Associated Air Balance Council (AABC)

AIA Provider Number: 50110105

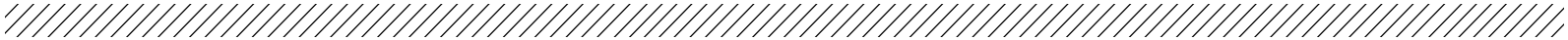
Air Density and its Effects on Building Pressure

Course Number: AABCTAB2023-6

Name: Paul Hoitink, Air Movement Services LTD.

Date: May 3, 2023

AIA Continuing Education Provider



Copyright Materials

About me

- Paul Hoitink from Air Movement Services
- Based out of Winnipeg, Manitoba, Canada

Course Description

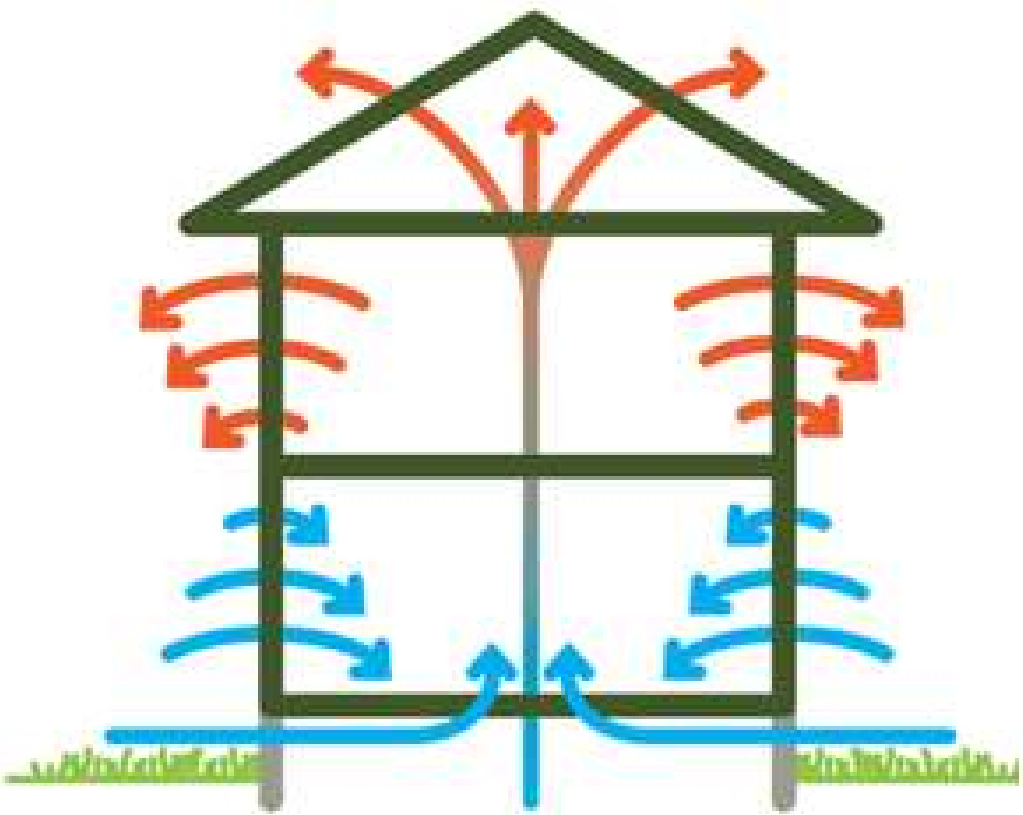
Exploring the science behind air density and how air density and temperature interact with one another. Showing and providing real-life examples of how air density can cause building pressure problems if not considered. Explaining our methods to mitigate these issues through air balancing to ensure this problem doesn't have a negative effect on building performance.

Learning Objectives

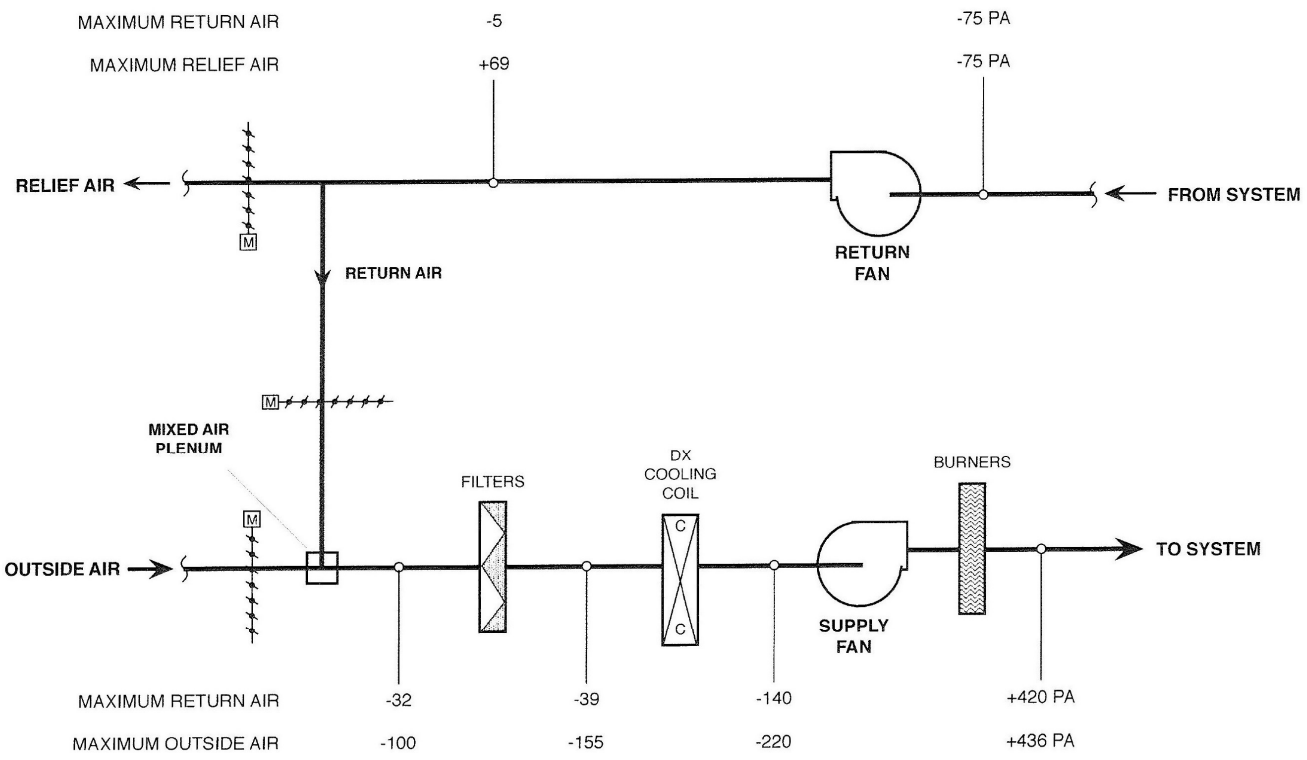
At the end of this course, participants will be able to:

- Understand the science behind temperature and density
- Learn methods of determining what is causing a building pressure problem
- Identify when density may be the cause of building pressure problems
- Determine what methods of balancing to use to correct pressure problems caused by density

Introduction



Background

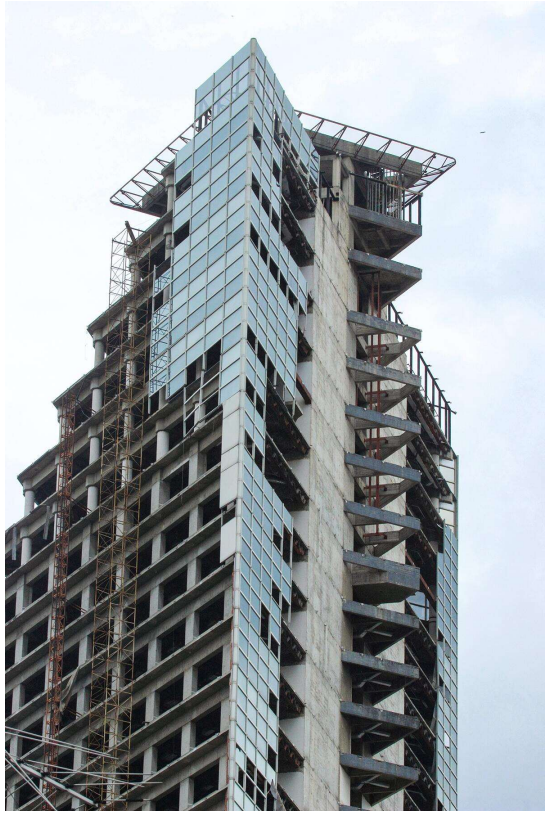

MAXIMUM RETURN AIR
MAXIMUM RELIEF AIR
-5
+69
-75 PA
-75 PA
RELIEF AIR
FROM SYSTEM
M
RETURN AIR
RETURN FAN
M
MIXED AIR PLENUM
FILTERS
DX COOLING COIL
BURNERS
M
C
C
OUTSIDE AIR
TO SYSTEM
SUPPLY FAN
MAXIMUM RETURN AIR
MAXIMUM OUTSIDE AIR
-32
-100
-39
-155
-140
-220
+420 PA
+436 PA

My method(s) to determine what is causing a building pressure problem

- Look for building envelope issues.
- Shut off equipment until building pressure returns to an acceptable level
- Look for “Connecting” issues

Building envelope issues

- Building envelope pressure issues are caused by differences in density
- Building envelope issue doesn’t have to be obvious

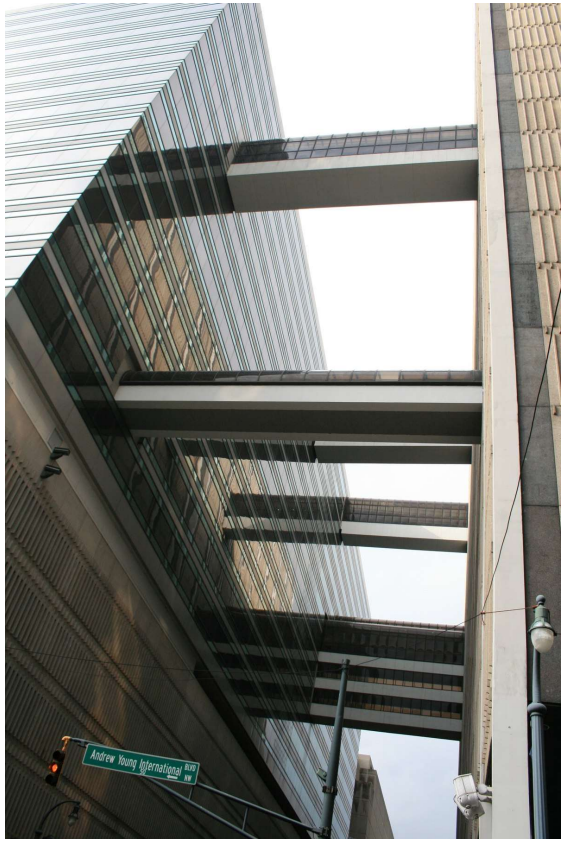


Systematically Turning Equipment Off

- Systematically turn equipment off while monitoring building pressure to determine what is causing the issue
- Investigate problem piece of equipment
- Usually a maintenance issue

“Connecting” Issues

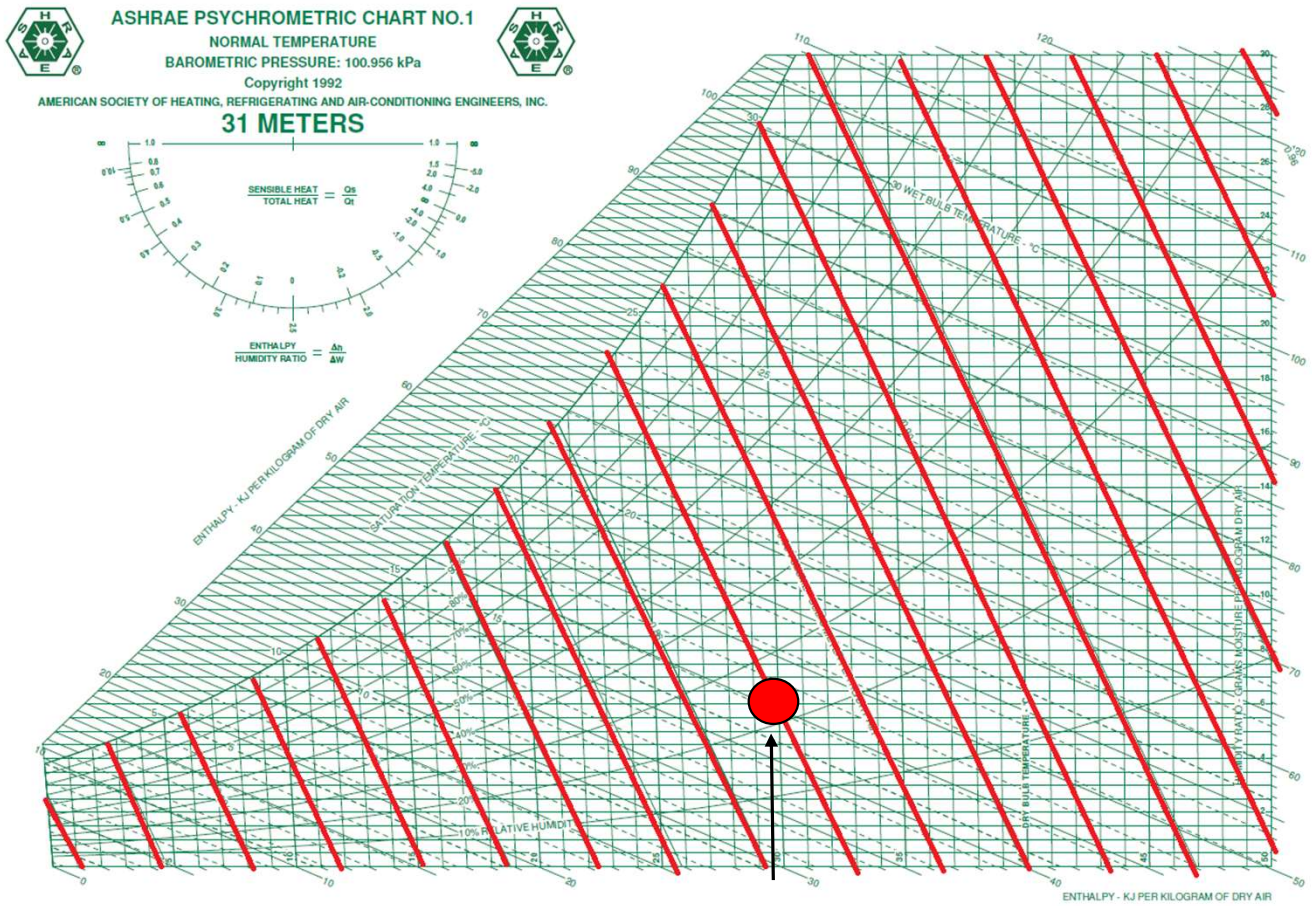
- If possible separate the two buildings back into their own spaces.
- Do not try to correct the problem of the neighbor.



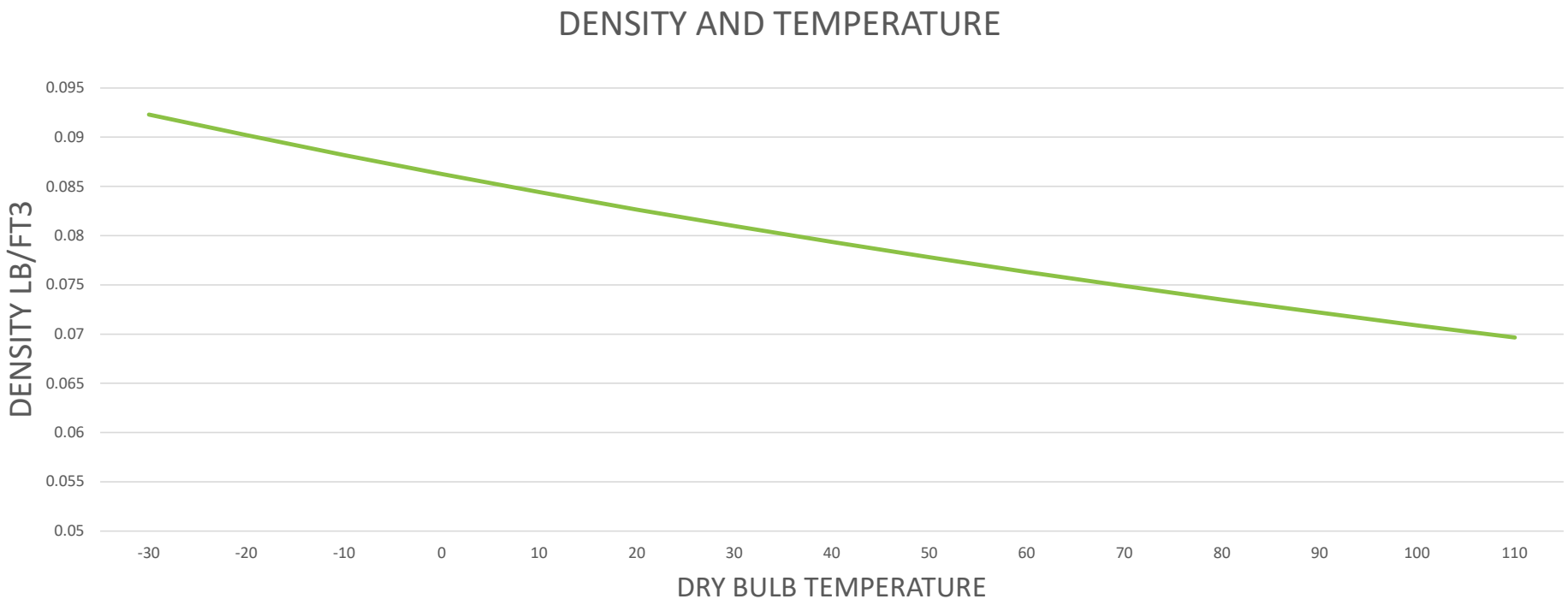
A Refresher on Density

- Density= LB of dry air/FT^3
- Specific Volume= FT^3/LB of Dry air

Specific Volume



Density

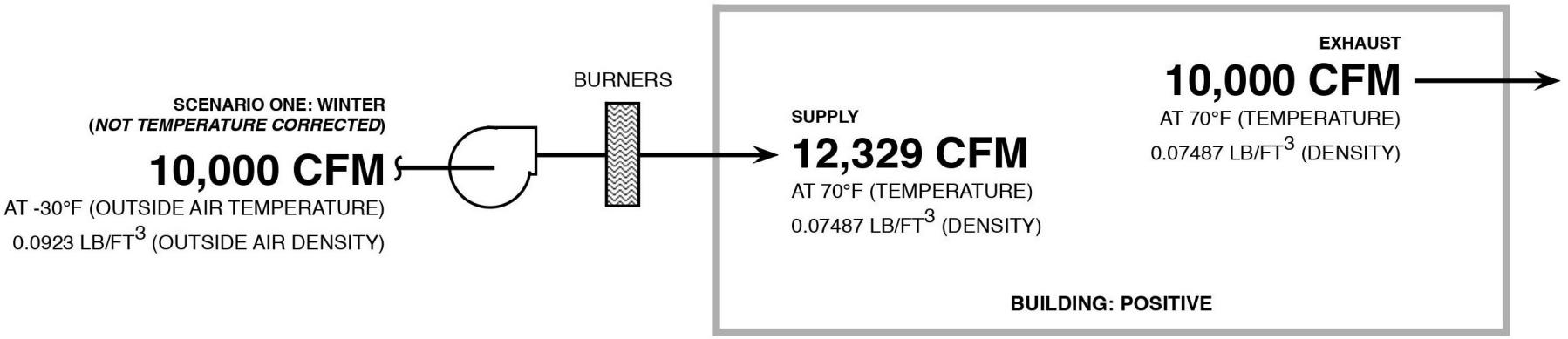

DENSITY AND TEMPERATURE
DENSITY LB/FT3
0.095
0.09
0.085
0.08
0.075
0.07
0.065
0.06
0.055
0.05
-30
-20
-10
0
10
20
30
40
50
60
70
80
90
100
110
DRY BULB TEMPERATURE

What's the point?

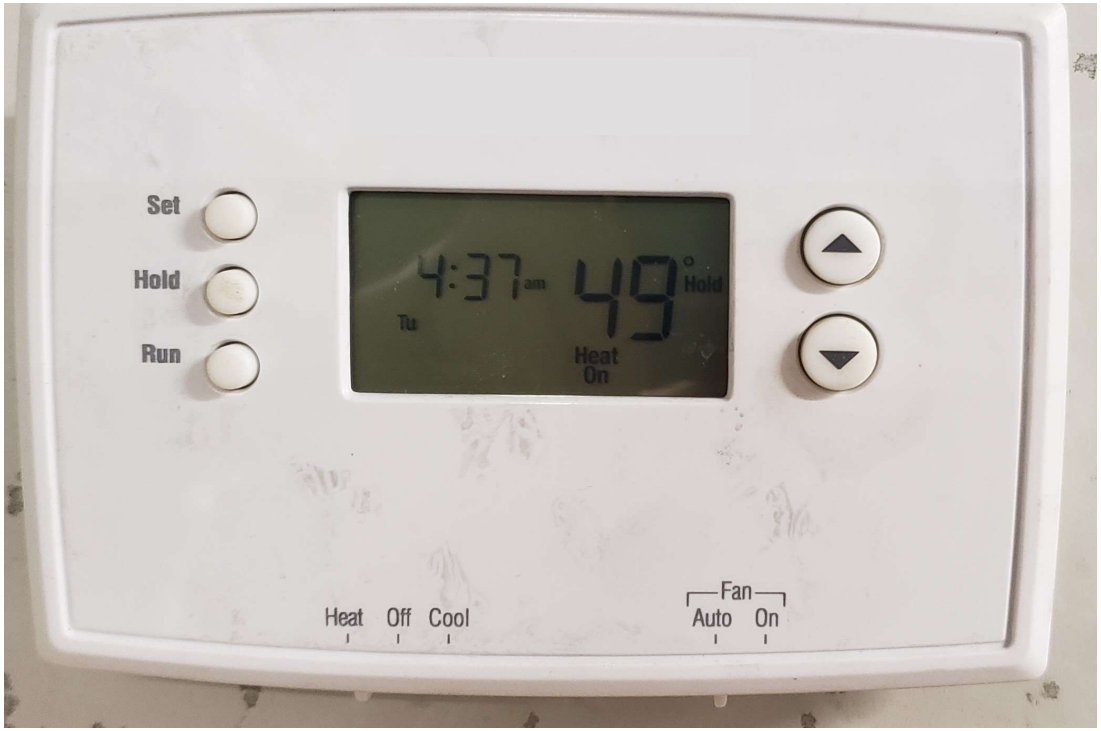
- If unaccounted for density can cause a large building imbalance.
- "Installation and air balancing is often done during warmer weather than that experienced in the cold of winter. If the air balance did not account for ambient temperature, the appliance could be having lower than expected temperature rise in cold weather conditions. As the fan is a constant volume device and as it is located before the heat exchanger, air will expand as it is heated. The amount of change could be up to a 20% increase in air volume from -30°F to +70°F." *

* Engineeredair.com/manuals/cencon-tech pg. 55

The Problems



The Problems, cont’d

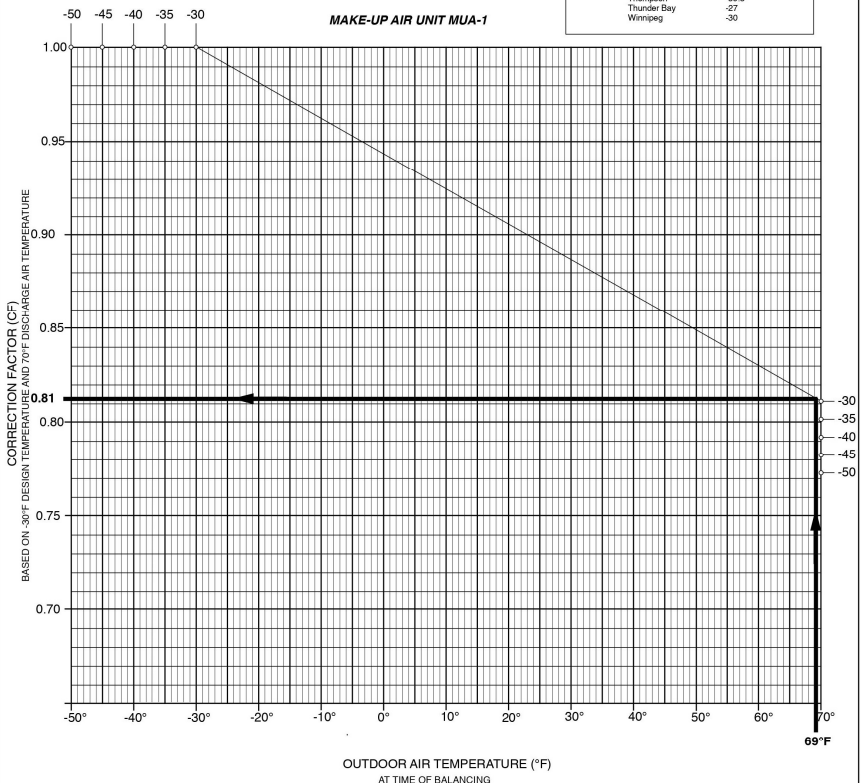


PRJECT NAME
ADDRESS

MAKE-UP AIR UNIT MUA-1

ASHRAE 2001 FUNDAMENTALS WINTER DESIGN °F

Brandon	-30
Churchill	-41
Dauphin	-31
Flin Flon	-41
Portage La Prairie	-28
The Pas	-37
Thompson	-39.3
Thunder Bay	-27
Winnipeg	-30



V_C = CORRECTED VOLUME
V_D = DESIGN VOLUME
CF = CORRECTION FACTOR

OUTSIDE AIR TEMPERATURE: 69 °F

DISCHARGE AIR TEMPERATURE: 70 °F

ASHRAE DESIGN TEMPERATURE: -30 °F

EXAMPLE: THE DESIGN AIRFLOW VOLUME FOR THE MUA UNIT IS 5500 CFM.
THE OUTDOOR TEMPERATURE DURING THE TEST WAS 69°F.
AT 00°F OUTDOOR TEMPERATURE THE CORRECTION FACTOR IS 0.81
THE RECORDED AIRFLOW VOLUME SHOULD BE:
5500 CFM x 0.81 = 4455 CFM

00000

The Math

DENSITY AT 69F 0.07501 LB/FT3

DIVIDED BY

DENSITY AT -30F 0.0923 LB/FT3

GIVE US A 0.81 RATIO OR CORRECTION FACTOR

0.07501/0.0923=0.81 CORRECTION FACTOR

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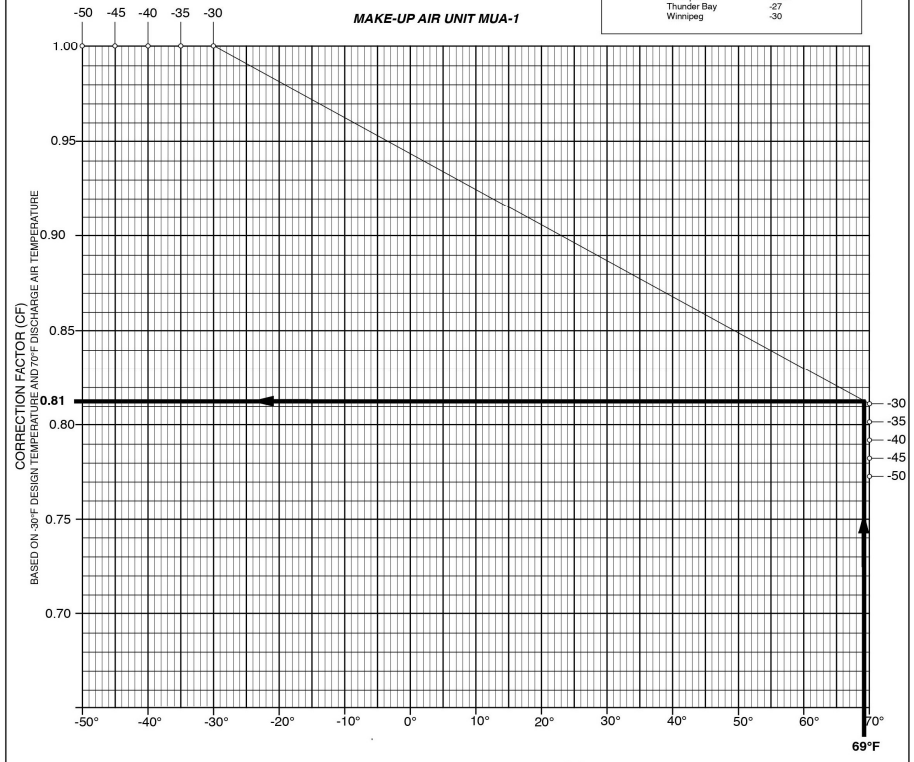

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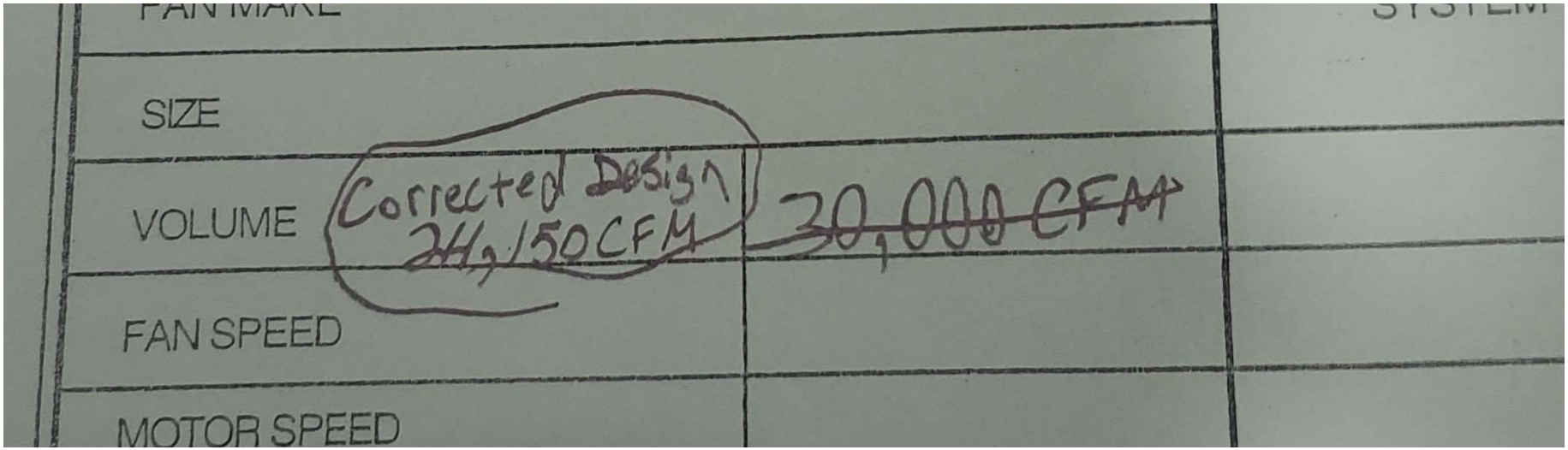
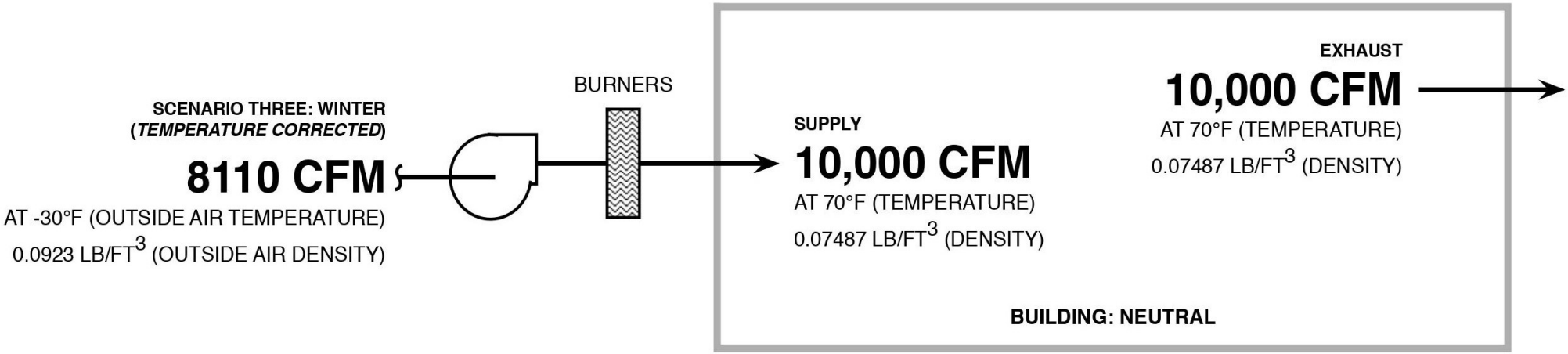
Correcting design for density

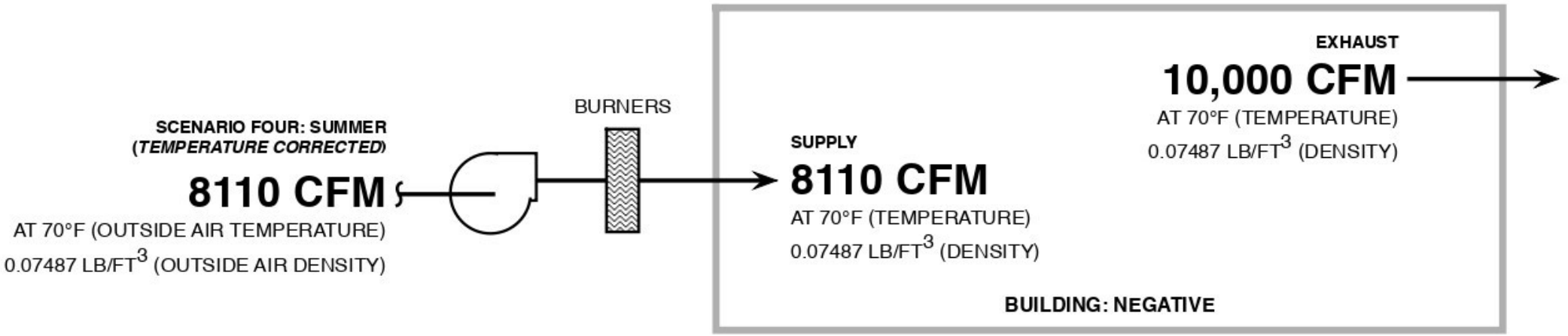


A Winter condition with a corrected design

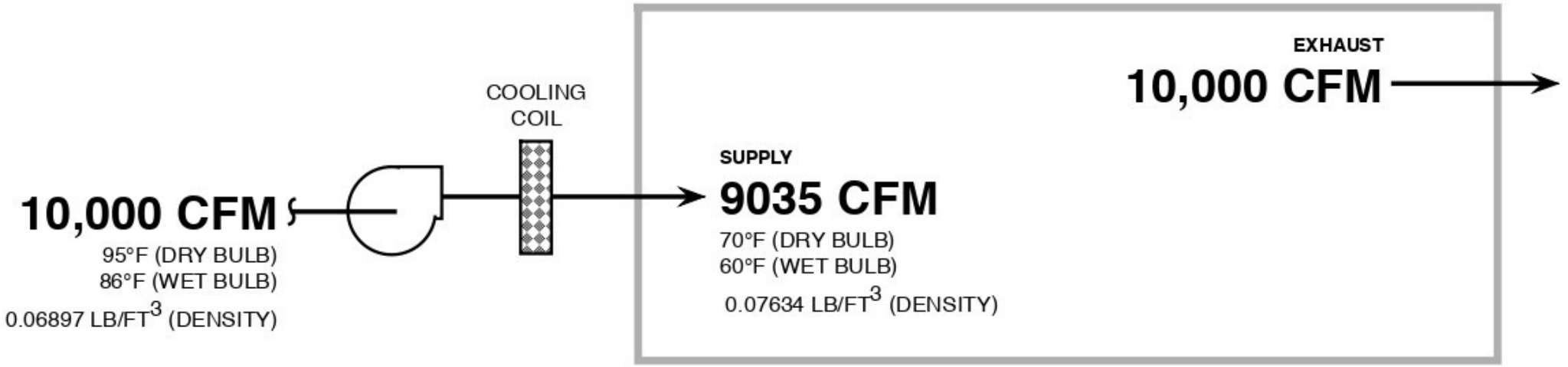


My Manometer already corrects for density!

A warm weather condition with corrected design



Give us more examples!



When and where will I use this?

Is there a solution?

Questions? Comments?

This concludes The American Institute of Architects
Continuing Education Systems Course

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AABC
Quality. Integrity. Independence.