

Practical and Effective Approaches to Residential Ventilation for Production Builders

by

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Building Science Consortium

USDOE Building America Program

for

Affordable Comfort Conference 2002

Cincinnati, Ohio

18 April 2002



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Durability can be insured with respect to moisture by:

- **Providing a building envelope design that can dry should it get wet**
- **Preventing excessive pressurization and depressurization of occupied spaces and cavities**
- **Installing controlled mechanical ventilation systems, and dehumidification separate from cooling for humid climates**

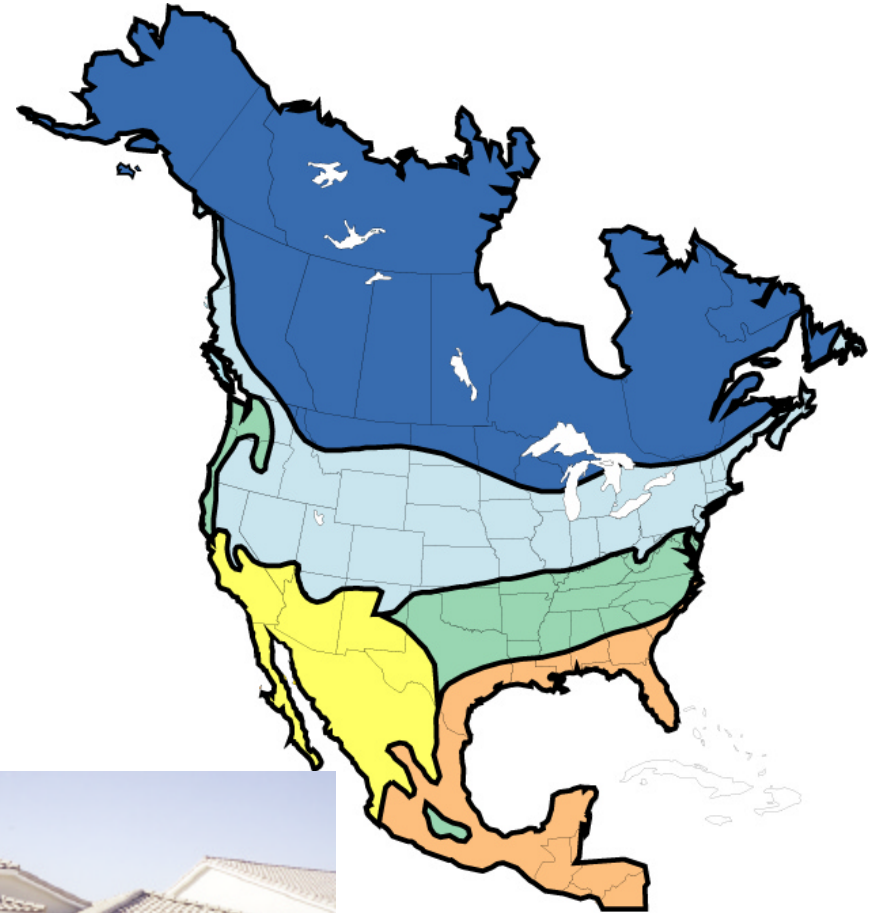
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Purposes of mechanical ventilation

1. Point-source ventilation - Remove Pollutants
 - exhaust fans: kitchen, bath, laundry
2. Whole-building ventilation - Dilute Pollutants
 - supply, exhaust, or balanced fans distributing to all rooms

Climate Specific Design Solutions



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Intermittent Operation

- Sizing

- Intermittent flow is determined by the constant flow requirement, the fan duty cycle fraction, and a low-level of background infiltration when the blower is not on.
- Note: Regardless of the size of the house, the intermittent flow is never sized less than the constant flow requirement.

$$\dot{Q}_{in} = \frac{(\dot{Q}_{co}) - \left(\frac{I}{60} V (1 - f)\right)}{f}$$

Outside air flow rate and duct sizing for central-fan-integrated supply ventilation systems for BSC Building America homes

Heating/cooling season fan duty cycle 0.33
 Ventilation cfm per bedroom 10
 Base infiltration when not ventilating (ach) 0.07

Number of bedrooms	Floor area	Wall height (ft)	OA flow needed (cfm)	OA Duct size (inch)	OA Duct Pressure	
					(Pa)	(Inch H2O)
2	1200	9	52	5	13	0.05
2.5	1400	9	61	5	18	0.07
3	1800	9	63	5	20	0.08
3.5	2000	9	72	5	26	0.10
4	2200	9	81	5	33	0.13
4.5	2400	9	89	5	40	0.16
5	2600	9	98	5	48	0.19

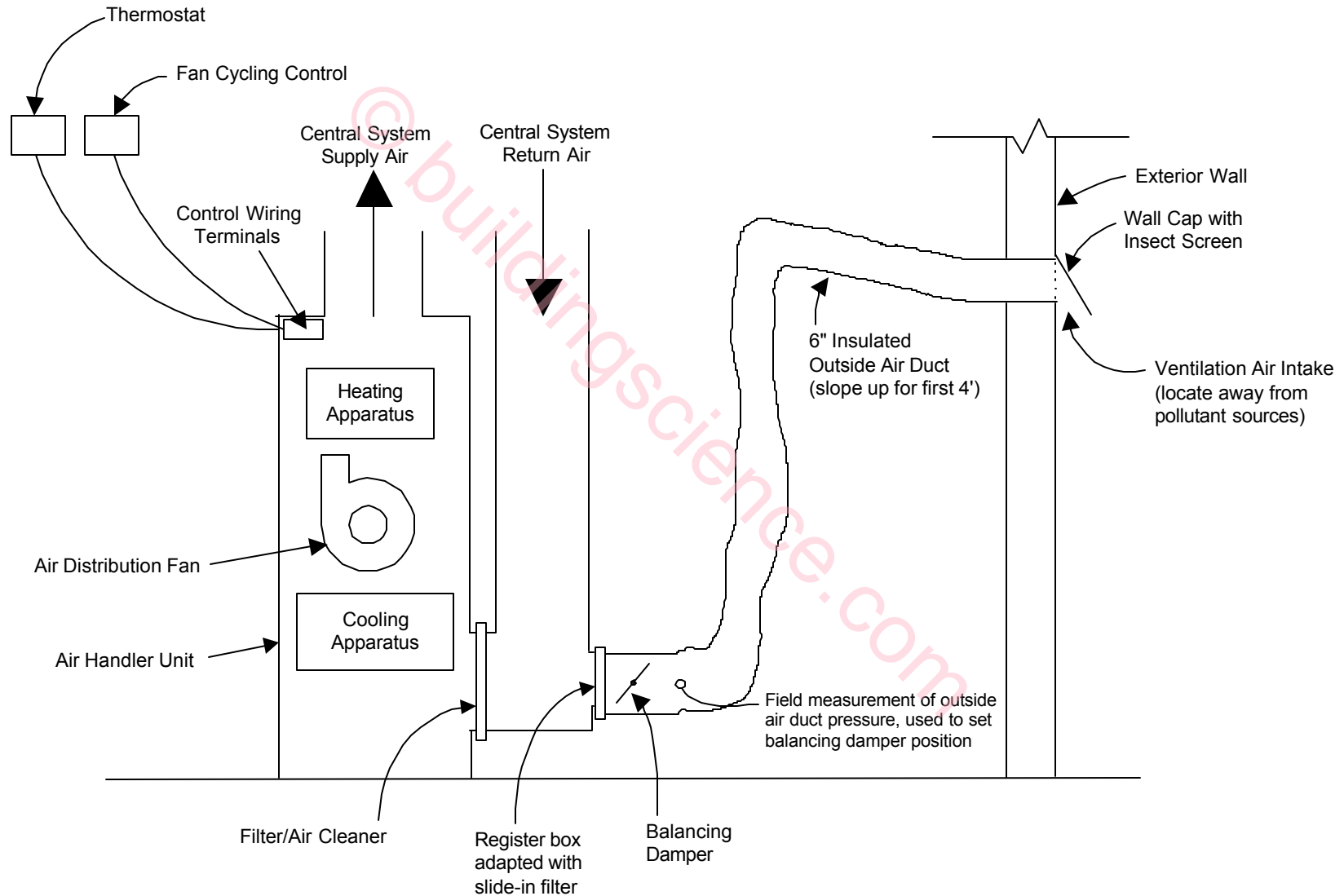
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2.5	1400	9	61	6	14	0.05
3	1800	9	63	6	15	0.06
3.5	2000	9	72	6	19	0.08
4	2200	9	81	6	24	0.10
4.5	2400	9	89	6	29	0.12
5	2600	9	98	6	35	0.14

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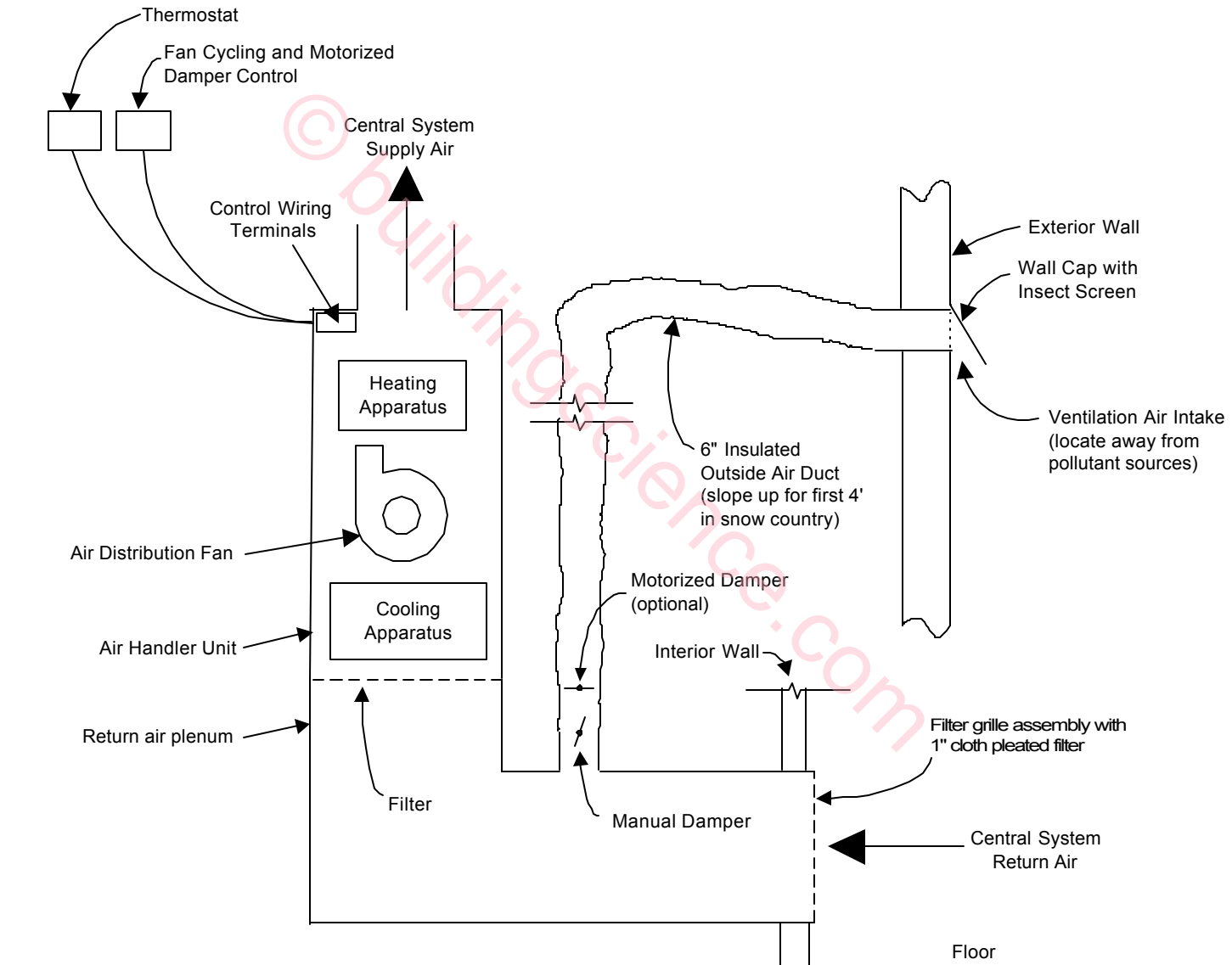
Central-fan-integrated supply ventilation

Interior closet or basement configuration



Central-fan-integrated supply ventilation

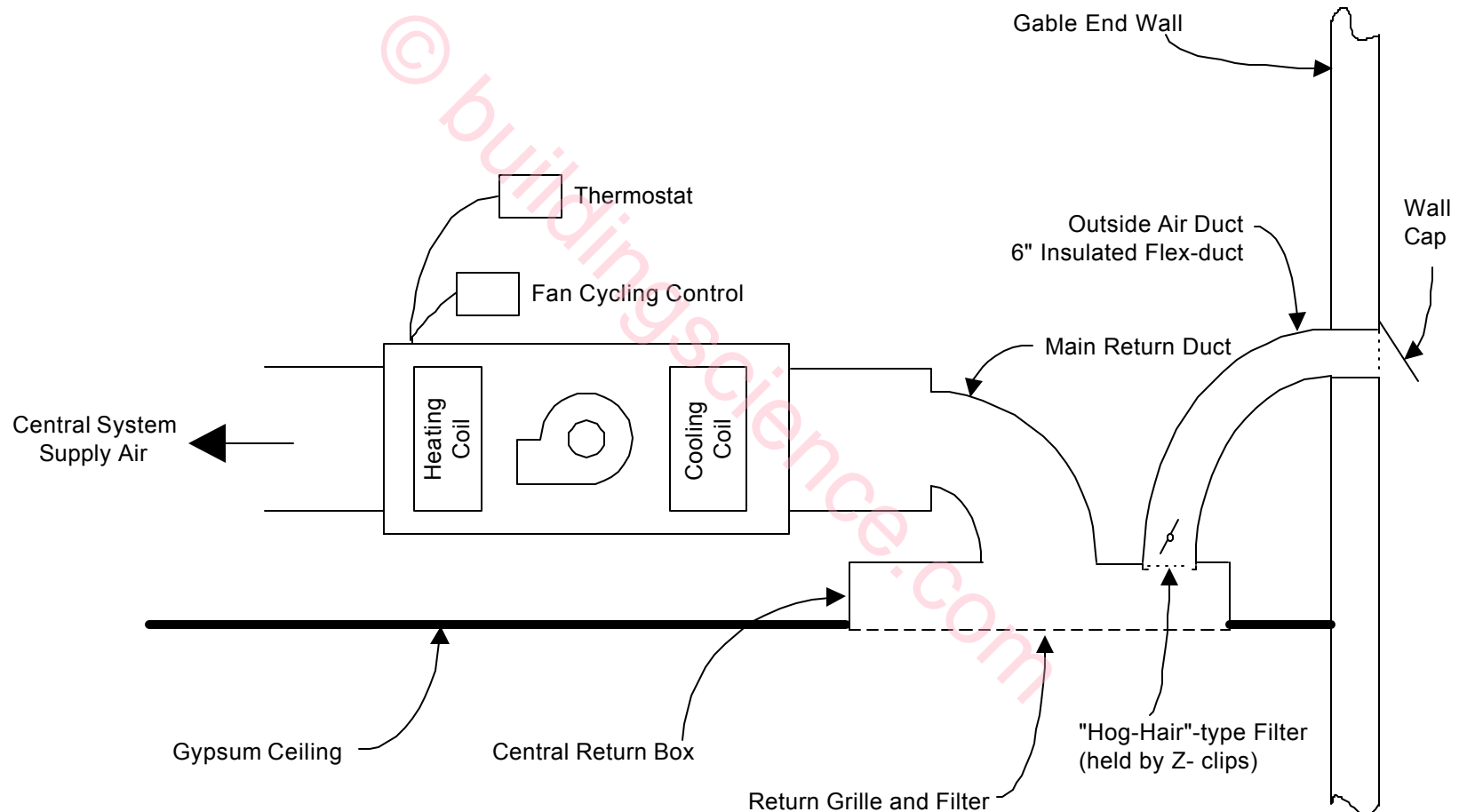
Interior mechanical closet



Central-fan-integrated supply ventilation

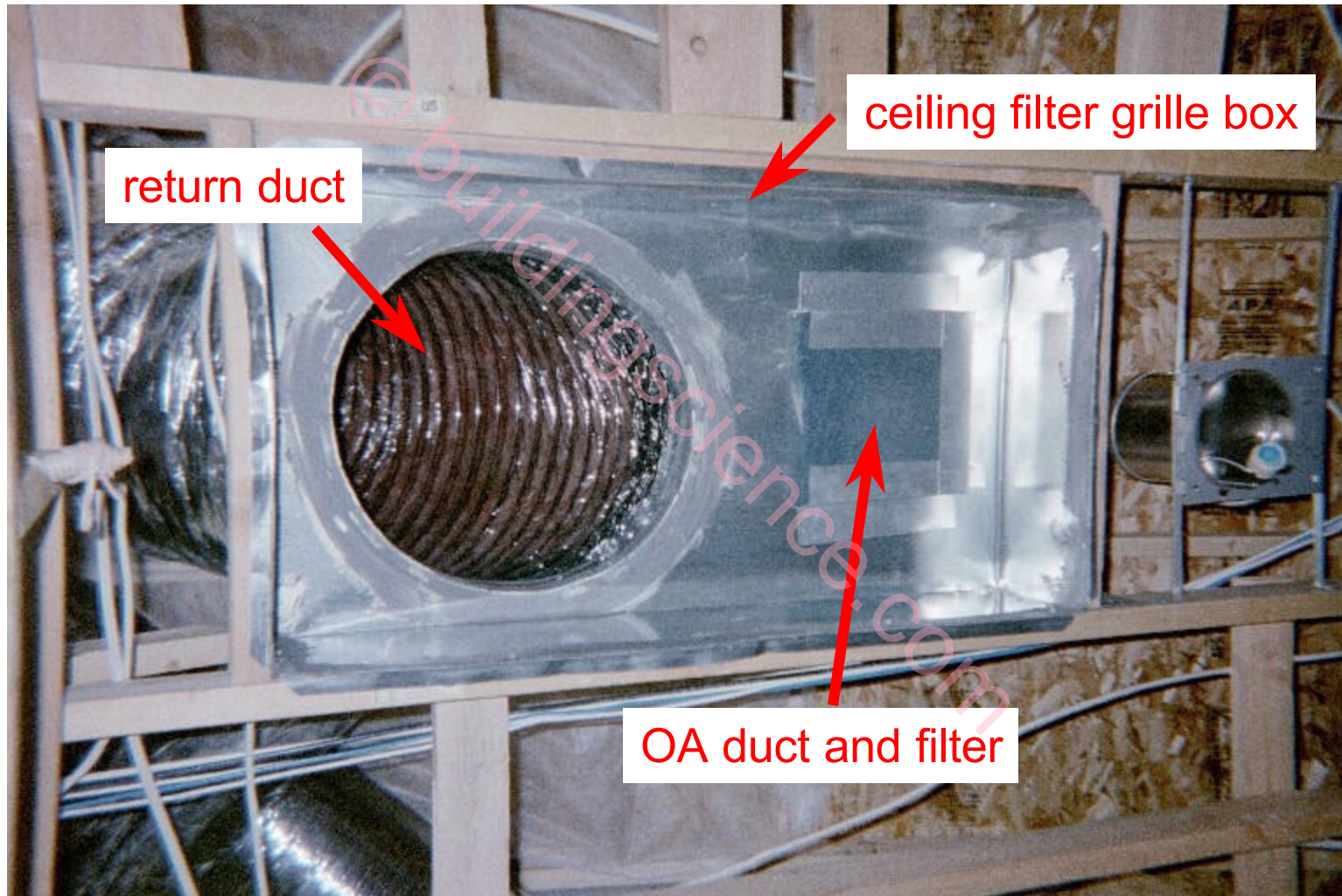
Unvented-cathedralized attic configuration

Gable end intake



Central-fan-integrated supply ventilation

Outside air duct (filtered) connected to return filter grille box



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Central-fan-integrated supply ventilation

Outside air duct (filtered) connected to return filter grille box



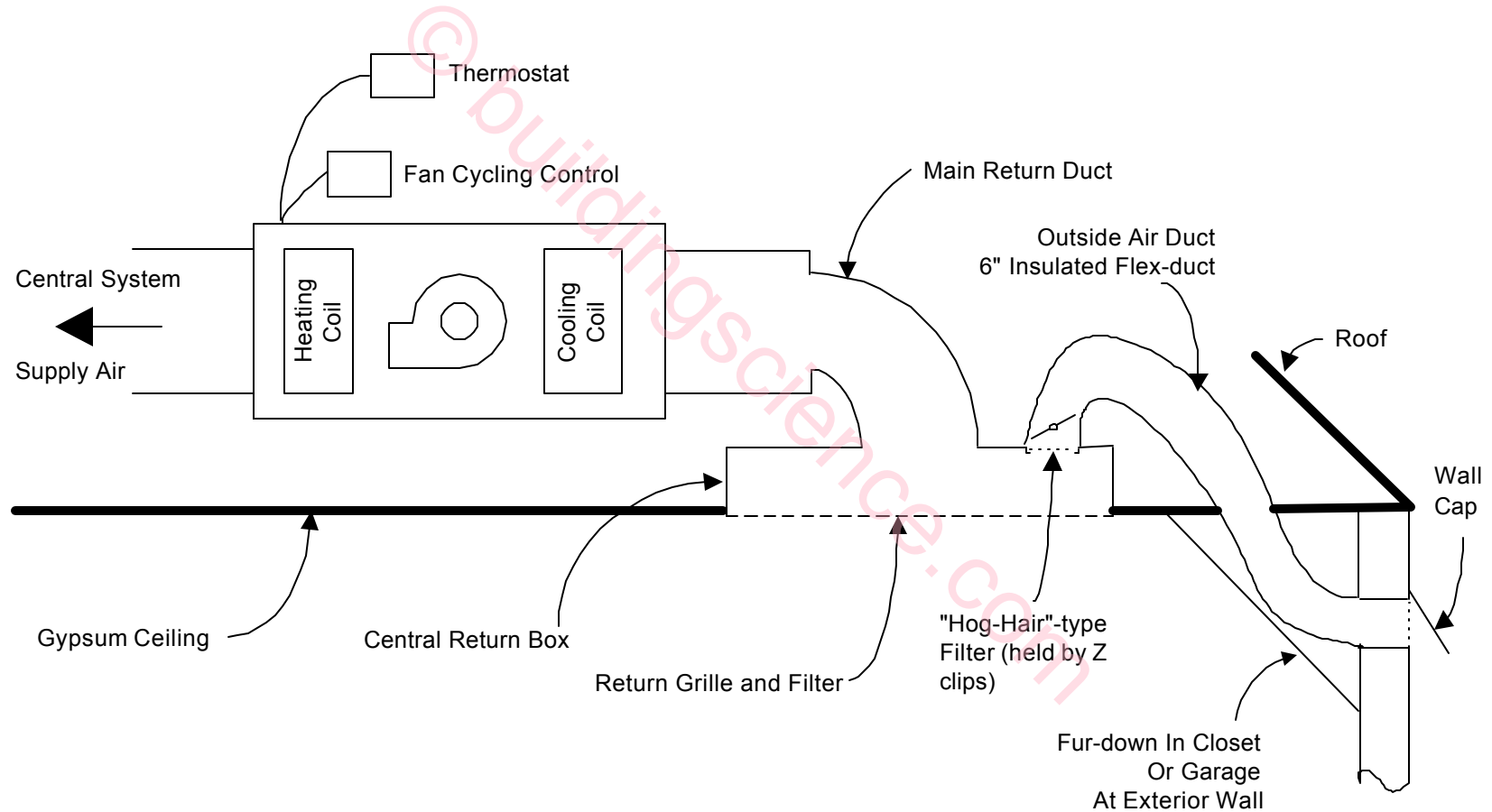
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Central-fan-integrated supply ventilation

Unvented-cathedralized attic configuration

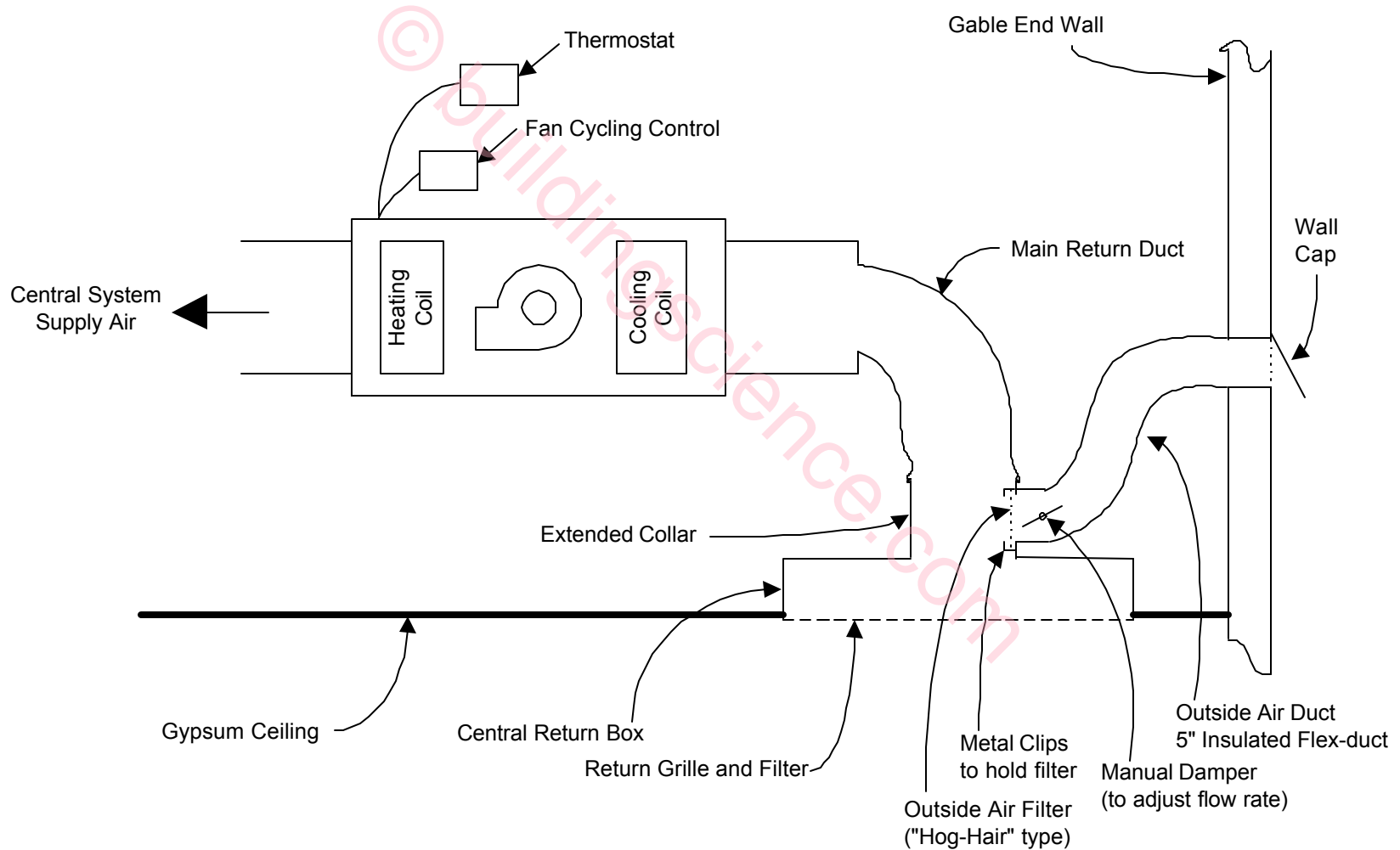
Side-wall intake



Central-fan-integrated supply ventilation

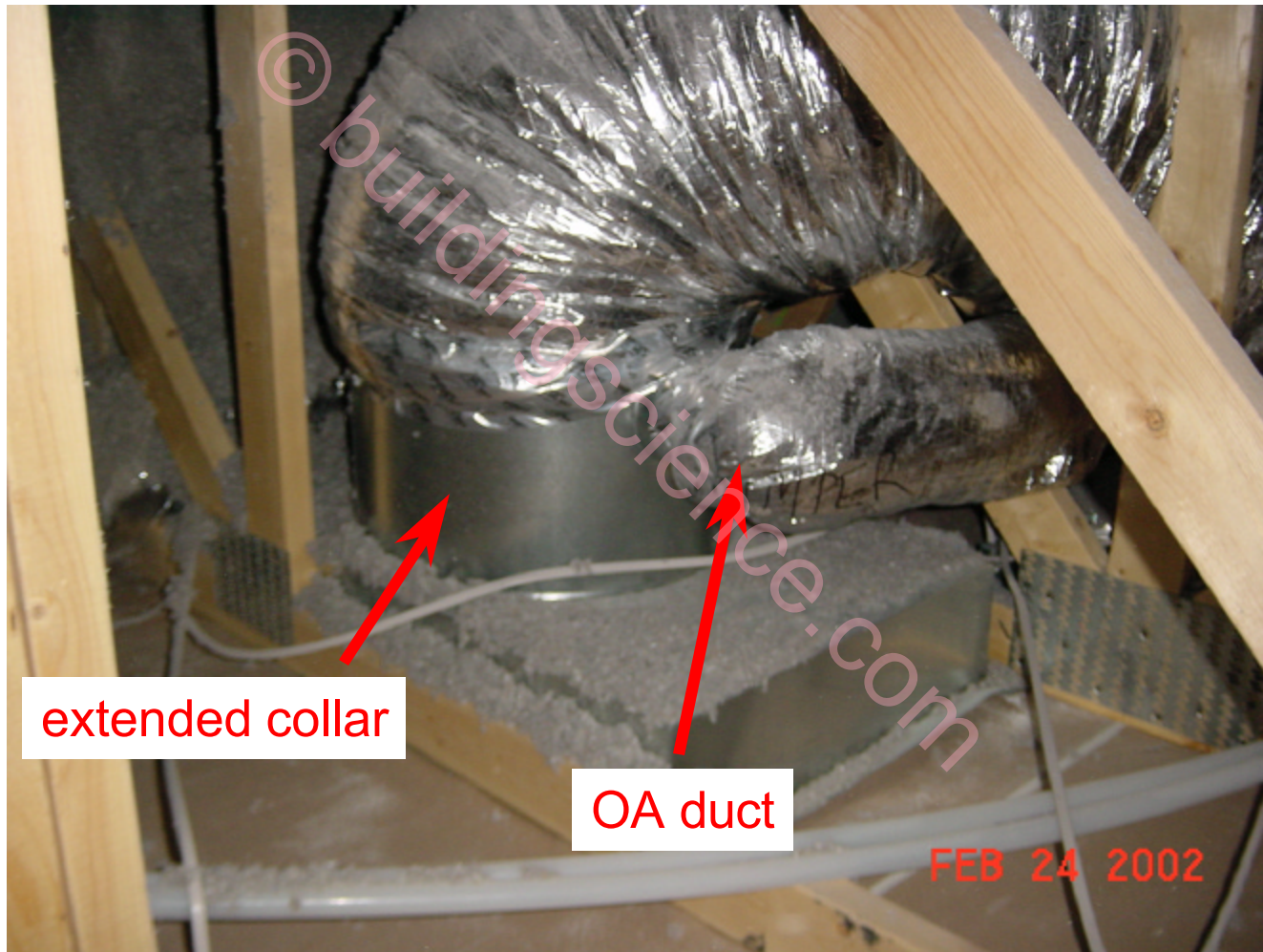
Unvented-cathedralized attic configuration

Extended collar (gives more air flow)



Central-fan-integrated supply ventilation

Outside air duct (filtered) connected to extended collar at return filter grille box

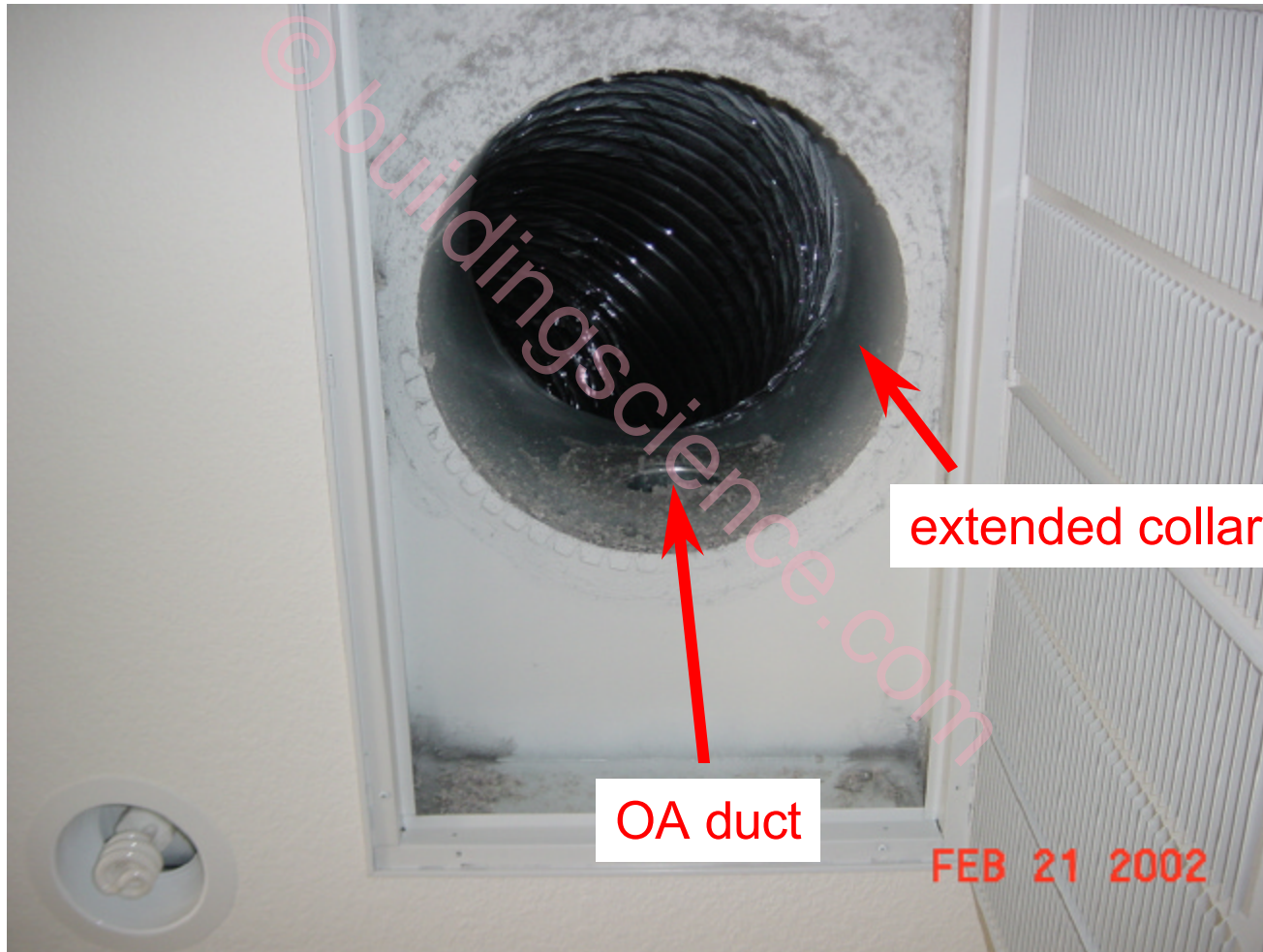


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Central-fan-integrated supply ventilation

Outside air duct (filtered) connected to extended collar at return filter grille box



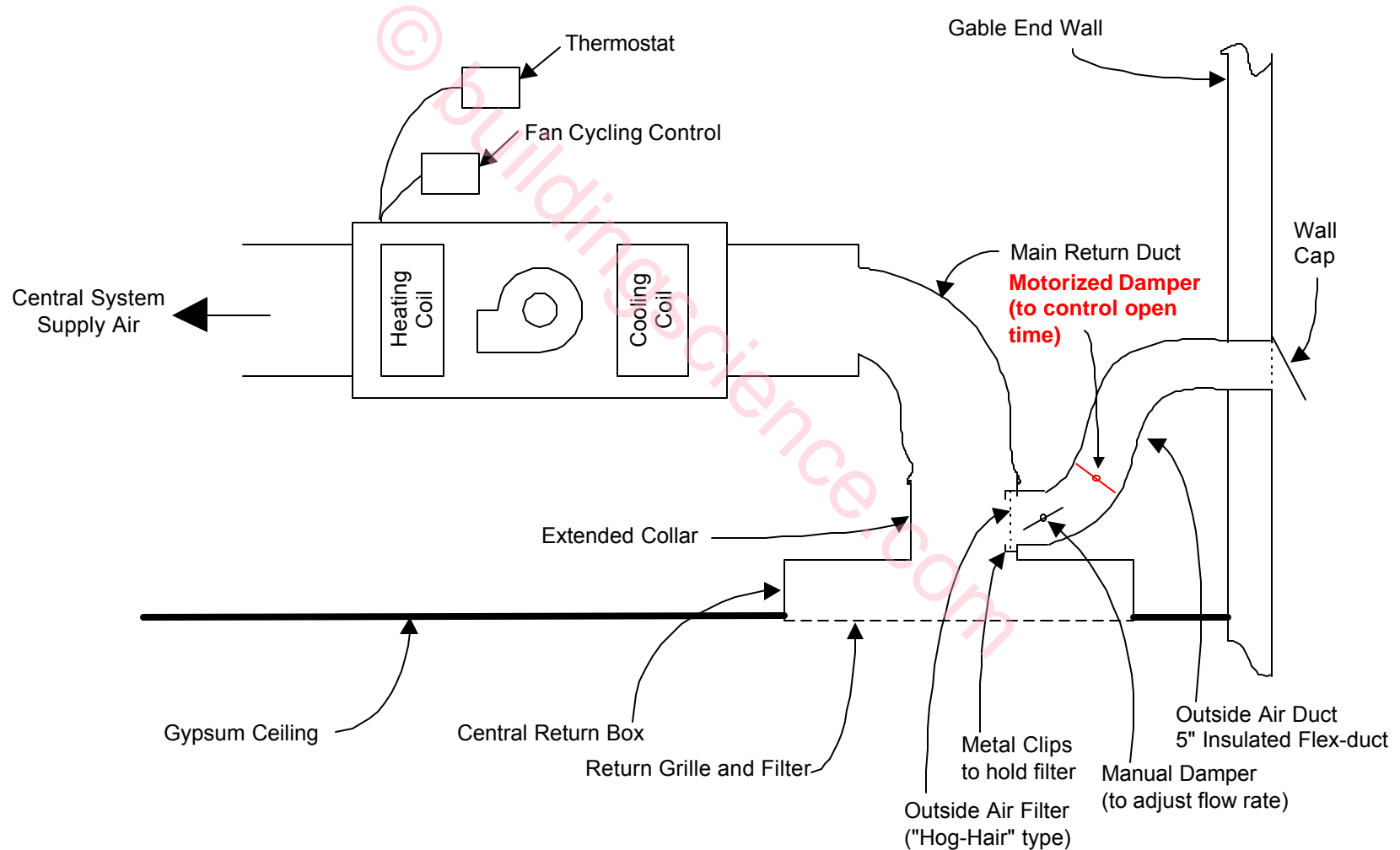
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Central-fan-integrated supply ventilation

Unvented-cathedralized attic configuration

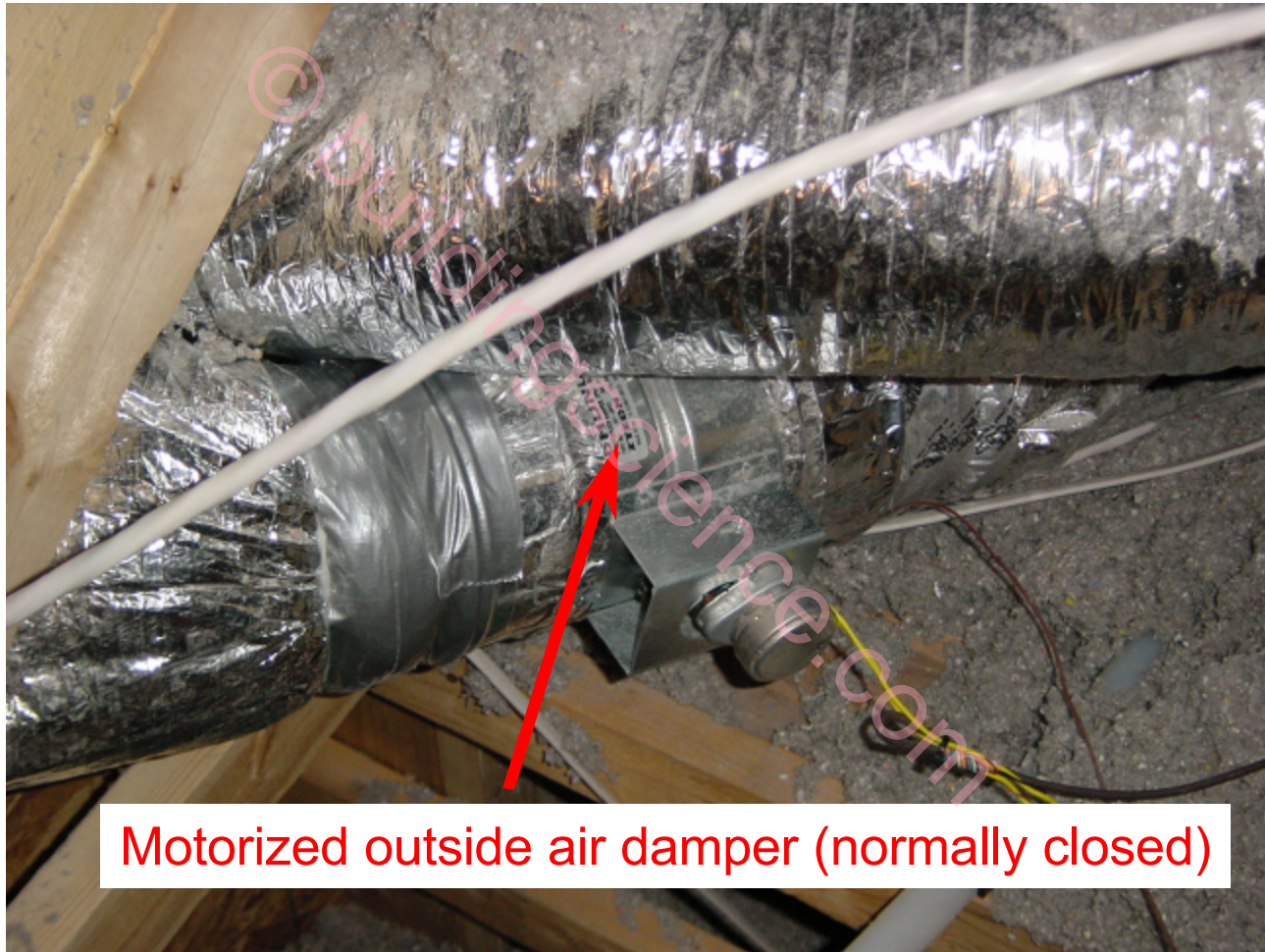
With motorized damper and damper cycling control



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Central-fan-integrated supply ventilation

Outside air duct with motorized damper



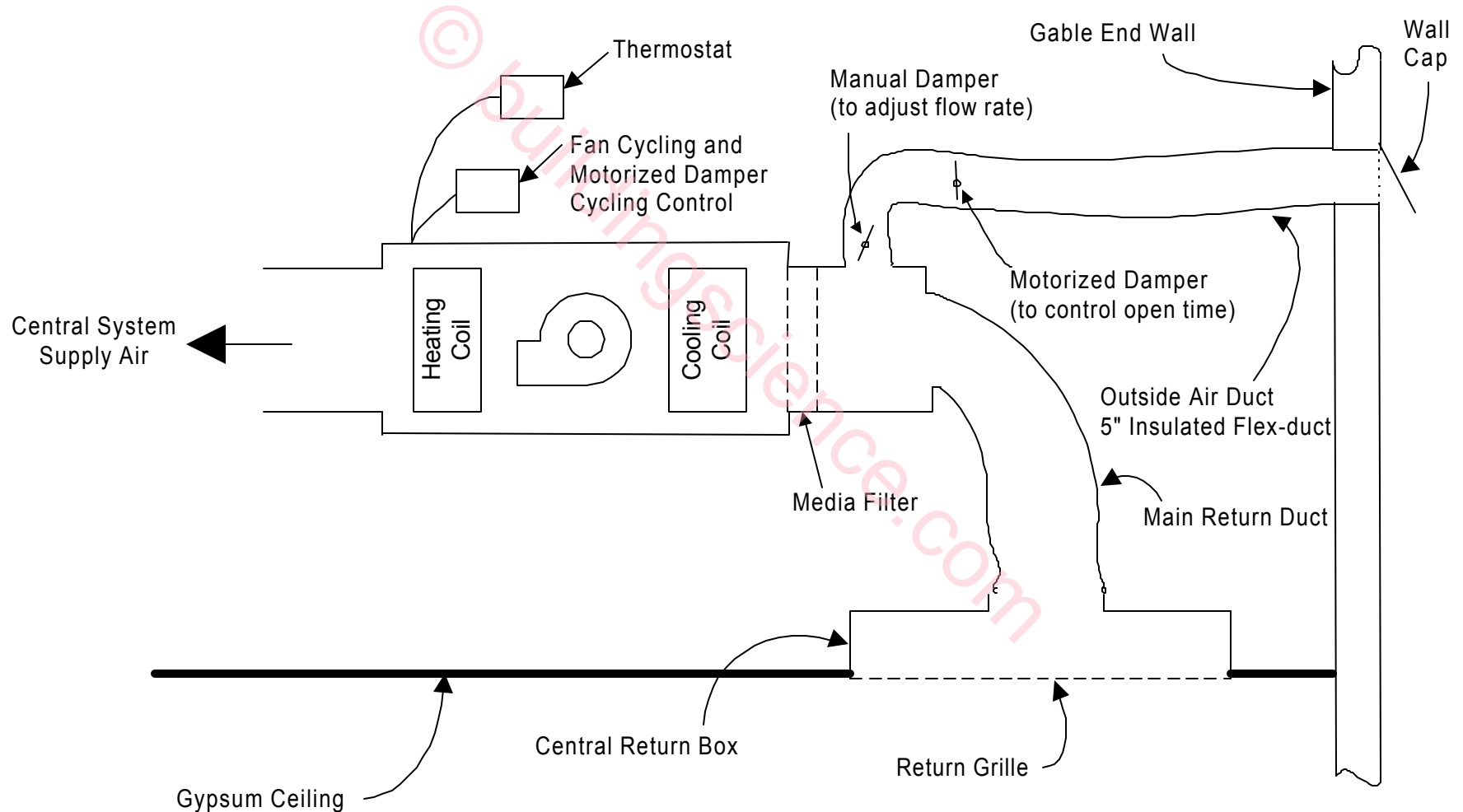
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Central-fan-integrated supply ventilation

Unvented-cathedralized attic configuration

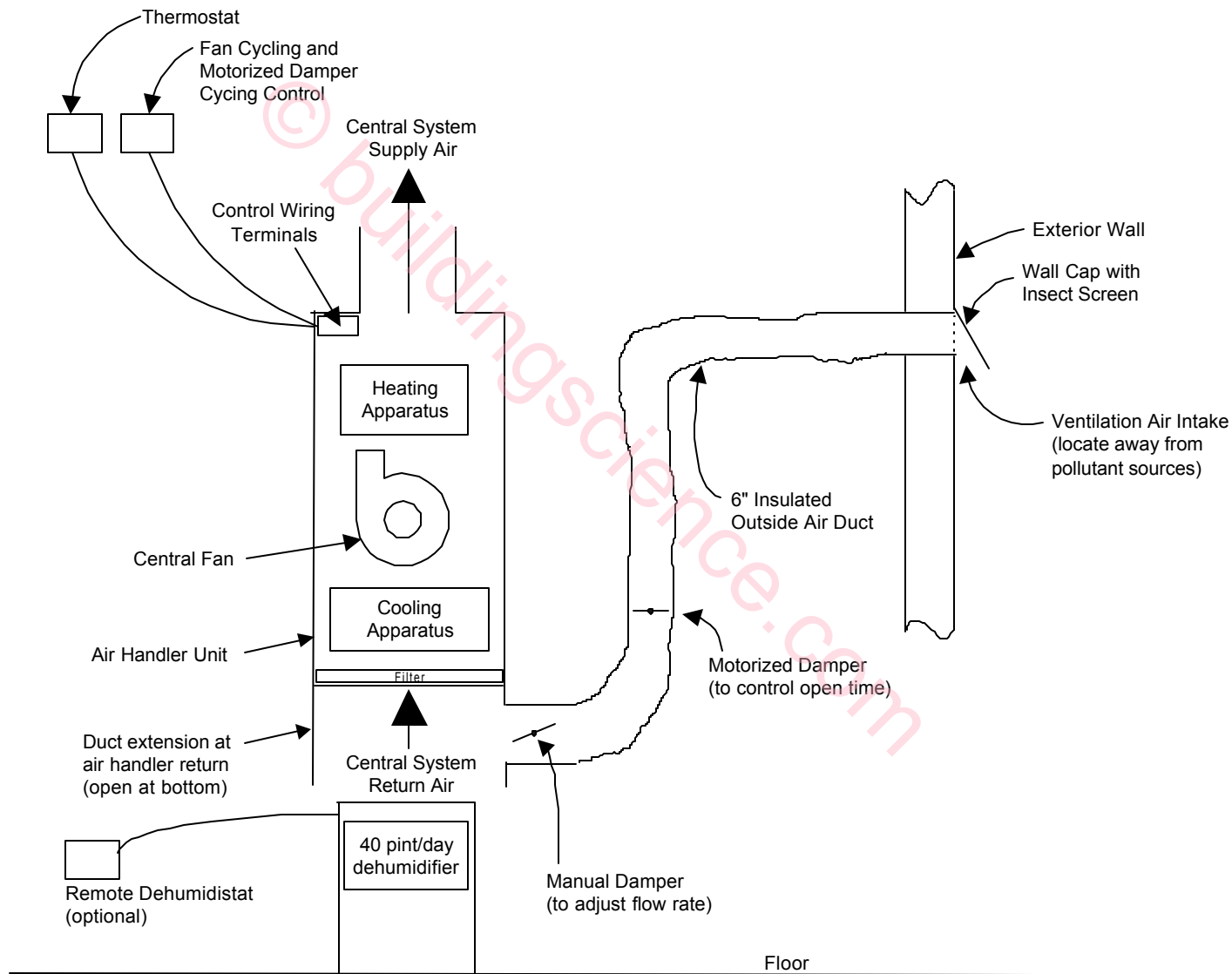
Media filter and motorized damper



Central-fan-integrated supply ventilation

With dehumidification separate from cooling

Hot-humid climate, interior mechanical closet configuration





Monitored Runtime Data

Centennial Crossing, Lot 22

	Cool ON	Heat ON	Fan Recycling	
	(%)	(%)	Vent ON (%)	Cost (\$)
Apr (27-30)	0	12	12	0.24
May	1	2	15	3.06
Jun	7	1	10	2.05
Jul	10	0	12	2.58
Aug	10	0	13	2.72
Sep	5	0	15	2.96
Oct	0	4	15	3.07
Nov	0	13	10	1.99
Dec	0	20	6	1.31
Jan	0	31	3	0.60
Feb	0	23	5	0.95
Mar (1-9)	0	25	4	0.23

Notes: Fan recycling control set for 25 min OFF, 6 min ON (19% duty cycle)

Monitored Runtime Data

Centennial Crossing, Lot 176

	Cool ON (%)	Heat ON (%)	Fan Recycling Vent ON (%)	Cost (\$)
Aug	21	0	17	3.52
Sep	10	0	21	4.24
Oct	0	5	20	4.12
Nov	0	15	12	2.33
Dec	0	27	6	1.35
Jan	0	35	3	0.54
Feb	0	24	5	1.00

Notes: Fan recycling control set for 20 min OFF, 8 min ON (29% duty cycle)

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Monitored Runtime Data

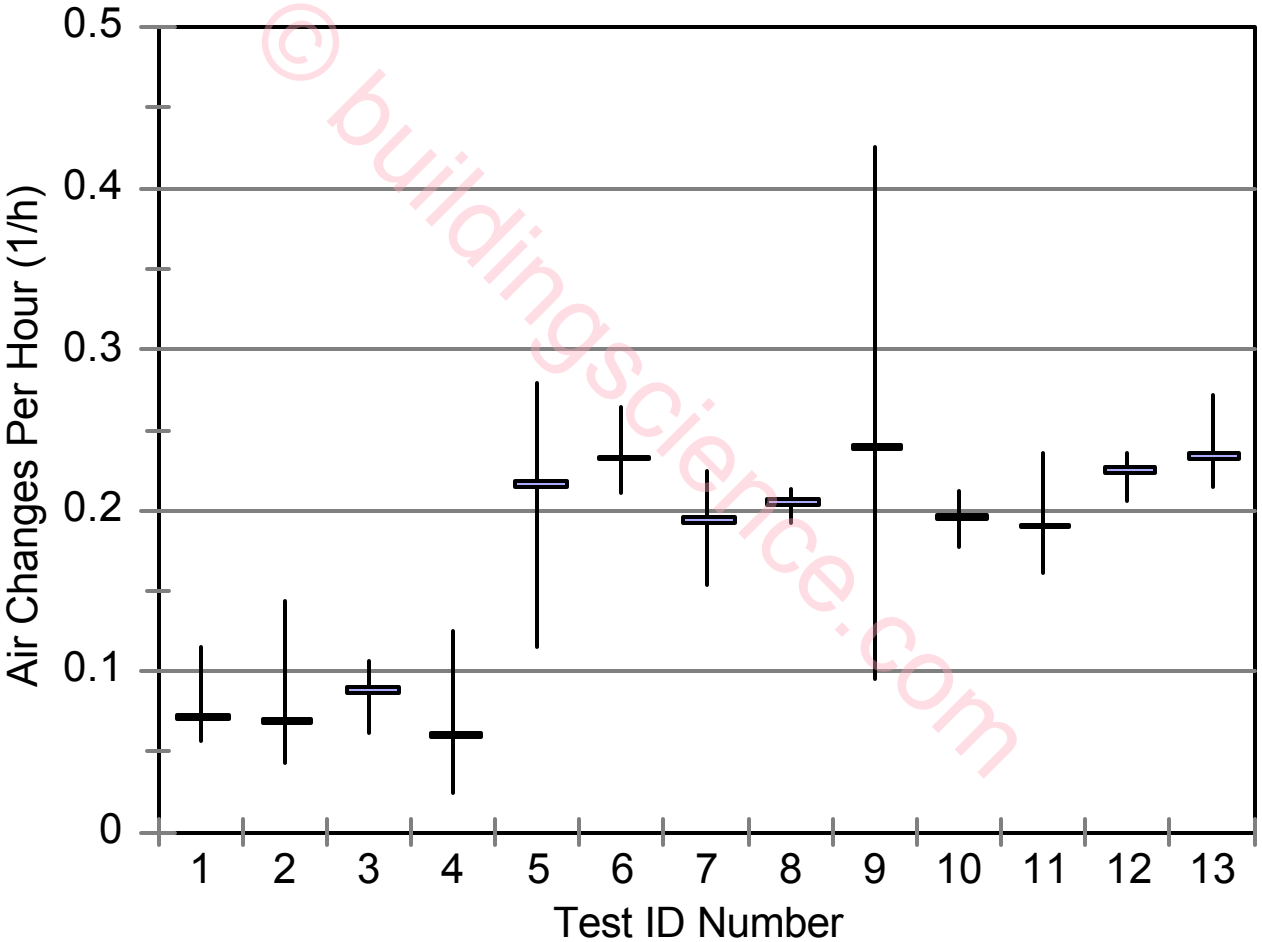
Centennial Crossing, Lot 179

	Cool ON (%)	Heat ON (%)	Fan Recycling Vent ON (%)	Cost (\$)
Oct	0	5	24	4.97
Nov	0	15	14	2.81
Dec	0	25	9	1.81
Jan	0	34	3	0.68
Feb	0	26	6	1.18
Mar (1-8)	0	31	3	0.17

Notes: Fan recycling control set for 20 OFF 10 ON (33% duty cycle)

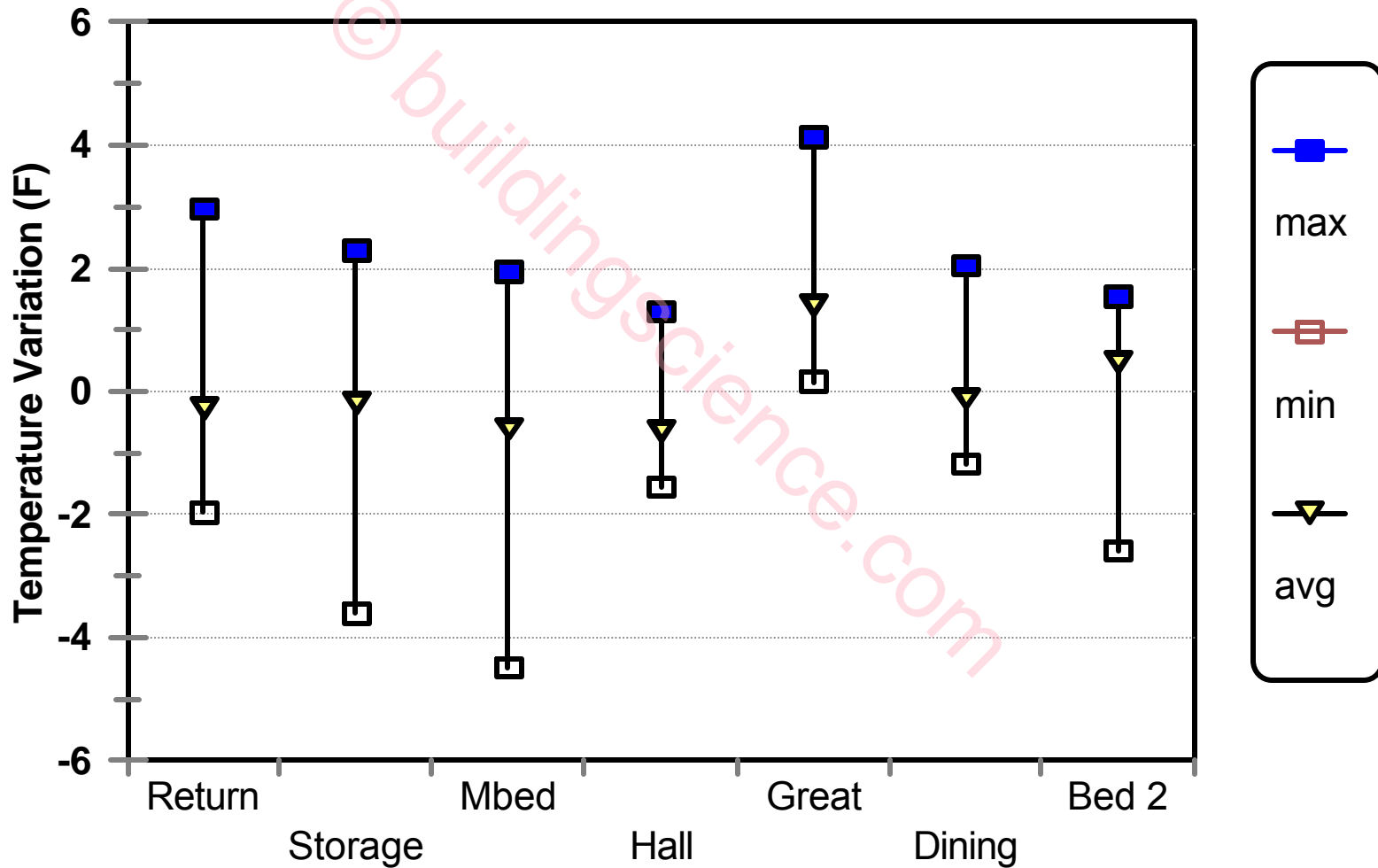
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Minneapolis ventilation study shows importance of distribution and mixing between rooms



Lot 6
Arbor View

Indoor temperature variation from the house average



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