



Solstice 68 deg ce 22 de SE JZTH AV Sunlight Path

DAYLIGHTING ANALYSIS L. Patterson and C. Hardman

Sustainable architecture is a necessity for the preservation of the planet and all forms of life. To consider the future and long term effects of design, better use of resources is essential. Population growth, energy demands, and lifestyle continue to change the realities of energy production and consumption. In short, better design of our built world will allow for a less harmful human impact.

A variety of sustainability strategies can be considered in all types of design. To narrow the method to one single equation is impossible. Solutions should consider all aspects of a building and site. For example, daylighting can reduce the energy needs of a building. Daylight is limited based on the climate and location. It also depends on the relationship between building and sky. Daylighting is passive strategy to use natural light to brighten a space. The benefits range from aesthetic space to psychological health to energy efficiency. How to best incorporate daylighting into a design has become a digital activity for many architects and engineers. A continuous development in software aids in the process of scientifically answering these questions.

OVERVIEW

The goal of this research is to produce a daylight and energy analysis of the Yost Grube Hall Ankeny 'Net Zero' Multi-Family Housing project. The examination of current daylight levels provides information on what is gained or lost in regards to daylighting and net-zero goals. A focus on the progression of the surrounding neighbourhood development will guide the different daylight studies. This combined with the other strategies employed by YGH in their design efforts forms a narrative about the realities of 'Net-Zero' architecture and the various routes to success.

RESEARCH GOALS:

Daylighting Analysis

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YOST GRUBE HALL ARCHITECTURE

Energy Analysis in relation to daylighting **Graphics/Representation of results**

TERM BEGINS

.4.16 INTRO MEETING WITH YGH

mmunication between YGH and PSU established through mail, introduction to team and project, weekly meeting set

.11.16 INITIAL RESEARCH BRAINSTORM

itial questions about project, YGH established digital sharing e, YGH presents two potential research ideas, city review scussed, goals moving forward established

.18.16 DAYLIGHT ANALYSIS PART 1

odeling files shared, PSU works on sketchup and efaira, entire team is present to give input on deliverables

.25.16 WORK WEEK

meeting, work on digital model continued, questions about odeling issues discussed over email, PSU practices Sefaira s analysis tool

1.16 MEETING + WORK

ork on digital model continued, energy analysis comparison, scussion of midterm summary and goals, photographs of te model taken

resentation concept:

let-Zero' Narrative (Elements and Comparisons)

.8.16 MEETING

efaira modeling, midterm presentations, research of daylightg graphics,

15.16 NO MEETING

roduction and sefaira analysis, research of different energy andards/goals (2030 Challenge, etc.)

22.16 MEETING

oduction and sefaira analysis, research of different energy andards/goals (2030 Challenge, etc.)

29.16 FINAL MEETING

.8.16 resentation to class

hursday at 4" resentation to YGH

se of digital analysis tools and modeling mmunication between YGH and PSU

oduction of results







1. Analysis of block 'as is'

Focus:

"Residential" Hours Morning: 8-10 AM Evening: 3-6PM

Conclusion:

The direct daylighting is best during the summer month evenings

DECEMBER Morning: 1.1 hrs Evening: 0 hrs

JUNE Morning: 1.8 hrs Evening: 1.9 hrs





December 20

2. Analysis of block with NW portion developed at 75'

Conclusion: The NW portion developed at 75' blocks most direct daylight in zones 1 and 2.

INE	
orning:	

Evenina

zone 1&2 = 0 hrs zone 3 = 1.8 hrs

1.9 hrs all

DECEMBER Morning:

Evening:

zone 1 = .2 hrs zone 2&3 = 1.1 hr 0 hrs all

Daylighting and Energy Use



Initial Daylight Analysis Maximum Glazing Percentage



Current Design Daylight Analysis Glazing Percentage for better envelope



Unit experience: June 20th 4-6 pm 'Zone 2' experiences the most direct daylight in the gathering spaces of the apartment.

30% 40% 50% 60% 70% 80% 90%

3rd FLOOR PLAN - Not to Scale

Unit experience: June 20th 4-6 pm The upper units have more direct daylight in 'Zone 1' and 'Zone 2.'

6th FLOOR PLAN - Not to Scale

The team made design decisions that improved the envelope of the building in order to reach their net-zero goal. The glazing percentage was decreased in order to maintain a tighter seal as well as minimize heat gain. Whether or not this changed the quality of space in relationship to daylight can be investigated through a closer look at the individual units throughout the apartment.





zone 2 = .9 hrs

0 hrs all

Evening:

N.W. and S.W.			N.E. Developed		
	June 20		June 20	~	
	December 20		December 20		
	4. Analysis of block with NW and SW portions developed at 75' (Preserving 3 historic homes) Conclusion: The NW and SW portions developed at 75 feet decreases daylighting primarily in zone 1.		5. Analysis of block with NE portion developed at 75' Conclusion:The NE portion devel- oped at 75 feet blocks the least amount of direct daylight.		
	JUNE		JUNE		
	Morning: (Inco Evening:	onsistent reading) zone 1&2 = 0 hrs zone 3 = 1.8 hrs	Morning: Evening:	zone 1 = 1.1 hrs zone2&3 = 1.8hrs zone 1 = 1.1hrs zone 2&3 = 1.9hrs	
	DECEMBER				
	Morning:	zone 1 = .3 hrs zone 2&3 = 1 hrs	DECEMBER Morning	z_{0} ne 1 = 3 hrs	
	Evening:	0 hrs all	morning.	zone 2&3 = .9hrs	
			Evening:	0 hrs all	



INDICATES UNCHANGED AREA OF BLOCK



Best Direct-Daylight!

INDICATES AREAS WITH 0 HOURS OF DIRECT

Conclusions

Surrounding Development

The direct-daylight will be decreased if surrounding buildings on the block are developed.

Quality of Space

The daylighting of residential gathering spaces remains relatively high. When taking a closer look at the individual units at specifically "residential hours," the units still experience direct daylighting. Therefore, the daylighting was not lost in the efforts to reach net-zero standards.

Sefaira as a Tool of Analysis

Sefaira produced inconsistent numbers throughout the process of this research. Whether the glitch was a misread or an inability to read the digital model in any manner, the conclusion can be made that the concrete metrics desired for research cannot be found using Sefaira. However, the analysis of general relationships and relative increase or decrease is attainable using the tool.

20% 30% 40% 50% 60% 70% 80% 90% 100%

Daylighting Analysis of Ankeny Net-Zero Multi-Family Housing