BALL STATE UNIVERSITY

SUSTAINABLE DAYLIGHTING; CREATING A MODEL LEARNING ENVIRONMENT

by Joshua Ryan Campbell

Thesis Professor: Professor Jack Wyman
Department of Architecture

Thesis Advisor: Glenn Switzer
Department of Architecture

Thesis Advisor: Mike Schipp
Principal, Fanning/Howey Associates, Inc.
SUSTAINABLE DAYLIGHTING;
CREATING A MODEL LEARNING ENVIRONMENT

By
Joshua Ryan Campbell

A thesis submitted in partial fulfillment of
the requirements for the degree of
Bachelor of Architecture
Ball State University
2006

Approved by ____________________________________  Chairperson of Supervisory Committee
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________

Program Authorized to Offer Degree ____________________________________

Date ____________________________________
The author wishes to thank all of those who have helped me become the person I am today.

To my mom for your notes of encouragement that lifted my spirits when I was down and gave me the strength to continue.

My wife, whose patience with me the past few years and sticking by my side has given me the strength to realize a big step in accomplishing my dream.

Mike, your guidance and teaching have been instrumental to my development as a young designer. Your friendship and mentoring have been greatly appreciated!

Jack, for your help and guidance with my thesis. Your instruction and time in helping me to develop as a designer has been appreciated.

For those who have taken the extra time needed in helping me understand during my internships THANK-YOU!
Table of Contents

- **Chapter 1: Opening**
  - Front Cover
  - Title Page
  - Acknowledgements 3
  - Table of Contents 4
  - Abstract 5

- **Chapter 2: Research**
  - Precedent Analysis / Observations 6-11
  - Interpretations/Strategies/Benefits 12-15
  - Market Data 16 and 17

- **Chapter 3: Program**
  - Design Criteria 19 and 20
  - Site Location 21 and 22
  - Site Plan 23
  - Conceptual Design 24-28
  - Sun Angle Data 29
  - Classroom Layout 30 and 31
  - Light Study Explorations 1 and 2 32-37
  - Final Design / Renderings 38-45

- **Chapter 4: Reflection**
  - Conclusions/Further Explorations 46
  - Bibliography 47
Abstract

For my thesis I am designing an Elementary School for approximately 600 - 650 students. I want to explore the idea of having the amenities located centrally, allowing for a smaller school feeling while allowing more opportunities for expansion. I want to use sustainable design to enhance the performance of the built environment and education of students. I plan to explore the idea of day lighting strategies in a classroom to improve the atmosphere in which students learn.

- This will include:
  - Placement of windows and day lighting elements
  - Brightness
  - Light transmission
  - Light distribution within the classroom

- I will explore:
  - Using sun shading devices
  - Materials
  - Indirect lighting methods
  - Optimizing my site as a way to create a sustainable classroom.

In my thesis I want to explore how we, as designers, begin addressing day lighting issues as a primary focal point. Explore an Architect's moral obligation to the users, particularly in schools. If studies are showing that natural light improves test scores, has psychological importance, and other significant benefits, then why does day light often play a secondary role to aesthetics? I came across two articles that I found interesting and made me want to explore ways to exploit these potential savings.

- According to www.SBICouncil.org more than $7.8 billion dollars a year is being spent on energy for grades K-12.

- www.PSIC.org says that school districts can save 30%-40% on Utility costs each year for new schools and 20%-30% on renovated schools by applying sustainable, high performance design and construction concepts.

I want to look at effective precedent studies to use as a building block in helping me explore the potential of how to better harness day light.
Parkside Elementary School
Bartholomew Community School Corporation
The Architects Collaborative
(Norman Fletcher, Principal Architect)
Location: Columbus, IN.

Parkside Elementary School was chosen as a precedent study by advice from Jack Wyman. Jack explained Parkside Elementary School had multiple good examples of natural day lighting. A special thanks to those at Parkside Elementary School for opening their doors and making me feel welcome!
1962 Renovation of Parkside Elementary School
Observations (Site Visit)

• Principal was trying to get gym windows tinted because glare was an issue during sporting events.
• High gloss surface provides problems
• Exterior Gym elevation.
Observations (Site Visit)

- Most blinds remained closed rendering potential daylighting strategies useless. The pictures are of the interior and exterior of the library space.
Observations (Site Visit)

• Typical classroom wing. Cantilevered overhang to help protect classrooms from overheating. Proved to be an inadequate strategy by the teachers who used the classrooms.
• Teachers pointed out that the southern window blinds remained closed due to glare and heat gain in the classroom.

• Skylight lit the corridor between the kindergarten classrooms that served as an interior play area.
Excerpt taken from Building Type Basics for elementary and secondary schools

- **Centralized resources with double-loaded classroom wings.** This is probably the most fundamental building form. The essence of this concept is the centralization of all shared resources, from auditorium and gymnasium to school administration. Centralization of these functions minimizes travel distances from classrooms. This concept is readily used with elementary schools, where shared facilities are typically less in quantity and sophistication than they are for the upper grades. In addition, by dividing the classrooms into at least two wings, natural sub grouping within the school emerge, which may be a desired goal in schools with large populations or wide grade ranges.

Excerpt taken from Building Type Basics for elementary and secondary schools

- **Spine with single-loaded classroom wing.** In this model a “main street” separates classroom areas from shared resources. This configuration allows for visual and programmatic differentiation of the sides of the corridor.
Day lighting Strategies

Sidelighting

Window with Overhang

Window with shading

Window with light shelf

Toplighting

Skylight

Clerestory

Sawtooth or angled clerestory

Monitor
Benefits of High Performance Buildings

- **Daylighting saves energy**
  - Daylight hours correspond to peak energy use in most buildings. Spaces that are well daylit can reduce the cost to electrically light a building by up to 60%.

- **Cumulative savings**
  - Incremental costs for a high performance building can be recouped through savings on energy costs, increases in worker productivity, and fewer days of absenteeism. Plus, the savings accumulate for the life of the building.

- **Fewer missed days**
  - High performance buildings do more than create a better workplace. They also increase productivity by reducing absenteeism.

- **Productivity boost**
  - The benefits of high performance buildings go well beyond energy savings. Many also improve occupant comfort, which can lead to increased productivity.
Benefits of High Performance Buildings (Continued)

charts used with permission from www.betterbricks.com

---

**under-floor utility routing**

Placing electrical and HVAC distribution systems under the floor allows for flexibility in office configuration. Current tenants can change layouts if needed and new tenants can more easily customize a space to fit their requirements.

---

**fixed shading**

Interior light shelves and exterior overhangs block direct sunlight and reduce glare while bouncing daylight deeper into interior spaces. The combined effect boosts worker productivity and reduces energy costs, which saves money for both tenants and owners.

---

**integrating daylighting**

It is important to integrate daylighting with electric lighting systems. Light sensors detect the overall level of illumination, adjusting electrical lighting automatically as the level of natural light changes.

---

**building orientation**

Orienting the building to maximize north and south exposures while minimizing east and west exposures is a great way to start implementing daylighting.
Sustainable Design Research

National Data:

- www.psic.org says that school districts can save 30%-40% on Utility costs each year for new schools and 20%-30% on renovated schools by applying sustainable, high performance design and construction concepts.

- According to the U.S. Department of Energy’s Rebuild America EnergySmart Schools Program estimates, school energy costs are approximately $110 per student per year, depending on region and climatic conditions.

- High-performance, sustainable design solutions can yield savings of up to $56 per student per year!

- According to www.SBICouncil.org more than $7.8 billion dollars a year is being spent on energy for grades K-12.

- High Performance Schools
  - Healthy and Productive
    - Acoustic, visual, and thermal comfort
    - Safe
    - Air Quality
  - Cost effective
    - Life cycle costs
    - Optimize energy performance
  - Sustainable
    - Energy conservation
    - Environmentally responsive site planning
    - Materials

*Fishers, Indiana + HSE School Corp. Data: HSE Grades K-5th 2003-2010

- 6 New
- 1 Renovation

- HSE Grades k-5 2005 – 2010

<table>
<thead>
<tr>
<th>Year</th>
<th>% of Students</th>
<th># of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005 / 2006</td>
<td>9.13%</td>
<td>7,613</td>
</tr>
<tr>
<td>2006 / 2007</td>
<td>5.67%</td>
<td>8,045</td>
</tr>
<tr>
<td>2007 / 2008</td>
<td>6.0%</td>
<td>8,528</td>
</tr>
<tr>
<td>2008 / 2009</td>
<td>5.31%</td>
<td>8,981</td>
</tr>
<tr>
<td>2009 / 2010</td>
<td>4.6%</td>
<td>9,346</td>
</tr>
</tbody>
</table>

*All Data taken from a September 1, 2005 Survey done by HSE School Corporation. Used by permission from Fanning/Howey Associates with special permission from HSE.

- According to www.SBICouncil.org an estimated 6,000 new schools are needed by 2007 to serve the growing K-12 student population. And 1/3 of our existing schools are in need of repair or replacement!
Fishers Projected Growth Thru 2012
(Data used with permission from Fanning/Howey Associates and HSE school Corporation)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2002-2003</td>
<td>475</td>
<td>525</td>
<td>575</td>
<td>625</td>
<td>675</td>
<td>725</td>
<td>775</td>
<td>825</td>
<td>875</td>
<td>925</td>
<td>975</td>
<td>1025</td>
<td>1075</td>
<td>1125</td>
</tr>
<tr>
<td>2003-2004</td>
<td>500</td>
<td>550</td>
<td>600</td>
<td>650</td>
<td>700</td>
<td>750</td>
<td>800</td>
<td>850</td>
<td>900</td>
<td>950</td>
<td>1000</td>
<td>1050</td>
<td>1100</td>
<td>1150</td>
</tr>
<tr>
<td>2004-2005</td>
<td>525</td>
<td>575</td>
<td>625</td>
<td>675</td>
<td>725</td>
<td>775</td>
<td>825</td>
<td>875</td>
<td>925</td>
<td>975</td>
<td>1025</td>
<td>1075</td>
<td>1125</td>
<td>1175</td>
</tr>
<tr>
<td>2005-2006</td>
<td>550</td>
<td>600</td>
<td>650</td>
<td>700</td>
<td>750</td>
<td>800</td>
<td>850</td>
<td>900</td>
<td>950</td>
<td>1000</td>
<td>1050</td>
<td>1100</td>
<td>1150</td>
<td>1200</td>
</tr>
<tr>
<td>2006-2007</td>
<td>575</td>
<td>625</td>
<td>675</td>
<td>725</td>
<td>775</td>
<td>825</td>
<td>875</td>
<td>925</td>
<td>975</td>
<td>1025</td>
<td>1075</td>
<td>1125</td>
<td>1175</td>
<td>1225</td>
</tr>
<tr>
<td>2007-2008</td>
<td>600</td>
<td>650</td>
<td>700</td>
<td>750</td>
<td>800</td>
<td>850</td>
<td>900</td>
<td>950</td>
<td>1000</td>
<td>1050</td>
<td>1100</td>
<td>1150</td>
<td>1200</td>
<td>1250</td>
</tr>
<tr>
<td>2008-2009</td>
<td>625</td>
<td>675</td>
<td>725</td>
<td>775</td>
<td>825</td>
<td>875</td>
<td>925</td>
<td>975</td>
<td>1025</td>
<td>1075</td>
<td>1125</td>
<td>1175</td>
<td>1225</td>
<td>1275</td>
</tr>
<tr>
<td>2009-2010</td>
<td>650</td>
<td>700</td>
<td>750</td>
<td>800</td>
<td>850</td>
<td>900</td>
<td>950</td>
<td>1000</td>
<td>1050</td>
<td>1100</td>
<td>1150</td>
<td>1200</td>
<td>1250</td>
<td>1300</td>
</tr>
<tr>
<td>2010-2011</td>
<td>675</td>
<td>725</td>
<td>775</td>
<td>825</td>
<td>875</td>
<td>925</td>
<td>975</td>
<td>1025</td>
<td>1075</td>
<td>1125</td>
<td>1175</td>
<td>1225</td>
<td>1275</td>
<td>1325</td>
</tr>
<tr>
<td>2011-2012</td>
<td>700</td>
<td>750</td>
<td>800</td>
<td>850</td>
<td>900</td>
<td>950</td>
<td>1000</td>
<td>1050</td>
<td>1100</td>
<td>1150</td>
<td>1200</td>
<td>1250</td>
<td>1300</td>
<td>1350</td>
</tr>
</tbody>
</table>
### Program of Spaces
(K-5 Elementary School 600-650 Students)

- **GENERAL CLASSROOM SPACE**

<table>
<thead>
<tr>
<th>Classroom Type</th>
<th>Quantity</th>
<th>Area (sq/ft)</th>
<th>Total (sq/ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kindergarten Classroom</td>
<td>4</td>
<td>1,200</td>
<td>1,200</td>
</tr>
<tr>
<td>1st Grade</td>
<td>4</td>
<td>900</td>
<td>3,600</td>
</tr>
<tr>
<td>2nd Grade</td>
<td>4</td>
<td>900</td>
<td>3,600</td>
</tr>
<tr>
<td>3rd Grade</td>
<td>4</td>
<td>900</td>
<td>3,600</td>
</tr>
<tr>
<td>4th Grade</td>
<td>4</td>
<td>900</td>
<td>3,600</td>
</tr>
<tr>
<td>5th Grade</td>
<td>4</td>
<td>900</td>
<td>3,600</td>
</tr>
<tr>
<td>Prep Room</td>
<td>8</td>
<td>300</td>
<td>2,400</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>21,600 Total sq/ft</strong></td>
</tr>
</tbody>
</table>

- **SPECIALIZED CLASSROOMS**

<table>
<thead>
<tr>
<th>Room Type</th>
<th>Quantity</th>
<th>Area (sq/ft)</th>
<th>Total (sq/ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Art</td>
<td>1</td>
<td>860</td>
<td>860</td>
</tr>
<tr>
<td>Music</td>
<td>1</td>
<td>860</td>
<td>860</td>
</tr>
<tr>
<td>Special Education</td>
<td>2</td>
<td>195</td>
<td>390</td>
</tr>
<tr>
<td>Computer / Activity</td>
<td>1</td>
<td>634</td>
<td>634</td>
</tr>
<tr>
<td>L.G.I.</td>
<td>1</td>
<td>860</td>
<td>860</td>
</tr>
<tr>
<td>S.G.I.</td>
<td>4</td>
<td>195</td>
<td>780</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>6,730 Total sq/ft</strong></td>
</tr>
</tbody>
</table>

- **ADMINISTRATIVE OFFICES**

<table>
<thead>
<tr>
<th>Office Type</th>
<th>Quantity</th>
<th>Area (sq/ft)</th>
<th>Total (sq/ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reception</td>
<td>1</td>
<td>170</td>
<td>170</td>
</tr>
<tr>
<td>Waiting</td>
<td>1</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>Principal</td>
<td>1</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Auxiliary Office</td>
<td>3</td>
<td>100</td>
<td>300</td>
</tr>
<tr>
<td>Records Room</td>
<td>1</td>
<td>85</td>
<td>85</td>
</tr>
<tr>
<td>Conference Room</td>
<td>1</td>
<td>165</td>
<td>165</td>
</tr>
<tr>
<td>Clinic</td>
<td>1</td>
<td>389</td>
<td>389</td>
</tr>
<tr>
<td>Clinic Restroom</td>
<td>2</td>
<td>80</td>
<td>120</td>
</tr>
<tr>
<td>Break</td>
<td>1</td>
<td>168</td>
<td>168</td>
</tr>
<tr>
<td>Workroom</td>
<td>1</td>
<td>287</td>
<td>287</td>
</tr>
<tr>
<td>Guidance</td>
<td>1</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Circulation</td>
<td></td>
<td>167</td>
<td>167</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>2,351 Total sq/ft</strong></td>
</tr>
</tbody>
</table>

- **MEDIA CENTER**

<table>
<thead>
<tr>
<th>Area Type</th>
<th>Quantity</th>
<th>Area (sq/ft)</th>
<th>Total (sq/ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stack, Reading, and Story-Pit Area</td>
<td>1</td>
<td>2,389</td>
<td>2,389</td>
</tr>
<tr>
<td>Office</td>
<td>3</td>
<td>100</td>
<td>300</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>2,689 Total sq/ft</strong></td>
</tr>
</tbody>
</table>
### Program of Spaces (Continued)

- **PHYSICAL EDUCATION**

<table>
<thead>
<tr>
<th>Facility</th>
<th>1 @ sq/ft</th>
<th>=</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gymnasium (74’ court)</td>
<td>5,532</td>
<td></td>
</tr>
<tr>
<td>Bleacher (300 people)</td>
<td>396</td>
<td></td>
</tr>
<tr>
<td>Stage</td>
<td>788</td>
<td></td>
</tr>
<tr>
<td>PE Storage</td>
<td>117</td>
<td></td>
</tr>
<tr>
<td>PE Storage</td>
<td>146</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>6,979</strong> Total sq/ft</td>
<td></td>
</tr>
</tbody>
</table>

- **FOOD SERVICE**

<table>
<thead>
<tr>
<th>Facility</th>
<th>1 @ sq/ft</th>
<th>=</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cafeteria</td>
<td>2,552</td>
<td></td>
</tr>
<tr>
<td>Dry Food Storage</td>
<td>265</td>
<td></td>
</tr>
<tr>
<td>Satellite Kitchen/Food Service</td>
<td>652</td>
<td></td>
</tr>
<tr>
<td>Ware wash</td>
<td>452</td>
<td></td>
</tr>
<tr>
<td>Janitor</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>Restroom</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Office</td>
<td>184</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>4,285</strong> Total sq/ft</td>
<td></td>
</tr>
</tbody>
</table>

- **FACULTY SPACE**

<table>
<thead>
<tr>
<th>Facility</th>
<th>1 @ sq/ft</th>
<th>=</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faculty Workroom/Dining</td>
<td>582</td>
<td></td>
</tr>
<tr>
<td>Toilets</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>702</strong> Total sq/ft</td>
<td></td>
</tr>
</tbody>
</table>

- **MAINTENANCE**

<table>
<thead>
<tr>
<th>Facility</th>
<th>1 @ sq/ft</th>
<th>=</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outdoor Storage</td>
<td>204</td>
<td></td>
</tr>
<tr>
<td>Custodial Workroom</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>Custodial Receiving</td>
<td>473</td>
<td></td>
</tr>
<tr>
<td>Custodial Office</td>
<td>144</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>1,021</strong> Total sq/ft</td>
<td></td>
</tr>
</tbody>
</table>

- **BUILDING SERVICES**

<table>
<thead>
<tr>
<th>Facility</th>
<th>1 @ sq/ft</th>
<th>=</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toilets</td>
<td>1,200</td>
<td></td>
</tr>
<tr>
<td>Storage</td>
<td>456</td>
<td></td>
</tr>
<tr>
<td>Electrical Closets</td>
<td>207</td>
<td></td>
</tr>
<tr>
<td>Storage</td>
<td>432</td>
<td></td>
</tr>
<tr>
<td>Electrical Closets</td>
<td>285</td>
<td></td>
</tr>
<tr>
<td>Technology</td>
<td>285</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>2,865</strong> Total sq/ft</td>
<td></td>
</tr>
</tbody>
</table>

- **NET BUILDING AREA** 58,900

- **CIRCULATION NET AREA** 17,047 sq/ft

- **SUBTOTAL** 75,947 sq/ft

- **CIRCULATION** 22%

- **CAPACITY (AS SHOWN)** 600-650 STUDENTS

- **AREA PER STUDENT** 126 sq/ft per student @ 600 students
Statewide, Fishers, a suburb of Indianapolis, has been Indiana's fastest-growing city with a population increase of more than 20,000 residents during the 1990s. Its rate of growth was four times as much as the rate for the second-fastest-growing city and its Hamilton County neighbor, Carmel.

- Corner of Cyntheanne Road and SR 238 in Fishers, IN.
- Chosen because it is HSE schools future Elementary School site. This is based on projected growth of Fishers, IN. and Hamilton County.
- Current state of site has no current context because it is site of future expansion.
Site Location (Continued)

Cyntheanne Road and State HWY 238

Site on right hand side
Sun Angles for 40 North Latitude
Fishers, Indiana

• June 21
  – 9 AM 50 degrees, 75 degrees ES
  – 12 NOON 75 degrees, 0 degrees
  – 3 PM 50 degrees, 75 degrees WS

• March 21
  – 9 AM 34 degrees, 58 degrees ES
  – 12 NOON 51 degrees, 0 degrees
  – 3 PM 34 degrees, 58 degrees WS

• September 21
  – 9 AM 34 degrees, 58 degrees ES
  – 12 NOON 51 degrees, 0 degrees
  – 3 PM 34 degrees, 58 degrees WS

• December 21
  – 9 AM 15 degrees, 43 degrees ES
  – 12 NOON 27 degrees, 0 degrees
  – 3 PM 15 degrees, 43 degrees WS

Program
30’ x 30’ classroom
Interior 24’ x 24’ square work area
Marker Boards on both interior side walls

Goals
It was my objective to find an ideal day light strategy for a 30’ x 30’ classroom for the months of Aug. – May from 8 am until 3 pm and account for a recess and lunch time of 1 hour around noon.

Observations
I found that the most light entered the classroom in the winter, when desired. In the morning and afternoon light would hit a secondary surface, side walls, and display light on the marker boards on the walls.

Future Exploration
Given more time I would take the top lighting of the classroom further. I would try to better control the light entering the classroom at noon to prevent potential overheating.
Classroom Layout

Classroom Cubicles

Looking at teaching wall and Exterior window

Teaching Wall

Typical Classroom Layout
Second Light Study Exploration
Side lighting March / September 21 @ 9, 12, 3
40 Degrees North Latitude

- In this application light penetration has some effect on the desk surfaces of the students at noon. If you look close some of the light is reflecting off the side walls of the classroom, but not enough to have an impact on glare.
I was not concerned to much with the sun penetration into the classroom in the month of June because students would already be out for summer. Any sun that might have entered would only be a potential for heat gain within the classroom. There was no sun penetration into the classroom on June 21 at 9am, Noon, and 3pm.
Second Light Study Exploration
Side lighting December 21 @ 9,12,3
40 Degrees North Latitude

Because of the sun angle in Indianapolis (40 degrees) and the location of my light shelf I found more sun in the winter than any other time of the year. The light entering the classroom would not hit the desk surface except at lunch when the students are out of the classroom. The only problem is at 9am and 3pm the light is being placed where the marker boards are placed causing the potential for glare.
First Light Study Exploration
Side lighting March / September 21 @ 9, 12, 3
40 Degrees North Latitude

• First lighting strategy with a smaller window. Little day light enters the classroom and does not reach the desk surfaces or side walls to help displace more light into the classroom.
First Light Study Exploration
Side lighting June 21 @ 9,12,3
40 Degrees North Latitude

- First lighting strategy with a smaller window. No light enters the classroom.
First Light Study Exploration
Side lighting December 21 @ 9,12,3
40 Degrees North Latitude

- First lighting strategy with a smaller window. Too much light enters into the classroom causing multiple situations for glare both on the student desks and on the marker boards located on the side walls.
Final Renderings

SOUTH WEST Birds-Eye View

SOUTH EAST Birds-Eye View
Final Renderings

Event Parking

Main Entrance Canopy
Final Renderings

Typical Classroom Entrance

Cafeteria and Sporting Event Entrance
Final Renderings

1<sup>st</sup> – 5<sup>th</sup> Playground

KAL-WAL skylight and clock

Playground Entry

Roof Plan
• **Possible Explorations**
  
  - Skylights
  - Light penetrations and effects in other areas
  - Glazing
  - Sloped ceiling
  - Explore other Day lighting strategies
  - Ways to reflect light back into the classroom without compromising views
  - How to better control the low angle of sun that penetrates most of the classroom using fins, louvers, or other mechanisms.
  - Lights reacting from various textures and surfaces
  - Why window are needed
  - How windows are used

• **Conclusions**

  During my thesis I learned that in Indianapolis the North side of the building does not receive light in the classroom until before 6am and after 6pm. The only ways of getting light into the classroom is light wells or by reflecting light back into the classroom off a surface. The downside is you lose view which I ruled as a more important thing! The low angle of the sun is tough to deal with. Many ways such as shades and other elements work, but as seen in the precedent study closing the shading devices defeats the purpose of having the window. The teachers at Parkside Elementary School enjoyed the window and courtyards that allowed having more window, however maintenance hated mowing the various segregated areas and had problems with people breaking into the courtyard areas during off school hours! Glare from the gym floor and other surfaces made having the windows a deterrent rather than creating a nice space. I learned to think of the placement and more about how the spaces would be used to determine rather a window was needed and how that window would best serve the user!
Bibliography

• http://www.gsa.gov
• http://www.daylighting.org
• www.betterbricks.com