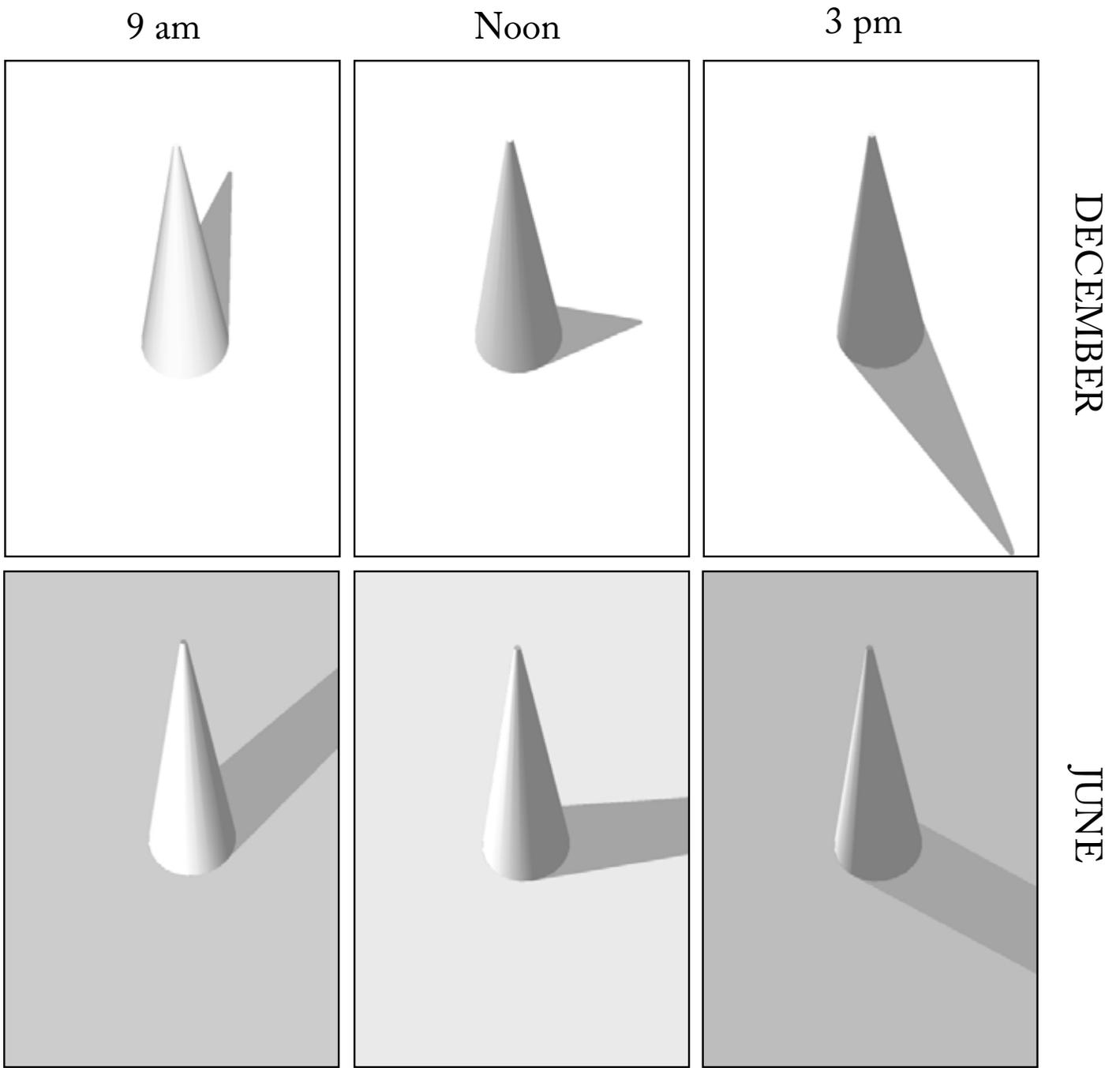


Figure 143 - shading study diagram, Schetchup

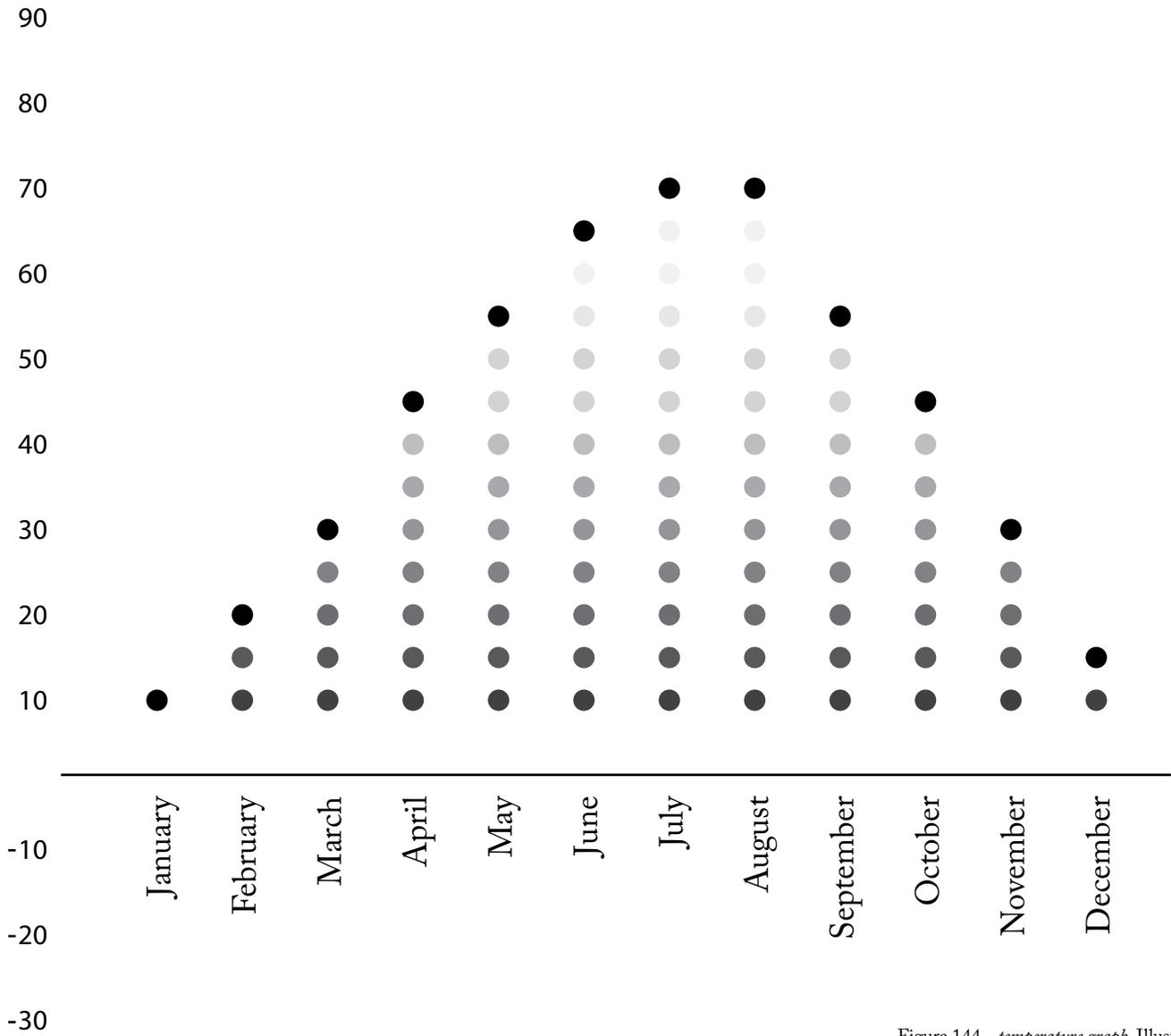


Figure 144 - *temperature graph*, Illustrator

TEMPERATURE

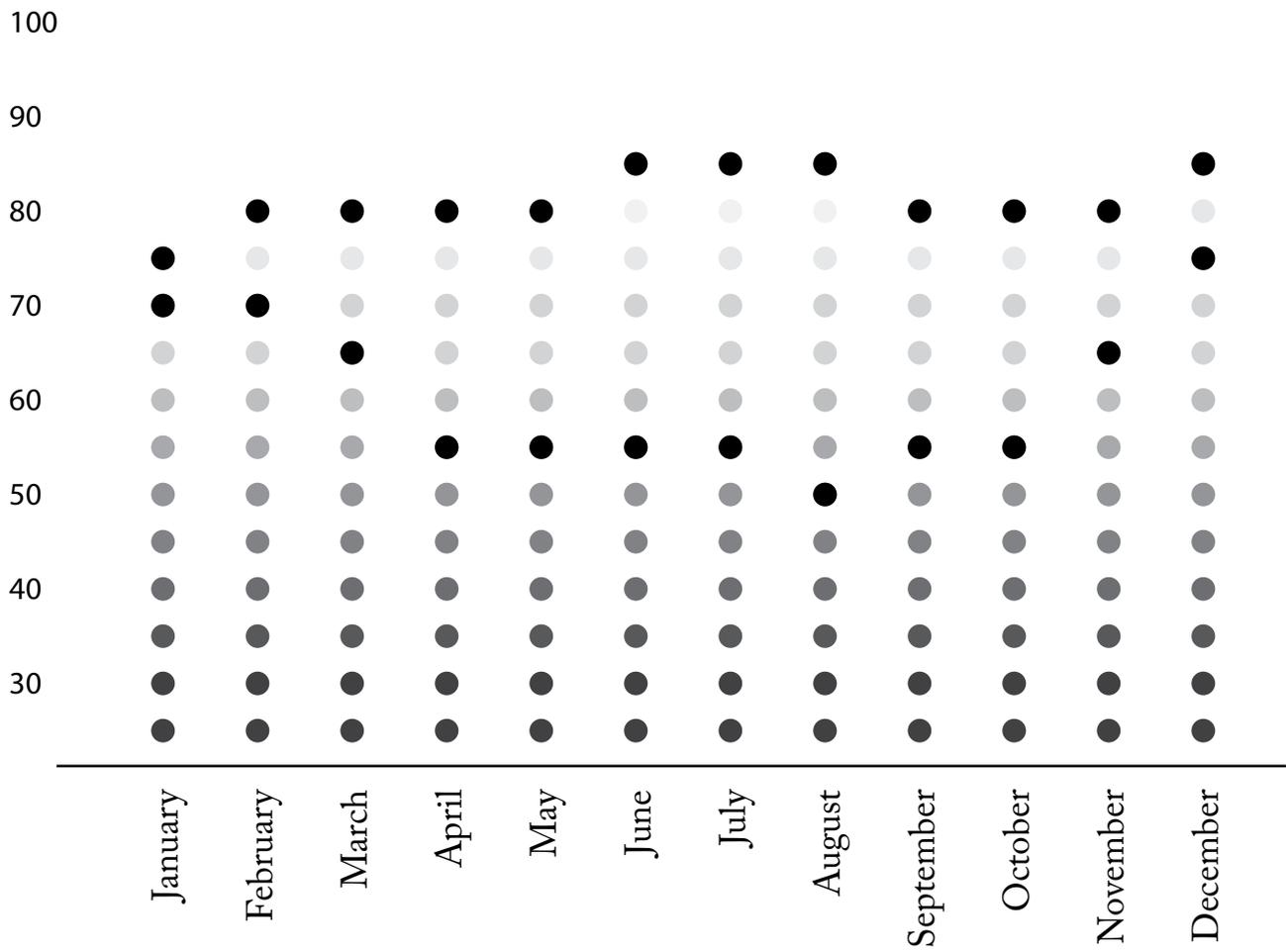


Figure 145 - *humidity graph*, Illustrator

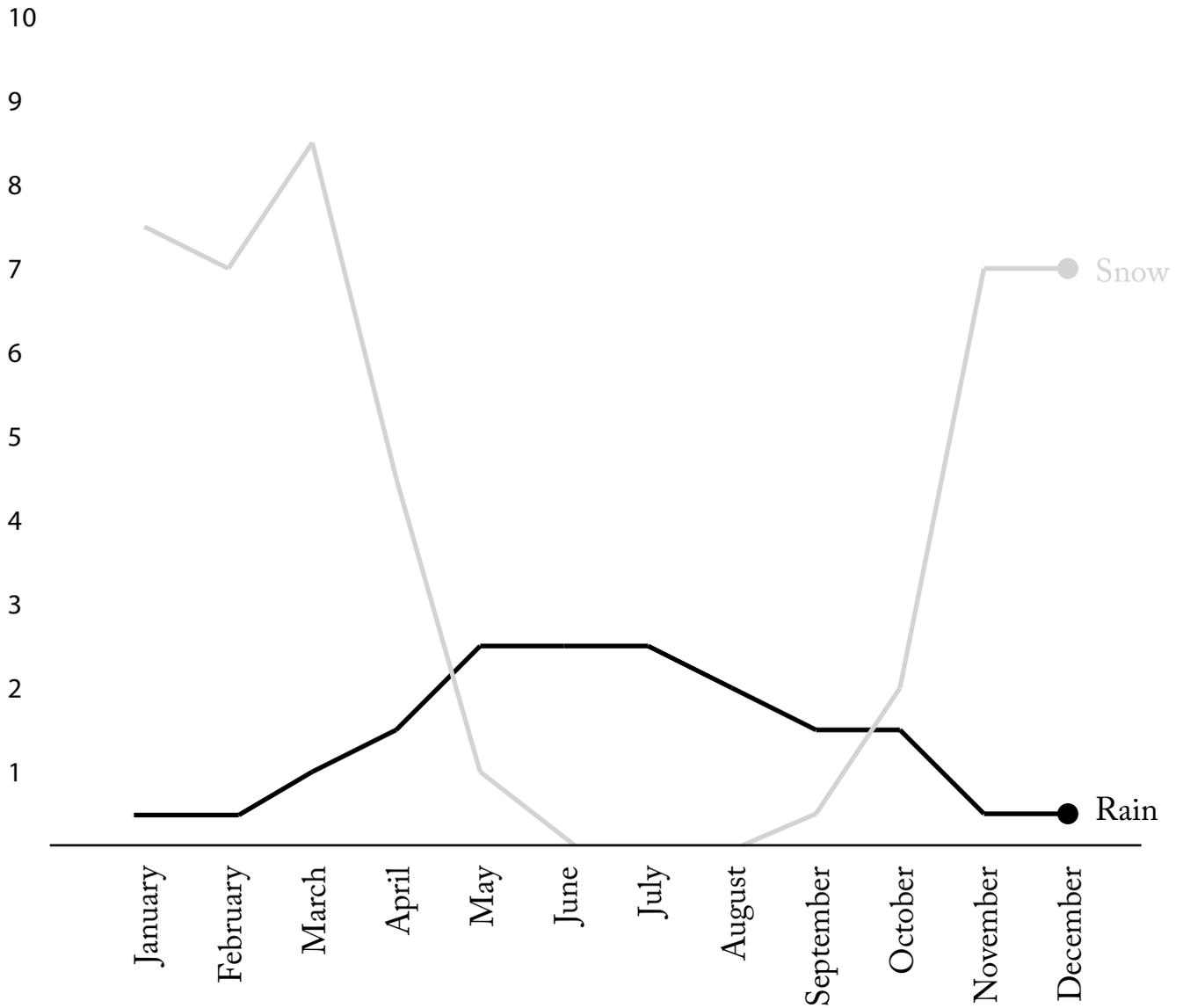


Figure 146 - rain and snow fall graph, Illustrator

RAIN & SNOW FALL

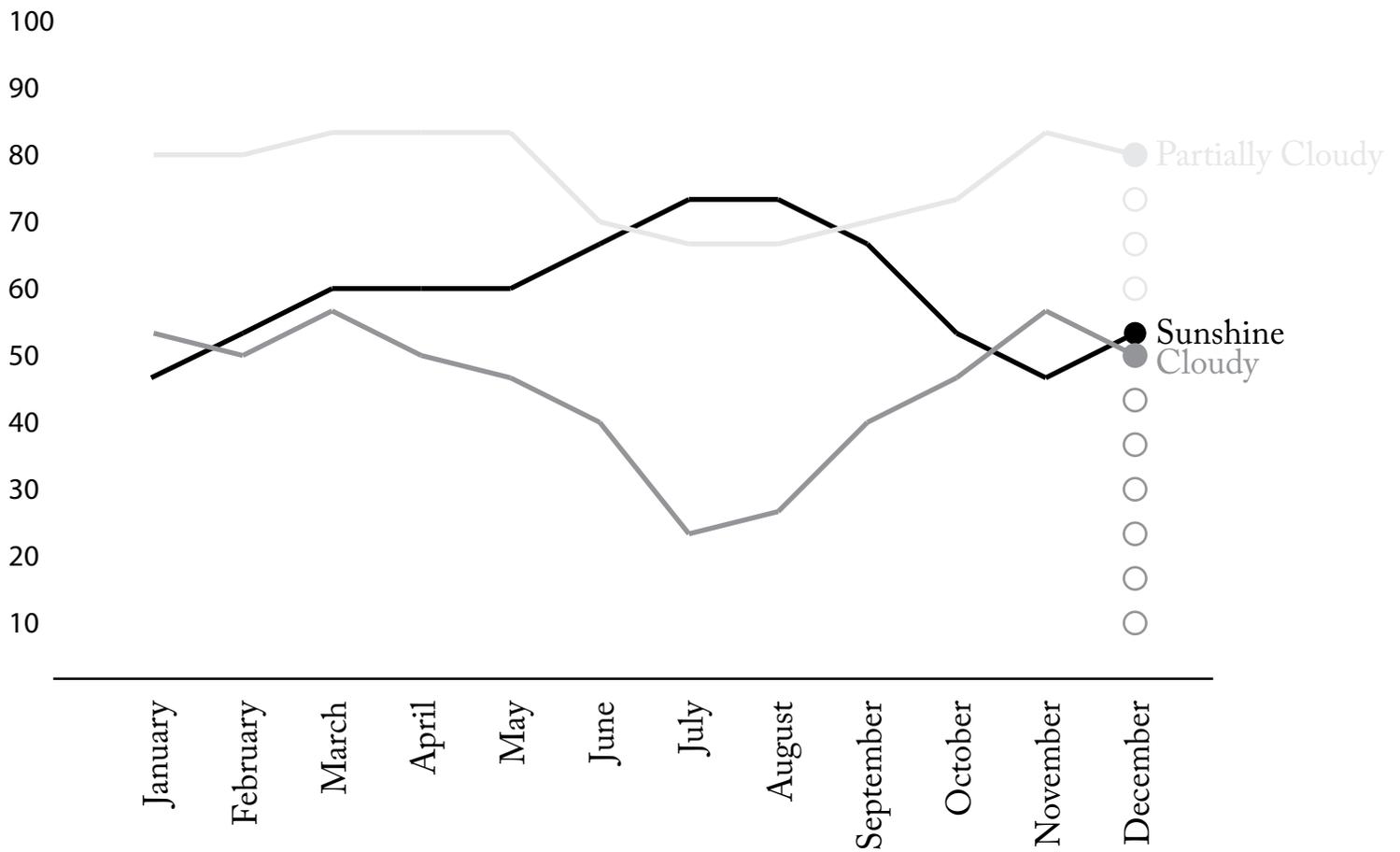


Figure 147- sunshine and clouds graph, Illustrator

SUNSHINE & CLOUDINESS

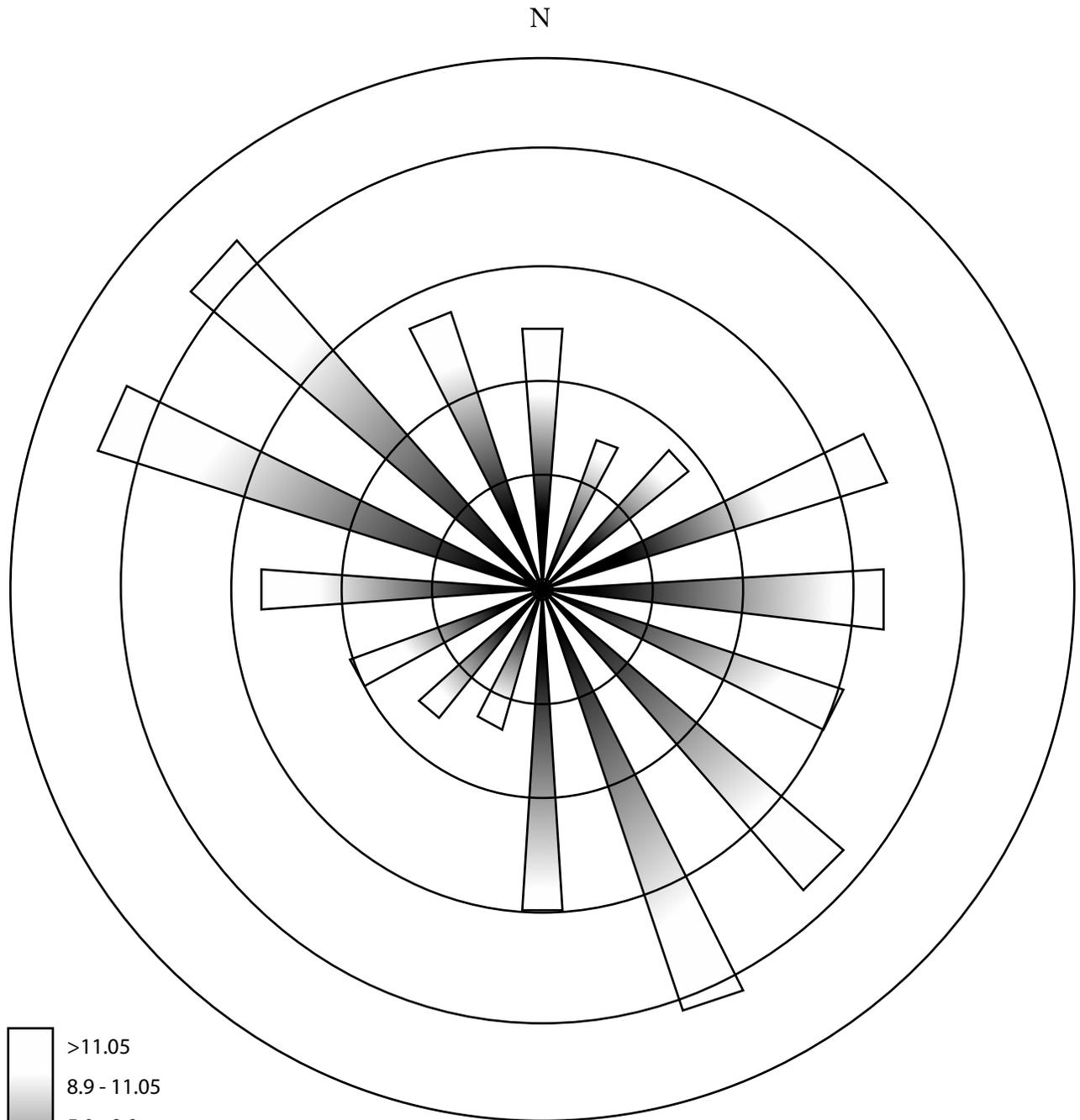


Figure 148 - wind rose diagram, Illustrator

WIND DIRECTION



Figure 149 - *wind speed graph*, Illustrator

WIND SPEED

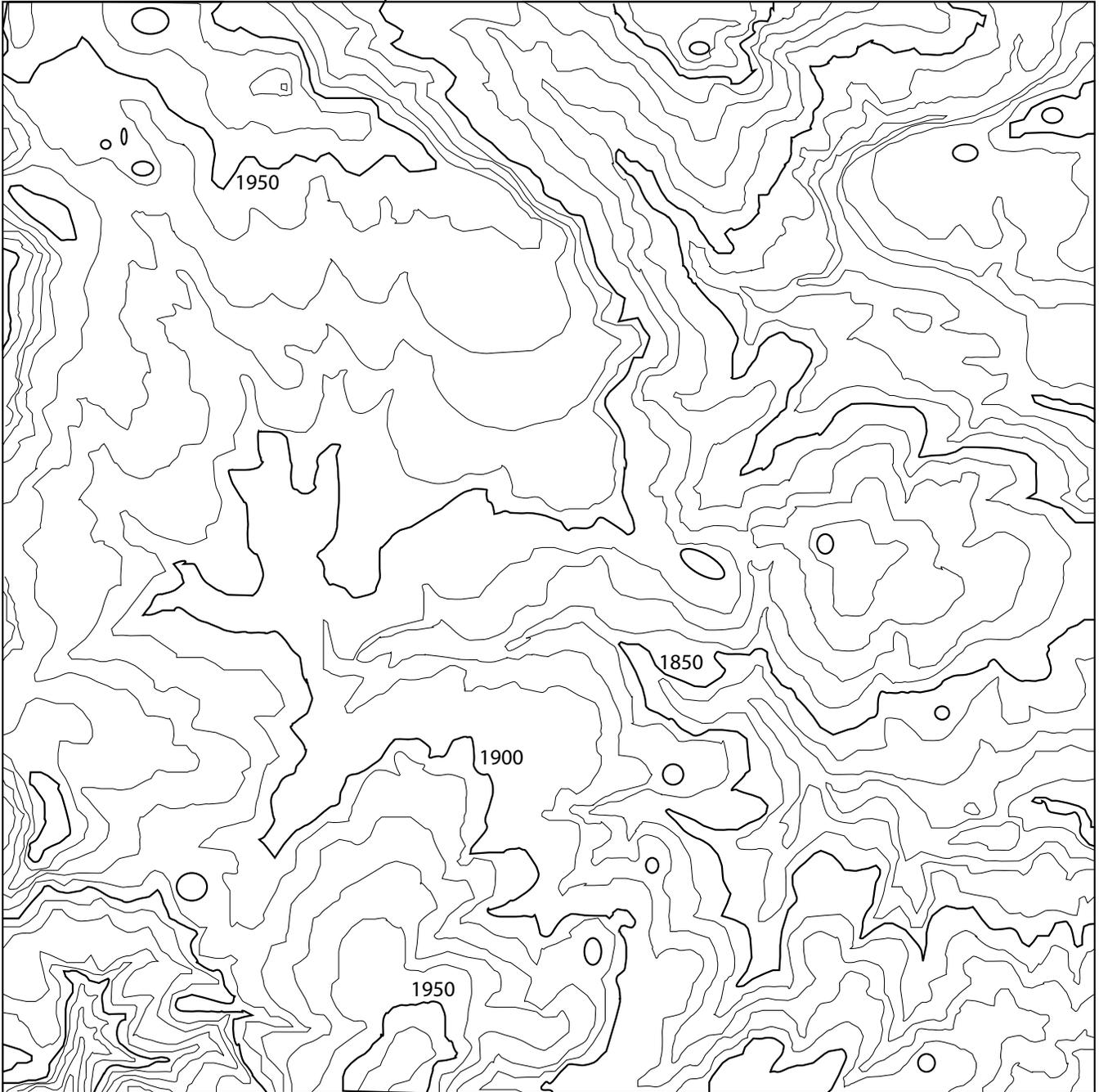
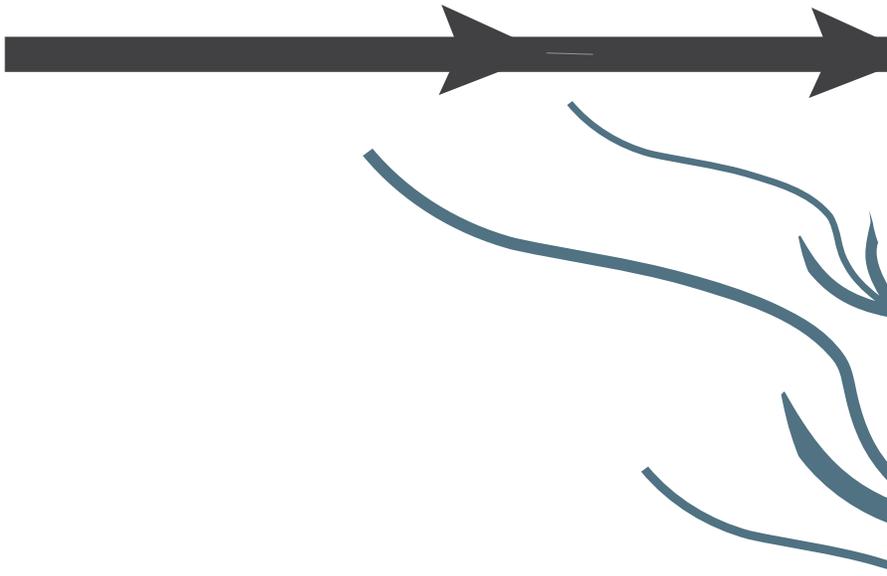


Figure 151 - *topography diagram*, Illustrator

TOPOGRAPHY

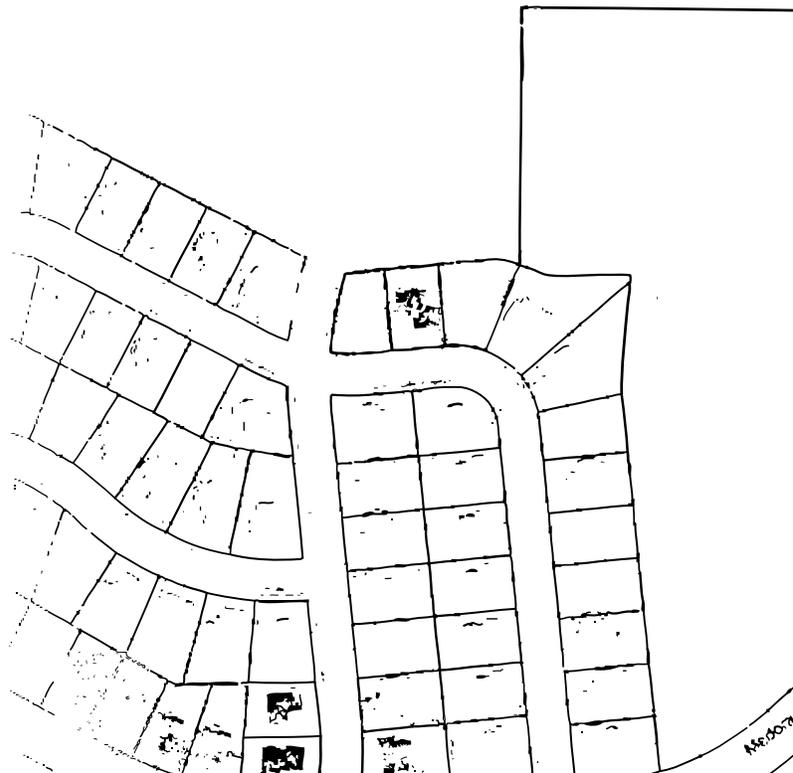


▶▶▶ Traffic

~ Wind

● Noise

Figure 152 - *site analysis diagram*, Photoshop & Illustrator



SITE ANALYSIS



N Washington St

Boulder Ridge



Ave

Square footages were determined by the 488 students currently estimated to attend the school. The community preferred an 18:1 student-to-teacher ratio, which determined the number of teachers: 27..

According to Bradford Perkins, author of *Building Type Basics for Elementary Schools and Secondary Schools*, listed suggestions for school square footages. They are as follows:

<i>Direct activity/classroom space</i>	<i>42 sq ft/child</i>
<i>Staff support/storage space</i>	<i>38 sq ft/child</i>
<i>Observation space</i>	<i>9 sq ft/child</i>
<i>Subtotal assignable space</i>	<i>89 sq ft/child</i>
<i>Nonassignable space</i>	<i>20 sq ft/child</i>
<i>Total facility space/child</i>	<i>109 sq ft/child</i>
<i>Outdoor activity space</i>	<i>75-200 sq ft/child</i>

Table 154 - *squarefootages*, Perkins

SQUARE FOOTAGES

Entrance Reception	840 sq ft
Administrative offices	1026 sq ft
Classrooms	20496 sq ft
Teacher's Lounge	570 sq ft
Counselor	200 sq ft
Nurse	200 sq ft
Restrooms	3560 sq ft
Music room	1680 sq ft
Gymnasium	28896 sq ft
Storage	1000 sq ft
Locker rooms	2520 sq ft
Cafe/gathering space	21252 sq ft
Concessions	150 sq ft
Kitchen	1000 sq ft
Library/computer - lab/reading room	8400 sq ft
Science lab/mess room.....	756 sq ft
Mechanical room	2000 sq ft
Janitorial space	400 sq ft
Coat dressing space	3416 sq ft
Playground	50600 sq ft

TOTAL	148,962 sq ft
--------------	----------------------

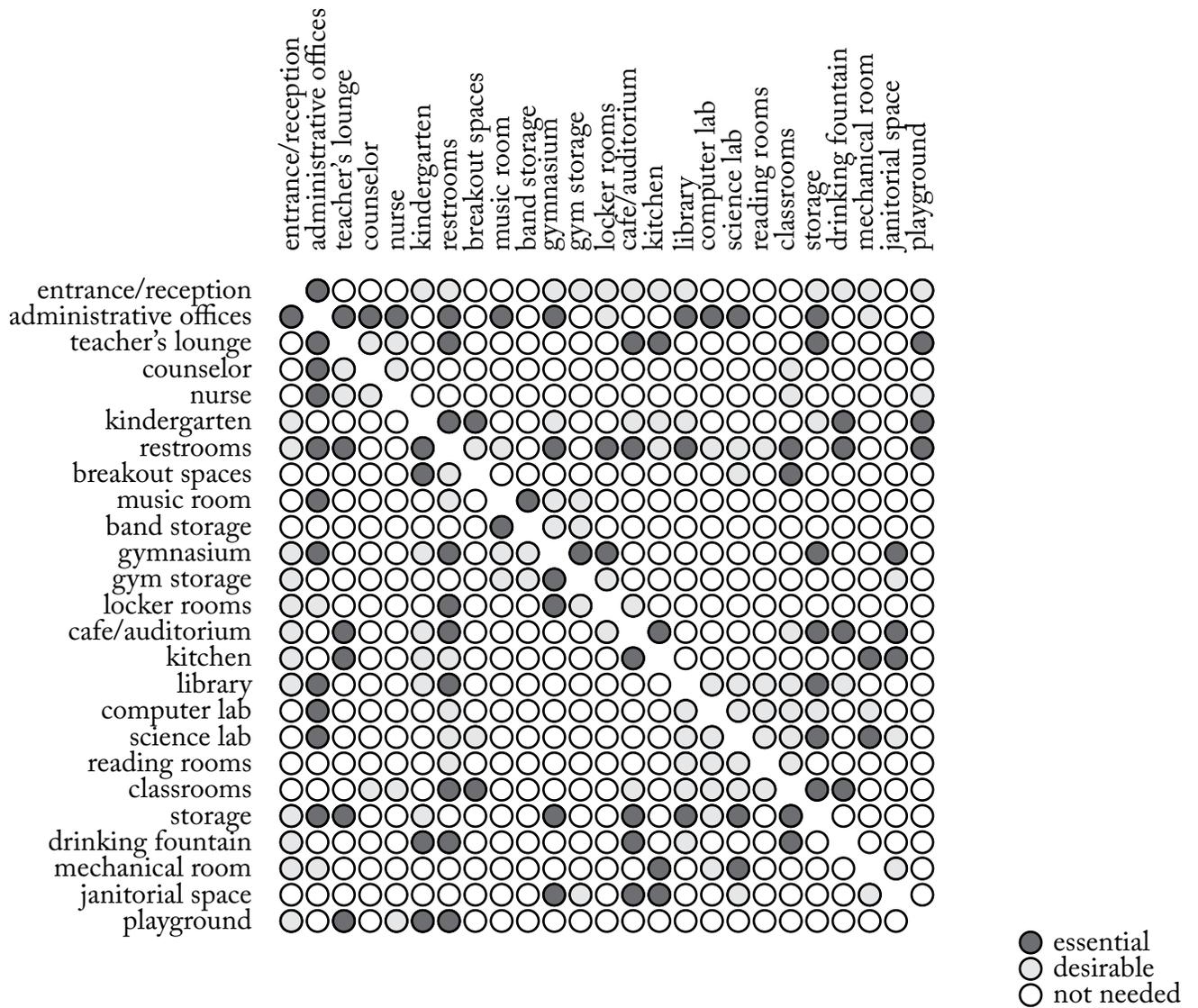


Figure 156 - interaction matrix, Illustrator

INTERACTION MATRIX

PUBLIC

FACULTY

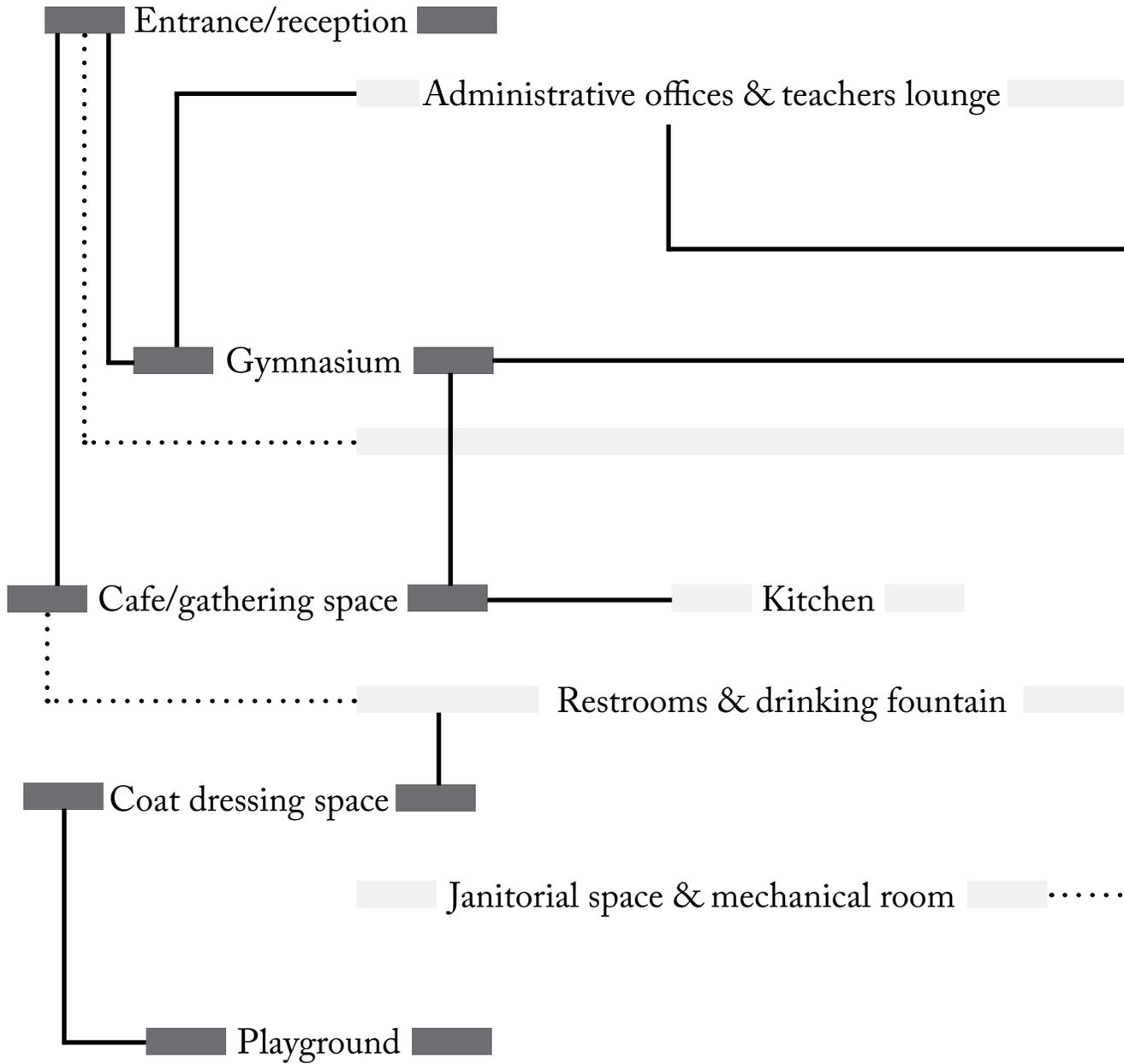
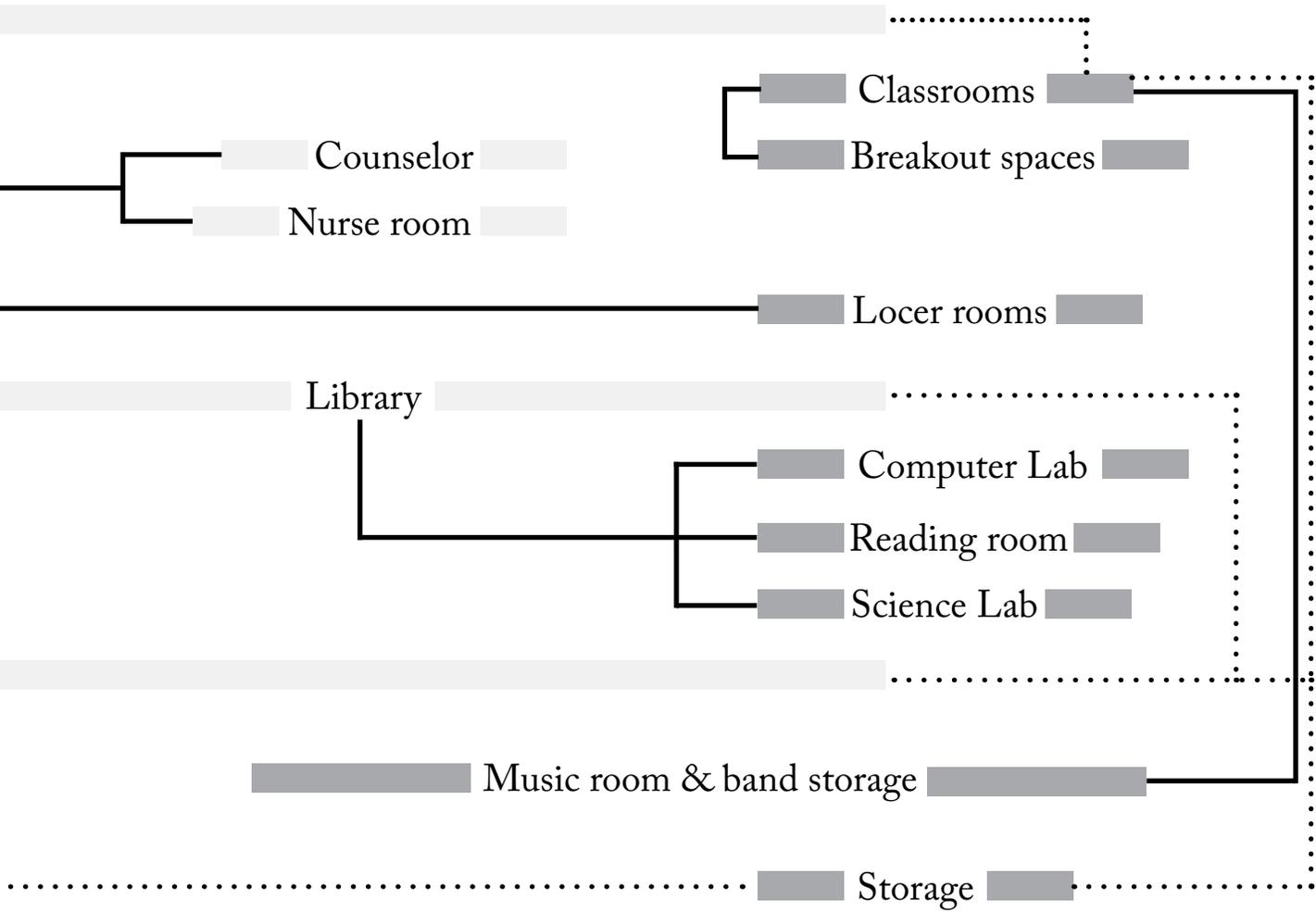


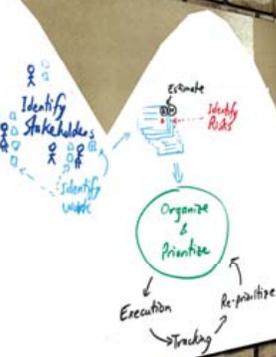
Figure 158 - *interaction net*, Illustrator

INTERACTION NET

STUDENTS



————— Adjacent space
..... Close Proximity



PRESENTATION
BOARDS & MODELS
Final Product













"No space, architecturally, is a space unless it has natural light."



INSPIRATION

PEOPLE AND THINGS



S KAHN



SITE VEGETATION



CATHEDRALS



PRAIRIE FORM



LIGHT & LEARNING



PROCESS SKETCHES & IDEAS

My thesis design had three primary constraints:

City: Bismarck, ND
 Typology: Elementary School
 Emphasis: Natural Light

These three elements shaped my thoughts and design as it progressed from one stage to another.

SITE



RESEARCH: "The site really captured the essence of Bismarck – very plain and simple, and at the same time very peaceful and delicate. The land was flat so a person could see distant townscapes in the horizon."

LEFT: The site was covered with a golden layer of Prairie Wheat Grass. The beauty of the landscape I wanted to incorporate into the design.

RIGHT: With the landscape in mind, I developed the orientation of the building to embrace the surrounding views.



LIGHT

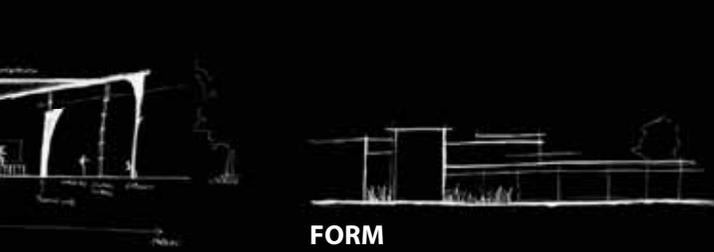


RESEARCH: "Of all the elements that make a high performance school, none has greater impact on the quality of learning than daylight." (Nair & Fielding, The Language of School Design, 2007)

LEFT: My first design with natural light was to use it as a tool for guiding movement throughout the building. It was difficult to develop this idea for elementary school age children.

RIGHT: As the design developed, my focus started to turn towards more exposure to natural light and the surrounding views.





RESEARCH: "Great learning environments exhibit similar characteristics to great cities and great landscapes." (Nair & Fielding, The Language of School Design, 2007)

LEFT: I gravitated towards prairie style architecture as the design was being developed within the site. The flat, horizontal, planar essence of the site helped shape the building's form.

RIGHT: The classroom was my primary focus - I used clerestory windows and storefront glazing to manipulate the light to accommodate tasks and ambience.

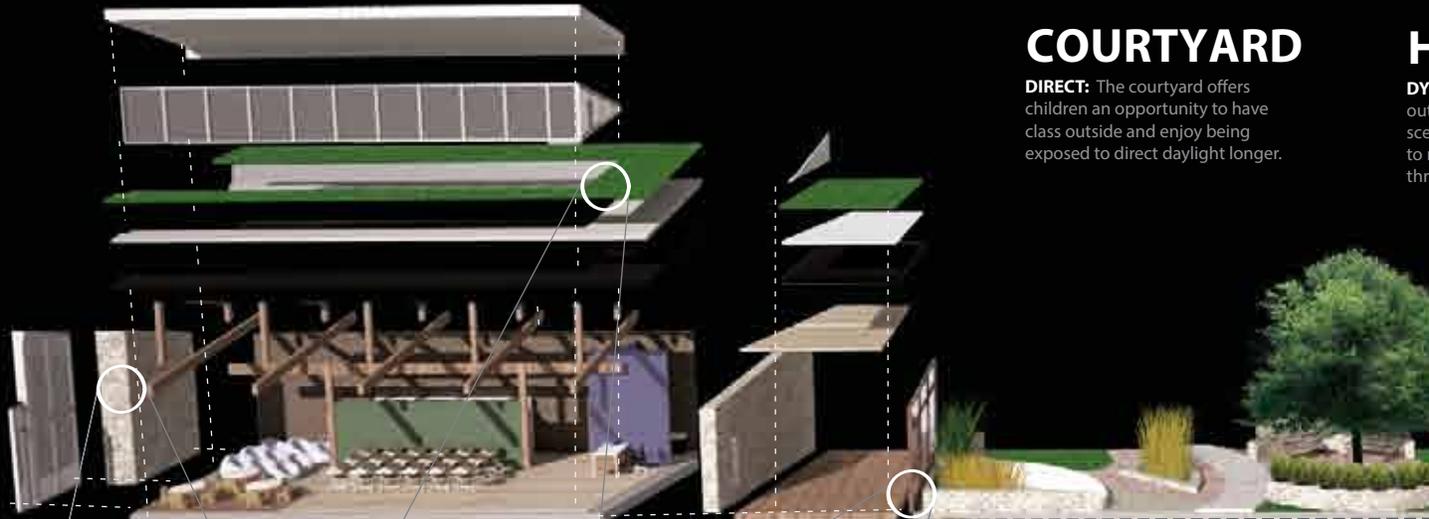


RESEARCH: Natural light brings the world to life. Light energizes a space through two primary ways: color and shadow.

LEFT: A sketch of a nook within the building's corridor where kids can sit after school hours and read while they wait for their parents. There are many different types of light: diffused, direct, ambient, warm, cold, intense, subtle, dynamic and static. My goal was to give children a variety of natural light scenarios to experience.

COURTYARD

DIRECT: The courtyard offers children an opportunity to have class outside and enjoy being exposed to direct daylight longer.



E



FIELDSTONE



GREEN ROOF



DURATHERM



HEBRON

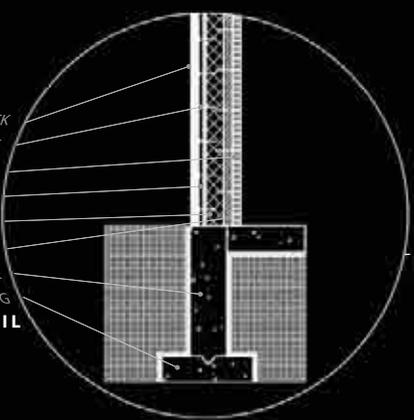


TERRAZZO

MATERIALS LOCAL & NATURAL

The material selection began with the local materials: Fieldstone and Hebron Brick. The Duratherm wood-framed windows and the bronze Pac Clad steel roofing materials matched the current materials and the landscape. Terrazzo Flooring and Green Roofs were used throughout the design. Holistically, these materials work well with the site and natural light.

C



- 6" BRICK
- 4" METAL STUDS
- 4" STONE VENEER
- 1" AIR SPACE
- 8" C.M.U.
- 2" RIGID INSULATION
- 1.5' CONCRETE
- 3.5' CONCRETE FOOTING

FOUNDATION DETAIL

SYSTEMS PASSIVE AND MECHANICAL



The foundation is shallow and has footings that are 5' below grade. The structure above is post-and-beam construction with load bearing masonry walls.

STRUCTURE

ALLWAY

AMBIENT: The hallways look out to the courtyards, giving students scenic views as well as exposure to natural light that moves throughout the corridors.

CLASSROOM

AMBIENT: The huge Clerestory windows act as a daylight catcher that provides ambient light to the entire classroom. The clerestory is high enough to protect against distracting direct light.

EMPHASIS NATURAL LIGHT

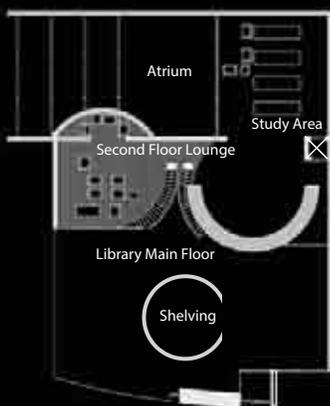
UNIFYING IDEA: Not only is light a biological need, but a catalyst in motivation and mood. The experience of a space is directly correlated with our developmental process and learning motivation. A well-lit space, inviting the natural light to enter, gives its inhabitants the ability to grow and enjoy learning.

JUSTIFICATION: Learning/education is very important to our society as a whole as well as individuals. The learning environment shapes our thoughts and influences our passions. I've experienced the power of light on an environment, and I want to pursue this topic so that others can learn, enjoy and explore that experience as well.

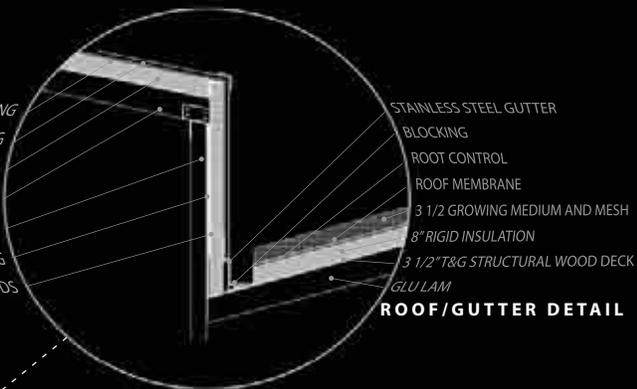


WEST-EAST SECTION PERSPECTIVE

F



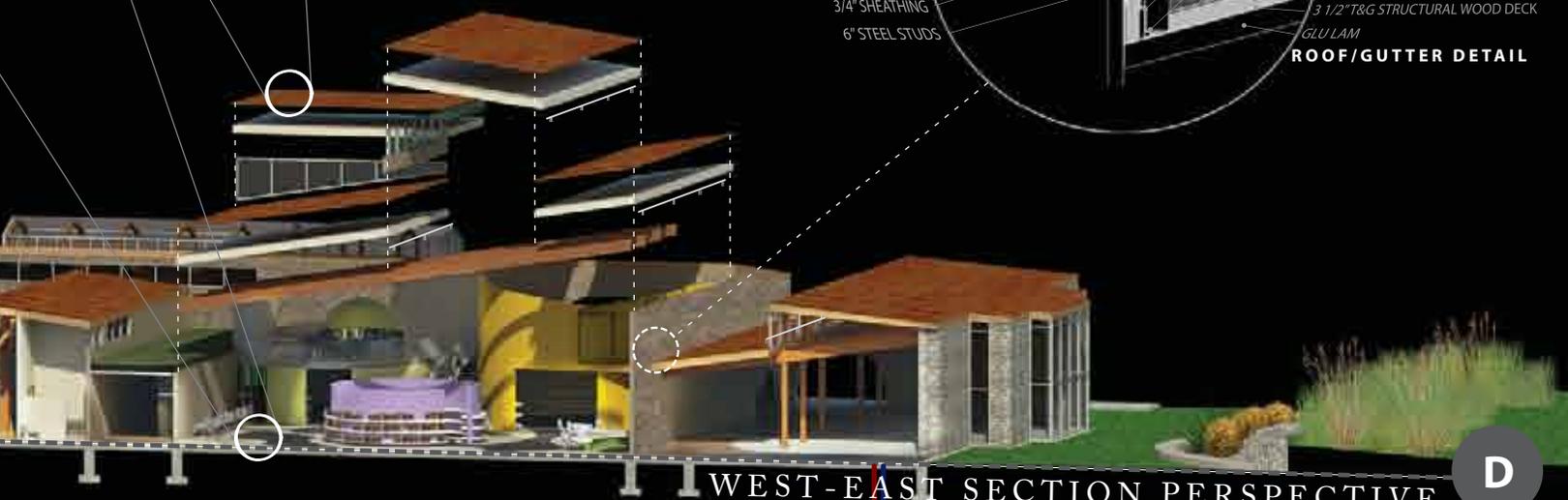
LIBRARY 2ND FLOOR PLAN



- WATER PROOFING
- 2" STANDING SEAM ROOFING
- 8" RIGID INSULATION
- GLUE LAM
- 3 1/2" T&H STRUCTURAL DECK
- 3/4" SHEATHING
- 6" STEEL STUDS

- STAINLESS STEEL GUTTER
- BLOCKING
- ROOT CONTROL
- ROOF MEMBRANE
- 3 1/2" GROWING MEDIUM AND MESH
- 8" RIGID INSULATION
- 3 1/2" T&H STRUCTURAL WOOD DECK
- GLU LAM

ROOF/GUTTER DETAIL



WEST-EAST SECTION PERSPECTIVE

D

The building is cooled by floor air vents and in the library and public spaces, and by ceiling vents in the classrooms.

HVAC

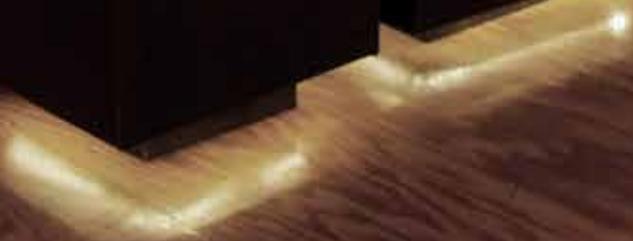
The geothermal system is the main source of heating and cooling for the school. The geothermal system lies underneath the North-East corner of the site.

GEOTHERMAL









OVERVIEW: My presentation was delivered on April 25th, 2013 at 2 p.m. in the afternoon. Stephan Wischer and Bakr Aly Ahmed were my guest critics. About thirty people were present altogether.

PRESENTATION: Every student was allotted an hour and a half - an hour to present their projects and half an hour to receive feedback from their critics. My presentation took only forty minutes. A couple key elements I focused on were the conceptual design process, the five elements of day lighting (Direct, diffused, dynamic, ambient, and shadow), and the experience of the children in the classrooms/hallways/courtyard. The presentation was a compilation of my research, mid-term presentation, final renderings and boards, as well as a few added materials. With the use of my mounted boards, hand-crafted models, Powerpoint slides, and oral speech I was able to deliver my presentation well.

CRITIQUE: Coming into the presentation I was expecting to be torn to pieces; however, the presentation went very well. Both critics loved the design and the use of natural light, and overall had great things to say about the project. Wischer's main criticism was to see the building relate more to the passage of time. Bakr on the other hand wanted to see more spaces of the building designed to a finer detail. The critique lasted about thirty-five minutes.

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**Background:**

Born in Fargo, North Dakota.
Grew up in a family of seven.
Enjoyed playing with Legos and exploring the outdoors.

Education:

High school attended Park Christian in Moorhead MN.
College attended North Dakota State University in Fargo ND.

Achievements:

2003 – AmericInn National Chess Champion
2004-2007 – North Dakota State Chess Champion
2007 – Varsity Tennis MVP
2009-2013 – NDSU Dean’s List
2011-Present - Member of Tau Sigma Delta
National Collegiate Honor Society
2011-Present - Member of Phi Kappa Phi Collegiate
Honor Society

Interests:

Piano, Tennis, Ping-Pong, Soundtracks, Writing, Chess,
Biking, Basketball, Drawing, and occasionally playing
with Legos.



Figure 165 - *self-portrait*, Luke Diekman

SPECIAL THANKS

MARK BARNHOUSE

Thank you Mark for being my thesis advisor. Mark was always willing to meet and always gave me helpful advice every time I stepped into his office. Thank you for your passion.

STEPHEN WISCHER

Thank you Stephen for equipping me with skills that I will take with me wherever I go. Your passion and work ethic will live on through me and many other students that you taught.

NDSU FACULTY

Thank you to all my teachers for imparting your lives to me and all the other students pursuing architecture. Your teachings have prepared us with knowledge and skills to help us succeed.

CLASSMATES

Thank you to all my classmates for all the times we shared together. Many of you have been my closest friends over the last five years - it has been a pleasure to learn alongside all of you guys, I wish you all success as we go from here.

