

Alexander Radkoff

Thesis Presentation Outline Draft

Advisor: Dr. Stephen Treado

Submitted: April 2nd, 2014

Thesis Presentation

Thesis:

- I. Introduction
 - A. Background
 - i. Location
 - ii. Building Use
 - iii. Construction
 - B. Design Conditions
 - i. Summer Design Conditions
 - ii. Winter Design Conditions
- II. Existing Mechanical System
 - A. Office and Warehouse Mechanical System breakdown
 - B. Annual Load Simulation
 - C. Energy Cost and Consumption
- III. **Variable Refrigerant Flow System – Depth**
 - A. System Layout and Pipe Sizing
 - i. VRF System Diagram or Schematic
 - B. VRF Unit Selection
 - a. Slim Duct or MSP FCU
 - b. Condensing Unit
 - c. Mode Change Unit
 - C. Refrigerant Data
 - a. R-410A Application
 - b. Antifreeze selection
 - c. CO2 Refrigerant Investigation
 - D. Head Loss Calculations
- IV. Cost Analysis
 - A. Monthly Energy Use
 - B. Cost Analysis Comparison
- V. Emissions Analysis
 - A. Natural Gas and CO2 Calculated Emissions
 - B. Reduction in Emissions
- VI. **Acoustical Breadth Design**
 - A. Recommended NC Rating for Offices
 - B. Existing Mechanical Conditions and NC Rating
 - C. Proposed Mechanical Conditions and NC Rating
- VII. Conclusion
 - A. Depth and Breadth Conclusions

- B. Acknowledgements
- C. References

Estimated Number of Slides: 22-25

Number of Breadths: 1

123 Alpha Drive

Pittsburgh,
Pennsylvania



Alexander Radkoff

Mechanical Option | Spring 2014
Advisor: Dr. Stephen Treado

123 Alpha Drive

Pittsburgh,
Pennsylvania

Introduction

Existing Mechanical System

Variable Refrigerant Flow System

Cost Analysis

Emissions Analysis

Acoustical Design

Conclusion

Alexander Radkoff

Mechanical Option | Spring 2014

Advisor: Dr. Stephen Treado

Background

Location: Pittsburgh, Pennsylvania

Building Use:

- Warehouse Storage
- Laboratory Space
- Offices

Footprint: 64,350 square feet

Ceiling Height:

- Offices: 9'
- Warehouse: 22' 6"

Renovated: 2012



123 Alpha Drive

Pittsburgh,
Pennsylvania

Introduction

Existing Mechanical System

Variable Refrigerant Flow System

Cost Analysis

Emissions Analysis

Acoustical Design

Conclusion

Alexander Radkoff

Mechanical Option | Spring 2014

Advisor: Dr. Stephen Treado

Design Conditions

Outdoor Design Conditions

	Summer Design Cooling	Winter Design Heating
OA Dry Bulb (°F)	89 °F	2.0 °F
OA Wet Bulb (°F)	72 °F	.3 °F

Indoor Design Conditions

	Offices & Lab	Warehouse & Packaging	Storage & Maintenance
Cooling Set Point	70 °F	85 °F	95 °F
Heating Set Point	55 °F	55 °F	60 °F
Relative Humidity	45%	-	-

123 Alpha Drive

Pittsburgh,
Pennsylvania

Introduction

Existing Mechanical System

Variable Refrigerant Flow System

Cost Analysis

Emissions Analysis

Acoustical Design

Conclusion

Alexander Radkoff

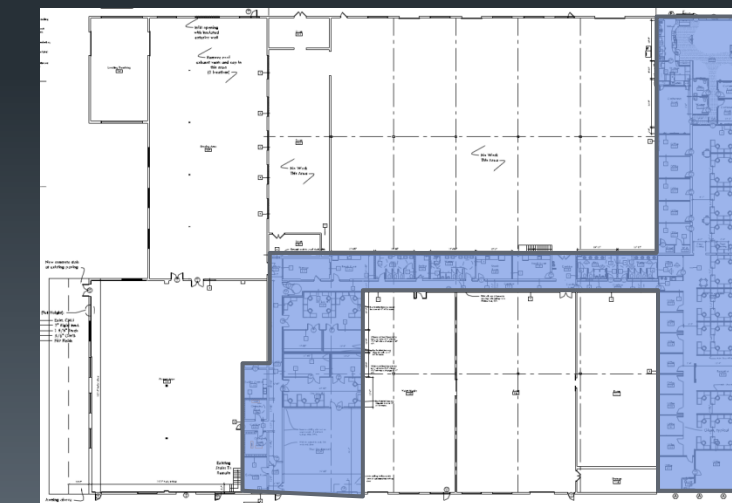
Mechanical Option | Spring 2014

Advisor: Dr. Stephen Treado

Existing Mechanical System

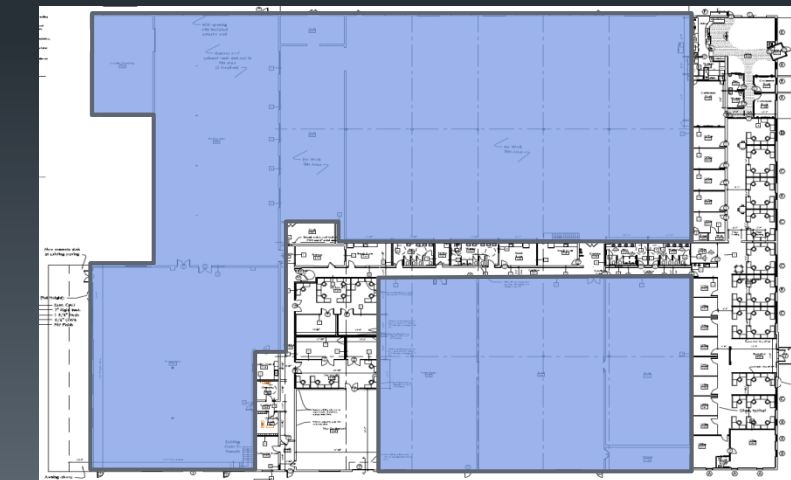
Office/Lab Space

- 6 single zone CAV rooftop units (RTUs)
- CO2 preheat conditioning option available
- CO2 radiant floor cooling and heating



Warehouse and Storage

- Primarily electric resistance heat
- 8 air handling units (AHUs)
- Makeup air handling unit



123 Alpha Drive

Pittsburgh,
Pennsylvania

Introduction

Existing Mechanical System

Variable Refrigerant Flow System

Cost Analysis

Emissions Analysis

Acoustical Design

Conclusion

Alexander Radkoff

Mechanical Option | Spring 2014

Advisor: Dr. Stephen Treado

Annual Load Simulation

Monthly Cooling Load Figure

HVAC/Lighting/Elect. Equip Breakdown

123 Alpha Drive

Pittsburgh,
Pennsylvania

Introduction

Existing Mechanical System

Variable Refrigerant Flow System

Cost Analysis

Emissions Analysis

Acoustical Design

Conclusion

Alexander Radkoff

Mechanical Option | Spring 2014

Advisor: Dr. Stephen Treado

Energy Cost and Consumption

Energy Consumption Table for
electric and natural gas

Electrical Annual Cost Breakdown
Chart

123 Alpha Drive

Pittsburgh,
Pennsylvania

Introduction

Existing Mechanical System

Variable Refrigerant Flow System

Cost Analysis

Emissions Analysis

Acoustical Design

Conclusion

Alexander Radkoff

Mechanical Option | Spring 2014

Advisor: Dr. Stephen Treado

Variable Refrigerant Flow System

System Layout

Pipe Sizing

VRF System Diagram or Schematic

123 Alpha Drive

Pittsburgh,
Pennsylvania

Introduction

Existing Mechanical System

Variable Refrigerant Flow System

Cost Analysis

Emissions Analysis

Acoustical Design

Conclusion

Alexander Radkoff

Mechanical Option | Spring 2014

Advisor: Dr. Stephen Treado




Acoustical Breadth Investigation

Recommended Noise Criterion - NC

	Recommended NC Rating	Equivalent Sound Level dBA
Open-Plan Offices	35-40	45-50
Private Offices	30-35	40-45
Conference Rooms	25-30	35-40



KEY

-  Private Offices
-  Conference Rooms
-  Open Plan Offices

123 Alpha Drive

Pittsburgh,
Pennsylvania

Introduction

Existing Mechanical System

Variable Refrigerant Flow System

Cost Analysis

Emissions Analysis

Acoustical Design

Conclusion

Alexander Radkoff

Mechanical Option | Spring 2014

Advisor: Dr. Stephen Treado

Acoustical Breadth Investigation

Existing Mechanical Conditions

- 5 Ton Carrier 50TCD06 Rooftop Unit
- 1" Fiberglass Insulation
- Room Dimensions : 34'x26'x8'
- Measure SPL to nearest diffuser

	Sound Power Level, dB (re 10 ⁻¹² W)						
Octave Band Frequency, HZ	63	125	250	500	1000	2000	4000
Discharge	85.8	84.3	80.5	78.7	76.4	72.7	68.3

Existing Mechanical NC Rating



NC-46
~ 48 dBA

123 Alpha Drive

Pittsburgh,
Pennsylvania

Introduction

Existing Mechanical System

Variable Refrigerant Flow System

Cost Analysis

Emissions Analysis

Acoustical Design

Conclusion

Alexander Radkoff

Mechanical Option | Spring 2014

Advisor: Dr. Stephen Treado

Acoustical Breadth Investigation

Recommended Noise Criterion - NC

	Recommended NC Rating	Equivalent Sound Level dBA
Open-Plan Offices	35-40	45-50
Private Offices	30-35	40-45
Conference Rooms	25-30	35-40

Existing Mechanical NC Rating



NC-46
~ 48 dBA

123 Alpha Drive

Pittsburgh,
Pennsylvania

Introduction

Existing Mechanical System

Variable Refrigerant Flow System

Cost Analysis

Emissions Analysis

Acoustical Design

Conclusion

Alexander Radkoff

Mechanical Option | Spring 2014

Advisor: Dr. Stephen Treado

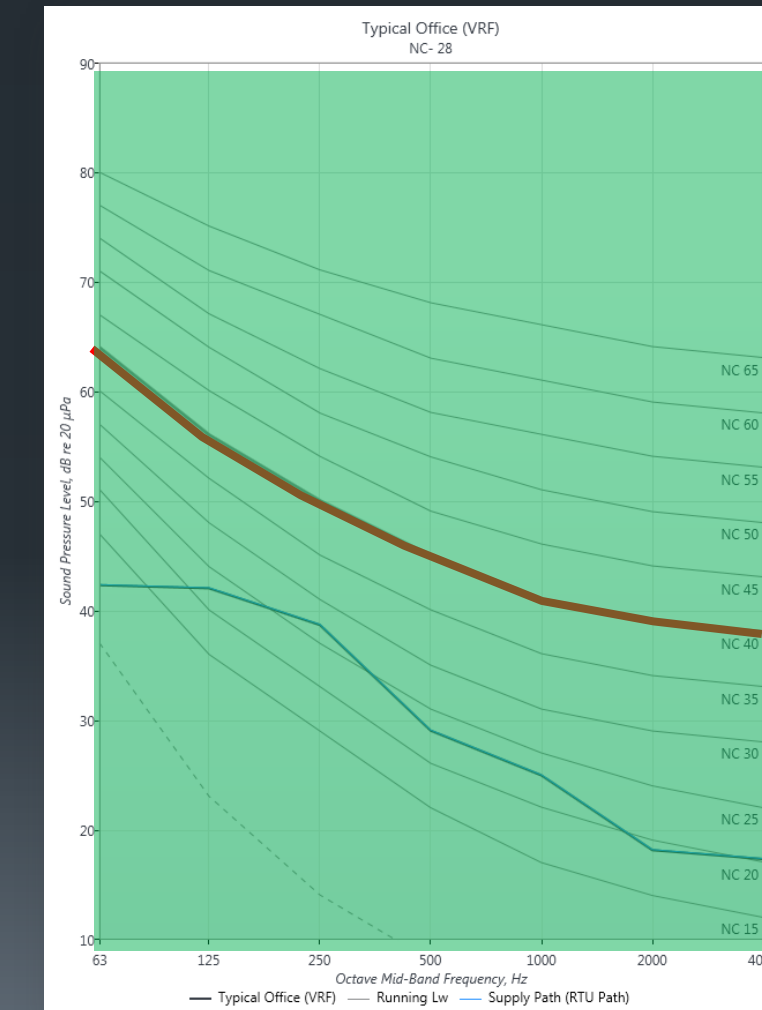
Acoustical Breadth Investigation

Proposed Mechanical Conditions

- Samsung DMV S60 Medium Static Pressure (MSP) Duct Fan Coil Units
- 1" Fiberglass Lining
- Room Dimensions : 34'x26'x8'

	Sound Power Level, dB (re 10 ⁻¹² W)						
Octave Band Frequency, HZ	63	125	250	500	1000	2000	4000
Discharge	47.1	44.2	43.4	40.0	36.7	34.3	29.6

Recommended Noise Criterion - NC



NC-28
~ 34 dBA

123 Alpha Drive

Pittsburgh,
Pennsylvania

Introduction

Existing Mechanical System

Variable Refrigerant Flow System

Cost Analysis

Emissions Analysis

Acoustical Design

Conclusion

Alexander Radkoff

Mechanical Option | Spring 2014

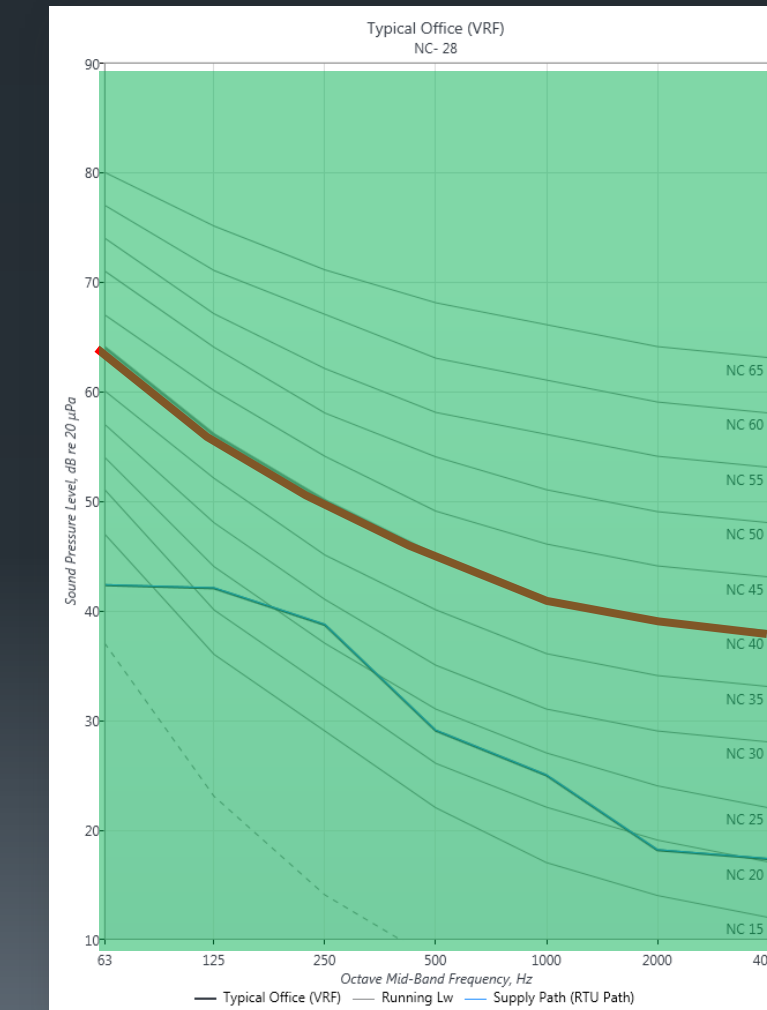
Advisor: Dr. Stephen Treado

Acoustical Breadth Investigation

Recommended Noise Criterion - NC

	Recommended NC Rating	Equivalent Sound Level dBA
Open-Plan Offices	35-40	45-50
Private Offices	30-35	40-45
Conference Rooms	25-30	35-40

Recommended Noise Criterion - NC



NC-28
~ 34 dBA

