CAE 464/517 HVAC Systems Design

Spring 2021

March 18, 2021

Air distribution systems: Fan selection example and air handling unit

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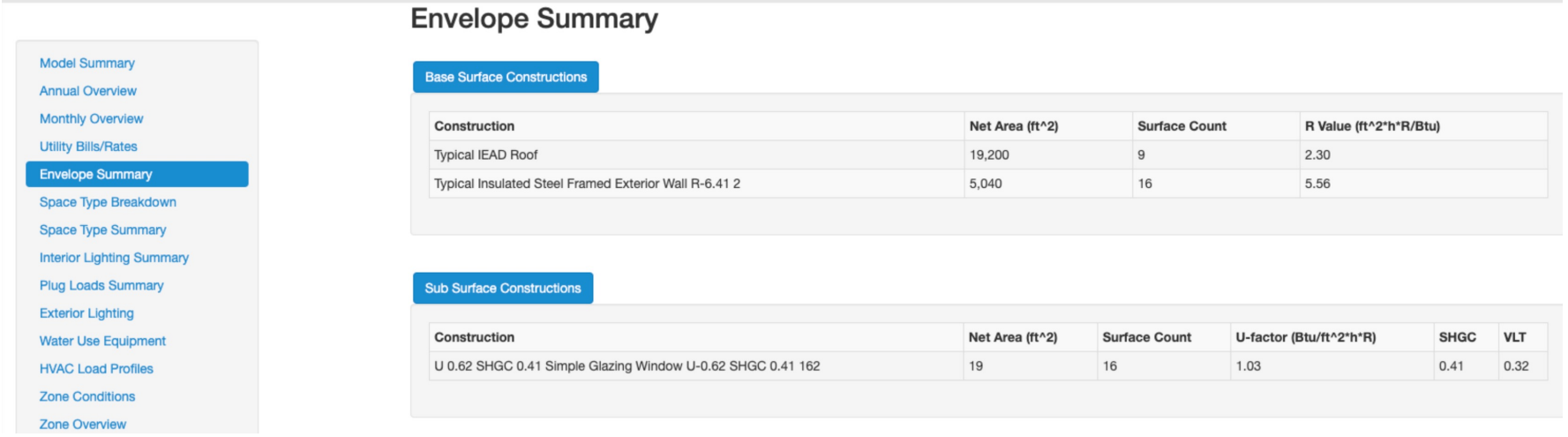
HOMEWORK / PROJECT / EXAM

Homework / Project / Exam

- Homework 3:
  - ❑ In the comparison between your hand calculation (or excel calculation) and OpenStudio pay attention to the OpenStudio model inputs



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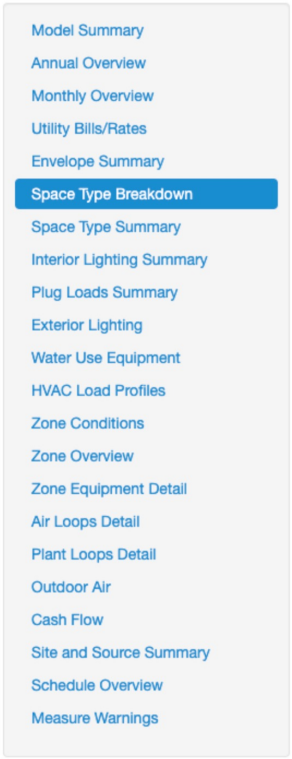

Space Type Summary

Office IT_Room
(1 spaces and 1 thermal zones)

Definition	Value	Unit	Inst. Multiplier
Office IT_Room People Definition	0.0050	people/ft^2	1.0
Office IT_Room Elec Equip Definition	2.0000	W/ft^2	1.0
Office IT_Room Lights Definition	2.0900	W/ft^2	1.0
Office IT_Room Infiltration	0.2232	cfm/ext wall area ft^2	
Office IT_Room Ventilation (outdoor air method Sum)	0.0500	cfm/ floor area ft^2	

Office MediumOffice - Breakroom
(1 spaces and 1 thermal zones)

Definition	Value	Unit	Inst. Multiplier
Office MediumOffice - Breakroom People Definition	0.0500	people/ft^2	1.0
Office MediumOffice - Breakroom Elec Equip Definition	1.3300	W/ft^2	1.0
Office MediumOffice - Breakroom Lights Definition	2.2800	W/ft^2	1.0
Office MediumOffice - Breakroom Infiltration	0.2232	cfm/ext wall area ft^2	
Office MediumOffice - Breakroom Ventilation (outdoor air method Sum)	15.0000	cfm/person	

Homework / Project / Exam

- Homework 3:
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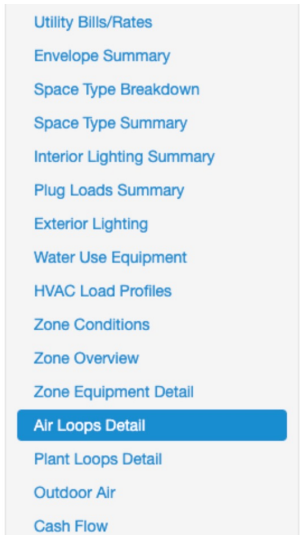


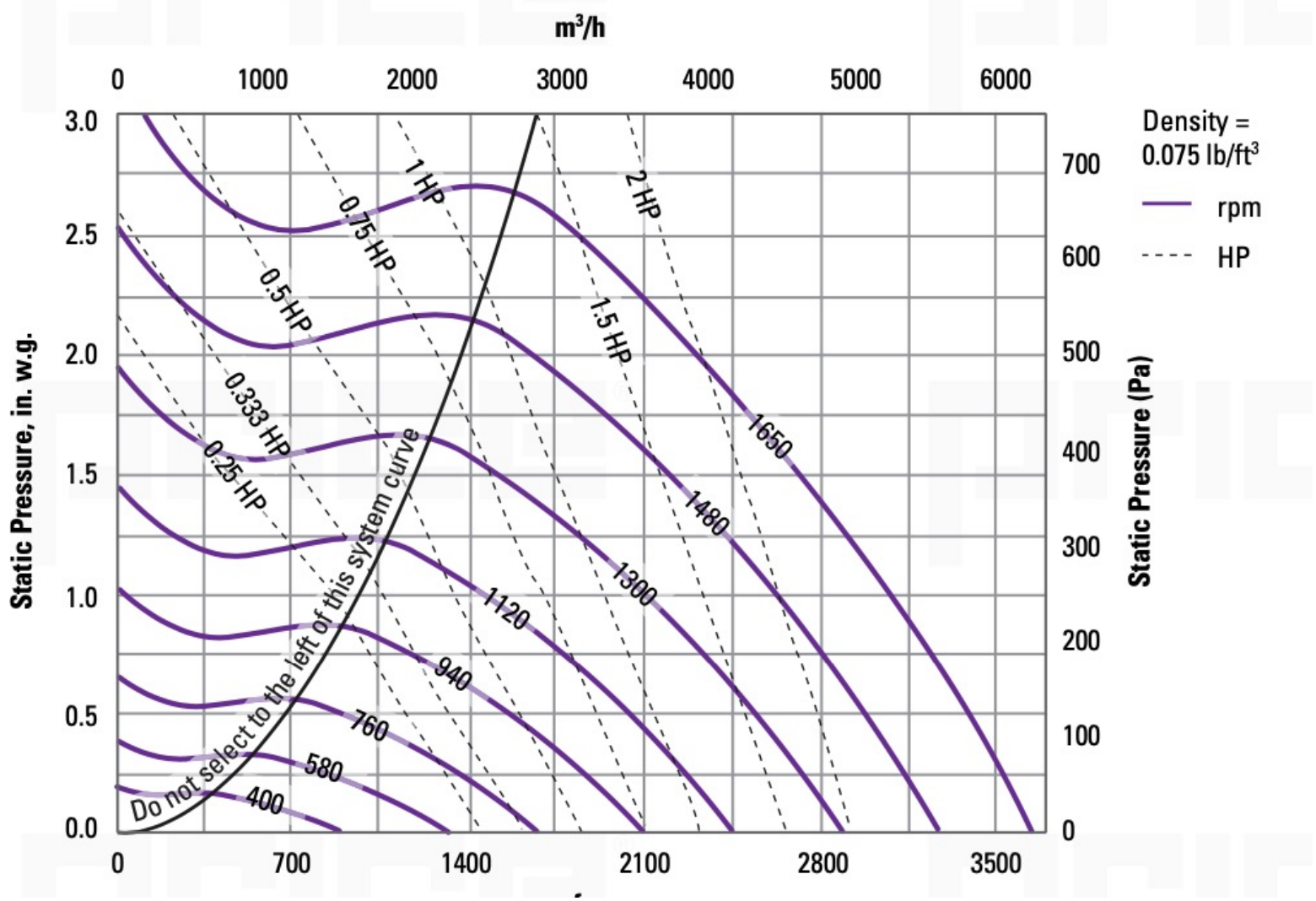
Outdoor Air

Average and Minimum Outdoor Air During Occupied Hours

	Average Number of Occupants	Nominal Number of Occupants	Zone Volume (ft^3)	Avg. Mechanical Ventilation (ach)	Min. Mechanical Ventilation (ach)	Avg. Infiltration (ach)	Min. Infiltration (ach)	Avg. Simple Ventilation (ach)	Min. Simple Ventilation (ach)
THERMAL ZONE 1	2.7	17.7	32400	0.0	0.0	0.278	0.003	0.29	0.001
THERMAL ZONE 2	27.44	60.0	54000	0.0	0.0	0.204	0.002	0.443	0.001
THERMAL ZONE 3	30.77	130.0	39600	0.0	0.0	0.341	0.003	1.135	0.003
THERMAL ZONE 5	74.33	162.5	29250	0.0	0.0	0.0	0.0	2.216	0.004

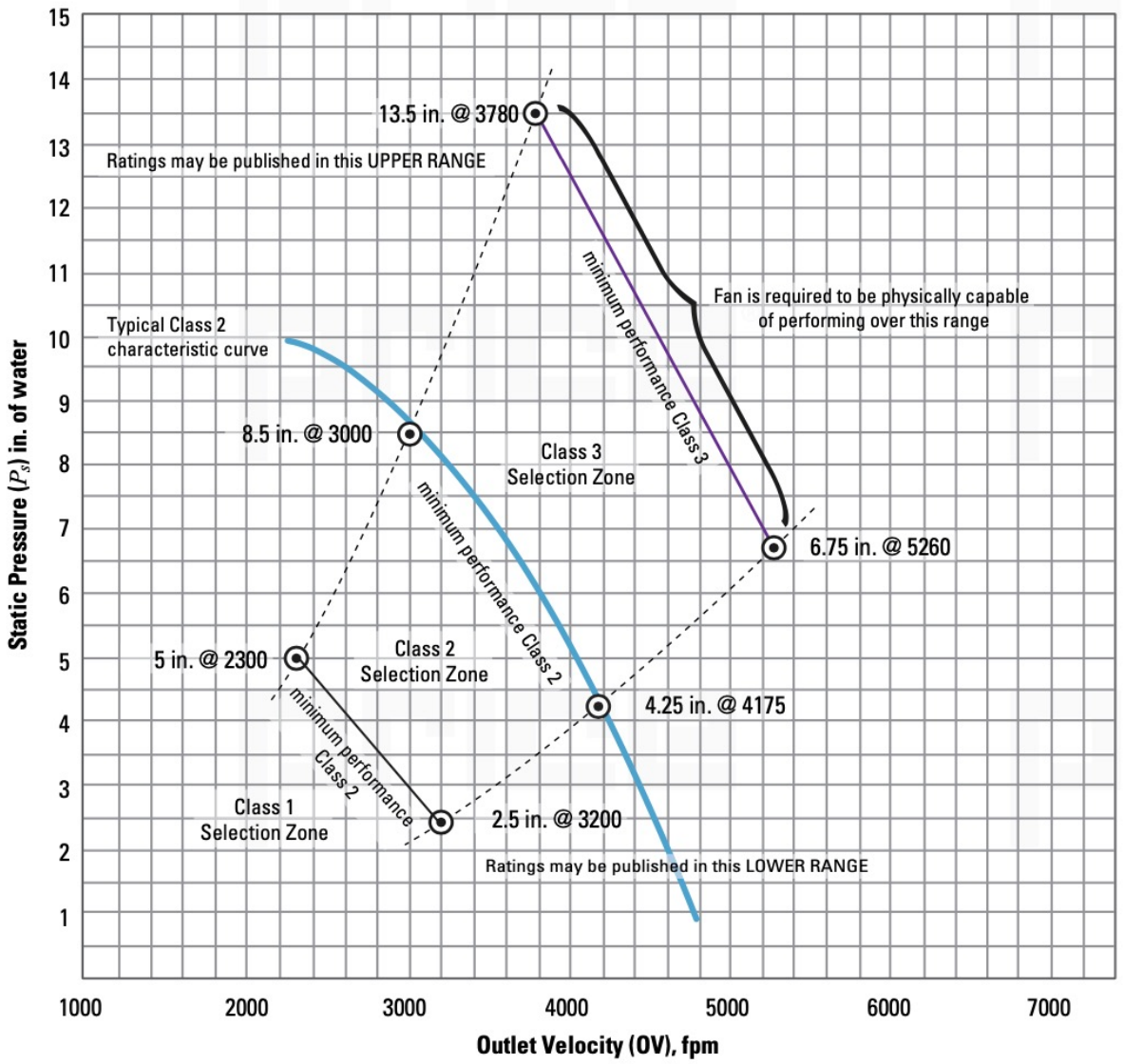
RECAP

Recap



Price Industries Engineering Handbook

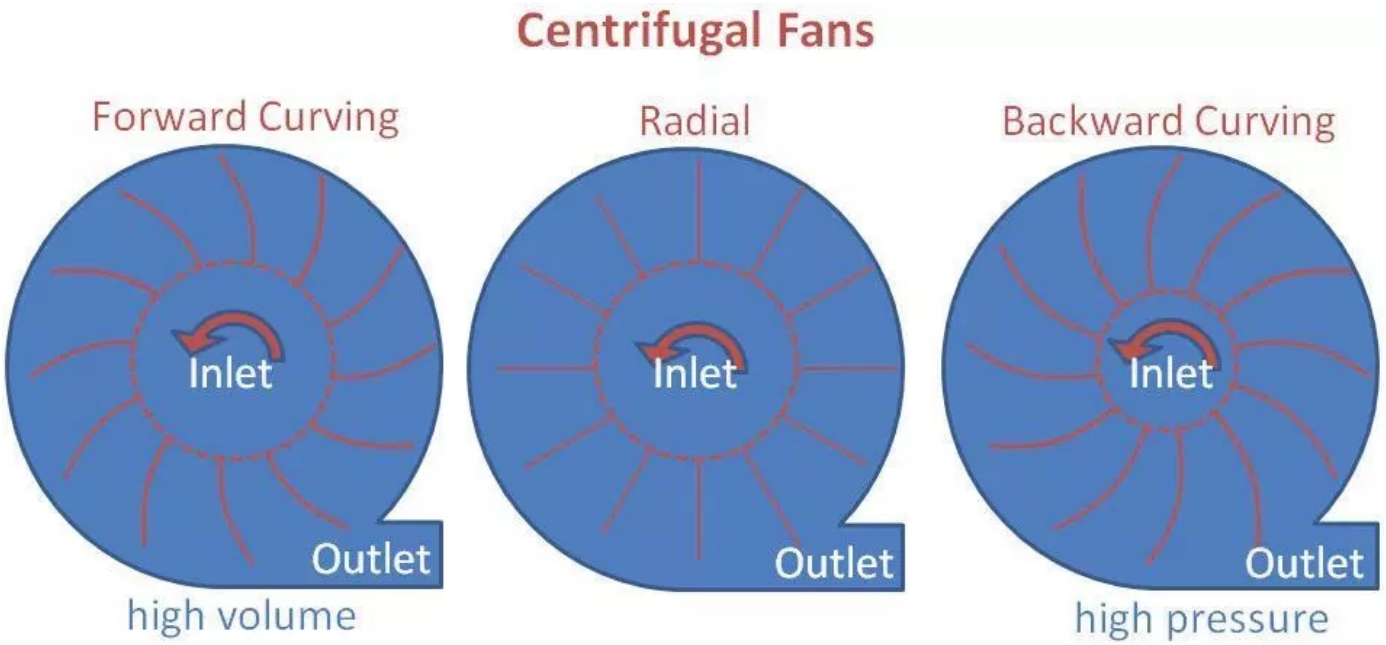
Recap



Price Industries Engineering Handbook

Recap

- Centrifugal fans are categorized as:
  - ❑ Backward inclined
  - ❑ Radial
  - ❑ Forward curved



https://www.homeintheearth.com/tech_notes/earth-tubes/fans/

Recap

- Fan Laws ”or Affinity Laws”:
  - Q: Fan volume (cfm)
  - N: Rotational speed (rpm)
  - P: Total pressure (in. w.c.)
  - W: Brake Horsepower
  - ρ: Fan density (lb/ft^3)

$$\frac{Q_1}{Q_2} = \frac{N_1}{N_2} . \frac{\rho_1}{\rho_2}$$

$$\frac{P_1}{P_2} = \left(\frac{N_1}{N_2}\right)^2 . \frac{\rho_1}{\rho_2}$$

$$\frac{W_1}{W_2} = \left(\frac{N_1}{N_2}\right)^3 . \frac{\rho_1}{\rho_2}$$

Recap

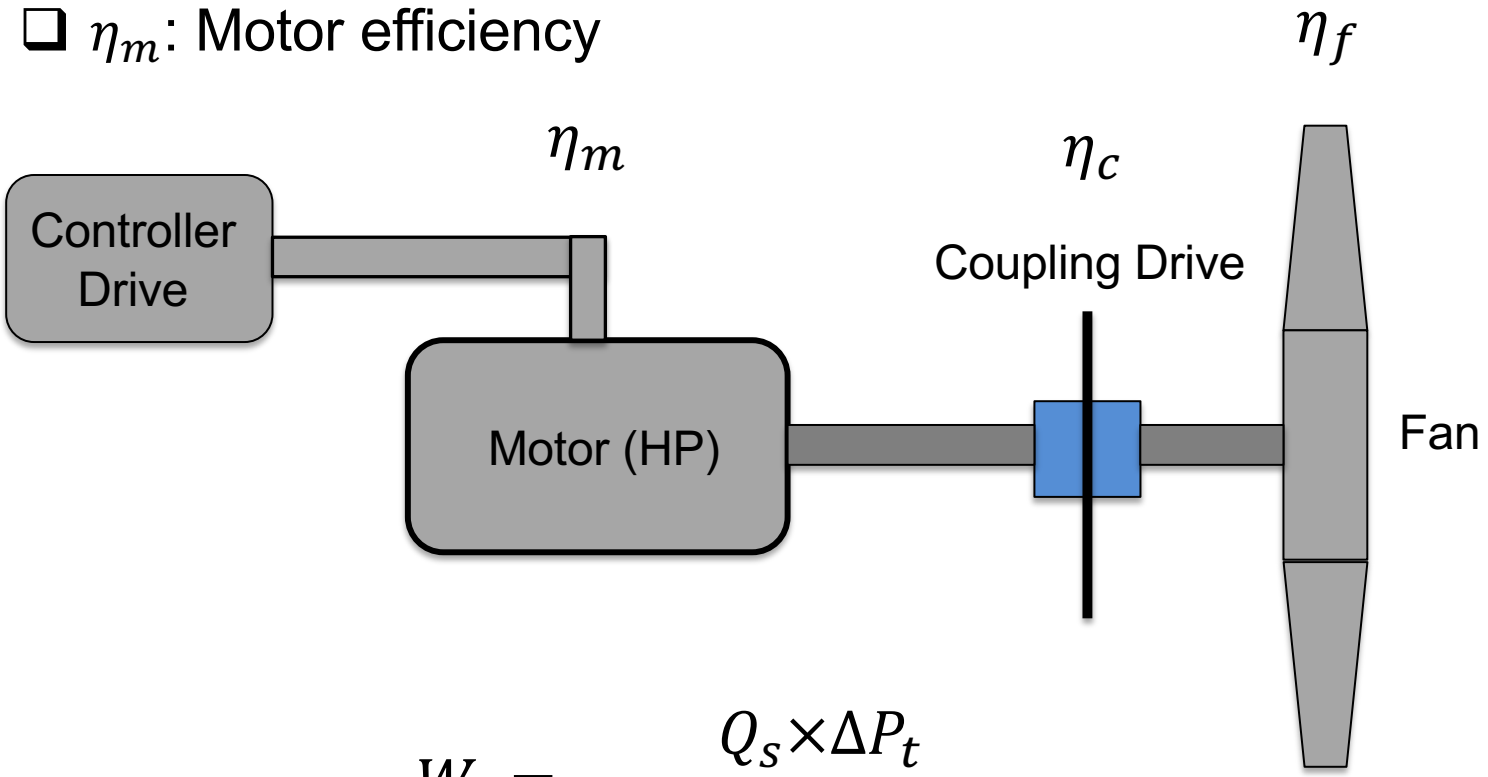
- Fan Laws ”or Affinity Laws”:

Flow Rate Reduction	Fan Energy Savings
10%	27%
20%	47%
30%	66%
40%	78%
50%	87%

Flow Rate Increase	Increased Fan Energy
10%	33%
20%	73%
30%	120%
40%	174%
50%	237%

Recap

- The fan power is impacted by different inefficiencies:
  - ❑ η_f: Fan total efficiency
  - ❑ η_c: Coupling efficiency (1-drive losses)
  - ❑ η_m: Motor efficiency

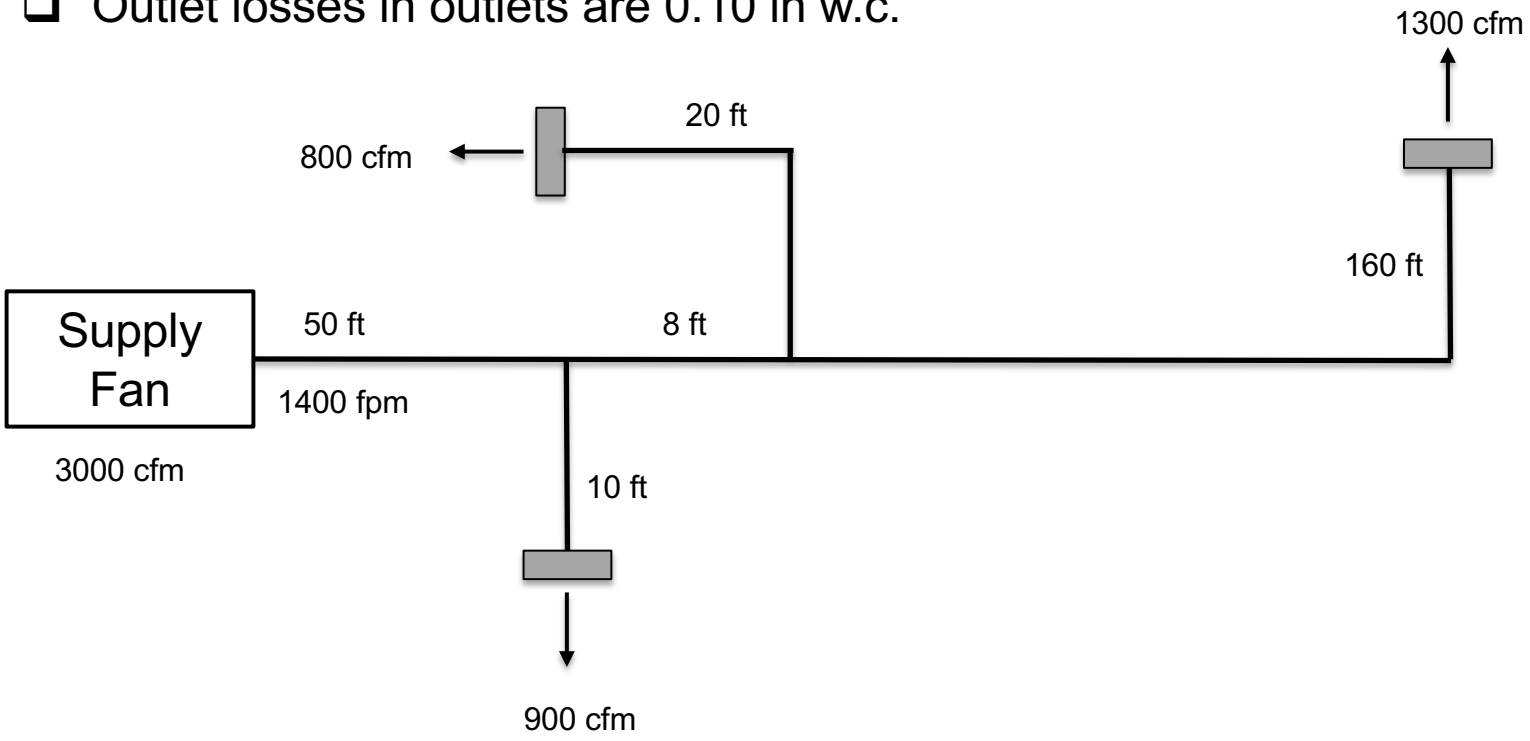


$$W_t = \frac{Q_s \times \Delta P_t}{6{,}356 \times \eta_f \times \eta_c \times \eta_m}$$

CLASS ACTIVITY

Class Activity

- The given information is given:
  - ❑ Ductwork needs to be rectangular at maximum depth of 12”
  - ❑ All ductwork sizes are in even inches
  - ❑ Use tees with 45-degree entry branches (e.g., SR5-13)
  - ❑ Use elbow radius ratio of r/D = 1.5 (e.g., CR3-1)
  - ❑ Outlet losses in outlets are 0.10 in w.c.

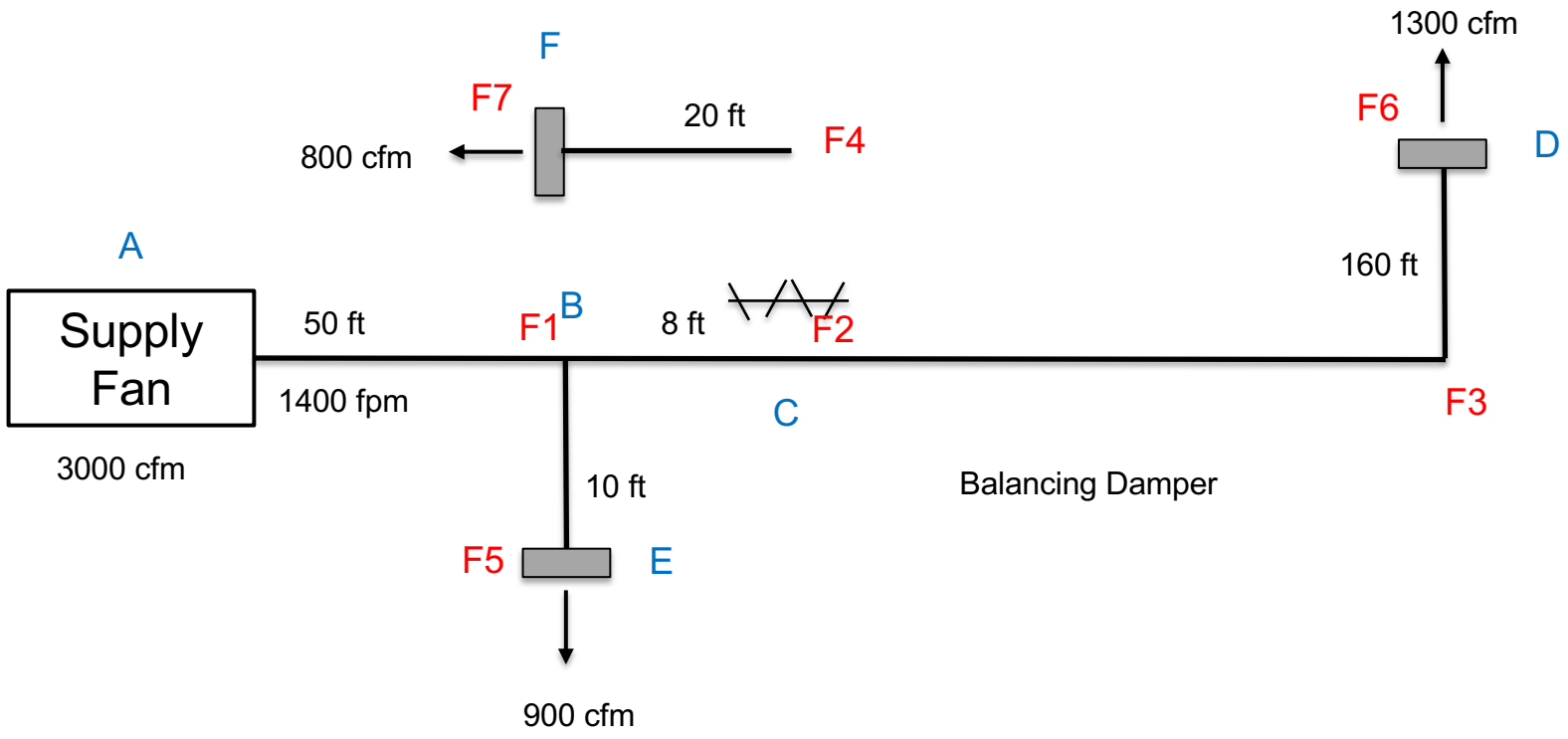


Class Activity

- Calculate the following information:
  - Pressure drop in each branch
  - Draw the system characteristics curve and the fan curve and select a fan option

Class Activity

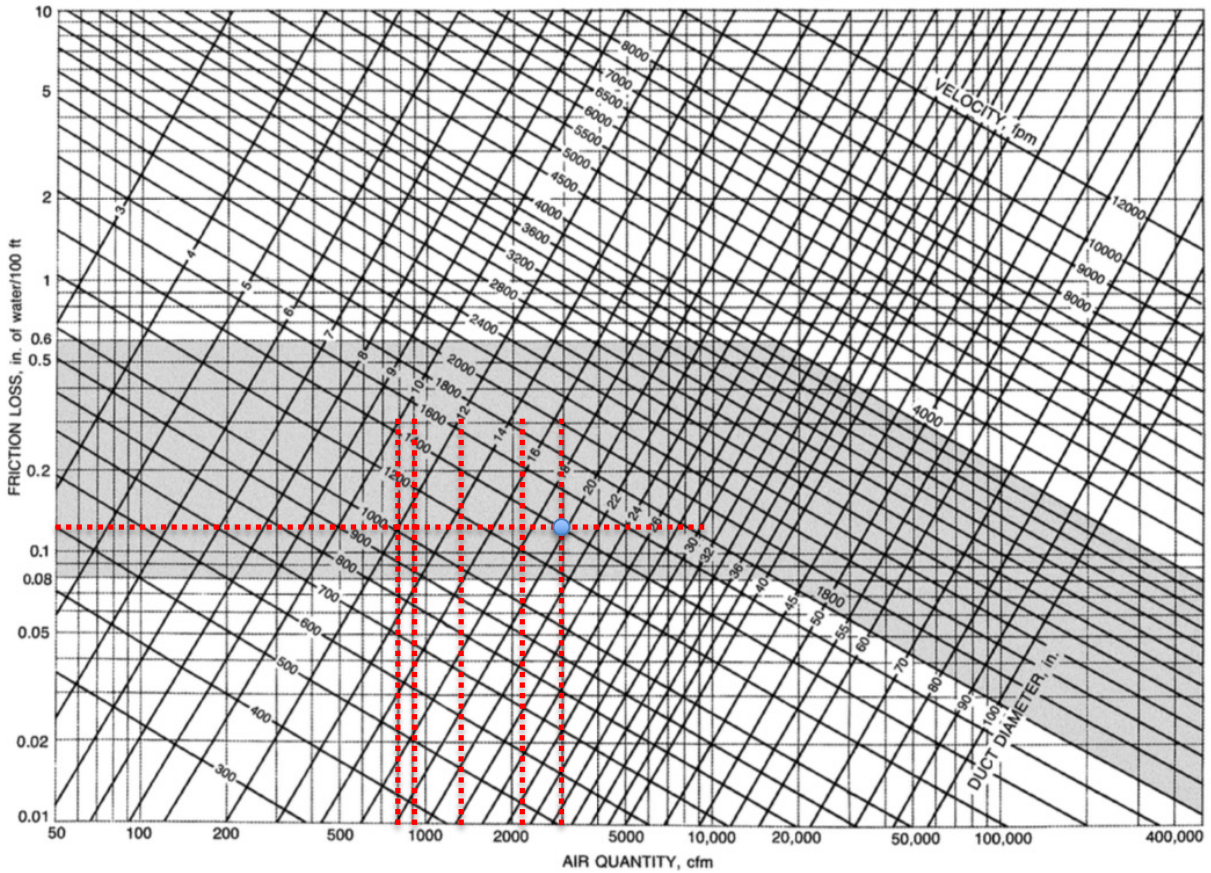
- **Solution:**
  - ❑ Add labels for different branches and fittings



Class Activity

- **Solution:**
  - ❑ Estimate the equal friction method

$$Q_{main} = 900\ cfm + 800\ cfm + 1300\ cfm = 3000\ cfm \qquad V_{max} = 1400\ fpm$$



0.13 in./100 ft

Class Activity

- **Solution:**
  - ❑ Find the friction losses at 0.13 in/100 ft

Section	Air Flow Rate (cfm)	D_e (in)	Length (ft)	Section Loss (in. w.c.)
A-B	3,000	20	50	$0.13\times\left(\frac{50}{100}\right)=0.065$
B-C	2,100	18	8	$0.13\times\left(\frac{8}{100}\right)=0.010$
C-D	1,300	14	160	$0.13\times\left(\frac{160}{100}\right)=0.208$
B-E	900	13	10	$0.13\times\left(\frac{10}{100}\right)=0.013$
C-F	800	12	20	$0.13\times\left(\frac{20}{100}\right)=0.026$

Class Activity

- **Solution:**
  - ❑ Find square duct sizes

Circular Duct Diameter, in.	Length of One Side of Rectangular Duct (a), in.																		
	4	5	6	7	8	9	10	12	14	16	18	20	22	24	26	28	30	32	34	36
	Length Adjacent Side of Rectangular Duct (b), in.																			
5	5																			
5.5	6	5																		
6	8	6																		
6.5	9	7	6																	
7	11	8	7																	
7.5	13	10	8	7																
8	15	11	9	8																
8.5	17	13	10	9																
9	20	15	12	10	8															
9.5	22	17	13	11	9															
10	25	19	15	12	10	9														
10.5	29	21	16	14	12	10														
11	32	23	18	15	13	11	10													
11.5		26	20	17	14	12	11													
12		29	22	18	15	13	12													
12.5		32	24	20	17	15	13													
13		35	27	22	18	16	14	12												
13.5		38	29	24	20	17	15	13												
14			32	26	22	19	17	14												
14.5			35	28	24	20	18	15												
15			38	30	25	22	19	16	14											
16			45	36	30	25	22	18	15											
17				41	34	29	25	20	17	16										
18				47	39	33	29	23	19	17										
19				54	44	38	33	26	22	19	18									
20					50	43	37	29	24	21	19									
21					57	48	41	33	27	23	20									

C-F

B-E

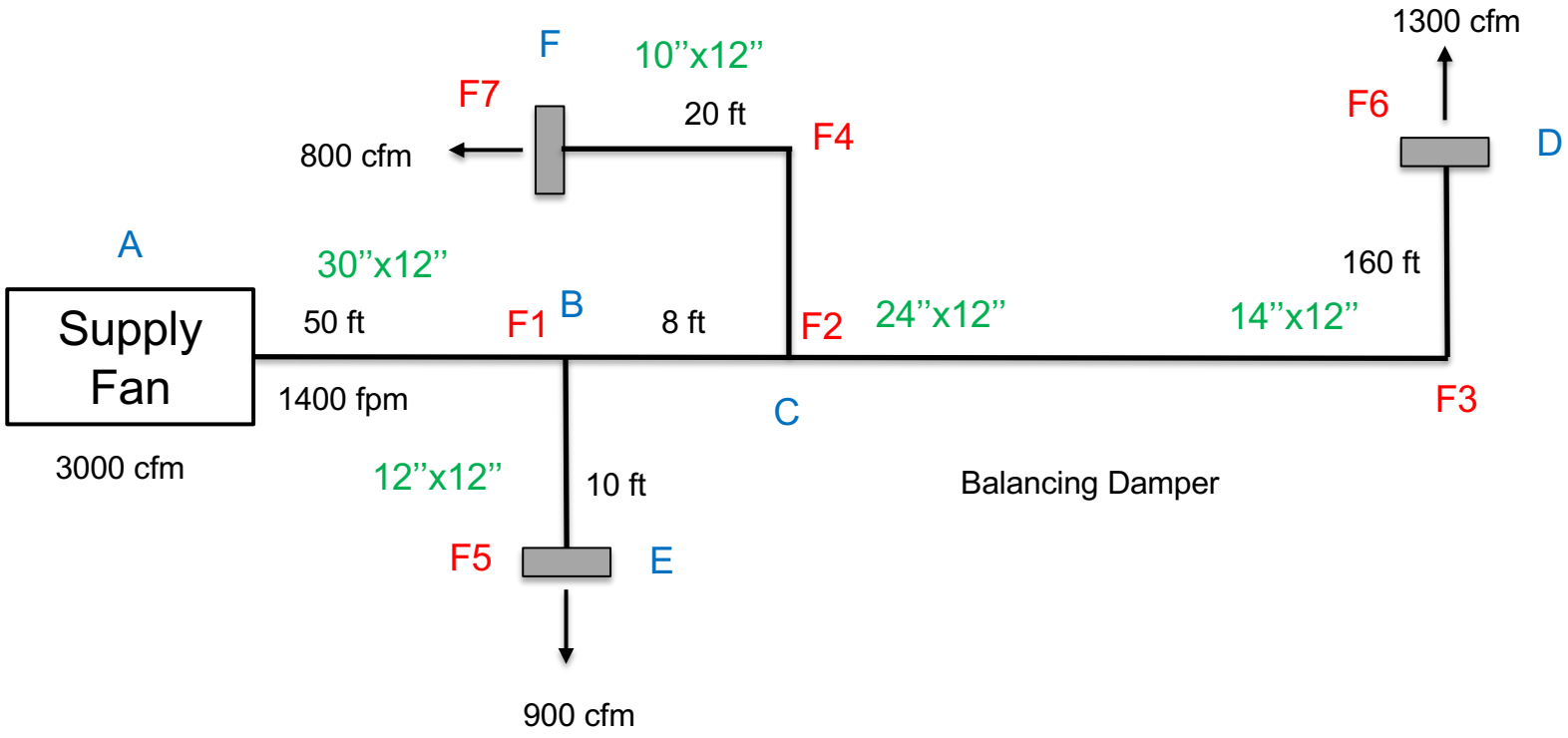
C-D

B-C

A-B

Class Activity

- **Solution:**
  - ❑ Add the duct sizes to the schematic



Class Activity

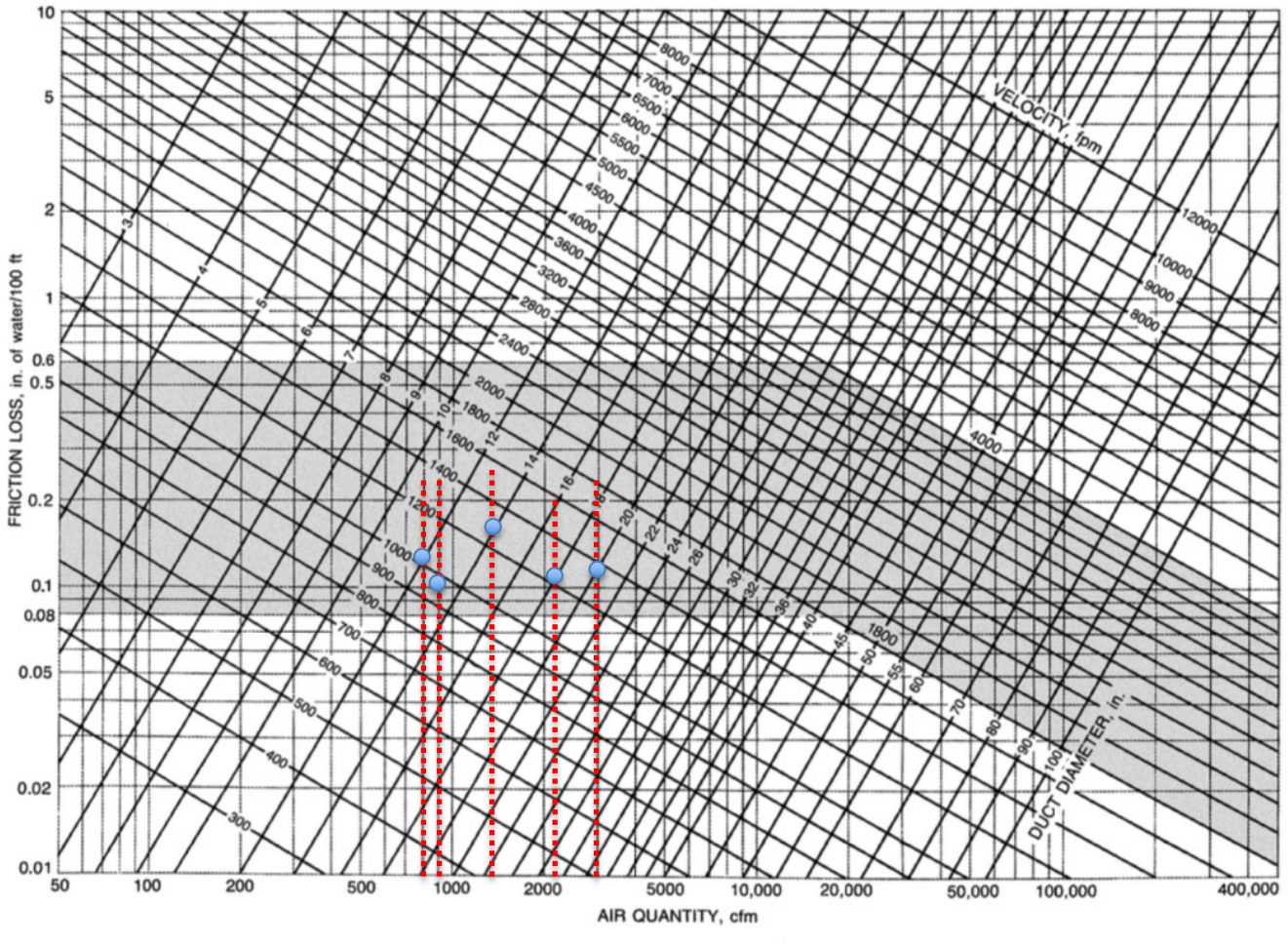
- **Solution:**
  - ❑ Add the rectangular values to the table

Section	Air Flow Rate (cfm)	Duct Size (in)	Duct (in Rectangular)	Area (ft^2)	Velocity (fpm)
A-B	3,000	20	30 / 12	2.50	
B-C	2,100	18	24 /12	2.00	
C-D	1,300	14	14 / 12	1.17	
B-E	900	13	12 / 12	1.00	
C-F	800	12	10 / 12	0.83	

Question: How do we calculate the velocity?

Class Activity

- **Solution:**
  - ❑ Method 1: Friction losses (in/100 ft) for round ducts



Class Activity

- **Solution:**
  - ❑ Method 1: Velocity using the chart for the round ducts

Section	Air Flow Rate (cfm)	Duct Size (in)	Duct (in Rectangular)	Area (ft^2)	Velocity (fpm)
A-B	3,000	20	30 / 12	2.50	1,300
B-C	2,100	18	24 /12	2.00	1,230
C-D	1,300	14	14 / 12	1.17	1,250
B-E	900	13	12 / 12	1.00	950
C-F	800	12	10 / 12	0.83	1,000

Class Activity

- **Solution:**
  - ❑ Method 2: Velocity using the cfm and area for the rectangular ducts

Section	Air Flow Rate (cfm)	Duct Size (in)	Duct (in Rectangular)	Area (ft^2)	Velocity (fpm)
A-B	3,000	20	30 / 12	2.50	(3,000)/(2.5)=1,200
B-C	2,100	18	24 /12	2.00	(2,100)/(2.0)=1,050
C-D	1,300	14	14 / 12	1.17	(1,300)/(1.17)=1,114
B-E	900	13	12 / 12	1.00	(900)/(1.0)=900
C-F	800	12	10 / 12	0.83	(800)/(0.83)=960

If I use the rectangular, can I use the chart?

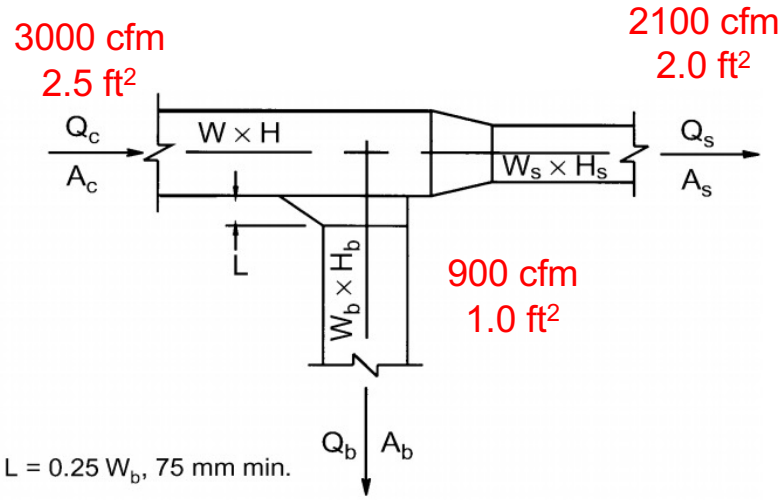
Class Activity

- **Solution:**
  - ❑ Find the fitting losses (F1)

SR5-13 Tee, 45 Degree Entry Branch, Diverging

	C_b Values								
	Q_b/Q_c								
A_b/A_c	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0.1	0.73	0.34	0.32	0.34	0.35	0.37	0.38	0.39	0.40
0.2	3.10	0.73	0.41	0.34	0.32	0.32	0.33	0.34	0.35
0.3	7.59	1.65	0.73	0.47	0.37	0.34	0.32	0.32	0.32
0.4	14.20	3.10	1.28	0.73	0.51	0.41	0.36	0.34	0.32
0.5	22.92	5.08	2.07	1.12	0.73	0.54	0.44	0.38	0.35
0.6	33.76	7.59	3.10	1.65	1.03	0.73	0.56	0.47	0.41
0.7	46.71	10.63	4.36	2.31	1.42	0.98	0.73	0.58	0.49
0.8	61.79	14.20	5.86	3.10	1.90	1.28	0.94	0.73	0.60
0.9	78.98	18.29	7.59	4.02	2.46	1.65	1.19	0.91	0.73

	C_s Values								
	Q_s/Q_c								
A_s/A_c	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0.1	0.04								
0.2	0.98	0.04							
0.3	3.48	0.31	0.04						
0.4	7.55	0.98	0.18	0.04					
0.5	13.18	2.03	0.49	0.13	0.04				
0.6	20.38	3.48	0.98	0.31	0.10	0.04			
0.7	29.15	5.32	1.64	0.60	0.23	0.09	0.04		
0.8	39.48	7.55	2.47	0.98	0.42	0.18	0.08	0.04	
0.9	51.37	10.17	3.48	1.46	0.67	0.31	0.15	0.07	0.04



Branch

$$\begin{cases} \frac{Q_b}{Q_c} = \left(\frac{900\ cfm}{3{,}000\ cfm}\right) = 0.3 \\ \frac{A_b}{A_c} = \frac{1.0\ ft^2}{2.5\ ft^2} = 0.40 \end{cases} \qquad C_{b1} = 1.28$$

Straight

$$\begin{cases} \frac{Q_s}{Q_c} = \left(\frac{2{,}100\ cfm}{3{,}000\ cfm}\right) = 0.7 \\ \frac{A_b}{A_c} = \frac{2.0\ ft^2}{2.5\ ft^2} = 0.80 \end{cases} \qquad C_{s1} = 0.08$$

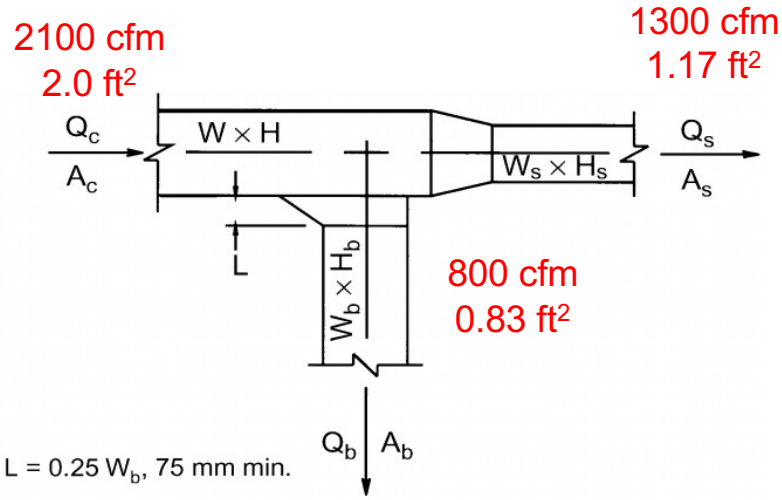
Class Activity

- **Solution:**
  - ❑ Find the fitting losses (F2)

SR5-13 Tee, 45 Degree Entry Branch, Diverging

	C_b Values								
	Q_b/Q_c								
A_b/A_c	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0.1	0.73	0.34	0.32	0.34	0.35	0.37	0.38	0.39	0.40
0.2	3.10	0.73	0.41	0.34	0.32	0.32	0.33	0.34	0.35
0.3	7.59	1.65	0.73	0.47	0.37	0.34	0.32	0.32	0.32
0.4	14.20	3.10	1.28	0.73	0.51	0.41	0.36	0.34	0.32
0.5	22.92	5.08	2.07	1.12	0.73	0.54	0.44	0.38	0.35
0.6	33.76	7.59	3.10	1.65	1.03	0.73	0.56	0.47	0.41
0.7	46.71	10.63	4.36	2.31	1.42	0.98	0.73	0.58	0.49
0.8	61.79	14.20	5.86	3.10	1.90	1.28	0.94	0.73	0.60
0.9	78.98	18.29	7.59	4.02	2.46	1.65	1.19	0.91	0.73

	C_s Values								
	Q_s/Q_c								
A_s/A_c	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0.1	0.04								
0.2	0.98	0.04							
0.3	3.48	0.31	0.04						
0.4	7.55	0.98	0.18	0.04					
0.5	13.18	2.03	0.49	0.13	0.04				
0.6	20.38	3.48	0.98	0.31	0.10	0.04			
0.7	29.15	5.32	1.64	0.60	0.23	0.09	0.04		
0.8	39.48	7.55	2.47	0.98	0.42	0.18	0.08	0.04	
0.9	51.37	10.17	3.48	1.46	0.67	0.31	0.15	0.07	0.04



Branch

$$\begin{cases} \frac{Q_b}{Q_c} = \left(\frac{800\ cfm}{2{,}100\ cfm}\right) = 0.38 \\ \frac{A_b}{A_c} = \frac{0.83\ ft^2}{2.0\ ft^2} = 0.42 \end{cases} \qquad C_{b1} = 0.94$$

Straight

$$\begin{cases} \frac{Q_s}{Q_c} = \left(\frac{1{,}300\ cfm}{2{,}100\ cfm}\right) = 0.62 \\ \frac{A_b}{A_c} = \frac{1.17\ ft^2}{2.0\ ft^2} = 0.59 \end{cases} \qquad C_{s1} = 0.034$$

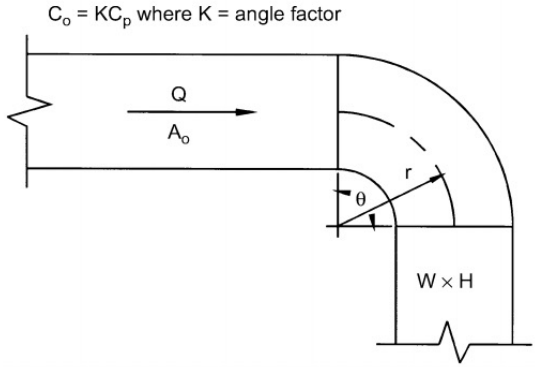
Class Activity

- **Solution:**
  - ❑ Find the fitting losses (F3 and F4)

CR3-1 Elbow, Smooth Radius, Without Vanes

C_p Values											
						H/W					
r/W	**0.25**	**0.50**	**0.75**	**1.00**	**1.50**	**2.00**	**3.00**	**4.00**	**5.00**	**6.00**	**8.00**
0.50	1.53	1.38	1.29	1.18	1.06	1.00	1.00	1.06	1.12	1.16	1.18
0.75	0.57	0.52	0.48	0.44	0.40	0.39	0.39	0.40	0.42	0.43	0.44
1.00	0.27	0.25	0.23	0.21	0.19	0.18	0.18	0.19	0.20	0.21	0.21
1.50	0.22	0.20	0.19	0.17	0.15	0.14	0.14	0.15	0.16	0.17	0.17
2.00	0.20	0.18	0.16	0.15	0.14	0.13	0.13	0.14	0.14	0.15	0.15

Angle Factor *K*											
θ	**0**	**20**	**30**	**45**	**60**	**75**	**90**	**110**	**130**	**150**	**180**
K	0.00	0.31	0.45	0.60	0.78	0.90	1.00	1.13	1.20	1.28	1.40



F3

$$\frac{H}{W} = \frac{12}{14} = 0.86$$

$$C_{03} = KC_{p3} = (1)(0.18) = 0.18$$

F4

$$\frac{H}{W} = \frac{12}{10} = 1.2$$

$$C_{04} = KC_{p3} = (1)(0.16) = 0.16$$

Class Activity

- **Solution:** Compute fittings

Section	Fitting No	Fitting Type	ASHRAE Fitting No.	Airflow rate (Q_c)	Airflow rate (Q_b)	Duct Size	Duct Area	Loss Coefficient	Velocity (fpm)	P_v	P_t
From – To	Number	Type	ASHRAE	cfm	cfm	$W \times H$	ft^2	C_0	fpm	in. w.c.	in. w.c.
A-B	F1	Tee Branch	SR5-13	3,000	2,100	24×12	2.00	0.08	1,050	0.069	0.0055
	F1	Tee Branch	SR5-13	3,000	900	12×12	1.00	1.28	900	0.050	0.646
B-C	F2	Tee Branch	SR5-13	2,100	1,300	14×12	1.17	0.034	1,111	0.077	0.0026
	F2	Tee Branch	SR5-13	2,100	800	10×12	0.83	0.94	960	0.058	0.0541
C-D	F3	Elbow	CR3-1	1,300	1,300	14×12	1.17	0.18	1,111	0.077	0.0139
C-F	F4	Elbow	CR3-1	800	800	10×12	0.83	0.16	964	0.058	0.0093

Class Activity

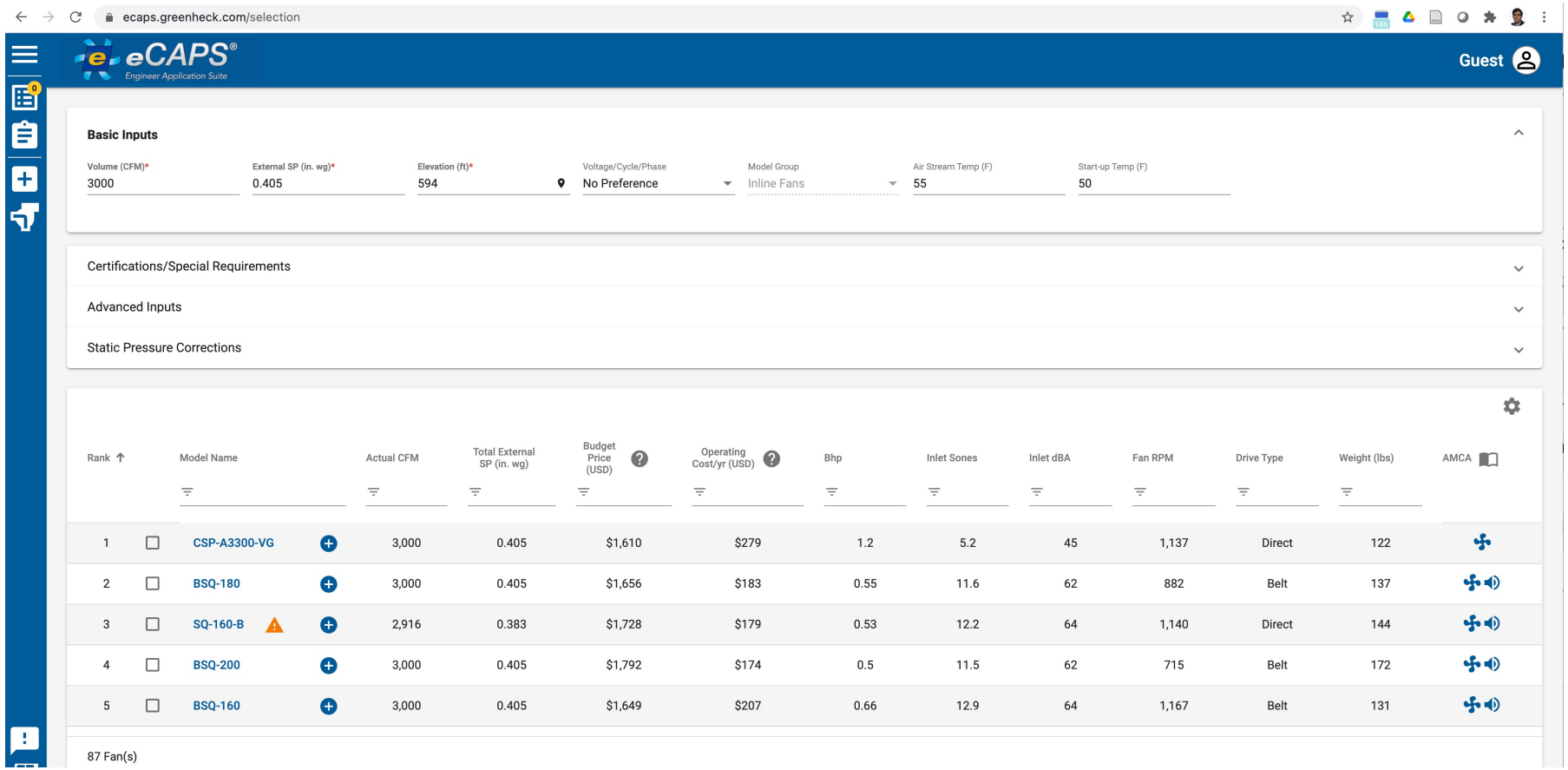
- **Solution:** Pressure loss summary

ΔP (in. w.c.)

Path	Note	Duct	Fitting	Duct	Fitting	Duct	Fitting	Device	Total	Differential Path ΔP
ABCD	Path/Fitting Duct	AB	F1	BC	F2	CD	F3	Outlet	in w.c.	in w.c.
Critical Path		0.0650	0.0055	0.0104	0.0026	0.208	0.0139	0.1	0.405	0.000
ABCF	Path/Fitting Duct	AB	F1	BC	F2	CF	F4	Outlet	in w.c.	Path ΔP
		0.0650	0.0055	0.0105	0.0541	0.026	0.0093	0.1	0.370	-0.135
ABE	Path/Fitting Duct	AB	F1	BE	---	--	--	Outlet	in w.c.	Path ΔP
		0.0650	0.0646	0.013	---			0.1	0.243	-0.163

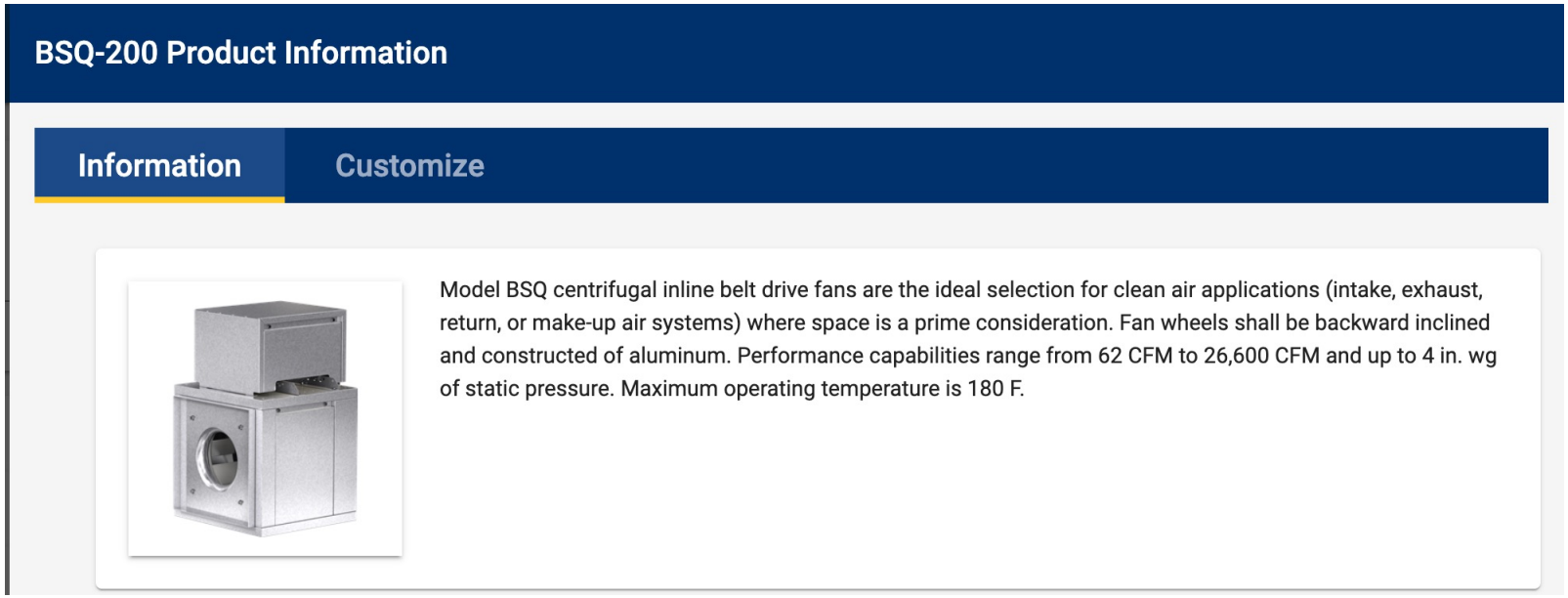
Class Activity

- **Solution:** Select the fan



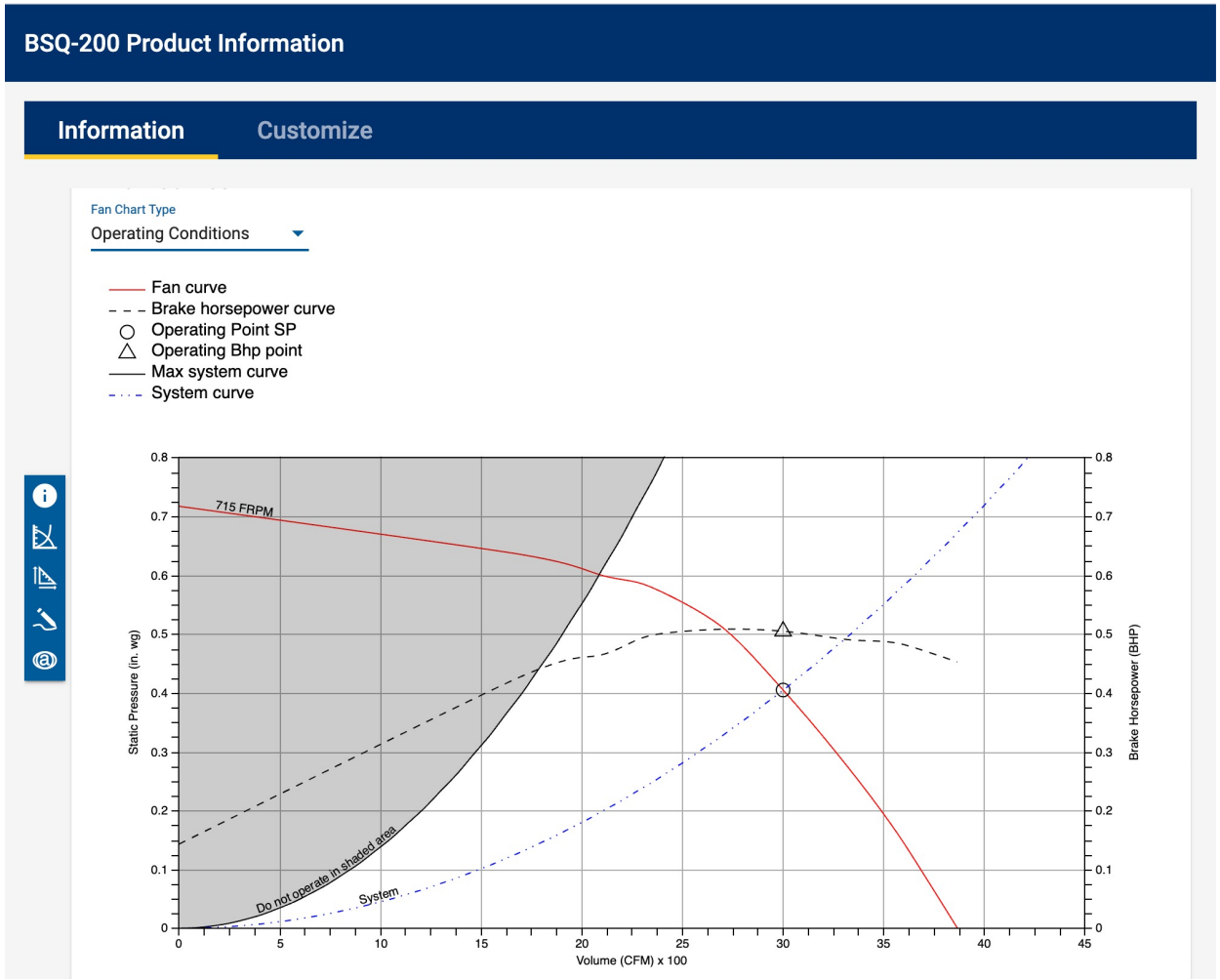
Class Activity

- **Solution:**
  - ❑ Select one of the fans from the list. For example:



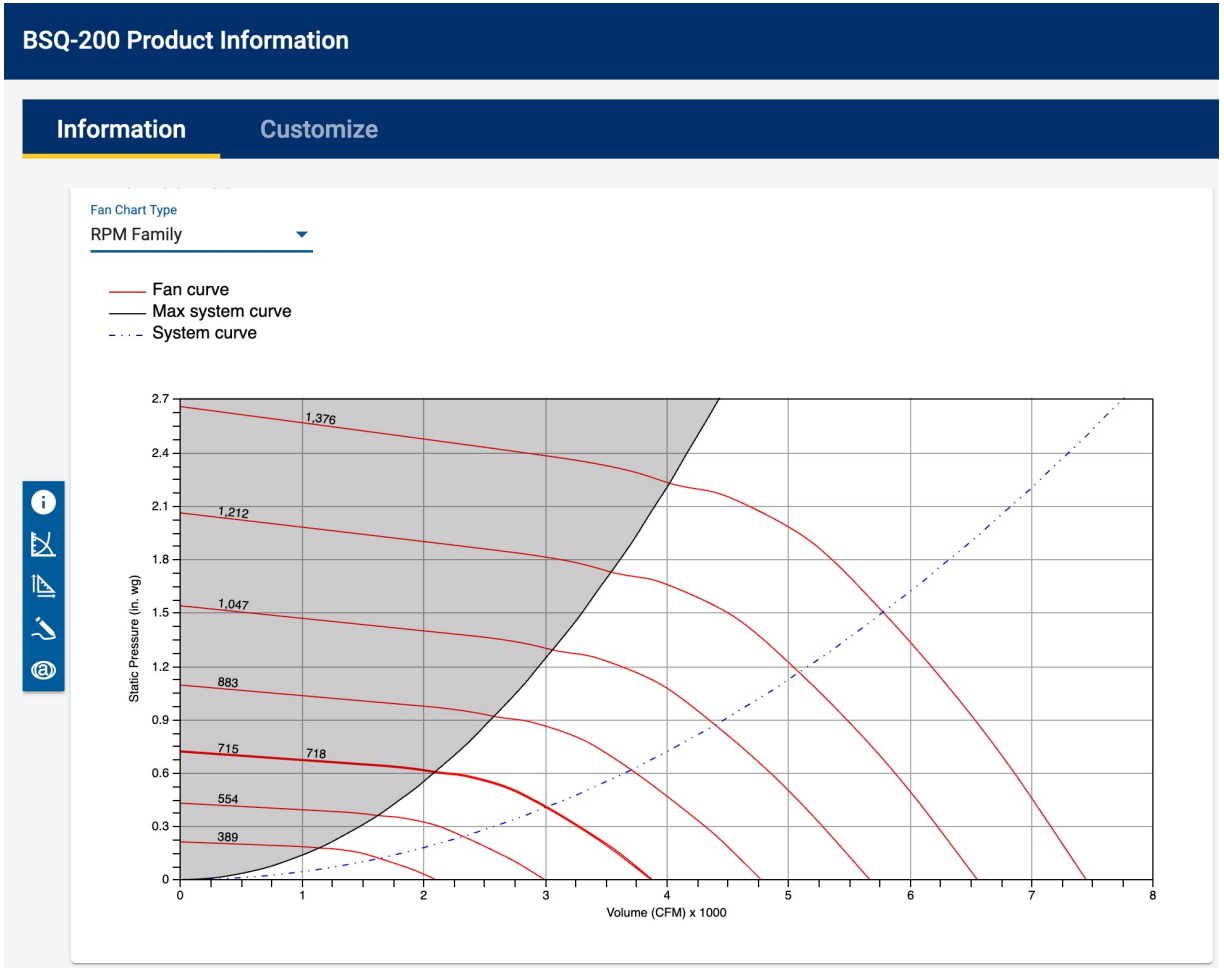
Class Activity

- **Solution:**
  - ❑ Look at the fan curve



Class Activity

- **Solution:**
  - ❑ Look at the family of fans



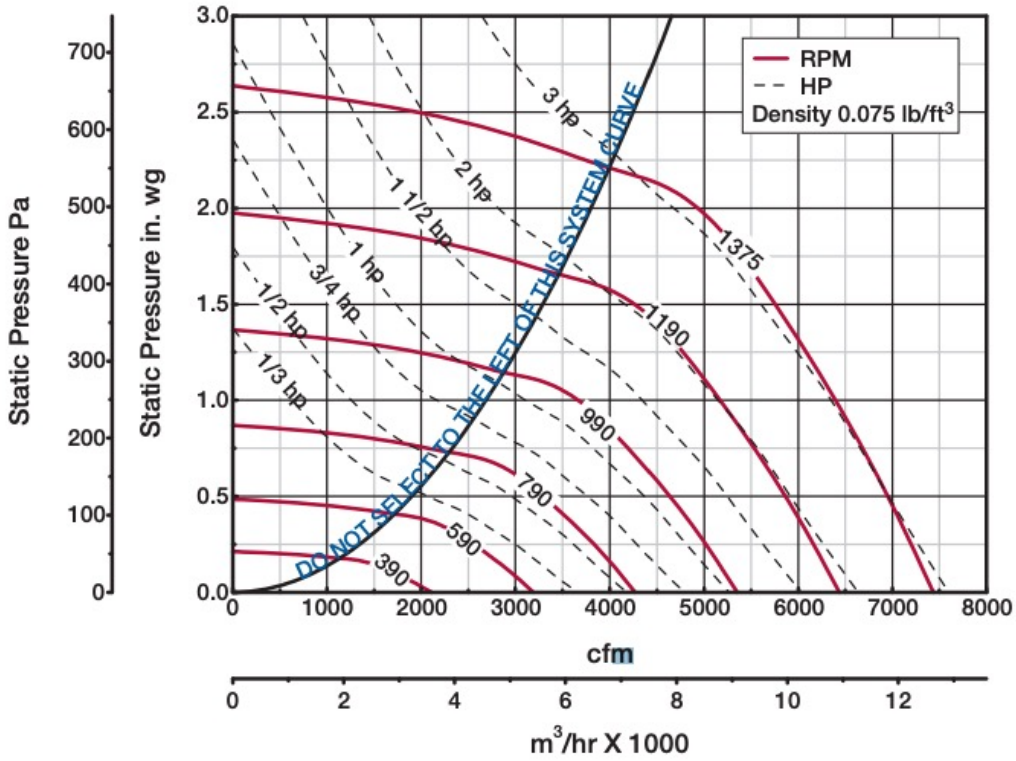
Class Activity

- **Solution:**
  - ❑ Not if you want to use the manufacture datasheets without the software?

https://content.greenheck.com/public/DAMProd/Original/10003/SQBSQ_catalog.pdf

Class Activity

- **Solution:**
  - ❑ Select the fan that meets your pressure drop and the volume flow rate:



What was the cfm and pressure drop for this example?

Class Activity

- **Solution:**
  - ❑ Select the fan that meets your pressure drop and the volume flow rate:

Model Number	Motor HP	Fan RPM		CFM / Static Pressure in Inches wg									
				0.125	0.250	0.500	0.750	0.875	1.000	1.250	1.500	1.750	2.000
200													
200-3	1/3	600	CFM	2960	2616								
			BHP	0.25	0.26								
			Sones	11.1	10.6								
		660	CFM	3315	3018	2042							
			BHP	0.33	0.34	0.33							
			Sones	11.7	11.2	10.5							
200-5	1/2	756	CFM	3867	3624	3036							
			BHP	0.49	0.50	0.52							
			Sones	12.7	12.0	11.7							
200-7	3/4	811	CFM	4179	3959	3442	2563						
			BHP	0.60	0.62	0.64	0.62						
			Sones	13.4	12.8	12.3	13.0						
		865	CFM	4484	4285	3812	3239	2516					
			BHP	0.73	0.75	0.77	0.79	0.72					
			Sones	14.1	13.7	13.1	13.0	13.9					
200-10	1	952	CFM	4972	4796	4391	3916	3646	3203				
			BHP	0.96	0.99	1.01	1.04	1.05	1.03				
			Sones	15.7	15.5	15.1	14.9	14.5	14.4				
200-15	1½	1090	CFM	5741	5587	5253	4874	4672	4452	3878			
			BHP	1.43	1.47	1.51	1.53	1.55	1.56	1.56			
			Sones	19.1	18.9	18.7	18.5	18.6	18.7	17.3			
200-20	2	1145	CFM	6046	5899	5588	5240	5047	4855	4413	3580		
			BHP	1.66	1.69	1.74	1.77	1.79	1.81	1.82	1.73		
			Sones	21	20	20	20	20	20	19.2	18.6		
		1200	CFM	6350	6210	5920	5597	5416	5233	4836	4316		
			BHP	1.90	1.94	2.00	2.02	2.04	2.06	2.09	2.08		
			Sones	22	22	21	21	21	21	21	19.8		
200-30	3	1287	CFM	6830	6699	6439	6138	5988	5818	5475	5088	4557	
			BHP	2.34	2.38	2.46	2.49	2.50	2.52	2.56	2.58	2.56	
			Sones	25	24	24	24	23	23	23	23	22	
		1375	CFM	7314	7192	6948	6677	6537	6396	6076	5753	5379	4862
			BHP	2.85	2.89	2.98	3.02	3.03	3.05	3.09	3.14	3.15	3.13
			Sones	27	27	26	26	26	26	25	25	25	24

MAX Bhp AT A GIVEN RPM = (rpm/937)^3
MAXIMUM RPM = 1375
TIP SPEED (ft/min) = rpm x 5.595
MAX NEMA MOTOR FRAME SIZE = 184T
OUTLET VELOCITY (ft/min) = 0.1870 x cfm

WHAT ELSE SHOULD WE CONSIDER?

Filtration

- What was one major recommendation to reopen buildings?

Mechanical Air Filters

- Filters consist of media with porous structures of fibers or stretched membrane material to remove particles from airstreams.

- The fraction of particles removed from air passing through a filter is termed "filter efficiency" and is provided by the Minimum Efficiency Reporting Value (MERV) under standard conditions.
  - MERV ranges from 1 to 16; higher MERV = higher efficiency
  - MERV ≥13 (or ISO ePM_1)) are efficient at capturing airborne viruses
  - MERV 14 (or ISO equivalent) filters are preferred
  - High efficiency particulate air (HEPA) filters are more efficient than MERV 16 filters.

https://www.ashrae.org/file%20library/technical%20resources/covid-19/ashrae-filtration_disinfection-c19-guidance.pdf

Filtration

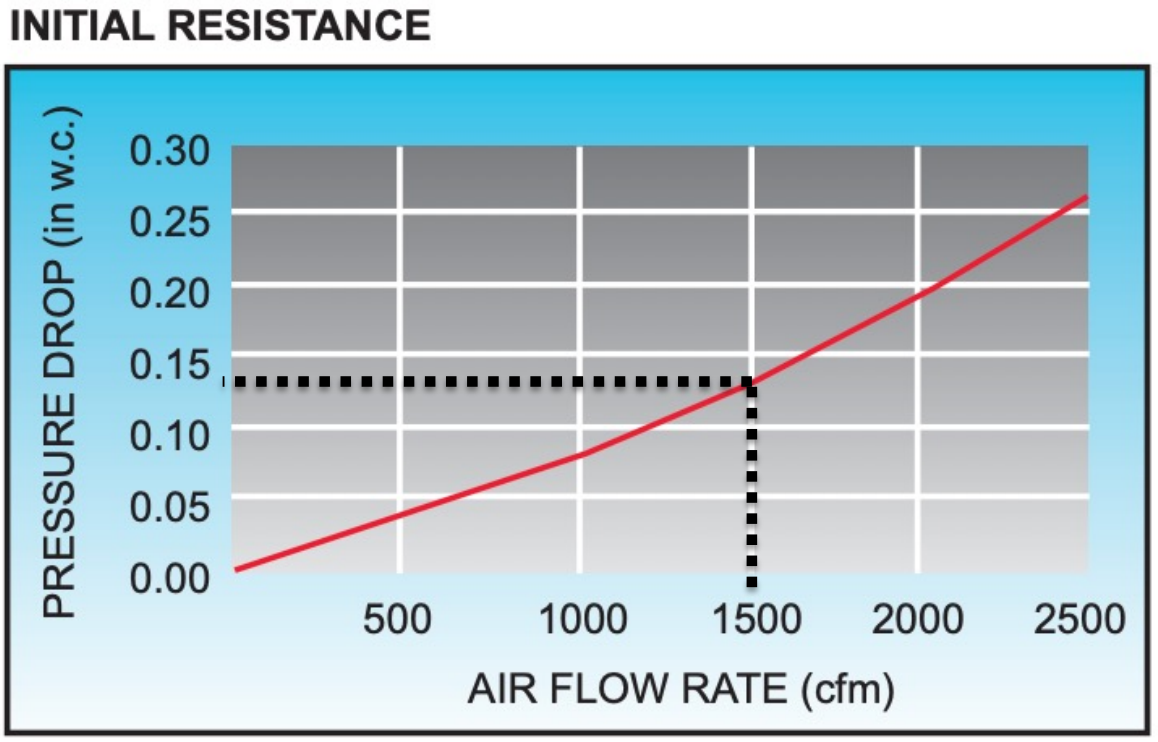
- Let's look at some manufacture data

Model	Nominal Size (L x W x D)	Capacity (CFM)		Case Quantity	Price (Case)
		Medium	High		
DF13-10x20x1	10x20x1	525	700	6	**$84.00**
DF13-12x12x1	12x12x1	375	500	6	**214.00**
DF13-12x20x1	12x20x1	625	825	6	**93.00**
DF13-12x24x1	12x24x1	750	1000	6	**108.00**
DF13-14x20x1	14x20x1	725	975	6	**97.00**
DF13-14x25x1	14x25x1	900	1200	6	**119.00**
DF13-15x20x1	15x20x1	775	1050	6	**100.00**
DF13-16x16x1	16x16x1	650	875	6	**228.00**
DF13-16x20x1	16x20x1	825	1100	6	**99.00**
DF13-16x24x1	16x24x1	1000	1325	6	**122.00**
DF13-16x25x1	16x25x1	1050	1400	6	**125.00**
DF13-18x20x1	18x20x1	925	1250	6	**109.00**
DF13-18x24x1	18x24x1	1125	1500	6	**129.00**
DF13-18x25x1	18x25x1	1175	1550	6	**137.00**
DF13-20x20x1	20x20x1	1050	1400	6	**112.00**
DF13-20x24x1	20x24x1	1250	1650	6	**140.00**
DF13-20x25x1	20x25x1	1300	1750	6	**142.00**
DF13-20x30x1	20x30x1	1550	2100	6	**148.00**
DF13-24x24x1	24x24x1	1500	2000	6	**152.00**
DF13-25x25x1	25x25x1	1625	2150	6	**170.00**

https://www.dwyer-inst.com/PDF_files/Priced/DF13_cat.pdf

Filtration

- Let's look at some manufacture data (MERV 8)

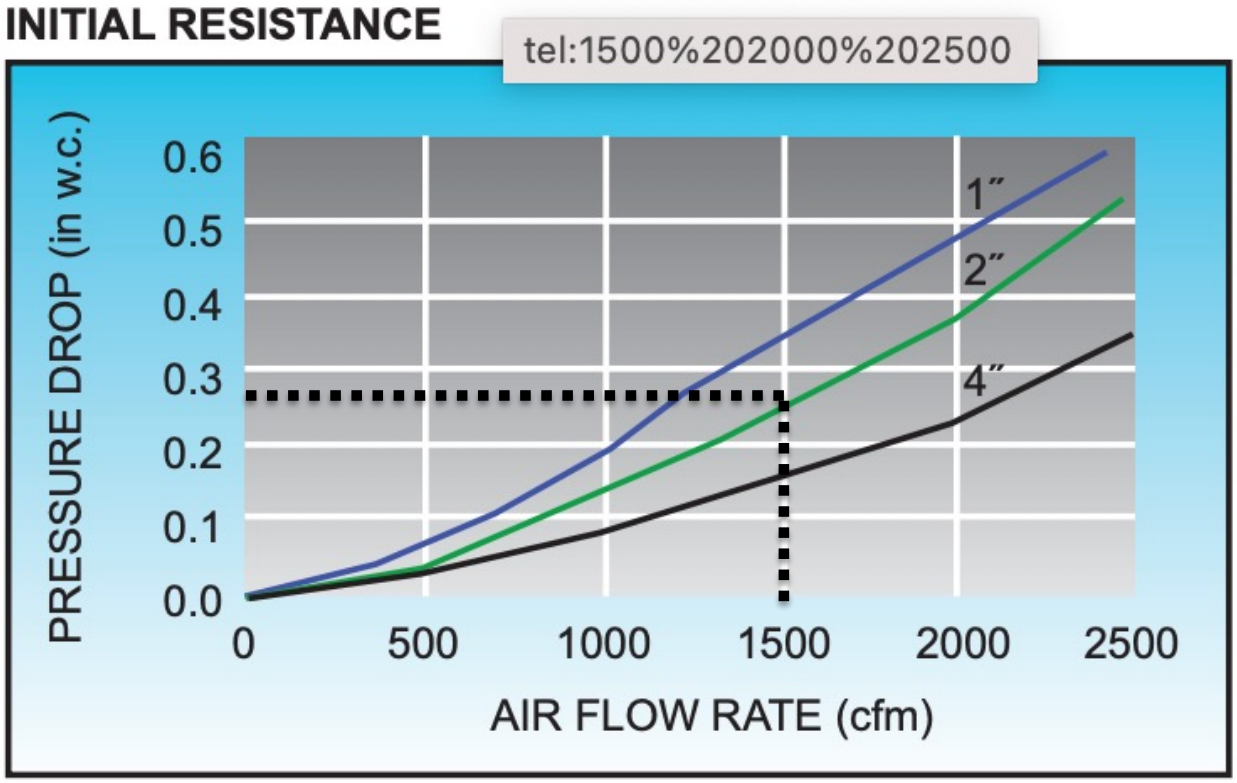


Why does it say initial resistance?

https://www.dwyer-inst.com/PDF_files/Priced/DF8_cat.pdf

Filtration

- Let's look at some manufacture data (MERV 13)

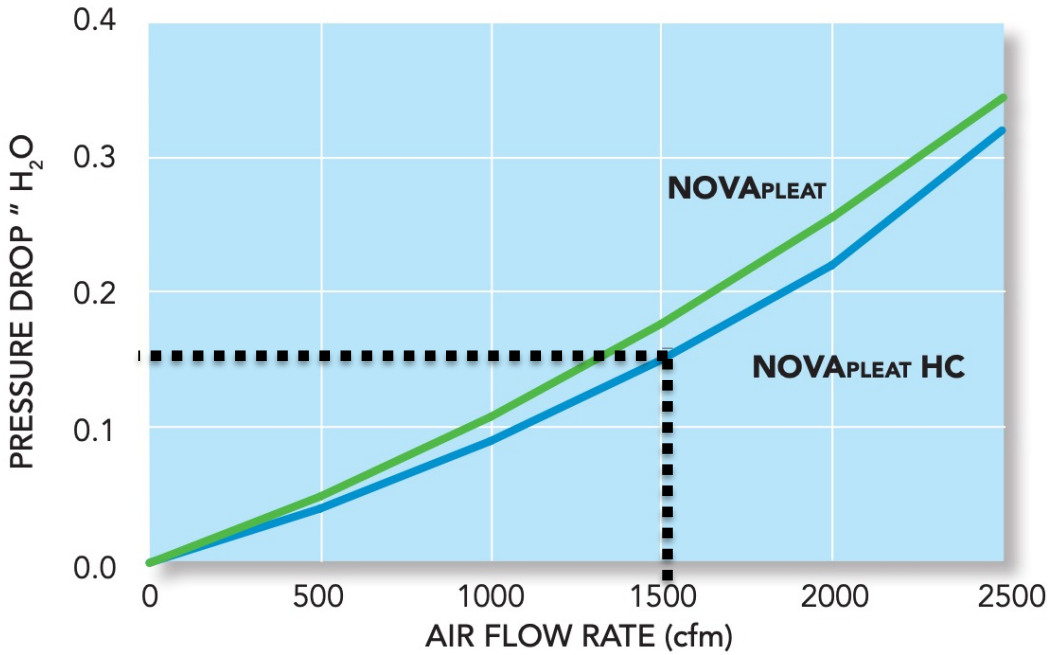


https://www.dwyer-inst.com/PDF_files/Priced/DF13_cat.pdf

Filtration

- Let's look at some manufacture data (MERV 8)

AIR FLOW vs PRESSURE DROP



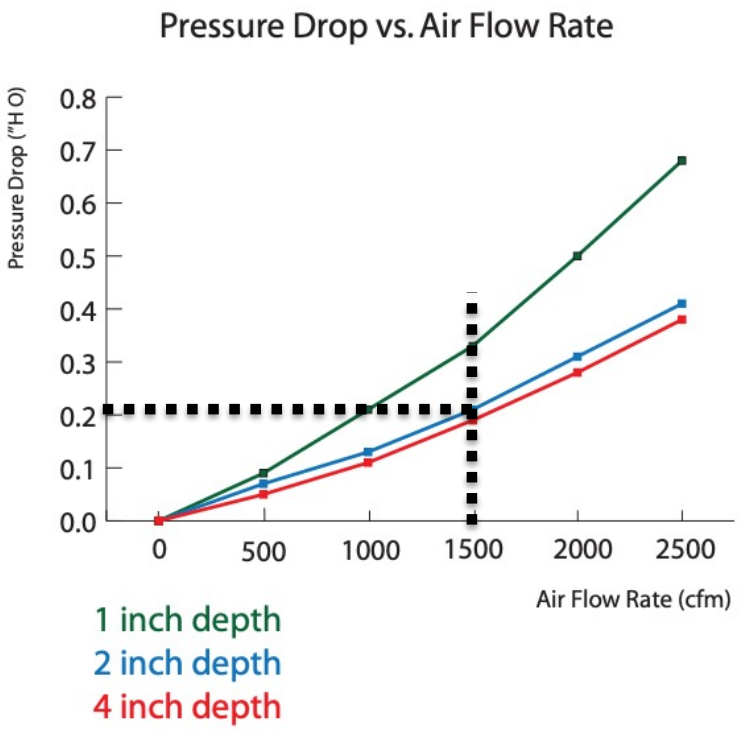
24 x 24 x 2 INITIAL RESISTANCE

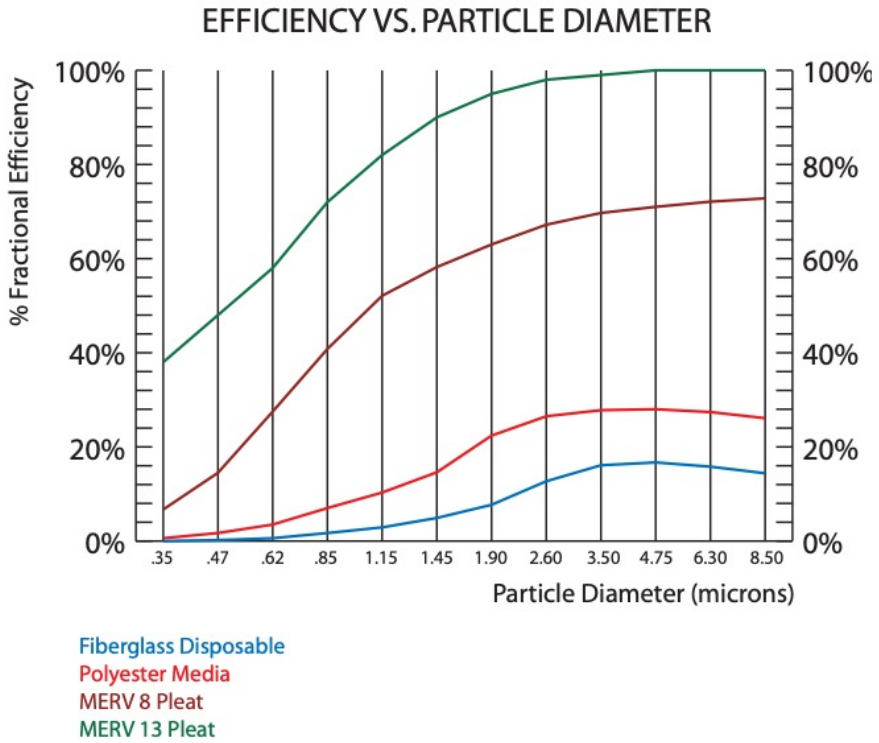
PRODUCT	300 FPM	500 FPM	MERV
NOVAPLEAT	0.14" w.g.	0.26" w.g.	8
NOVAPLEAT HC	0.11" w.g.	0.23" w.g.	8

https://www.filtersales.com/pdf/novapleat_2inch_lit.pdf

Filtration

- Let's look at some manufacture data (MERV 13)





https://leeduser.buildinggreen.com/sites/default/files/credit_documentation/EQc5_MERV13%20filter.pdf

Filtration

- Are there other resources to calculate the pressure drop due to the installation of the filter?
  - ❑ Fan manufacture – pay attention to the MERV

Model	Fan Size	Filter Box Weight	Filter Size	Filter Quantity	Filter Factor (F)			
					1 inch (25)		2 inch (51)	
					Aluminum	Paper Filters (MERV 7)	Aluminum	Paper Filters (MERV 8)
Model SQ	60 - 75	40 (18)	10 x 12 (254 x 305)	1	186	318.06	251.1	303.18
	80 - 95	74 (34)	14 x 25 (356 x 635)	1	21.8	37.28	29.43	35.53
	100	88 (40)	16 x 20 (406 x 508)	2	8.72	14.91	11.77	14.21
	120	114 (52)	16 x 25 (406 x 635)	2	5.58	9.54	7.53	9.10
	130	120 (54)	20 x 20 (508 x 508)	2	5.58	9.54	7.53	9.10
	140	174 (79)	20 x 25 (508 x 635)	2	3.57	6.11	4.82	5.82
	160	246 (112)	20 x 20 (508 x 508)	4	2.09	3.57	2.82	3.41
Model BSQ	70 - 80 - 90	117 (53)	14 x 25 (356 x 635)	1	21.8	37.28	29.43	35.53
	100	120 (54)	16 x 20 (406 x 508)	2	8.72	14.91	11.77	14.21
	120	144 (79)	16 x 25 (406 x 635)	2	5.58	9.54	7.53	9.10
	130 - 130HP	140 (64)	20 x 20 (508 x 508)	2	5.58	9.54	7.53	9.10
	140 - 140HP	181 (82)	20 x 25 (508 x 635)	2	3.57	6.11	4.82	5.82
	160 - 160HP	294 (133)	20 x 20 (508 x 508)	4	2.09	3.57	2.82	3.41
	180 - 180HP	344 (156)	20 x 25 (508 x 635)	4	1.34	2.29	1.81	2.18
	200 - 200HP	441 (200)	12 x 25 (305 x 635)	3	0.77	1.32	1.04	1.26
			16 x 25 (406 x 635)	3				
	240 - 240HP	573 (260)	20 x 25 (508 x 635)	4	0.41	0.70	0.55	0.67
			16 x 25 (406 x 635)	4				
	300 - 300HP	759 (344)	20 x 25 (508 x 635)	8	0.33	0.56	0.45	0.54
	360 - 360HP	957 (434)	16 x 25 (406 x 635)	10	0.15	0.26	0.20	0.25
			20 x 25 (508 x 635)	5				
	420	1185 (538)	16 x 25 (406 x 635)	5	0.13	0.22	0.18	0.21
			20 x 25 (508 x 635)	10				

Note: 24-inch side clearance is recommended for accessing and removing filters.
All dimensions in inches *(millimeters)* and weight in pounds *(kilograms)*.

$$P_t = F \times \left(\frac{cfm}{10{,}000}\right)^2$$

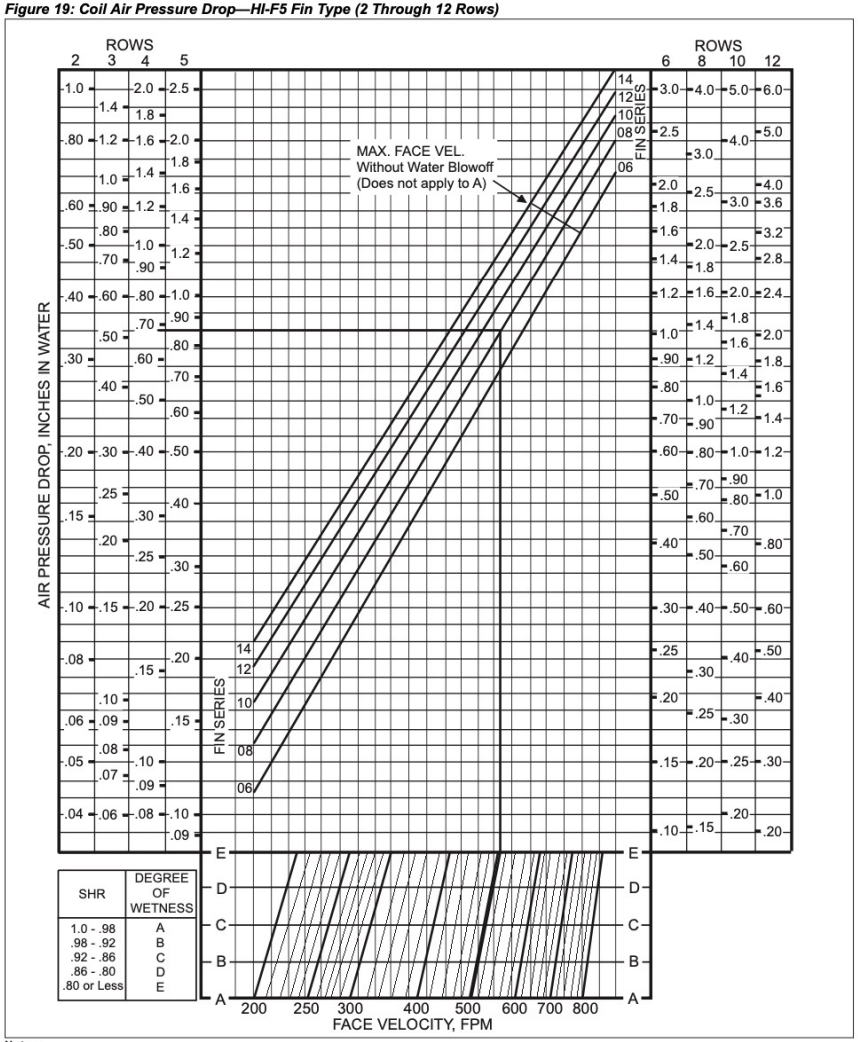
https://content.greenheck.com/public/DAMProd/Original/10003/SQBSQ_catalog.pdf

WHAT ELSE SHOULD WE CONSIDER?

Heating and Cooling Coils

- Heating and cooling coils:

Figure 19: Coil Air Pressure Drop—HI-F5 Fin Type (2 Through 12 Rows)



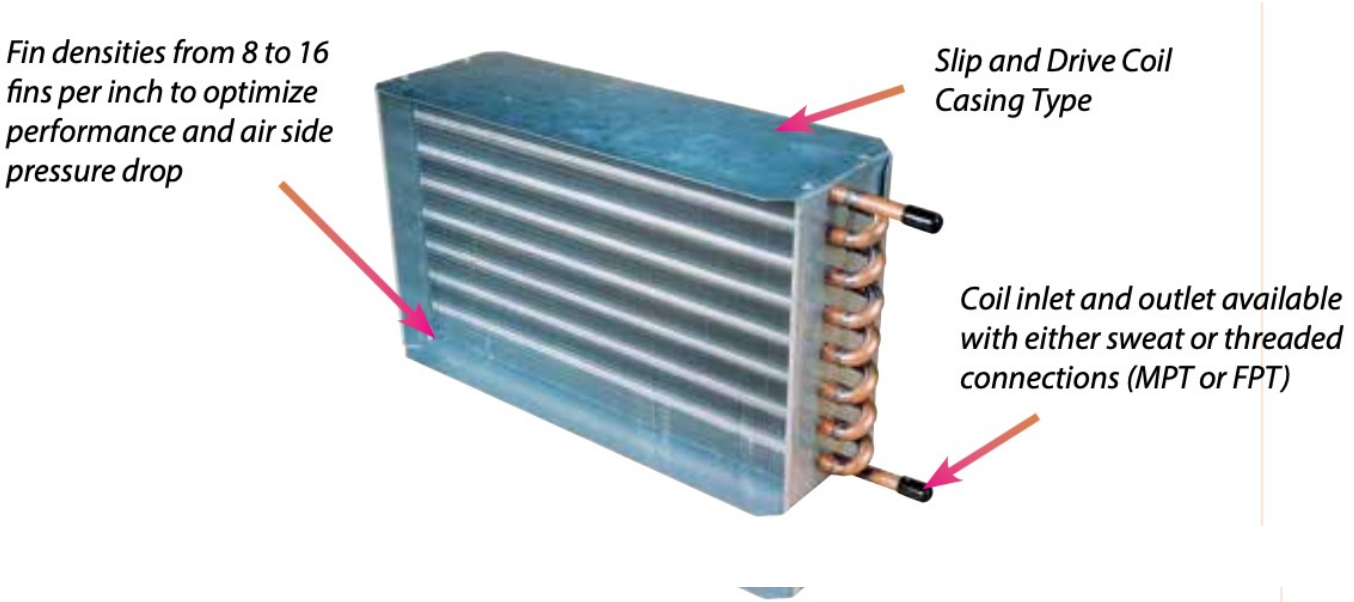
Notes:
- The letters A,B,C,D or E following the face velocity indicate the degree of wetness at which the coil is operating.
- Dry coils are shown by the letter A, wet coils by the letter E. Intermediate conditions are shown by the letters B, C, and D.
- Air pressure drop for odd fin spacings can be found by interpolation.

https://oslo.daikinapplied.com/api/daikindocument/DownloadDocumentByName/Doc100/Vision%20Indoor%20Air%20Handler%20Catalog%20Daikin%20CAT%20550.pdf/

AIR HANDLING UNIT SELECTION

Air Handling Unit Selection

- Heating and cooling coils:



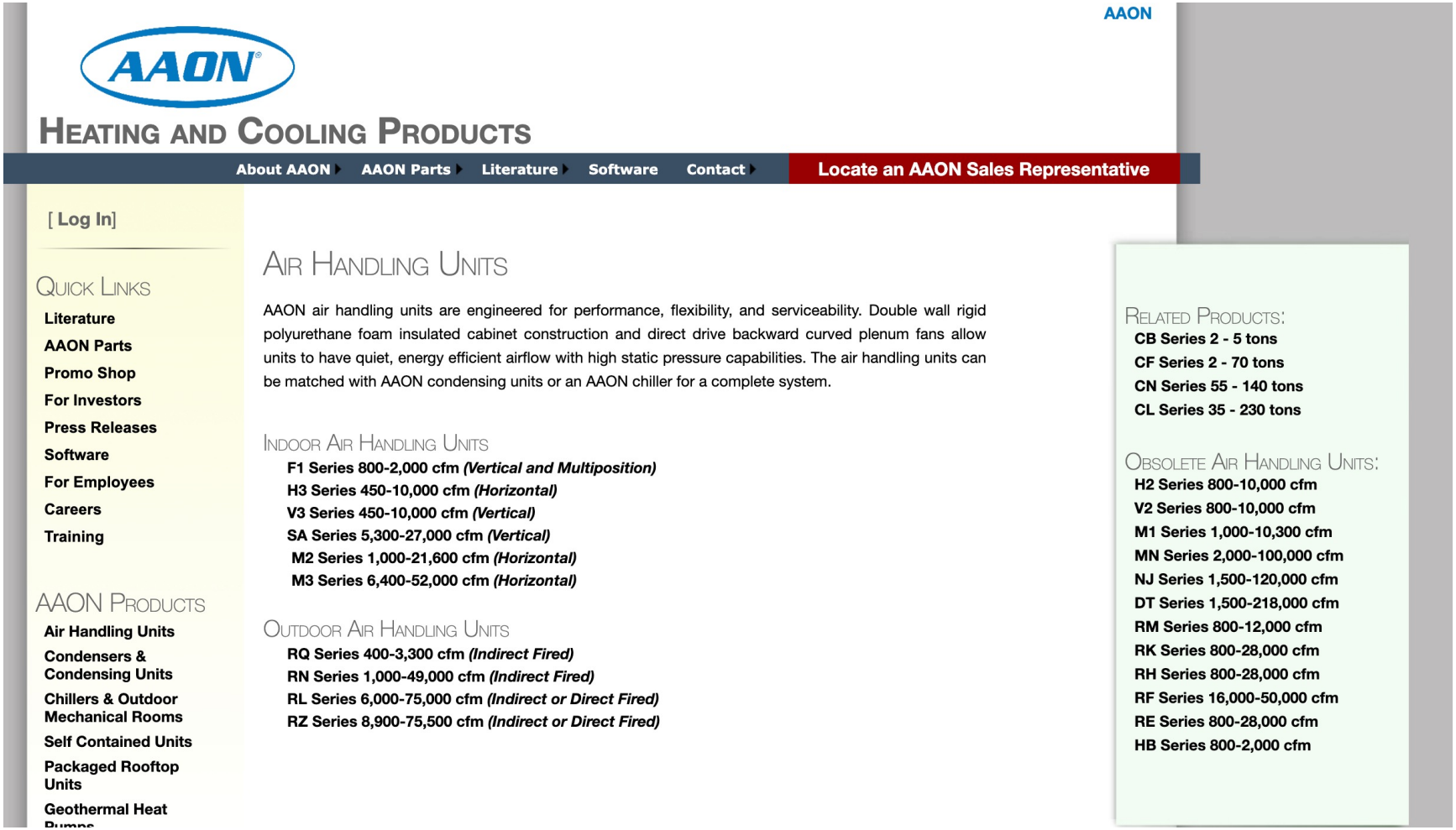
Booster Coils										
Type	Tube Material	Fin Material	Casing Material	Casing Type	Rows	FPI	Circuitry	Tube Diameter (OD)	Connection Type	Optional Corrosion Protection
Hot Water or Steam	Copper	Aluminum or Copper	G90 Galvanized, Aluminum, or 304 Stainless Steel	U-Flange, Slip and Drive or None	Up to 12	Up to 16	Quarter to Double Serpentine, or Steam Distributing	1/2" or 5/8"	Sweat, MPT, or FPT*	Polymer E-Coating

** MPT (Male Pipe Thread) and FPT (Female Pipe Thread)*

https://www.aaon.com/Coils

Air Handling Unit Selection

- Let's look at some manufacture: Aaon



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AAON PRODUCTS

- Air Handling Units
- Condensers & Condensing Units
- Chillers & Outdoor Mechanical Rooms
- Self Contained Units
- Packaged Rooftop Units
- Geothermal Heat Pumps

AIR HANDLING UNITS

AAON air handling units are engineered for performance, flexibility, and serviceability. Double wall rigid polyurethane foam insulated cabinet construction and direct drive backward curved plenum fans allow units to have quiet, energy efficient airflow with high static pressure capabilities. The air handling units can be matched with AAON condensing units or an AAON chiller for a complete system.

INDOOR AIR HANDLING UNITS

- **F1 Series 800-2,000 cfm *(Vertical and Multiposition)***
- **H3 Series 450-10,000 cfm *(Horizontal)***
- **V3 Series 450-10,000 cfm *(Vertical)***
- **SA Series 5,300-27,000 cfm *(Vertical)***
- **M2 Series 1,000-21,600 cfm *(Horizontal)***
- **M3 Series 6,400-52,000 cfm *(Horizontal)***

OUTDOOR AIR HANDLING UNITS

- **RQ Series 400-3,300 cfm *(Indirect Fired)***
- **RN Series 1,000-49,000 cfm *(Indirect Fired)***
- **RL Series 6,000-75,000 cfm *(Indirect or Direct Fired)***
- **RZ Series 8,900-75,500 cfm *(Indirect or Direct Fired)***

RELATED PRODUCTS:

- **CB Series 2 - 5 tons**
- **CF Series 2 - 70 tons**
- **CN Series 55 - 140 tons**
- **CL Series 35 - 230 tons**

OBSOLETE AIR HANDLING UNITS:

- **H2 Series 800-10,000 cfm**
- **V2 Series 800-10,000 cfm**
- **M1 Series 1,000-10,300 cfm**
- **MN Series 2,000-100,000 cfm**
- **NJ Series 1,500-120,000 cfm**
- **DT Series 1,500-218,000 cfm**
- **RM Series 800-12,000 cfm**
- **RK Series 800-28,000 cfm**
- **RH Series 800-28,000 cfm**
- **RF Series 16,000-50,000 cfm**
- **RE Series 800-28,000 cfm**
- **HB Series 800-2,000 cfm**

https://www.aaon.com/AirHandlers

Air Handling Unit Selection

- Let's look at some manufacture: Daikin

Catalog 550-14

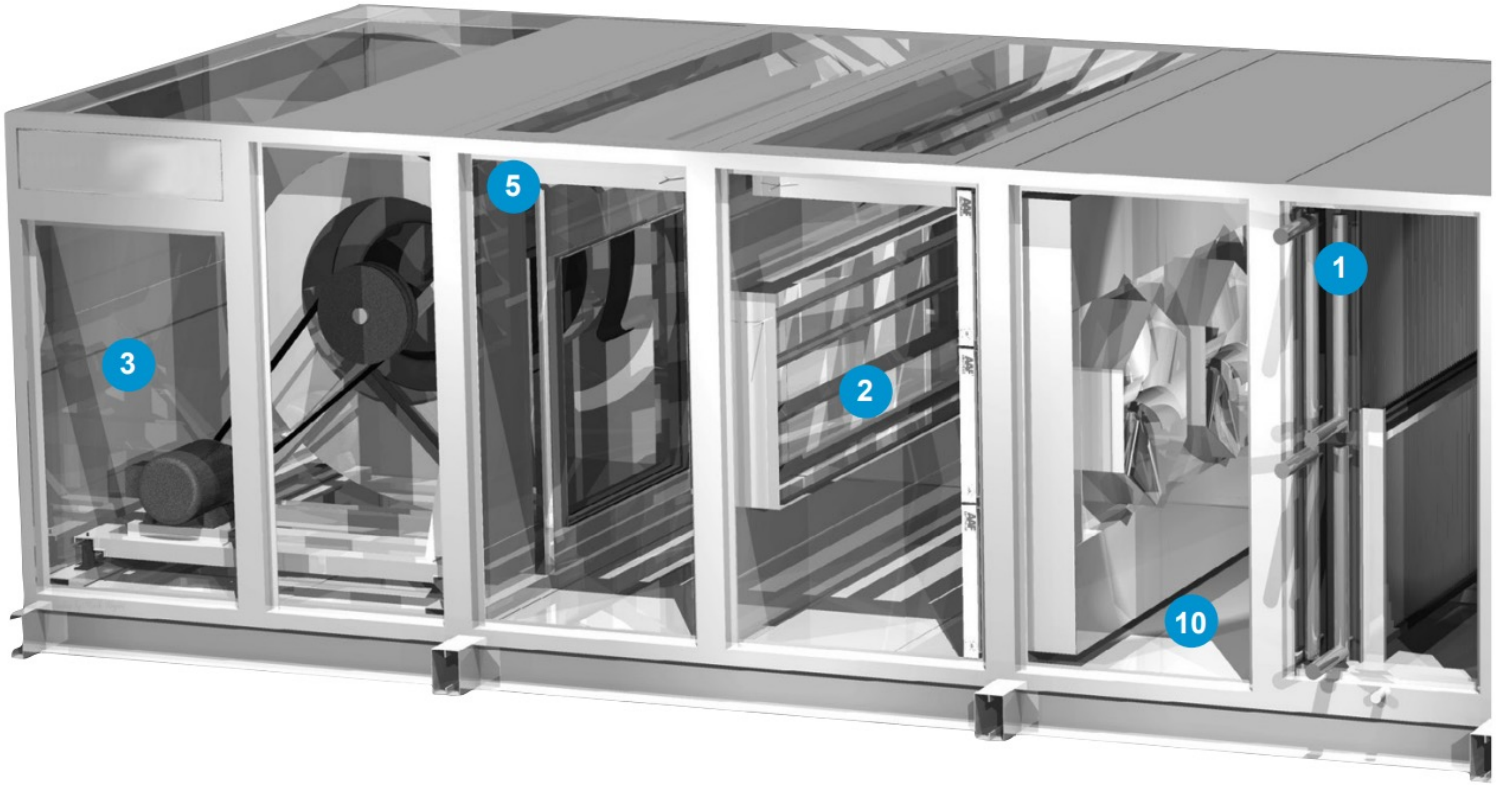
Vision® Air Handler

Sizes 003—090

https://oslo.daikinapplied.com/api/daikindocument/DownloadDocumentByName/Doc100/Vision%20Indoor%20Air%20Handler%20Catalog%20Daikin%20CAT%20550.pdf/

Air Handling Unit Selection

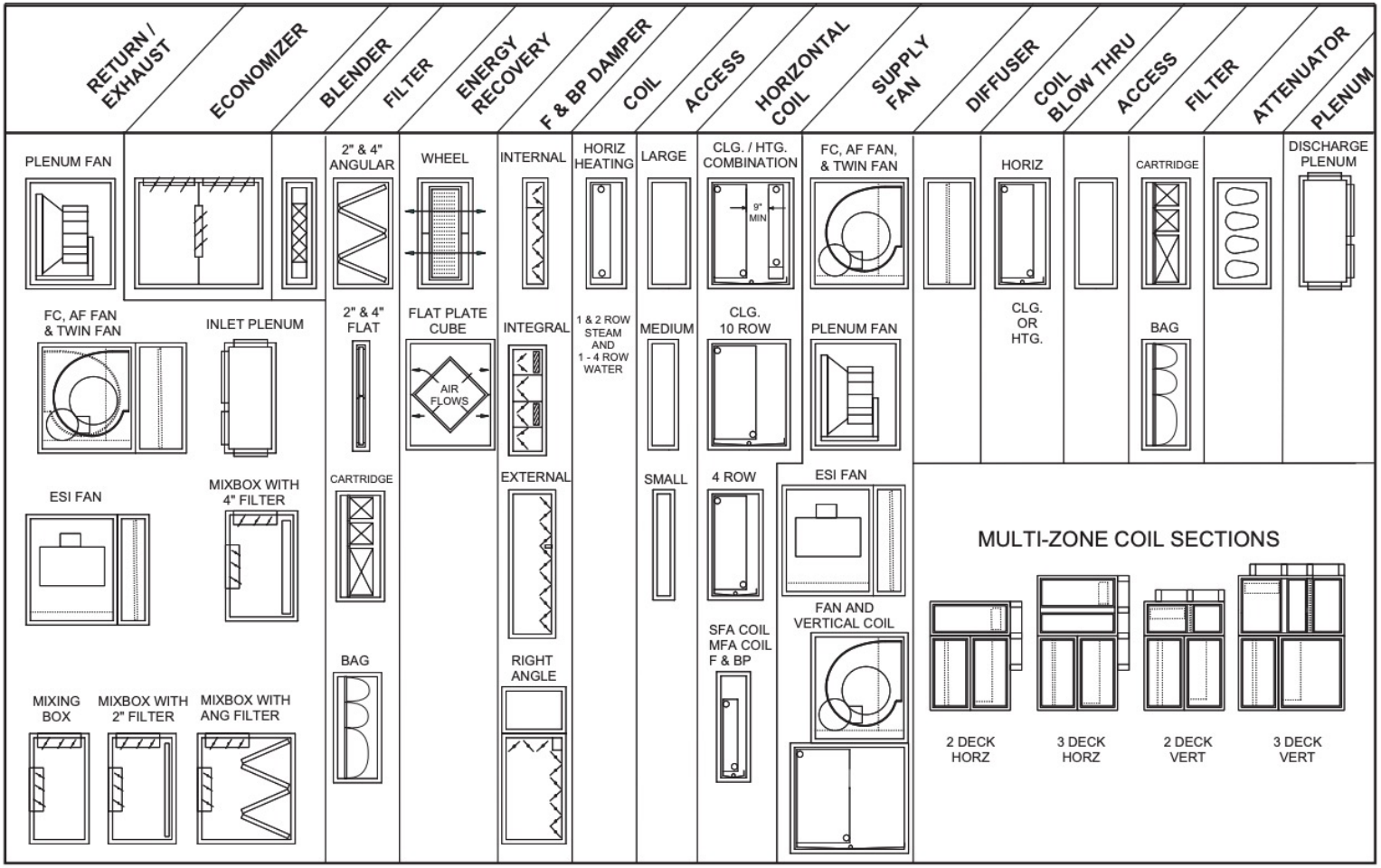
- Let’s look at some manufacture: Daikin



https://oslo.daikinapplied.com/api/daikindocument/DownloadDocumentByName/Doc100/Vision%20Indoor%20Air%20Handler%20Catalog%20Daikin%20CAT%20550.pdf/

Air Handling Unit Selection

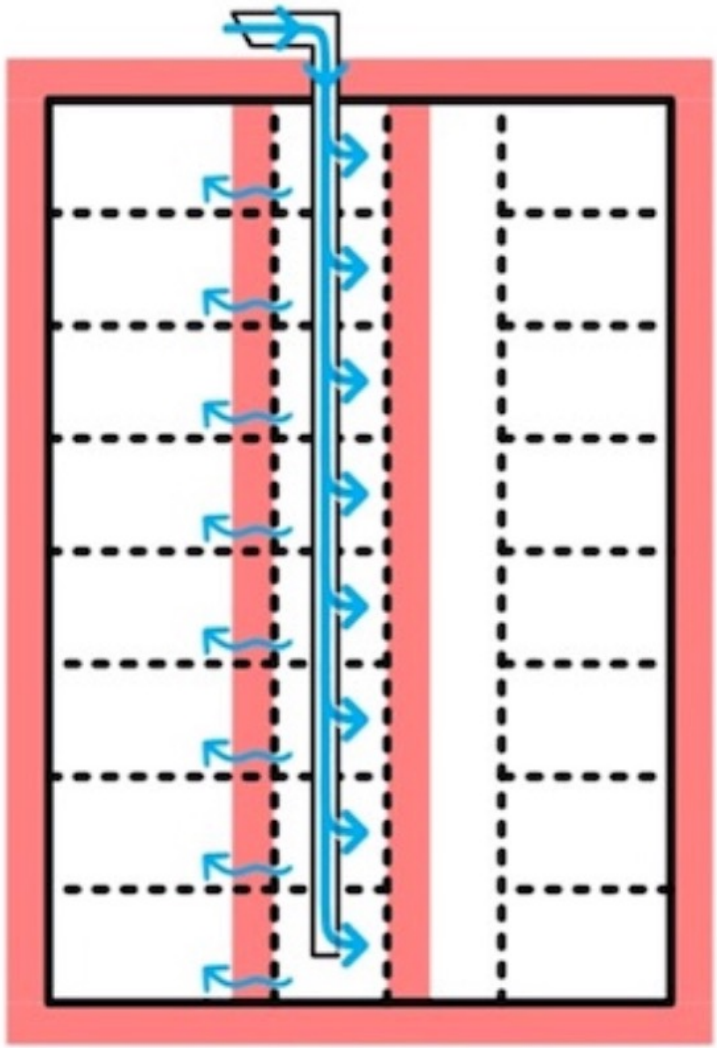
- Let's look at some manufacture: Daikin



https://oslo.daikinapplied.com/api/daikindocument/DownloadDocumentByName/Doc100/Vision%20Indoor%20Air%20Handler%20Catalog%20Daikin%20CAT%20550.pdf/

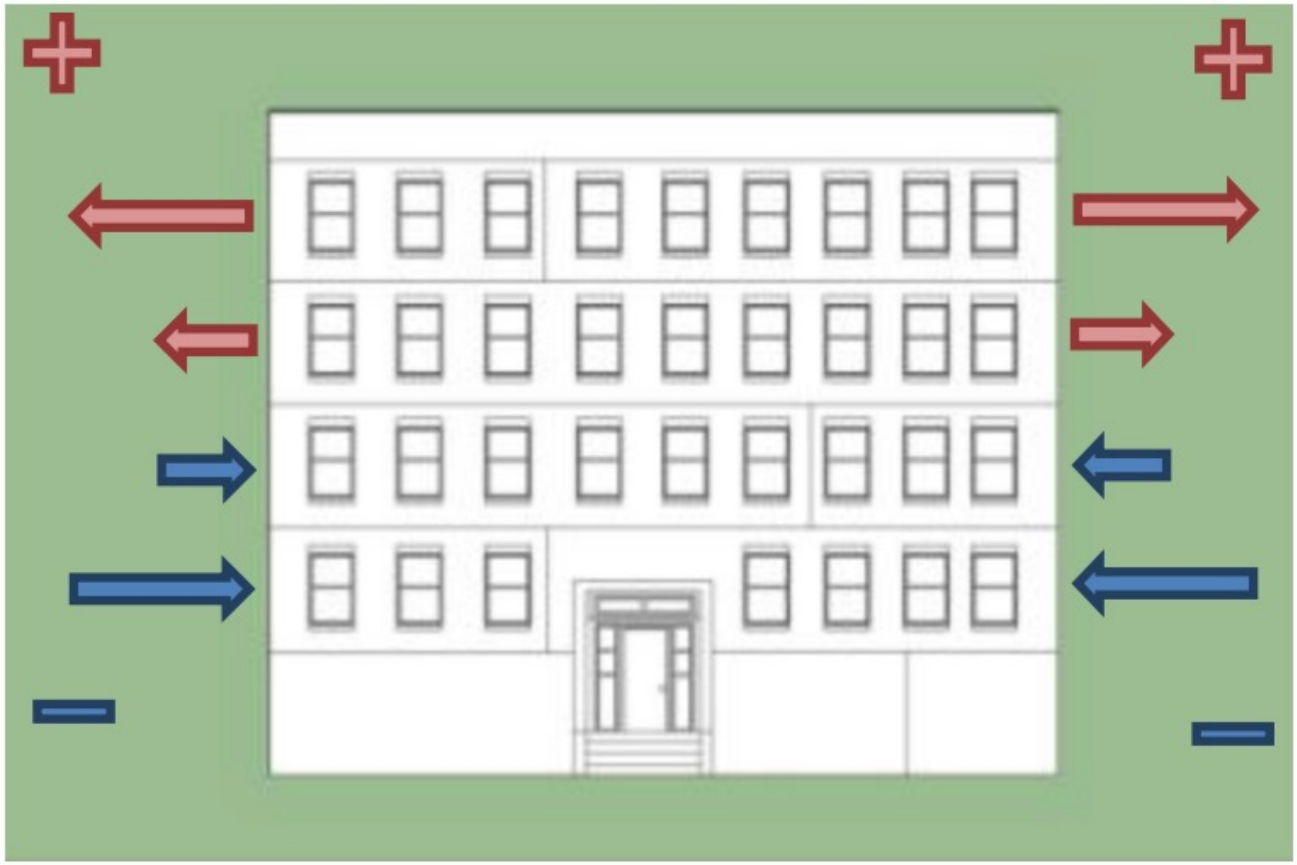
HALLWAY VENTILATION

Hallway Ventilation



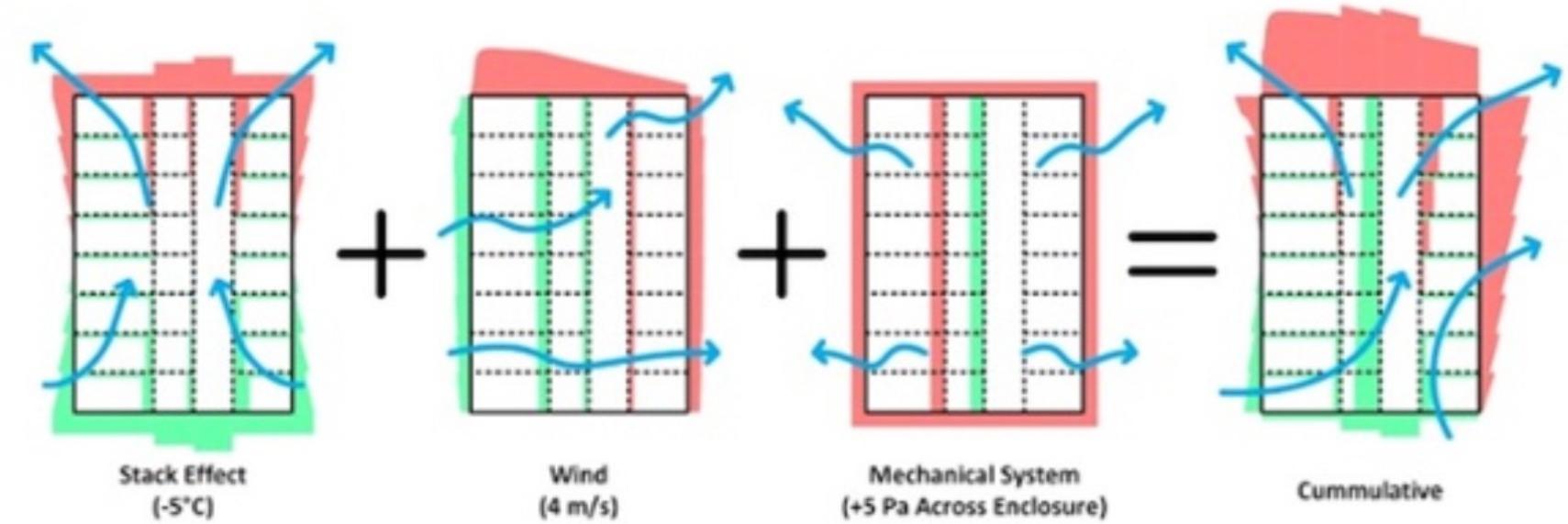
https://www.energyvanguard.com/blog/ventilating-high-rise-multifamily-buildings-a-first-look

Hallway Ventilation



https://www.nrel.gov/docs/fy14osti/62313.pdf

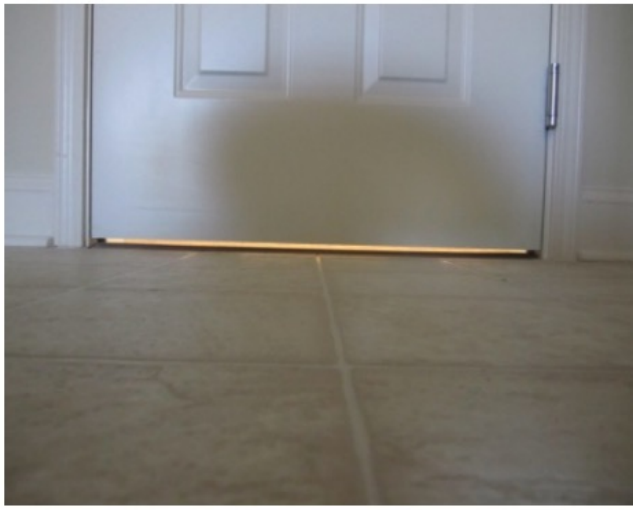
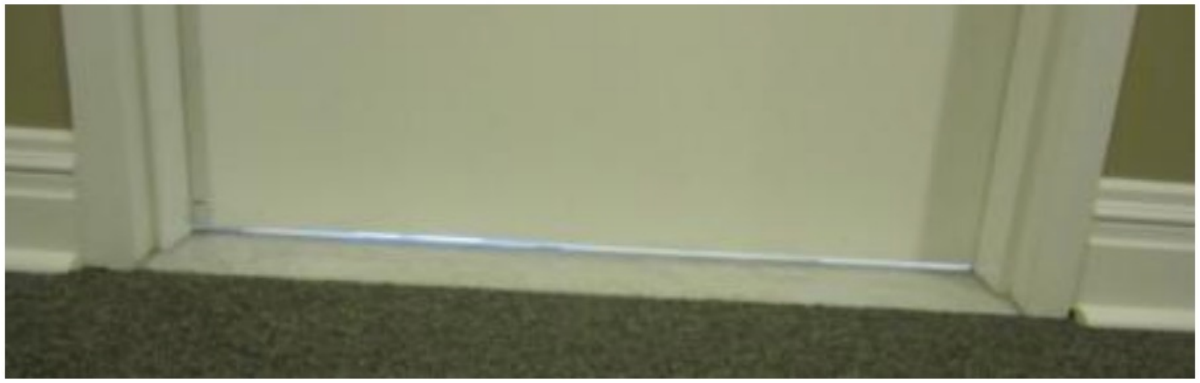
Hallway Ventilation



40% x 20% = 8%

https://www.energyvanguard.com/blog/ventilating-high-rise-multifamily-buildings-a-first-look

Hallway Ventilation

https://www.nrel.gov/docs/fy14osti/62313.pdf