The Elementary School

Philadelphia, PA

Breadth Topics

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Executive Summary

The following report outlines the two breadths that will be analyzed for the elementary school. The two breadths include a daylighting study and an acoustical study.

Spaces

The four spaces to be analyzed and redesigned are the following:

- Circulation Space: Main Lobby
- Large Work Space: Cafeteria
- Special Purpose Space: Media Center
- Building Exterior and Site

Breadths

Daylighting and acoustics present an excellent opportunity to coordinate with the design and engineering of the building. Studying the different glazing materials used on different facades and controls would be a stimulating analysis. Also, analyzing the various spaces in order to calculate appropriate reverberation times and adjusting the room materials where necessary can help improve the comfort for students and teachers.

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Building Information

The elementary school is located in Philadelphia, Pennsylvania that serves two different student bodies: a K-2 program and a 3-5 program. Three new elementary buildings have been developed to replace nine existing elementary structures. The buildings follow a concept called the “school within a school”, where each building functions as smaller units within the larger school, serving a total population of 1300 students. A common core of facilities that provide all the support needed from both programs serves the two programs. The buildings accommodate approximately 50 classrooms, an art room, an office suite, support spaces, multipurpose room with a stage, a full service kitchen, two cafeterias, and a library.

General Building Data

Name: The Elementary School

Location: Philadelphia, Pennsylvania

Occupancy Type: Educational

Size: 140,455 SF

Total Cost: $ 43 Million

Project Delivery Method: Design-Bid-Build

Project Team

Owner: Confidential

Architecture: Schraeder Group Architecture

Construction: Reynolds Construction LLC

Civil: Renew Design Group

MEP & Structural: Brinjac Engineering

Breadth Topics

Daylighting

Natural light is a significant component in energy efficiency as well as in psychological behavior. Good daylighting can be implemented with proper electric lighting control and can result in significant energy savings by reducing electric loads and mechanical loads. Daylighting can also improve a student's educational performance. The building presents a great opportunity to study daylighting because of the abundant amount of glazing surrounding the building, however it could cause glare and thermal discomfort. Therefore, a couple of elements need to analyzed in order to optimize the use of daylighting.

The following elements will be analyzed:

- Glazing material
- Daylight integrated controls
- Building Orientation

Simple tools and calculations include:

- Sun path diagrams to calculate available daylighting during various seasons
- Daylight factor calculation for available interior daylight
- Glazing factor calculation for available interior daylight
- Comfen Analysis tool

The table below shows the different glazing types used in the building. All glazing material uses double-pane windows separated by a vacuum or gas filled space. The goal for this breadth is to control direct sunlight when necessary and utilize beneficial passive solar strategies when appropriate, fully integrate with other building systems including mechanical and electrical, and finally achieving significant energy savings.

Make-up Name	Make-up	Outboard Substrate & Coating	Inboard Substrate & Coating	Transmission			Reflectance			U-Value		RHG (Btu/ hr-ft²)	SC	SHGC	LSG
				Visible Light %	UV %	Solar Energy %	Visible Out %	Visible In %	Solar Energy Out %	Winter Night (Btu/hr-ft²-F)	Summer Day (Btu/hr-ft²-F)				
GL-1		SunGuard® SN 68 on Clear	Clear	68	29	33	11	12	32	0.29	0.28	90	0.43	0.38	1.80
GL-2		SunGuard® SN 68 on Clear	Guardian SatinDeco® on Clear Tudela Spain	66	29	32	11	12	32	0.29	0.28	90	0.43	0.38	1.76
GL-3		SunGuard® SN 68 on Clear	White Frit 100% Full Coverage on Clear	21	0	10	27	51	38	0.29	0.28	65	0.31	0.27	0.79
GL-4		SunGuard® SN 54 on Clear	Clear	54	15	23	13	18	33	0.29	0.27	68	0.32	0.28	1.90
GL-5		SunGuard® SN 54 on Clear	Guardian SatinDeco® on Clear Tudela Spain	52	15	23	13	18	33	0.29	0.27	68	0.32	0.28	1.87
GL-6		SunGuard® SN 54 on Clear	White Frit 100% Full Coverage on Clear	17	0	7	23	52	37	0.29	0.27	51	0.23	0.21	0.84

Calculation Standard: NFRC 2010

Table 1. Glazing types

Mechanical

Since daylighting is analyzed as one of the breadths, it would be practical to perform the building load calculations for the HVAC design process to size the mechanical system accordingly. Buildings consume 40% of the primary energy. Therefore, taking into consideration HVAC is crucial because HVAC control systems are created to be energy efficient and to improve the air quality and the occupants' comfort. The goal is to achieve significant energy savings by reducing lighting energy costs and associated cooling energy costs.

Acoustics

Acoustics is significant to the design and functionality of a given space. Sound behaves differently indoors than outdoors due to its boundaries and its interactions with those boundaries. Indoors, the boundaries will typically amplify sound while keeping out background noise allowing the sound to reflect and bounce around, absorb, or disperse the reflected sound in different directions. Whereas outdoors, there may be no boundaries to absorb sound and overcome any outdoor background noise. The way sound behaves is determined by its characteristic including the primary use of the room, room geometry and dimensions, absorptive properties of surface finishes and diffusion.

Part of the building analysis process is to identify the spaces that generate noise and spaces that require low background noise levels and high amounts of isolation. I intend to study the cafeteria space for additional acoustical analysis. There are no existing acoustical panels in the large space. Taking into consideration that the cafeteria space is open to the gymnasium will be a challenge to study. Wall partitions and surface materials cause each space to have different acoustical values and in order to calculate appropriate reverberation times, room materials will have to be adjusted where necessary.

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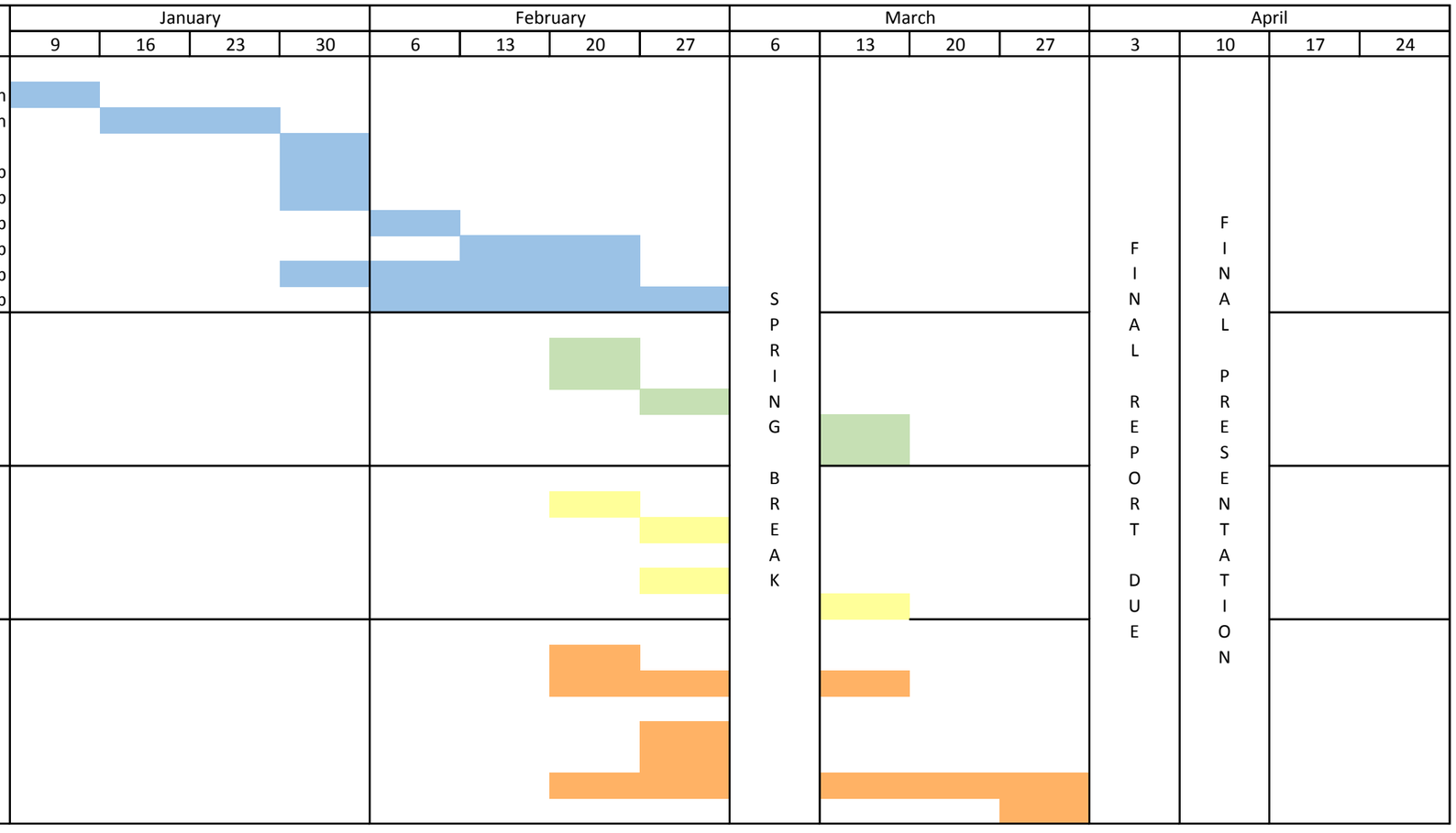
The Elementary School

Thesis Progress Schedule Spring 2017

Project Timeline	Start	Finish
Lighting Depth		
Revise Design Solution	9-Jan	13-Jan
Architectural Modeling	16-Jan	28-Jan
Fixtures & IES Files	28-Jan	30-Jan
DD: Main Lobby	30-Jan	2-Feb
DD: Cafeteria	2-Feb	5-Feb
DD: Media Center	6-Feb	9-Feb
DD: Exterior	9-Feb	12-Feb
Lighting Calculations	30-Jan	20-Feb
Written Report	1-Feb	27-Feb
Electrical Depth		
Revise Design Solution	20-Feb	26-Feb
Research Strategies	20-Feb	26-Feb
Load Analysis	27-Feb	5-Mar
Cost Analysis	13-Mar	19-Mar
Written Report	13-Mar	19-Mar
Daylighting Breadth		
Research Strategies	20-Feb	26-Feb
Written Report	27-Feb	5-Mar
Acoustic Breadth		
Research Strategies	27-Feb	5-Mar
Written Report	13-Mar	19-Mar
Report		
Formatting	20-Feb	26-Feb
Compiling Reports	20-Feb	19-Mar
Presentation		
Formatting	27-Feb	5-Mar
Outline	27-Feb	5-Mar
Develop	20-Feb	2-Apr
Practice	20-Feb	2-Apr



Milestones	
Revit Updated with 2 DD of spaces completed	10-Feb
Lighting Depth Complete & Electrical Depth Started	3-Mar

All breadths and depths completed	31-Mar