VAV Systems

Design, Performance and Commissioning Issues

Supply and Return Fan Tracking Control

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Matching VAV Supply and Return Fan Performance

A Number of Options

- Speed tracking
- Flow tracking
- Building static pressure based
- Return fan discharge static pressure based
- Mixed air plenum static pressure based

A Number of Issues

- Minimum outdoor air flow control
- Building make-up/exhaust balance
- Zone pressure control
- Building pressurization
- Economizer performance

Matching VAV Supply and Return Fan Performance

A Number of Options

- Speed tracking
- Flow tracking
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National Building Controls Information Program

Application Guideline

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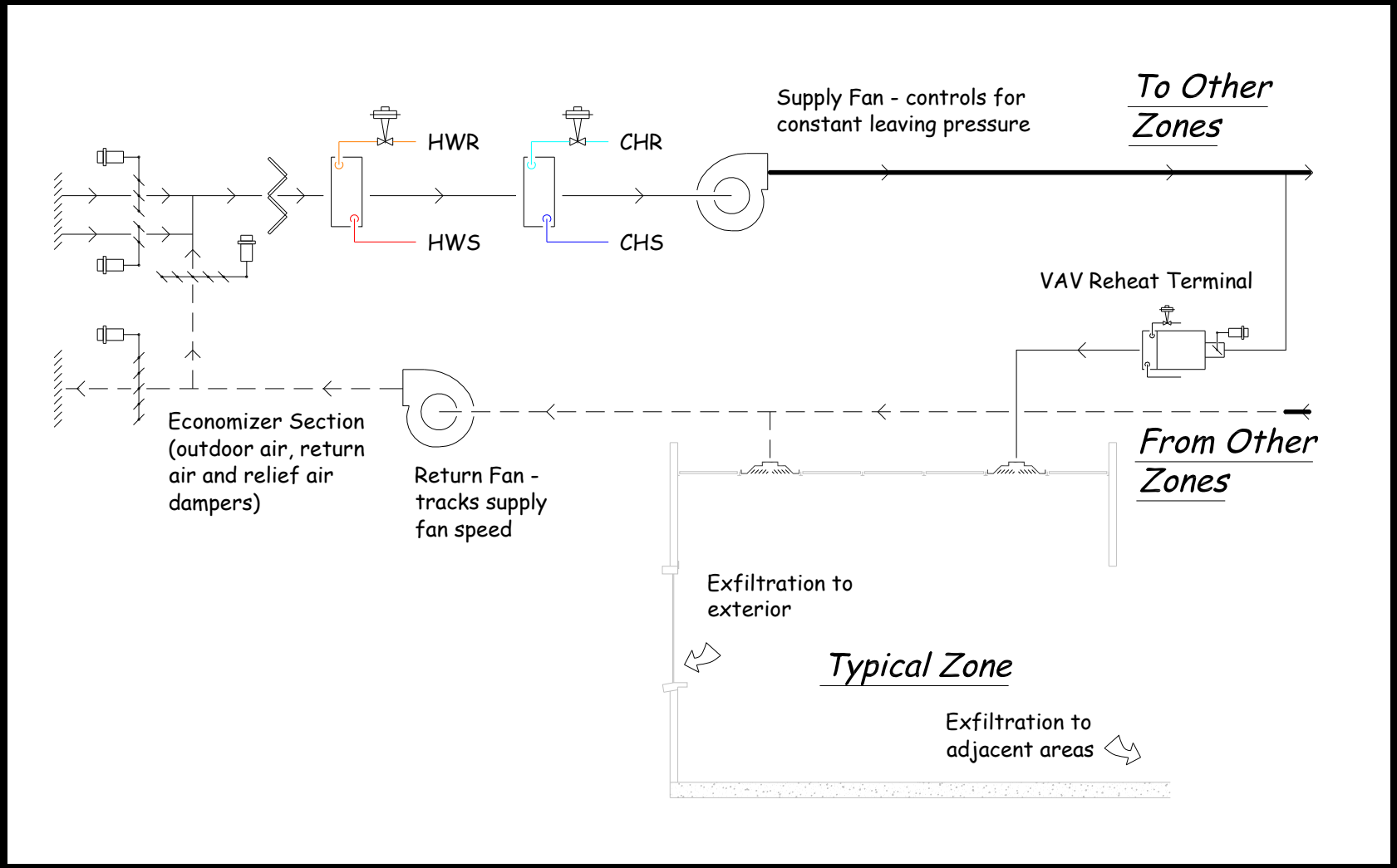
Matching VAV Supply and Return Fan Performance

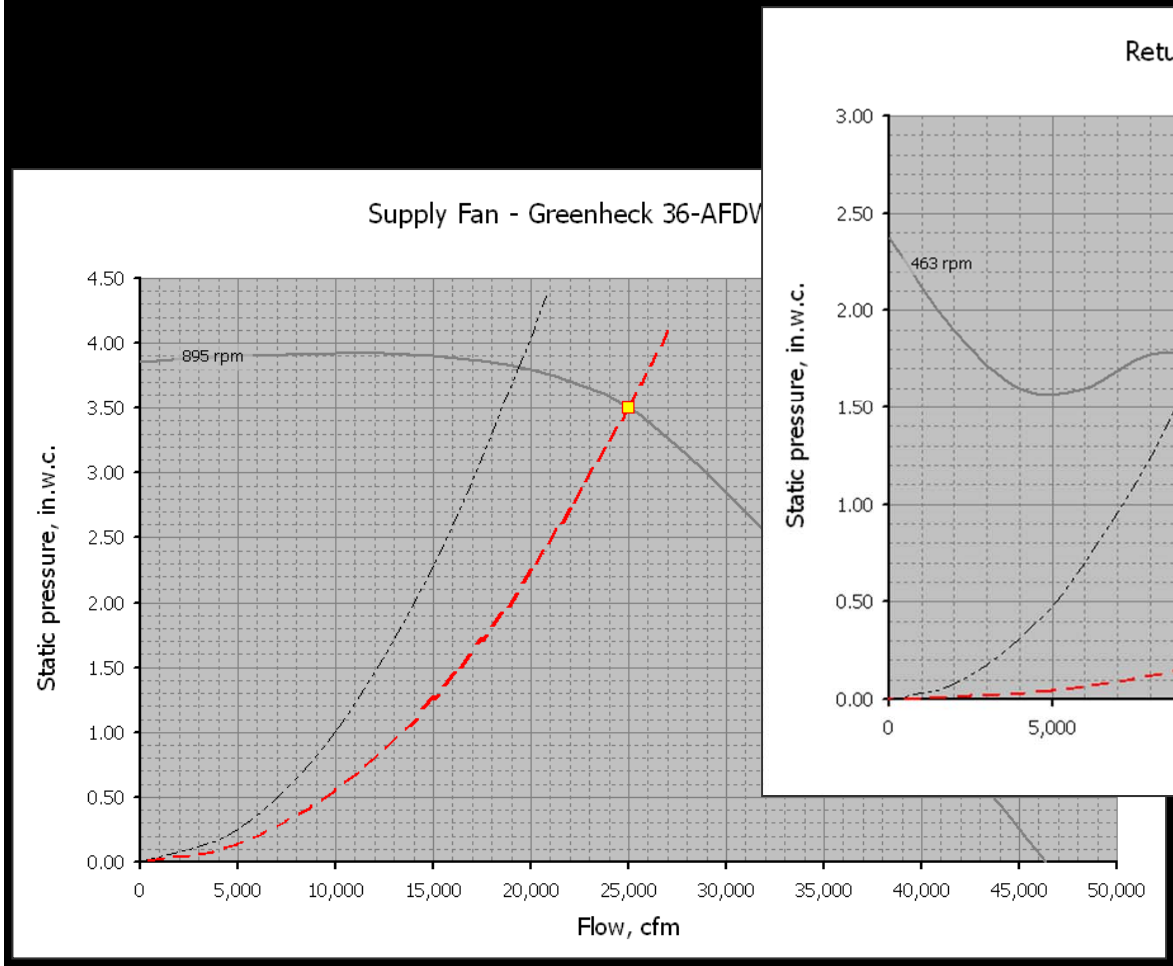
Theory vs. Reality: Applying a VFD to a VAV System Return Fan:

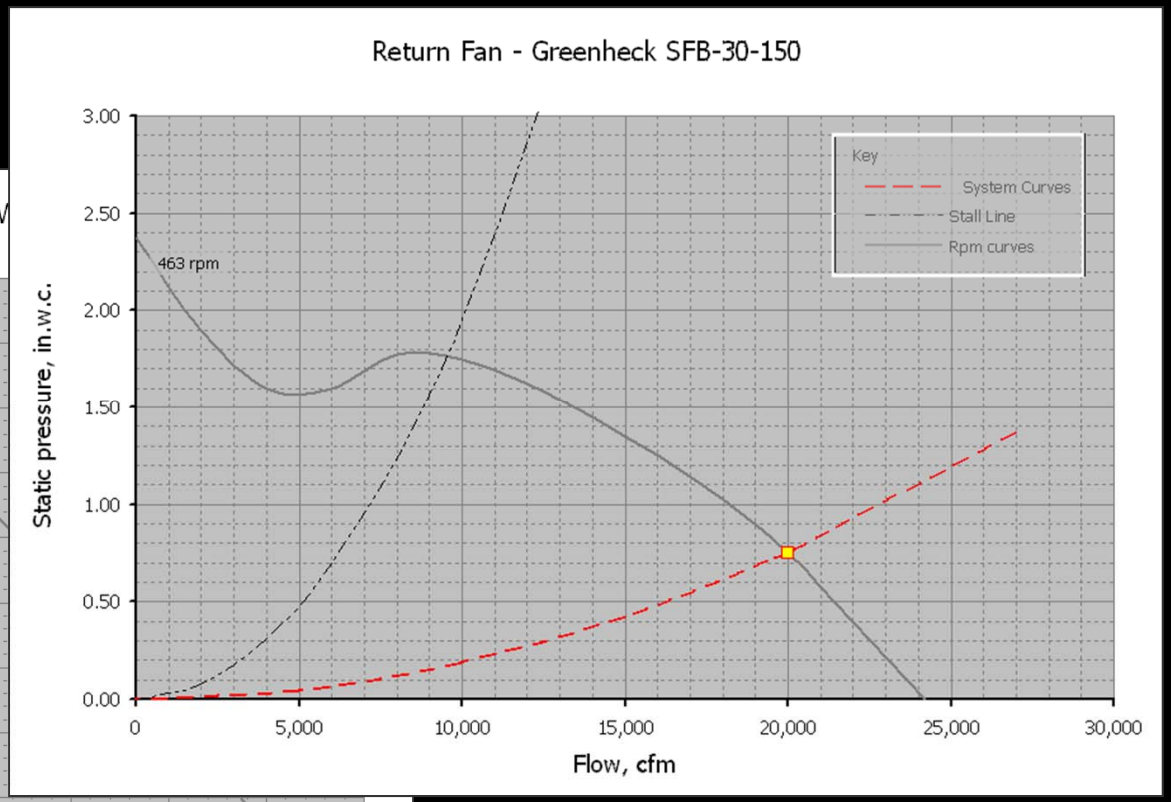
- 25,000 cfm fan system
- Serves an average low-rise office building
- Design intent – provide a constant 5,000 cfm minimum outdoor air flow
- Supply fan controlled to maintain a fixed discharge static pressure
- Supply fan static = 3.5 inches w.c.
  - 1.5 inches w.c. internal
  - 2.0 inches w.c. external
- Return fan controlled by signal tracking technique

The System Diagram



The Design Selection Points

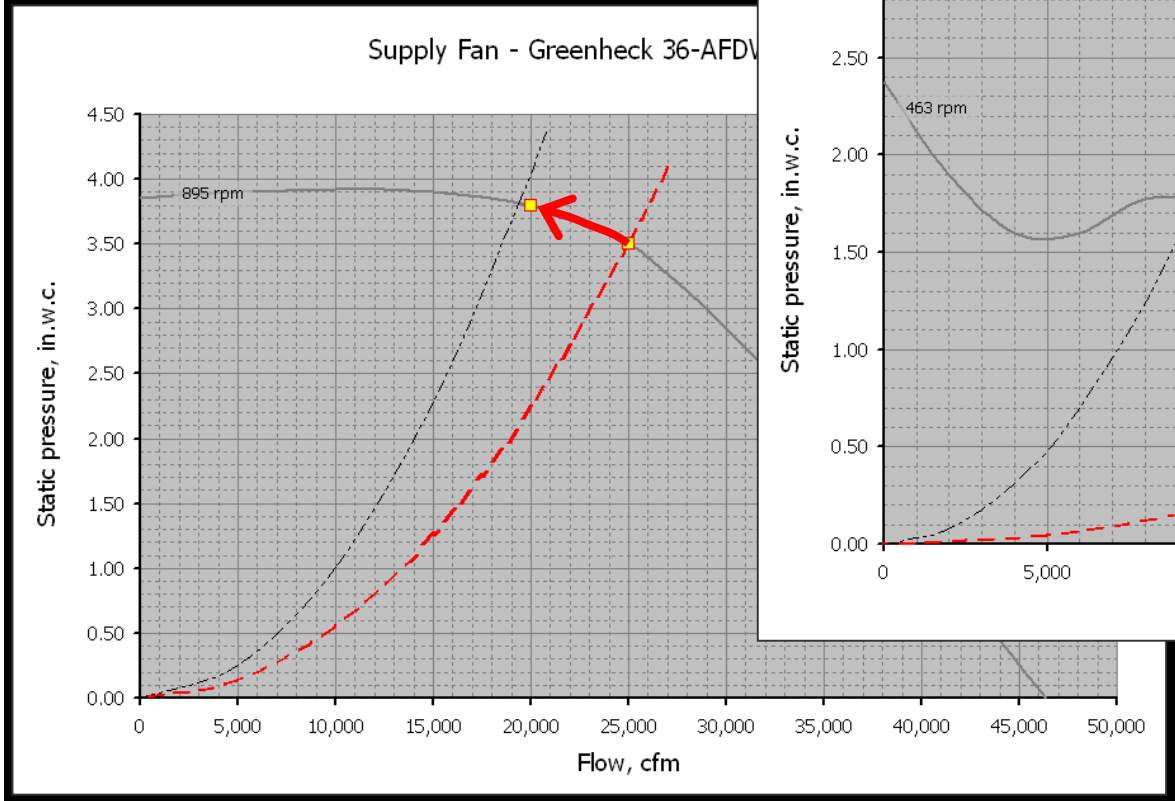


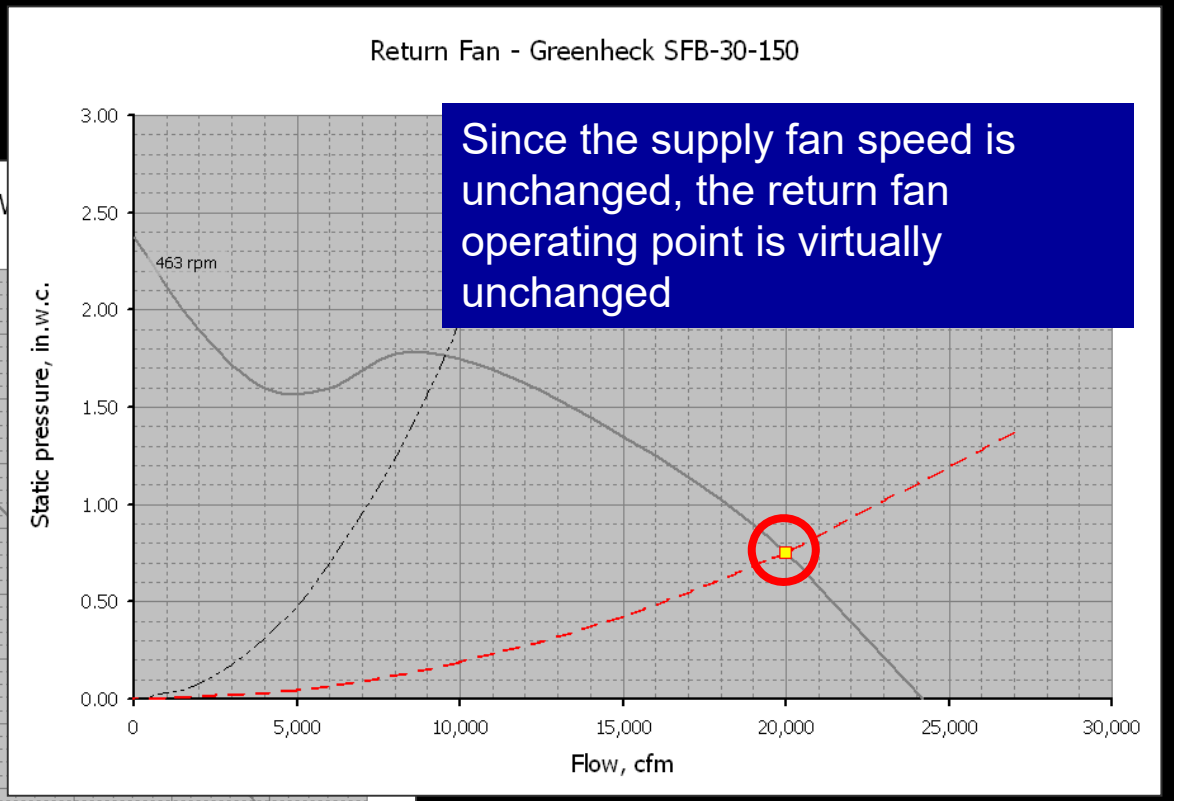


Flow differential = 5,000 cfm

Step 1:
The VAV Terminal Unit Throttles from 5,000 to 0 cfm

The VAV box throttling forces the supply fan up its curve



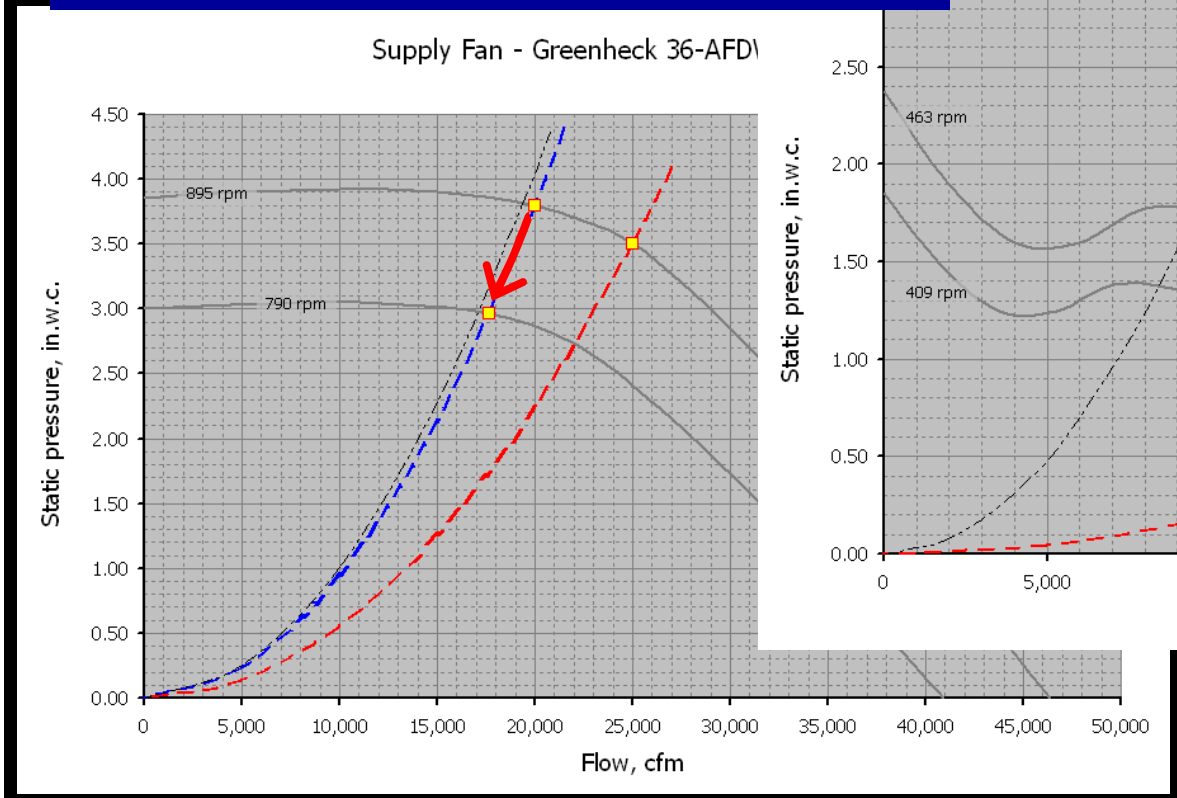


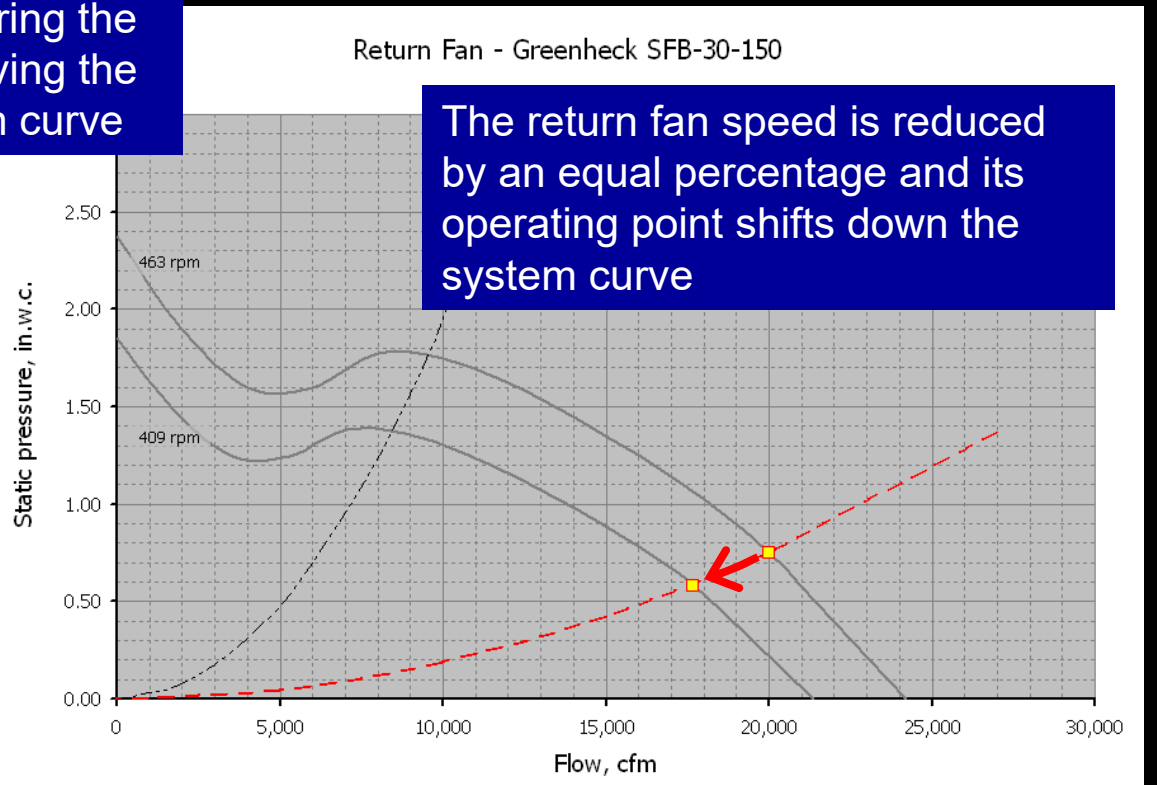
Since the supply fan speed is unchanged, the return fan operating point is virtually unchanged

Flow differential = 0 cfm

Step 2:
The Supply Fan and Return Fan Operating Points Shift

The supply fan VFD slows down to bring the discharge static under control by moving the operating point down the new system curve



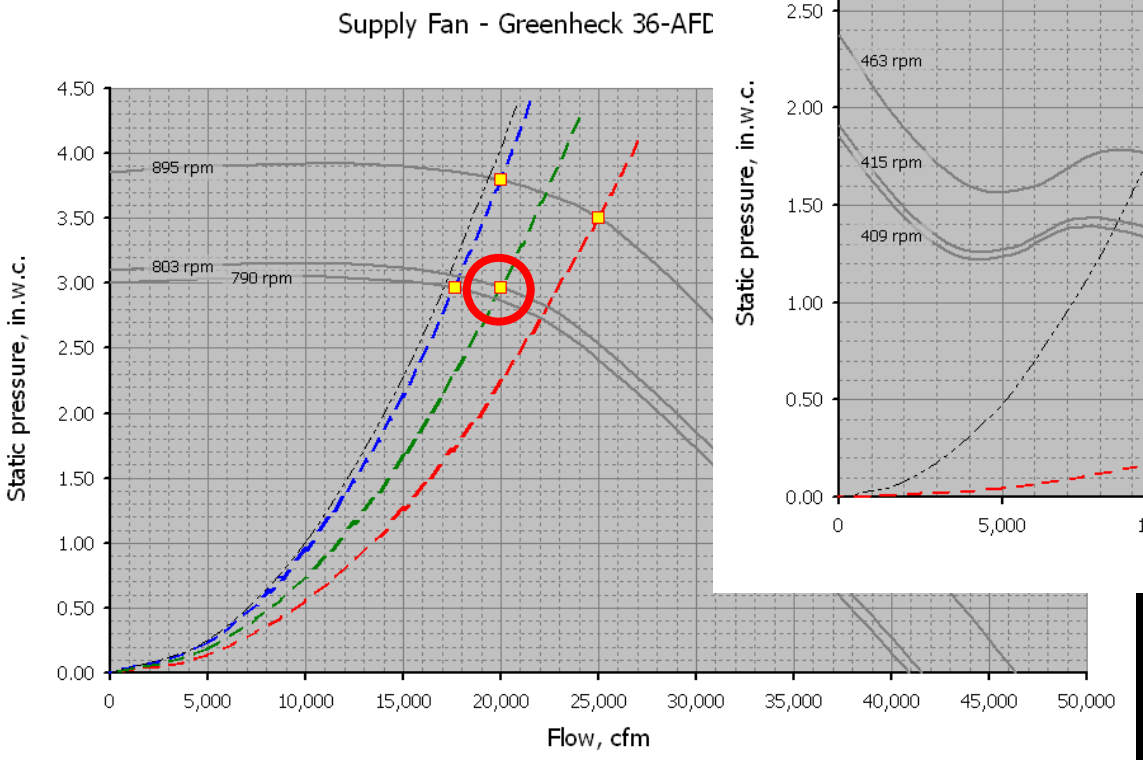


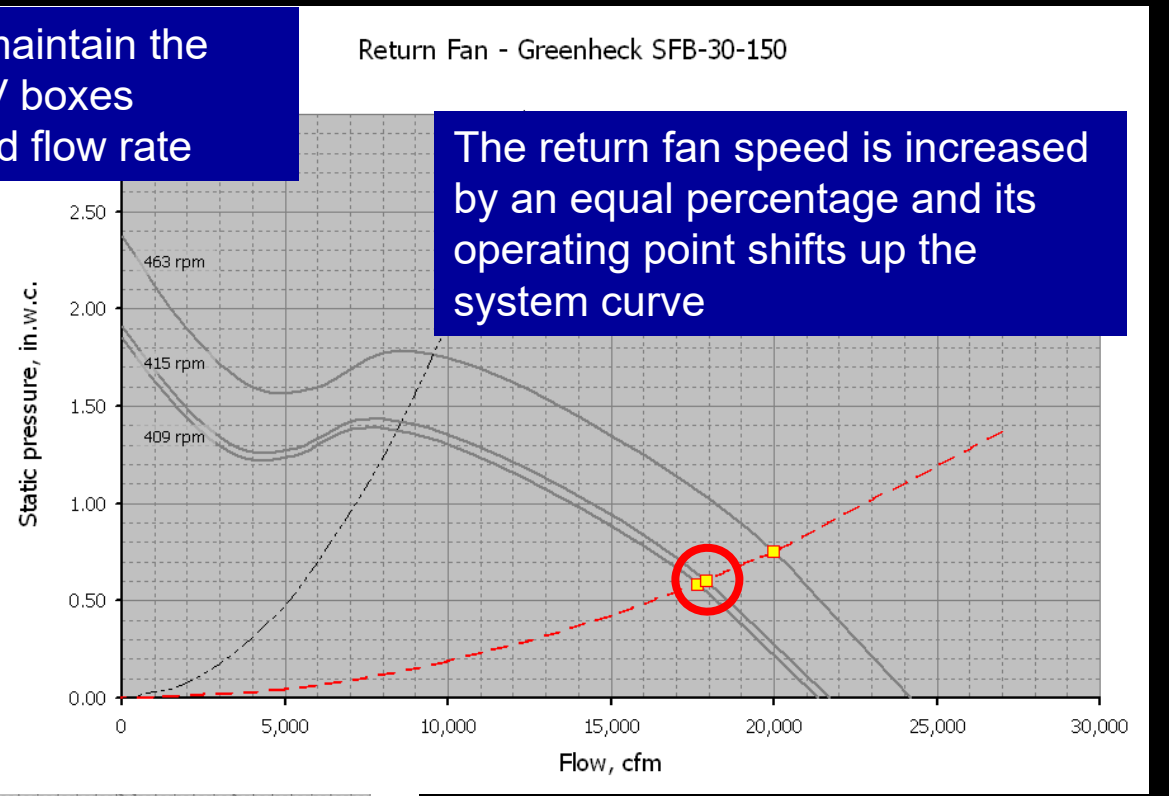
The return fan speed is reduced by an equal percentage and its operating point shifts down the system curve

Flow differential = 0 cfm

Step 3:
The Supply Fan and Return Fan Operating Points Shift

The supply fan speed increases to maintain the discharge static pressure as the VAV boxes reposition to re-establish the required flow rate





The return fan speed is increased by an equal percentage and its operating point shifts up the system curve

Flow differential = 2,067 cfm

Summary

Step	Flow							
	Supply		Return		Outdoor Air		OA Deviation from Design	
	cfm	% Change	cfm	% Change	cfm	% of Supply	cfm	% of Supply
Desgin	25,000	Base case	20,000	Base case	5,000	20%	Base case	Base case
1	20,000	20%	20,000	0%	0	0%	-5,000	-20%
2	17,650	29%	17,650	12%	0	0%	-5,000	-20%
3	20,000	20%	17,933	10%	2,067	10%	-2,933	-10%

Step	Speed					
	Supply	Return	Change from Base Case			
			Supply		Return	
	rpm	rpm	rpm	%	rpm	%
Desgin	895	463	Base case	Base case	Base case	Base case
1	895	463	0	0%	0	0%
2	790	409	-105	-12%	-54	-12%
3	803	415	-92	-10%	-48	-10%