Final Thesis Report

Bradley Sisenwain

Lighting / Electrical Option

Faculty Adviser

Kevin Houser and Ted Dannerth

Gateway Community College

New Haven, CT

Table of Contents

Executive Summary 4
Abstract 5
Building Statistics 7
Lighting Depths | Overall Design Objectives: 9
Lighting Depth | Tiered Classroom 10
Lighting Depth | Library 19
Architectural Breadth | Library Skylight / Roof Garden Walkway 37
Structural Breadth | Library 39
Mechanical Breadth | Library Fenestration 45
Lighting Depth | Roof Garden 49
Lighting Depth | Student Gathering 57
Architectural Breadth | Student Gathering 67
Structural Breadth | Student Gathering Roof 72
Mechanical Breadth | Student Gathering Fenestration 75
Electrical Depth | Tiered Classroom 78
Electrical Depth | Library 80
Electrical Depth | Roof Garden 84
Electrical Depth | Student Gathering 87
Efficient Transformer Analysis 94
Photovoltaic Analysis 101
Coordination Study 108

Short Circuit Analysis 110
Summary and Conclusions 112
References 113
Acknowledgments 114
Appendix A Lighting A1
Appendix B Calculations B1
Appendix C Materials and Equipment C1

Executive Summary

The new campus for Gateway Community College is meant to "create a meaningful identity for the College while enhancing the urban qualities of the surrounding New Haven neighborhood."[i] The new identity created from joining programs from the Long Wharf and North Haven campuses will have a LEED Gold rating when completed and a number of dramatic spaces. The use of sustainable methods is prevalent throughout the building, and includes: photo-voltaic panels on the roof, daylight harvesting, and chillers that produce ice during off-peak hours that cools air during the day.

The main focus of this report is the building's lighting and electrical design. My study will include the redesign of four space's electric lighting and equipment. These spaces include; a Tiered Classroom, Library, Roof Garden, and Central Atrium or Student Gathering Space. The electrical implications of the lighting changes will also be examined, and will include; resizing of the affected distribution equipment, an examination of the building's photovoltaic panels, an efficient transformers analysis, coordination study of the distribution systems protective devices, and a short circuit analysis. Along with the former points mentioned, I will be examining the effects and integration of daylight on/into the mechanical and structural systems of the building.

It will be a goal to abide by all LEED criteria that are within the design goals of the lighting design and better the current services of the building where possible. It is an overall goal to consider the building as one entity, and to enhance the design both in engineering and architecture.

Renderings and Logo by Perkins + Will Architects

Gateway Community College New Haven, CT

Owner: Gateway Community College **MEPFPT:** BVH Integrated Services **Structural:** The Thorton Tomasetti Group

Architects: Perkins + Will **Lighting Designer:** HLB Lighting Design

Exterior View at Reading Lounge

Bradley Sisenwain Lighting Electrical Option

www.engr.psu.edu/ae/thesis/portfolios/2009/bds239/

Architecture:

The four story buildings total 360,000 SF and estimated at $147 million to complete. Designed around an elongated atrium—that acts as an "interior street" for student and faculty gathering—Gateway's building spans two blocks and over George Street. The first floor is home to a three story library, outdoor patios and playground, and community center. Classrooms, laboratories, and offices can be found on every floor. Exterior materials consist of brick, aluminum curtain wall systems, concrete panels, and aluminum wall panels. Three roofs are used: "cool roof" and two green roofs.

Special Features:

LEED Gold Certification, the first in the state of Connecticut. This new campus will make use of alternative energy technologies including solar, hot water, and photovoltaic panels.

Structural:

The primary structural system is a typical wide-flange layout of columns, girders, and beams. The Floors above grade are composite metal deck. Full-height trusses support the walkway and are visible from the inside and out; creating an interesting and contemporary structural identity. Concrete footers are located below the basement (North Tower) and below grade (South Tower). A 5" slab on grade tops the footings on these levels.

Mechanical:

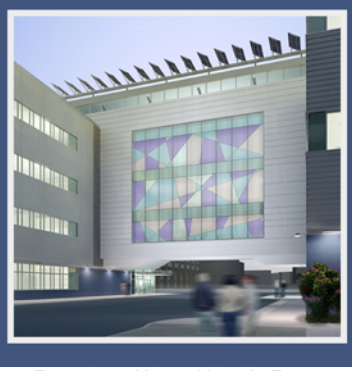
The central plant consists of three fire-tube boilers and two centrifugal water chillers. During off peak hours (at night) the two chillers produce ice which is then used to cool air during the day. This air is allocated by six air handling units located on the roof of the fourth floor. One cooling tower is also located on the roof.

Lighting/Electrical

Electric lighting is a balance between function, performance, and appearance. The majority of lamp types are linear/compact fluorescent and metal halide, and are designed to the lowest wattage consuption to meet LEED criteria.

The utilities incoming power is the split between two 2500 KVA step-down transformers which feed two 4000A, 480Y/277V main switchboards which are located in both the North and South Towers. The 1000KW emergency power generator is controlled by four automatic transfer switches.

Gathering Space



Exterior View North East

Exterior View North West

Exterior View South West

Background

As an educational facility, GCC contains a wide variety of spaces. The first floor will be home to a three story library, outdoor patio and playground, and community center. Classrooms, laboratories, and offices can be found on every floor. The site also separated into two buildings; in order to continue George Street through the existing and new site. A four story tall gathering space is centralized amongst the other spaces and is continued by bridges that span over the intersection. This is intended to serve as an interior street and give access to major departments.

The building will be located in New Haven Connecticut, and is designed by Perkins + Will (New York City). The 360,00ft^2 education facility is five stories above grade and totals nine levels if including the parking garage. A new LED screen will create a focal point above the major street below the atrium's bridge. This will make the school an attraction for the neighboring buildings and continuing enrollment.

Construction is planned to begin sometime in 2009.

Building Statistics

Building Name: Gateway Community College

Location: New Haven, CT

Building Occupant Name: Gateway Community College

Occupancy or function types: Assembly (A-2, A-3), Business (B), Educational (E), Mercantile (M), Storage (S-2)

Size (total square feet): 369,000 SF

Number of stories above grade / total levels: 5 Stories, 9 levels total (including parking garage) above grade

Primary Project Team:

- Owner: Gateway Community College (www.gwctc.commnet.edu)
- Architects: Perkins & Will (www.perkinswill.com)
- Structural Engineer: The Thornton-Tomasetti Group (www.thettgroup.com)
- MEPFPT Engineer: BVH Integrated Services, Inc. (www.bvhis.com)
- Civil Engineer: Stantec Consulting (www.stantec.com)
- Lighting Consultant: Horton Lees Brogden Lighting Design (www.hlblighting.com)

Dates of construction: 2009 - 2012

Actual cost information: $147 Million

Project delivery method: Design - Bid – Build

Special Features:
LEED® Gold Certification, the first in the state of Connecticut. This new campus will make use of alternative energy technologies including solar, hot water, and photovoltaic panels.

Construction:
Not constructed. Start date is tentatively designated for 2009.

Structural:
The primary structural system is a typical wide-flange layout of columns, girders, and beams. Wide-flange columns have multiple depths, which typically include 8, 10, 12, and 14 inches with varying pounds per foot. The Floors above grade are

composite metal deck, which use steel deck coupled with (lightweight or normal weight) concrete as a dual floor system. The four typical floor systems are:

The floors are supported by the beams which run to girders, and are then connected to columns. The column load is then carried into footers below grade. Concrete footers are located below the basement (North Tower) and below grade (South Tower). A 5" slab on grade tops the footings on these levels. Full-height trusses support the walkway and are visible from the inside and out; creating an interesting and contemporary structural identity.

Mechanical:

The central plant consists of three fire-tube boilers and two centrifugal water chillers. During off peak hours (at night) the two chillers produce ice which is then stored and used to cool distributed air during the day. This air is allocated by six air handling units located on the roof of the fourth floor. One cooling tower is also located on the roof. Single duct air terminal units account for local reheating of air in independent spaces.

Electrical:

The utility service entrance (awaiting response on voltage rating) is fed to a 15KV switch and located in the basement of the North Tower. Incoming power is the split to two 2500 KVA step-down transformers which feed two 4000A, 480Y/277V, 3Φ 4W main switchboards which are located in the North Tower. The 1000KW emergency power generator is controlled by four automatic transfer switches (one 800A standby and one 200A emergency from each main switchboard).

Lighting:

Electric lighting is a balance between function, performance, and appearance. The majorities of lamp types are linear/compact fluorescent and metal halide, and are designed to the lowest wattage consumption to meet LEED® criteria. Time clock control as well as daylight and occupancy sensors are used to limit the operation time and electric load consumed by different fixtures.