Fundamentals of Energy in Buildings Undergraduate 4.42J, 2.66J, 1.044J

Students from courses
1,2,3,4 and 10

Subject Outline

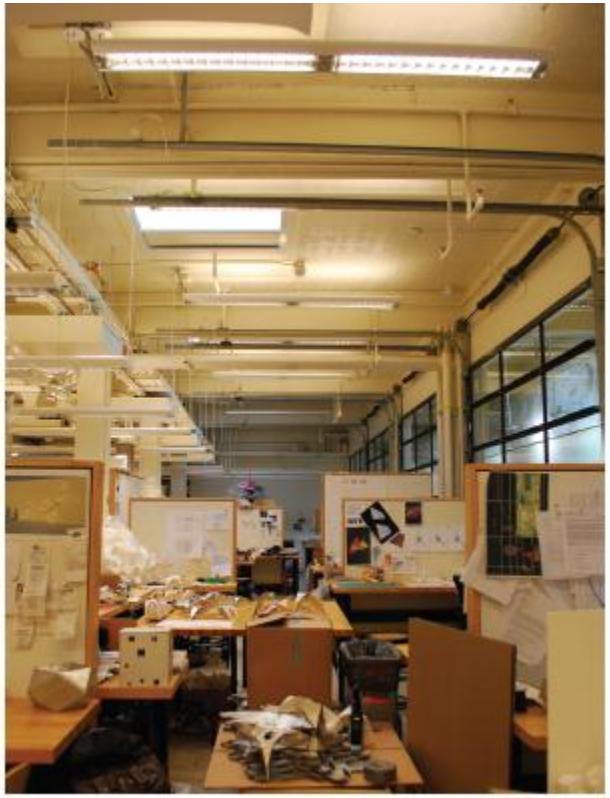
- Fundamentals of
  - Thermodynamics
  - Heat Transfer
  - Fluid Flow
- Applied to the design and operation of energy efficient buildings
- Issues of economics, behavior, environment
- Creative design project
- Hands on performance measurements

(with equipment obtained with MITEI support)

Examples of student design projects

DESIGN PROJECT 2

LIGHTING IN ARCHITECTURE STUDIO 7



For the purpose of simplicity we selected one particular desk (approximately) right under the desk, and decided to use that as our lighting test zone.

We used a Extech HD450 light meter to take readings at the location under different lighting circumstances. The data is shown below:

At Night (Fluoroscent Lights only) = 680 Lux

During the Day (Fluoroscent Lights only/skywindows closed) = 850 Lux

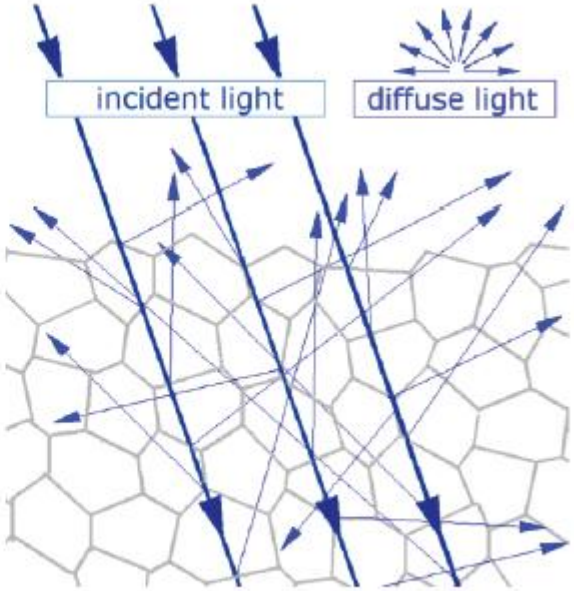
During the Day with straight Glare = 11000 Lux

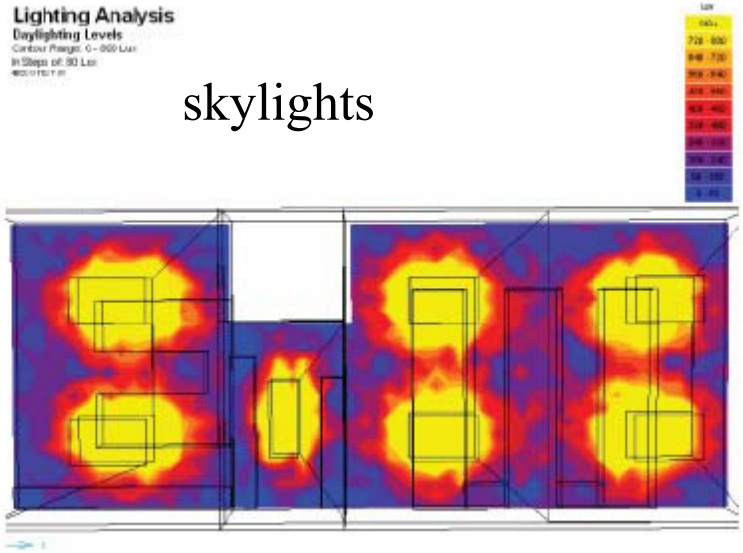
During the Day with straight Glare and White museum Board = 14500 Lux

Mezannine with Lights off : 65 Lux

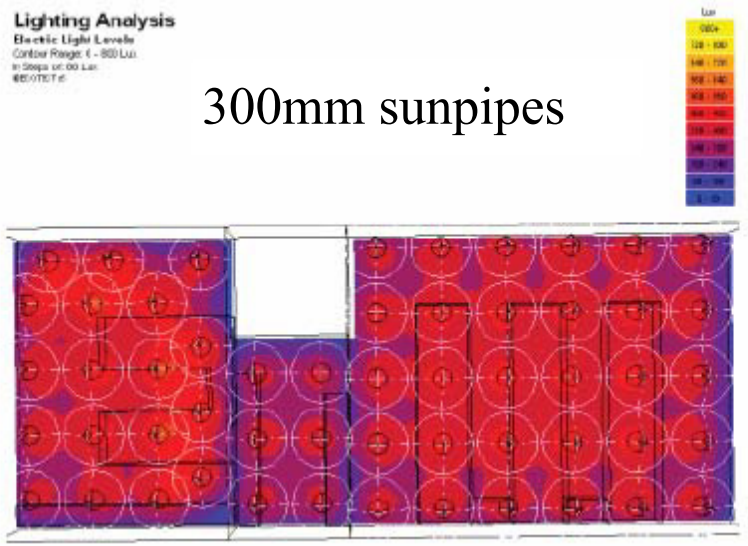
Mezannine with Lights on : 628 Lux

Image of Extech HD 540 light meter removed due to copyright restrictions.


incident light
diffuse light



skylights

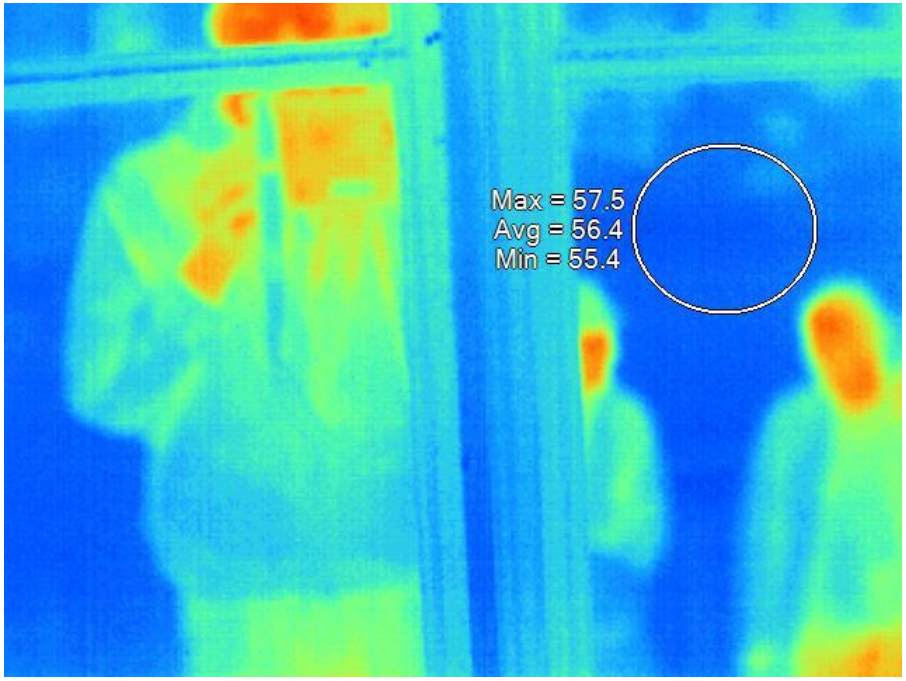


300mm sunpipes

Estimated yearly savings for one studio

- $1700 per year savings

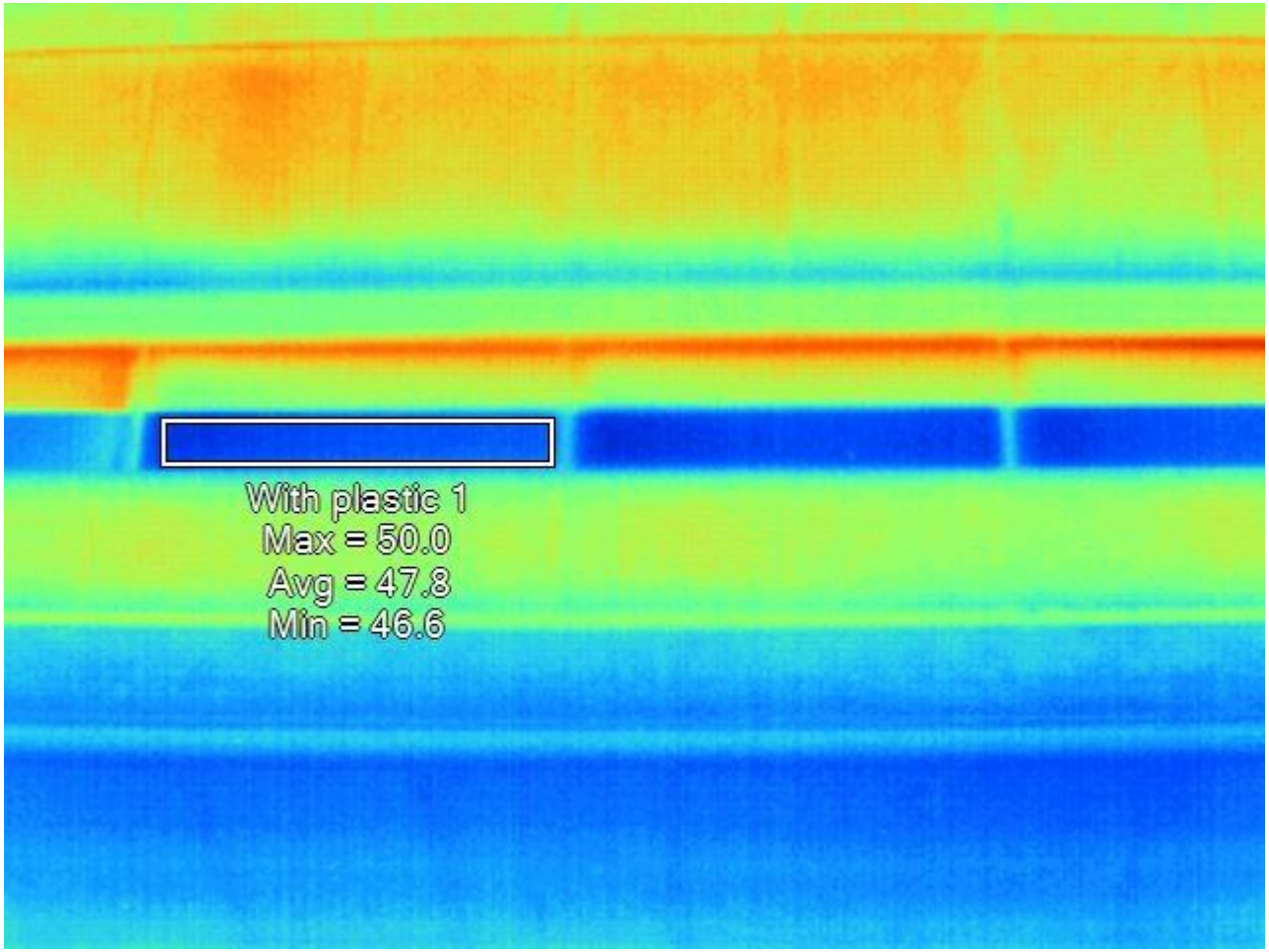
Single Pane: Building 3



Plastic Surgery

for old buildings

- non-obtrusive to currently inoperable windows
- discreet
- scaleable to entire building
- simple to install and maintain


With plastic 1
Max = 50.0
Avg = 47.8
Min = 46.6

19.2 GJ saved per heating season

- Equivalent to 20% of season heat for a single family home in Boston

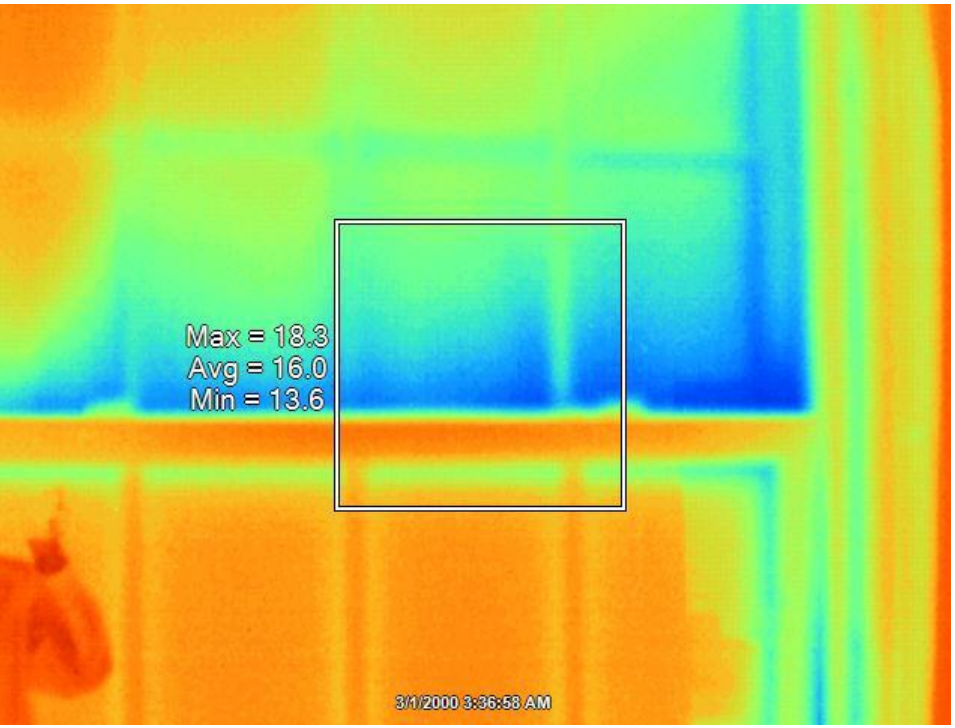
Current Situation

Windows are **efficient**

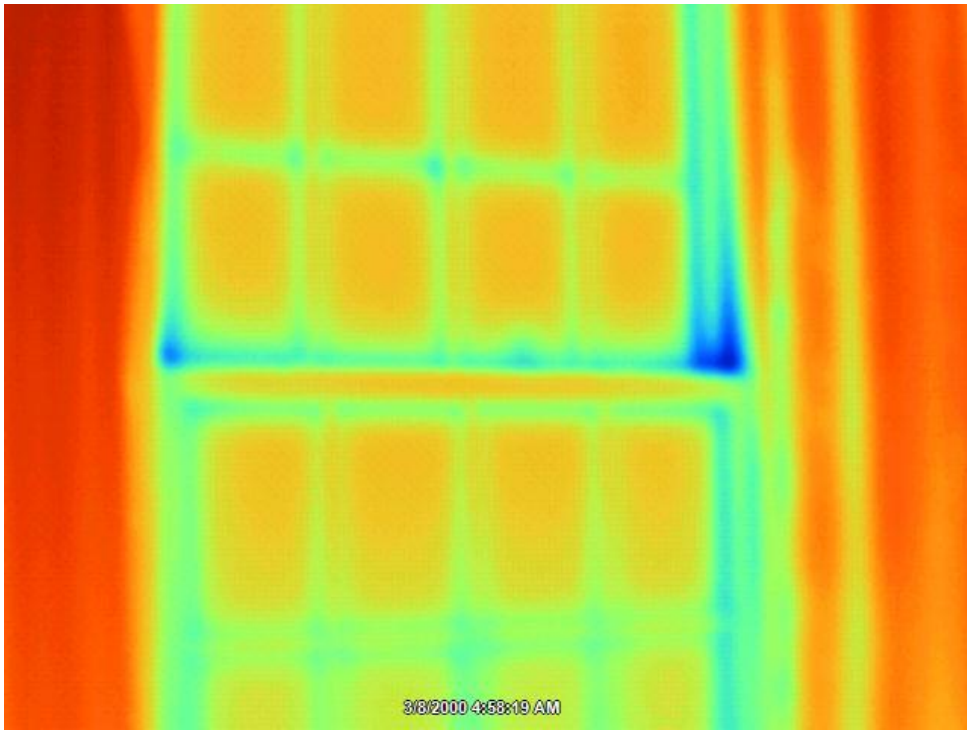
Living Room – casement windows

Dining Room – double-hung windows

Before



After



477 - 479 Commonwealth

Dining Room Windows

- Storm Windows
- Leaky due to wood frames
- Large and Operable
- Curved to fit walls of room - expensive to replace
- 5 inch gap between inner and outer windows

CO2 Leakage through Windows

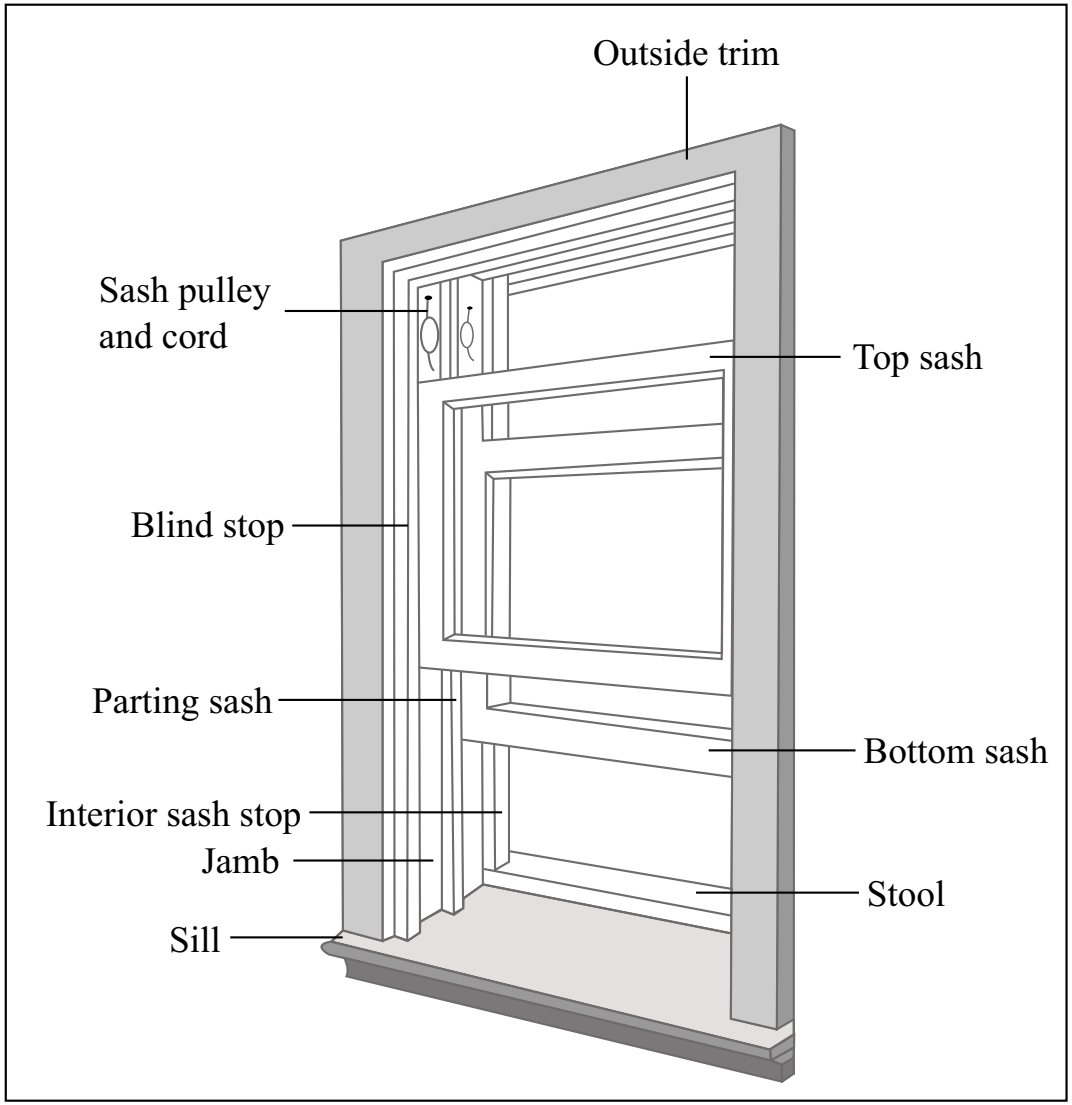
The purpose of our experiment is to evaluate the air leakage through the windows in a controlled environment, by measuring the rate of CO2 flow out of the otherwise sealed room.

Estimated Savings of Caulking and Weather stripping

Estimated Heat loss due to old/ leaky windows: 10,348 MJ/window

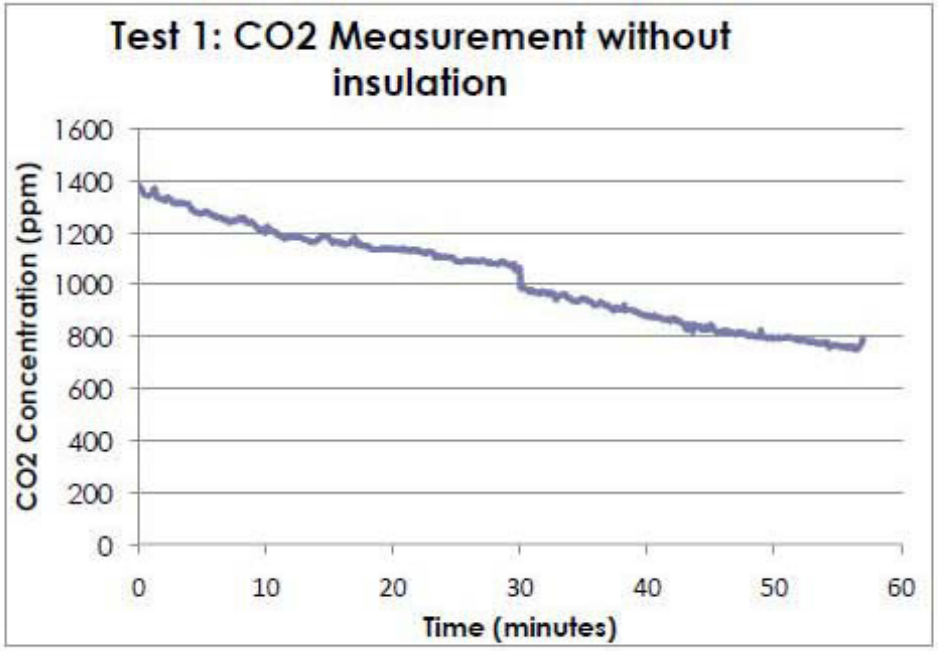
By completely eliminating air leaks (ideal case) we can save:

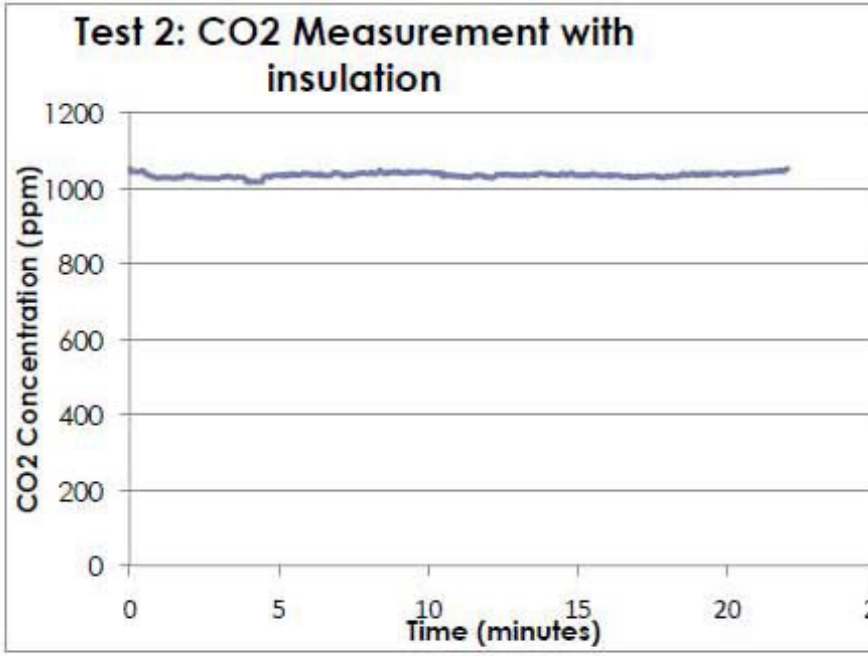
$2164/year



Experiment Setting: Dining Room

RESULTS


Test 1: CO2 Measurement without insulation
CO2 Concentration (ppm)
1600
1400
1200
1000
800
600
400
200
0
0
10
20
30
40
50
60
Time (minutes)


Test 2: CO2 Measurement with insulation
CO2 Concentration (ppm)
1200
1000
800
600
400
200
0
0
5
10
15
20
Time (minutes)

4.42J / 1.044J / 2.45J Fundamentals of Energy in Buildings
Fall 2010