Testing and Balancing

September 16th,2020

Why do we Test and Balance?

- Occupant Comfort
- Occupant Safety
- Energy Efficiency
- Ensure systems are performing as you designed them.

QUALITY ASSURANCE

How is Testing and Balancing Performed?

- Adjusting mechanical systems to operate as designed.
  - Air and Water Flows
  - Pressures
- Certifications
  - TABB – Testing, Adjusting, and Balancing Bureau
  - NEBB – National Environmental Balancing Bureau

Basis of Air Balancing – Equalizing Pressures

Fan Size:

6,000 CFM @ .459”

Duct – 70 ft. × 0.19/100 = **0.133 in.w.g.**
Elbow – C × V_p = 0.23 × 0.20 = **0.046 in.w.g.**
Fitting – C × V_p = 0.07 × 0.20 = **0.014 in.w.g.**
Duct AC Total = **0.193 in.w.g.**

b) **Duct CD** – 4000 cfm, 20 × 16 inches
Table 21-2, Circular Equivalent = 19.5 in.
Figure 21-1, Friction Loss = 0.22 in.w.g./100 ft.
Velocity = Q/A = 4000/20 × 16/144 = 1800 fpm

$$V_p = \left(\frac{1800}{4005}\right)^2 = 0.202 \text{ in.w.g.}$$

Table 21-11 (A), 45° entry fitting (Main flow loss)
branch velocity = 1125 fpm
V_b/V_c = 1125/1800 = 0.625
Fitting, C = 0.07 (Main)

Duct – 25 ft. × 0.22/100 = **0.055 in.w.g.**
Fitting – C × V_p = 0.07 × 0.20 = **0.014 in.w.g.**
Duct CD Total = **0.069 in.w.g.**

c) **Duct DF** – 2000 cfm, 16×16 inches
Table 21-2, Circular Equivalent = 17.5 in.
Figure 21-1, Friction Loss = 0.11 in.w.g./100 ft.
Velocity = 1125 fpm (from above)

$$V_p = \left(\frac{1125}{4005}\right)^2 = 0.079 \text{ in.w.g.}$$

Table 21-9 (F), Elbow, C = 0.26
Table 21-13 (B), Damper, C = 0.04 (open)

d) **Total Duct A to F**

AC	= 0.193 in.w.g.
CD	= 0.069 in.w.g.
DF	= 0.197 in.w.g.
Total	= 0.459 in.w.g. TP

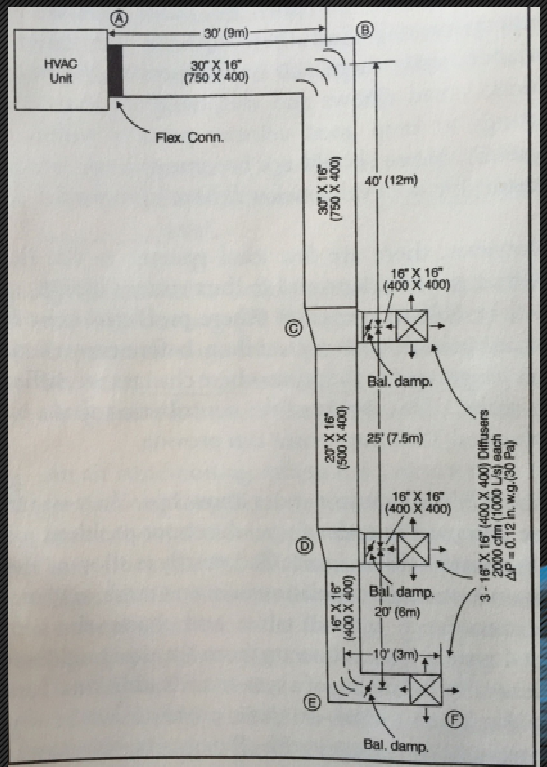


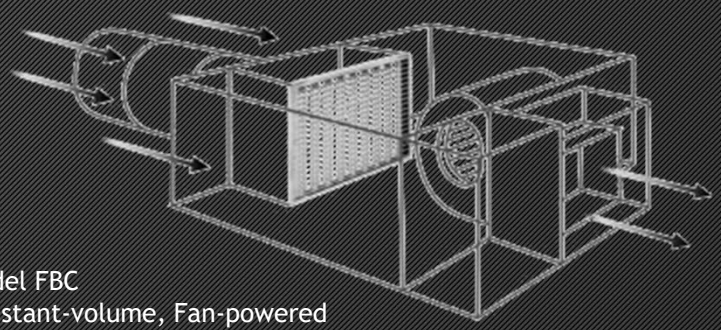
Figure 11-1 Sample Duct System Layout

Balancing Procedure – Low Pressure (CV)

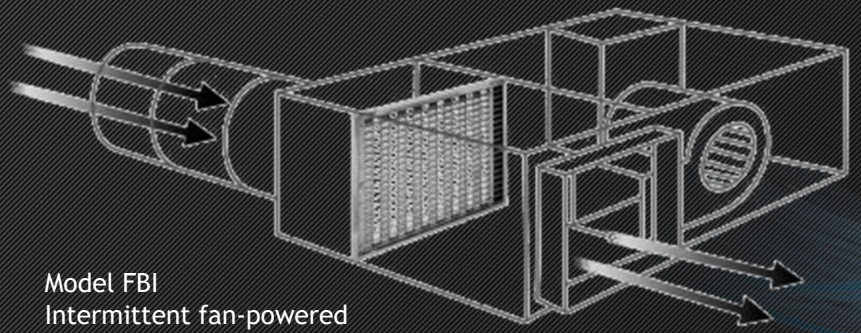
Pre-read total on fan to ensure enough airflow
All balancing dampers open
Proportions branches – MVDs!
Proportion outlets
Final setup of unit

Balancing Procedure – Medium Pressure (VAV System)

Take static pressure reading in duct (system should be set for minimum 1.5” SP)
Read total flow from VAV box
If it differs from BAS, make correction to calibration factor on system
Balance outlets
Once all VAVs are balanced, dump whole system and finalize units

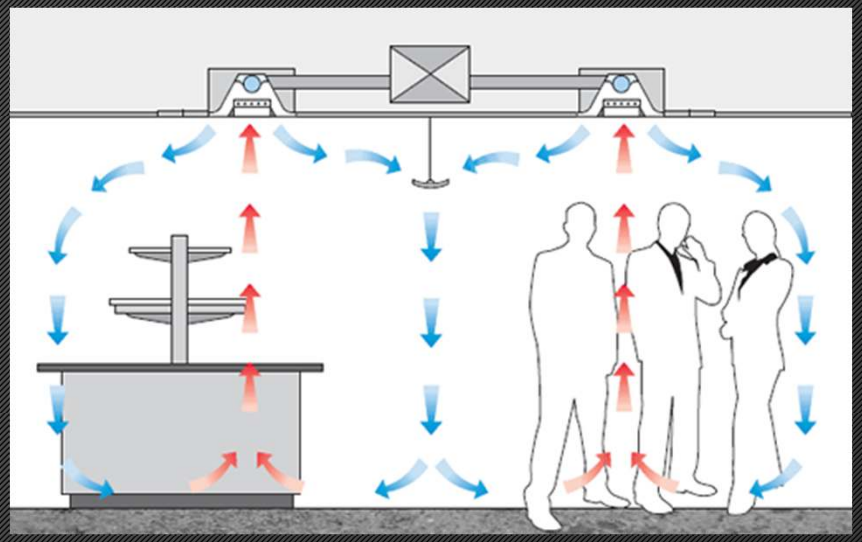


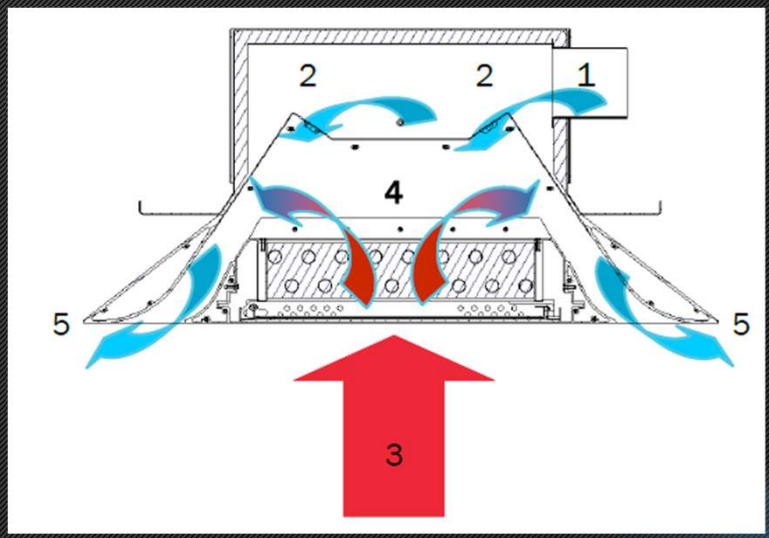
Model FBC
Constant-volume, Fan-powered
Series flow



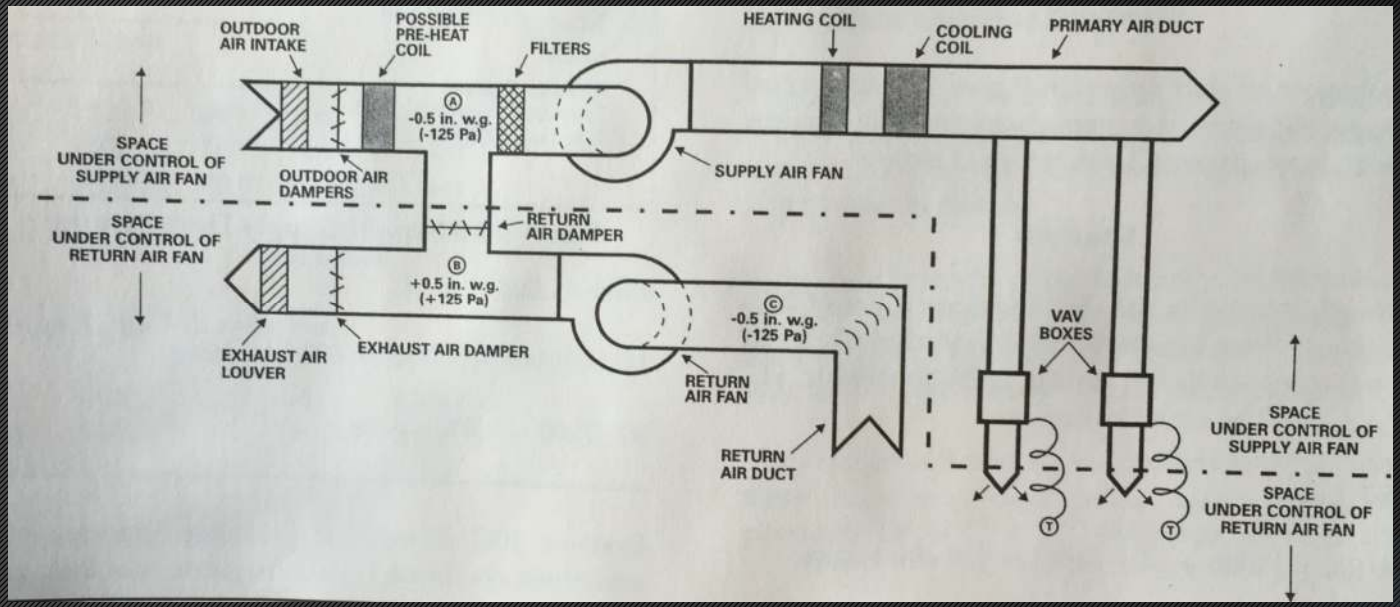
Model FBI
Intermittent fan-powered
Parallel flow

Balancing Procedure – Chilled Beams





Balancing Procedure – Chilled Beams



- Fan tracking and pressures
- Setup MA dampers, setpoints, outdoor airflow, AFMS

What defines a properly balanced system?

- Regardless of the method, the objectives remain the same and the system will be considered balanced in accordance with NEBB procedural standards when the following conditions are satisfied:
  - All measured airflow quantities are within **+/- 10% of the design airflow** quantities unless there are reasons beyond the control of the NEBB Certified TAB firm. Deficiencies shall be noted in the TAB report summary.
  - There is at least one path with fully open dampers from the fan to an air inlet/outlet. Additionally if a system contains branch dampers, there will be **at least one wide-open path downstream of every adjusted damper**.

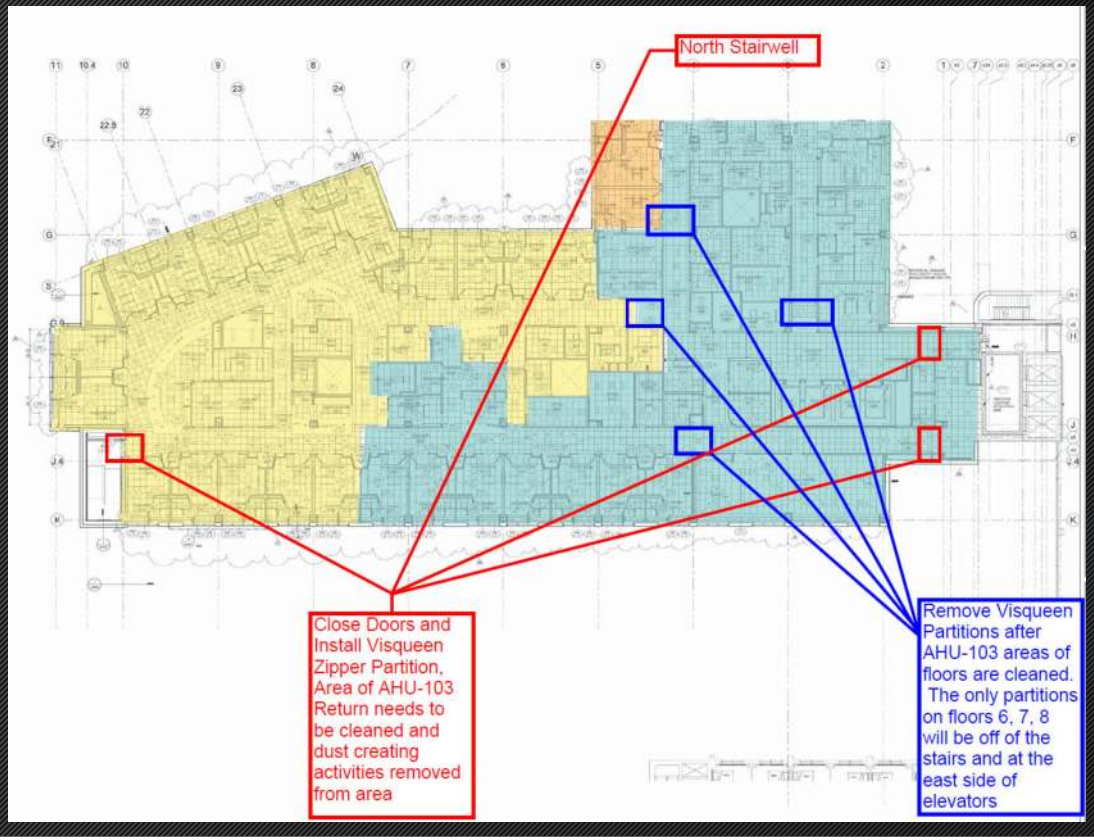
Existing System Balancing

- What conditions are we balancing to?
- Does this affect other areas “NIC?”
  - During construction
  - Final product
- Sound vs comfort

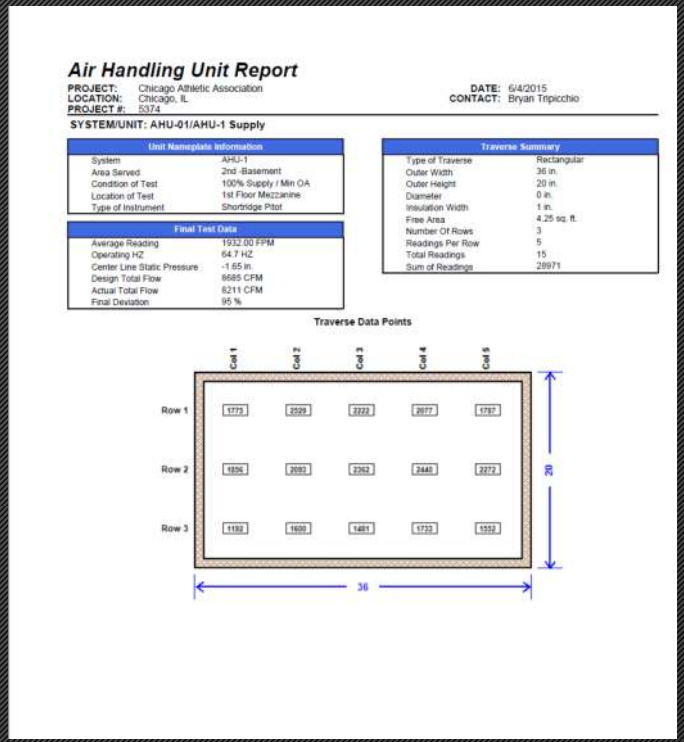
Job Preparation – Early!

- What to look for in the spec
- Procedures (SEE ATTACHMENT)
- Durations based on zoning
- Sequencing – work backwards
- GC buy-in and accountability
- Document and sign-off of deviations
- Consistent balancer between projects

Coordination/Construction



System Balancing With Static and MVDs



Air Handling Unit Report

PROJECT: Chicago Athletic Association
LOCATION: Chicago, IL
PROJECT #: 5374
DATE: 6/4/2015
CONTACT: Bryan Tripicchio

SYSTEM/UNIT: AHU-01/AHU-1 Supply

Unit Nameplate Information	
System	AHU-1
Area Served	2nd -Basement
Condition of Test	100% Supply / Min OA
Location of Test	1st Floor Mezzanine
Type of Instrument	Shortridge Pitot

Final Test Data	
Average Reading	1932.00 FPM
Operating HZ	64.7 HZ
Center Line Static Pressure	-1.65 in.
Design Total Flow	8685 CFM
Actual Total Flow	8211 CFM
Final Deviation	95 %

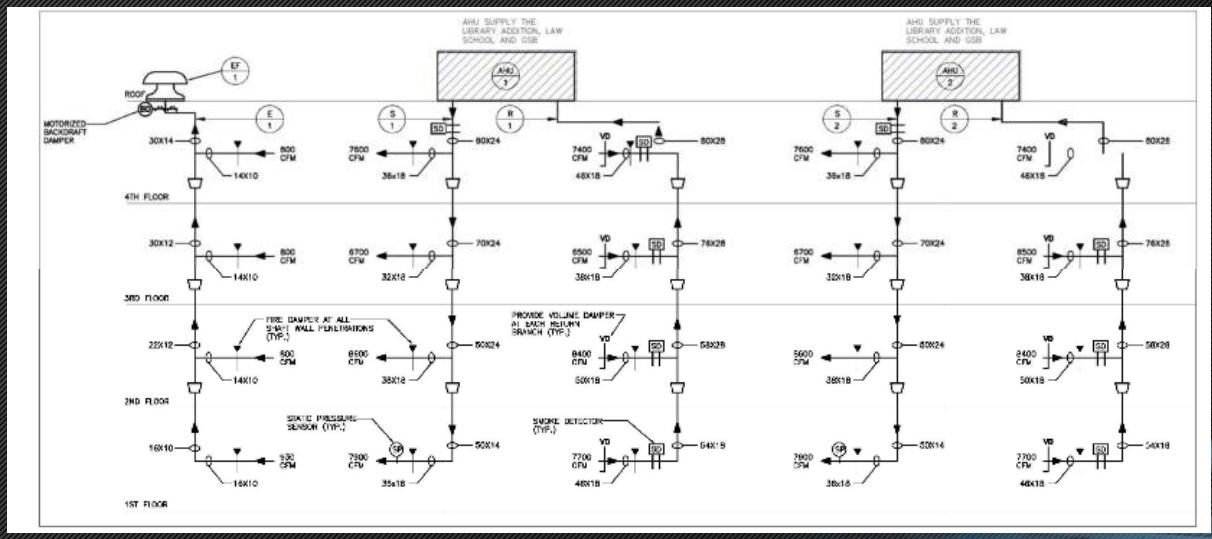
Traverse Summary	
Type of Traverse	Rectangular
Outer Width	36 in.
Outer Height	20 in.
Diameter	0 in.
Insulation Width	1 in.
Free Area	4.25 sq. ft.
Number Of Rows	3
Readings Per Row	5
Total Readings	15
Sum of Readings	28971

Traverse Data Points

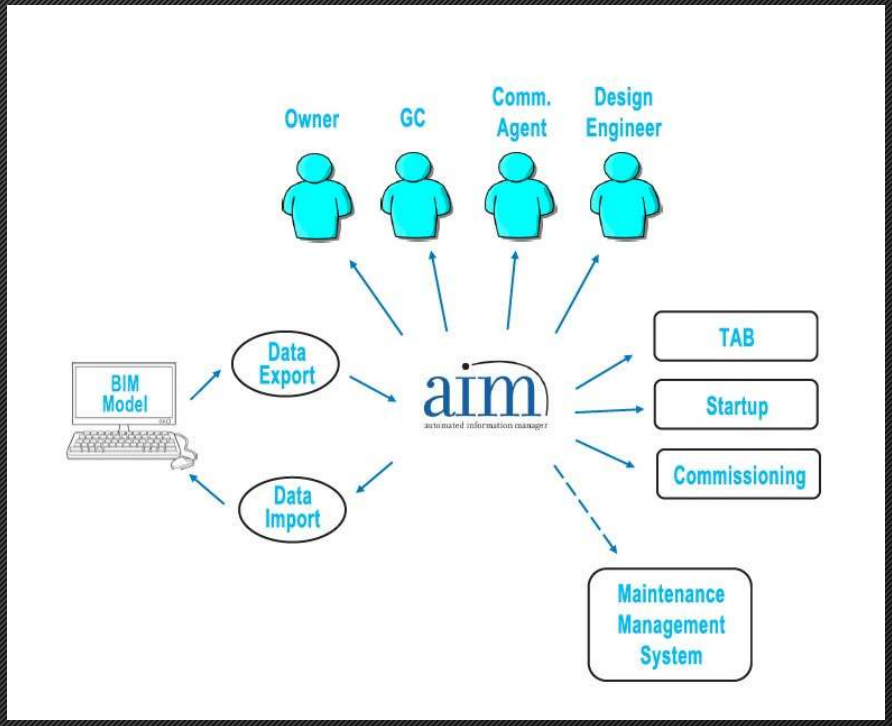
	Col 1	Col 2	Col 3	Col 4	Col 5
Row 1	1775	2529	2222	2077	1787
Row 2	1936	2093	2362	2446	2272
Row 3	1192	1600	1481	1733	1552

20

36



Automated Reporting



Report Review / Common Issues

- Numbers that look too good.
  - Need to be honest with the issues and work to correct them.
- “Hood” for everything
- Same calibration factors on VAVs/FPBs
- Balancing box without outlets
- TAB is 100% labor

Tools


ALNOR


INCHES OF WATER
.25 .50 .75 1.0 .25 .50 .75
MAGNEHELIC
MAX. PRESSURE 15 PSIG


Dwyer
INCHES OF WATER

By The Numbers

500+

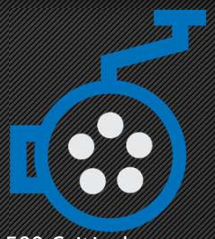
Aero has over 500 years of Combined experience.

1968

Aero was founded in 1968

41

41 Retrocommissioning and Monitoring Based Commissioning projects in 2019.



1,500 Critical rooms certified each year.

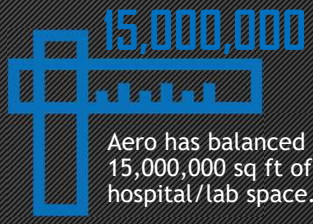
32

Aero has 32 certified professionals.

4,250,000

Over 4,250,000 kWh saved in 2019.

15,000,000



Aero has balanced over 15,000,000 sq ft of new hospital/lab space.

$447,925

$447,925 saved for clients off their utility bills in 2019.

A total of 147,022 hours worked without injury.

Other Services

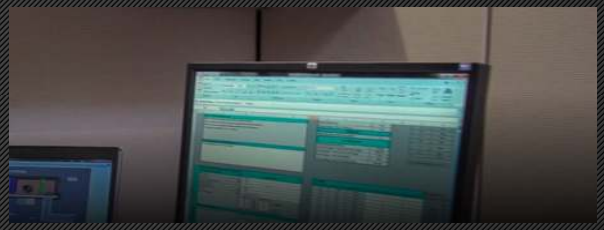
Room & Building Envelope Pressure Testing

Indoor Air Quality Testing

Steam Trap testing

Ultrasonic Flow Testing

Commissioning / Energy Services



Critical Environment Testing

Questions??