ARCHITECTURAL ENGINEERING SENIOR THESIS



- Montgomery County Equipment Maintenance and Operations Center

Introduction

Existing Conditions

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Rockville, MD



Architectural Breadth



Introduction Building Statistics Existing Conditions Building Orientation

BUILDING STATISTICS

- 16624 Crabbs Branch Way, Rockville, MD
- Project Team:
- Owner: Montgomery County
- Architect: Michael Baker, Jr., Inc.
- GC: Coakley Williams Construction
 MEP: S3E Klingemann, Inc.
- **Size:** 75,000 SF
- Cost: \$15 million
- 2 stories above grade
- Completion in February 2013
- LEED Gold



Architectural Breadth

Mechanical Depth Mechanical System





Introduction **Building Statistics** Existing Conditions Building Orientation

BUILDING ORIENTATION

Site Orientation

- Building 1 Location and Orientation
- Attached Parking Garage
- Bus Circulation Around Complex



Mechanical Depth Mechanical System Architectural Breadth

Percentage of Energy Total Energy Use



- Lighting
- Space Heating Electricity
- Space Heating Gas
- Space Cooling
- Heat Rejection
- Fans
- Receptacles

EXISTING MECHANICAL SYSTEM

- Equipment
 - VAV Rooftop Units (RTUs) and VAV Boxes
- Energy Recovery Units (ERUs) and Garage Spaces Floor Plans
- RTU and AC Unit Service Areas
 - AC 1,2,3,4,5,6
- RTU 1
- RTU 2
- RTU 3



Introduction **Building Statistics**

Existing Conditions **Building Orientation**

- 2nd Floor
- 1st Floor
- Energy Distribution (By % of Total)



Mechanical Depth Mechanical System Architectural Breadth

- Reduce the Total Energy used by the building and the central plants
- Keep to all required codes and standards
- Apply passive elements to Office Spaces

	Current Energy Use (10^6 BTU/yr)	Current Annual Running Cost (\$)
Scope of Project	4,133	29,737.00
Central Plant		

Existing Conditions Proposal Overview

MECHANICAL DESIGN OBJECTIVES



Mechanical Depth New Design

Architectural Breadth

Results



PROPOSAL OVERVIEW

- Scope
- Office Spaces
- Passive/Natural Ventilation System

 - Louvers and Operable Windows
- Combination of RTUs
 - 3 to 2
- Chilled Beams

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Introduction Design Objectives Existing Conditions Proposal Overview

- Garage Spaces
- Courtyard Enclosure



Architectural Breadth

Mechanical Depth New Design





- Passive/Natural Ventilation System
- Enclosure Design

 - Mechanical "Cap"
- Operable Windows in Office Spaces
- Calculation Procedure
 - Basic CFM from Indoor and Outdoor Temperatures

Existing Conditions Proposal Overview

THE NEW DESIGN

- Added Height: 17.5ft

CFM with Solar Influence





Mechanical Depth New Design

Architectural Breadth

Project Dedication



- Active VAV Rooftop Unit Combination
- Purpose
 - Reduce initial construction costs
- New Service Areas

 - RTU 1

Existing Conditions Proposal Overview

THE NEW DESIGN

- Remove mechanical shed from courtyard
- AC 1,2,3,4,5,6
 - 2nd Floor
 - 1st Floor
- RTU 2



Mechanical Depth New Design

Architectural Breadth

Project Dedication

CFM from stack effect (Total Effective)



- System Control
- All ventilation and load must be accounted for regardless of outdoor conditoins

Introduction Design Objectives Existing Conditions Proposal Overview

THE NEW DESIGN

- Combination of Passive and Active Systems

 - Based on outdoor air temperature
 - Favorable vs. Unfavorable days

Project Dedication

Comp	oonents	Cost						
Rooftop Units (Fr	rom Previous Slide)	30,415						
то	TAL:	30,415						
<u>Energy</u>	(10^6 BTU/yr)	(10 ⁶ BTU/yr)	Savings					
Building	4,133	4,079	8.8%					

Components	Cost
Rooftop Units (From Previous Slide)	25,155
Enclosure (Estimate Details in Report)	34,981
TOTAL:	60,136

- Energy Use
- Annual Operating Cost
- Payback Period
 - Essential Components System Cost
 - How long would it take to make up for additional cost?

Existing Conditions Proposal Overview

RESULTS

Difference in Operating Cost (\$)	Difference in System Cost (\$)	Payback Period	Savings
2 775	20 721	10 71 years	9.3%
Central Plant	343,896	341,121	0.8%

Mechanical Depth New Design

Architectural Breadth

Project Dedication

- Integrate with mechanical depth
 - Enclosure serves mechanical and architectural purpose
- Provide better break and relaxation area for off-duty drivers and office workers
 - Courtyard is now usable year-round and more effectively
- Remain within the urban fabric of the site and surrounding community
- Designate this building as the "head" building in the complex
- Promote green building technology



Introduction

Existing Conditions

ARCHITECTURAL BREADTH



Architectural Breadth



Introduction

Existing Conditions

PROJECT DEDICATION

This thesis project is dedicated to the life and memory of

Frances J. Palko

THANK YOU

Questions?