SITE ANALYSIS  
exploration of the site

EXISTING SITE CONDITIONS  
understanding the site through different layers

BIOCLIMATE STUDIES  
site climate + changes throughout the year

<table>
<thead>
<tr>
<th>Month</th>
<th>Spring Semester</th>
<th>Summer Break</th>
<th>Fall Semester</th>
<th>Winter Break</th>
<th>Spring Semester</th>
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SPRING  
- solar studies

SUMMER  
- solar studies

FALL  
- solar studies

WINTER  
- solar studies

Average temperature range: 40ºF - 59ºF
- Maximization of natural ventilation through windows and doors
- HVAC has lower capacity loads
- Passive solar gains are at an average

Average temperature range: 68ºF - 73ºF
- Class not in session thus classroom space is closed off for energy
- Shading devices optimized for least amount of insolation
- HVAC conditioning only utilized space
- Prevalent south wind

Average temperature range: 32ºF - 61ºF
- Maximization of natural ventilation through windows and doors
- Thermal flux zone is able to open up to the outside
- HVAC has lower capacity loads
- Prevalent north wind

Average temperature range: 13ºF - 20ºF
- Shading devices optimized for greatest amount of insolation
- Natural light maximization through glazing
- Prevalent north wind - greater R-value on walls and windows to conserve energy

Conclusion on Studies, going forward

Both spaces need to have some type of congruence. This can be achieved through materiality, special qualities provided by light and a cohesive language that is reflected throughout. We seek to achieve this with the addition of the mnZED Lab, where functionality and aesthetics are fused as one.

New Rapson Hall Addition

There is a dynamic play of light and aesthetics, a beauty in the addition. This is notably reflected in the lobby area, where there is a stark contrast in light intensity and also within the visual interaction between the exterior and interior. This is most apparent in the study space where there is a strong use of diffused light because such light is desired. Also, both buildings are seamlessly separated from each other through shape and materiality.

"Old" Rapson

The courtyard, acting as the hearth of space, provides most of the natural light for the area. Though some diffused light is achieved through the hyperbolic paraboloids this light is mostly uncontrolled and at times unpleasant. Also present in the design is the emphasis on symmetry, where functionality was the main focus of the space. This increased by the use of interior symmetry. As a result of this, the space has no clear sense or orientation on point of coherence and can thus get easily lost.

Conclusion on Studies, going forward

All in all, both spaces need to have some type of congruence. This can be achieved through materiality, special qualities provided by light and a cohesive language that is reflected throughout. We seek to achieve this with the addition of the mnZED Lab, where functionality and aesthetics are fused as one.
CONCEPT DIAGRAM layering of assemblies

**LIGHT SHADING LAYER**
Light Shading Layer is represented and is an integral layer that protects the building from unwanted outside influence while allowing a broad opportunity for interaction.

1. **Filter light into courtyard**
2. **Reduce glare through layering of light**
3. **Reduce heat gain during the afternoon**

**THERMAL LAYER**

1. **Horizontal shading that combines beauty and function**
2. **Allow for light sharing to reduce need for electric lighting**
3. **Bring light deep into labs through open lighting concept**
4. **View windows that allow for ambient light**
5. **Controlled lighting through punched openings**

**LIGHT RECEIVING LAYER**

1. **North Elevation**
   - Admits the majority of light and is expressed by the main corridor, a light receiving layer.

**LIGHT-SHARING LAYER**
Light-Sharing Layer is directly tied to light receiving layer, and is focused on allowing the light to pass through all adjacencies, which are all vertical feature lights, or in other words, this layer is expressed by the main corridor, a light receiving layer.

**SENSORY/EXPERIENTIAL LAYER**

1. **Sheltering facade through thickened wall assembly**
2. **Ribbon skylight washes down the roof**

**FORMAL MASSING CONCEPT**

1. **Two wings intertwined by a light corridor**

**CONCEPTUAL NARRATIVE**

- The building has a unique role in the fusion of architectural knowledge and the perceptual field. We see in such a manner that the visible and the perceptual exist simultaneously and are fluidly transitional. We began by understanding that the building not only did we work on systems that would aid us in our pursuit of zero energy but also within these systems, we sought for the spark that takes us a bit away. We use with these multidisciplinary layers that we found the above precedents and the repeated them.

- In addition, because we as humans have a state of constant change having the ability to conform is what has taken us to where we are now. But what if what we applied them.

**FACEAD LIGHTING**

- Optimizing each facade based on its orientation

- **North Elevation**
  - Controlled light through punched openings
  - Corrugated facade through horizontal curvature

- **West Elevation**
  - Sunlight from the Western sun through horizontal louveres
  - Flat light in corridor

- **South Elevation**
  - Sunlight from the Southern sun through horizontal louveres
  - Flat light in corridor

- **East Elevation**
  - Sunlight from the Eastern sun through horizontal louveres
  - Flat light in corridor
ECOTECT ROOM STUDIES, exploring the southwest lab + corridor spaces

**Detail Model Studies**, detailing the southwest corridor/lab conditions

**Light Shelf 1**

Horizontal louver system on south-facing facades blocks undesired sunlight.

**Light Shelf 2**

Vertical louvers help reducing glare from low morning/afternoon sun and are used on east- and west-facing facades.

**Light Shelf 3**

North-facing clerestory is used to admit soft ambient light in the lab space.

**Sunspace Exposure**

Louvers allow for maximum solar intake in the winter months, while blocking the light in the summer months, when heat is not desired.

**SOUTH CORRIDOR LOUVER STUDIES**, understanding through parametric lighting studies

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ECOTECT ROOM STUDIES, exploring the southwest lab + corridor spaces

**Light Shelf 1**

Encased lightshelf provides the most amount of diffusion throughout the space. Yet it does not reflect the light evenly throughout, thus creating hot spots and dark areas.

**Light Shelf 2**

Standard lightshelf provides the same diffusion throughout the space. Consequently, this creates heat spots and dark areas.

**Light Shelf 3**

No lightshelf creates uneven distribution of light with high contrasts and high glare. This provides diffused light on the ceiling instead of the work area.

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Louvers allow for maximum solar intake in the winter months, while blocking the light in the summer months, when heat is not desired.

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**FINAL LIGHTING DESIGN**  
final lighting concept, studies + strategies

**LIGHTING CONCEPT** understanding through nature

- **Emergent Spaces**: Experiencing spaces, passion, strategies, experiences. Lighting qualities both vertically and horizontally.

- **Filtering Light**: Filtering light through space makes the space memorable and grand.

- **Light Sharing**: Share light from one space to another through use of layering to minimize use of electric lighting. Share light from one space to another through use of layering.

- **Light from Above**: Light from above makes spaces feel lighter and loftier.

- **Varying Experiences**: Change throughout the day/year. Varying experiences make spaces feel lighter and loftier.

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**LAB LIGHTING STUDY** light throughout the year

**BASELINE LIGHTING MODEL** initial lighting design

- **DAYSIM AUTONOMY** annual lighting analysis

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**FINAL LIGHTING MODEL** lighting studies throughout the year

**LIGHT DISTRIBUTION** physical lighting distribution + electric lighting

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**BASELINE LIGHTING CONCLUSION**: Our baseline lighting model came from our project01 design. Based on our analysis we were not getting much light into our interior spaces where the users would be working. Because our lighting remained primarily on the outer edge we decided that going forward we would try to bring light deeper into the spaces through layering of light as well as light sharing between the spaces.

**DAYSIM AUTONOMY CONCLUSION**: Our daysim autonomy analysis shows that we are receiving a great amount of light throughout the year on both the third and the fourth floor. Our greatest amount of light was seen in the corridor spaces where the light is then diffused to the interior rooms (offices + labs + classrooms). The darkest part of our design were the elevator core (no glazing) and the daylighting lab where there is not a great need for light as blackout capabilities are required. Overall we would speculate based on our analysis that we get light into our spaces about 85-90% of the time, a great improvement from the baseline as well as a large reduction of the need for supplemental electric lighting.
FINAL THERMAL DESIGN

THERMAL MODEL - BASELINE 75.7 kBTus/SF

Month-to-Month Heating/Cooling Loads
Location: Minneapolis, MN
4 Stories, 10,800 sf, 2.7 sf/ft²

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<th>Month</th>
<th>Heating Load kW</th>
<th>Cooling Load kW</th>
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THERMAL MODEL - DESIGN 66.6 kBTus/SF

THERMAL MODEL - DESIGN + RE 37.0 kBTus/SF

Displacement Ventilation System
All buildings were altered to incorporate displacement ventilation systems.
FINAL DESIGN Plans + Implementation of Passive/Renewable/Thermal Design Strategies

FINAL STRATEGIES IMPLEMENTED, optimizing our design

SHADING DEVICES
A well-designed passive system provides a healthy microclimate, making the occupants comfortable and enhancing their productivity. To achieve this, we designed shading devices that are adjustable in different settings, allowing for increased energy efficiency and improved indoor comfort. These devices are designed to be unobtrusive, blending in with the architecture of the modern space.

WINDBREAK
Windbreaks minimize wind conditions by moving the wind away from the building. Therefore, it is important to consider every detail. Due to the Minnesota climate conditions, it is important to keep the wind out of the building. The windbreak helps to prevent the wind from entering the building while still admitting part of it in. The structure consists of perforated metal panels, which are equipped with LED-lights.

GREEN ROOF
Green roofs serve several purposes for a building - absorbing rainwater, providing insulation, enhancing wildlife habitat, and helping to lower urban air temperatures and combat the heat island effect. There are two types of green roofs: intensive roofs, which are thicker and can support a wider variety of plants but are heavier and require more maintenance, and extensive roofs, which are covered in a variety of plants and are lighter. Current design uses intensive green roof technology in occupied areas, and extensive in other areas.

PV PANELS
Photovoltaic panels are increasingly incorporated into new buildings as an important renewable source of electrical power. The panels convert sunlight directly into electricity. Photovoltaics (PV), also often called solar panels, transform sunlight into electricity. Solar power is pollution-free during use. When grid-connected, it can replace some or all of the highest-cost electricity used during times of peak demand (in most climatic regions). PV installations can operate for many years with little maintenance or intervention after their initial installation.

HYBRID GREEN ROOF, plan of northeast green roof

Third Floor Floorplan
Fourth Floor Floorplan
Scale 1/16"=1'

Systems Integration, bringing together passive + renewable energy systems

All systems work in harmony to provide a comfortable living and working environment. The east and west façades of the building are equipped with large south-facing louvers designed in accordance with low sun angles to admit heat and light during winter time. N-S Section. Winter.

Displacement ventilation outlets are situated in the walls and columns, at the floor level. The ventilation concept is the so-called displacement ventilation. This type of ventilation will provide an even distribution of air throughout the floor and will create a more comfortable environment for the occupants.

INTERACTIVE PATIOS
Allows for user to stay in the garden space, gives user great views of surrounding campus as well as reflection and interactive learning about green roofs.

INTENSIVE GARDEN
Combination of louver systems, interactive learning about green roofs, provides user great views of surrounding campus as well as reflection and interactive learning about green roofs.

EXTENSIVE GARDEN
Combination of louver systems, interactive learning about green roofs, provides user great views of surrounding campus as well as reflection and interactive learning about green roofs.

INTERACTIVE PATIOS
Combination of louver systems, interactive learning about green roofs, provides user great views of surrounding campus as well as reflection and interactive learning about green roofs.

SOUTH ELEVATION, scale: 1/32" = 1'

EAST ELEVATION, scale: 1/32" = 1'

WEST ELEVATION, scale: 1/32" = 1'

FULL BUILDING SECTIONS, summer + winter conditions

INTERACTIVE PATIOS
Combination of louver systems, interactive learning about green roofs, provides user great views of surrounding campus as well as reflection and interactive learning about green roofs.

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Combination of louver systems, interactive learning about green roofs, provides user great views of surrounding campus as well as reflection and interactive learning about green roofs.