



400 West Georgia St.

# **VENTILATION RECOVERY STUDY**

**Office Centralized (Roof) vs. Decentralized Distribution**

Rooftop vs. Floor-by-Floor Ventilation

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# EXECUTIVE SUMMARY

The heat recovery ventilation (HRV) or energy recovery ventilation (ERV) have been the norm for typical office design and construction for the last 20 years, helping achieving indoor air quality and energy performance. The purpose of this study was to analyze the difference between two typical HRV approaches for 20 level office: centralized (large HRV on the roof with vertical riser) vs. decentralized (HRV units located in ceiling space of each floor) in regard to:

- Leasable floor area (duct riser and roofs)
- Ductwork costs (materials and insulation)
- Equipment costs (materials and insulation)
- Maintenance costs
- Air quality (getting the right amount of air to the targeted space)
- Other considerations (louvers, code requirements for duct operation, distance redundancy, ease of access for maintenance/service/filter changes)

The two office ventilation designs have been provided: centralized vs. decentralized, and pricing for each option provided by contractors to assists in analysis.

**Summary Table**

	Centralized	Decentralized	Notes
<b>Construction Cost</b>	X	X	\$0.16/sq.ft cheaper for decentralized (\$1.49M vs. \$1.54M)
<b>Revenue</b>	X	X X X	\$7.5M for 50 years (\$150K annually)
<b>Maintenance</b>	XX	X	\$200K for 50 years (\$4K annually)
<b>Redundancy</b>	X	XX	1 unit vs. 24

XXX - Excellent    XX - Good    X - Minimum

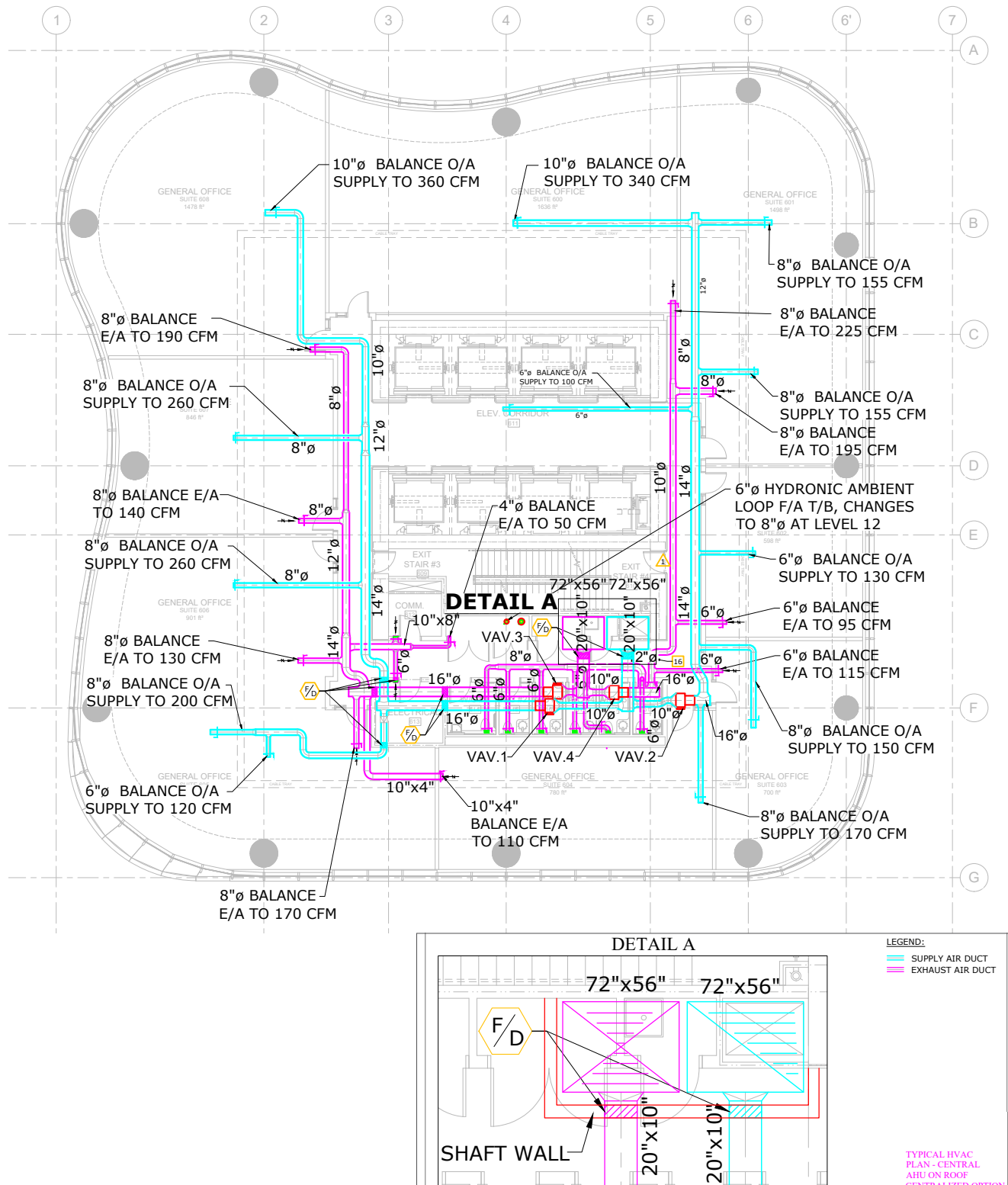
Both options provide excellent air quality in targeted areas with CO<sub>2</sub> sensors and have a similar heat recovery efficiency. Centralized system has a slight advantage in regard to the first cost and maintenance which is heavily outweighed by decentralized system revenue generated by eliminating vertical risers and roof access requirements and redundancy; the latest office towers in Vancouver: 400 W. Georgia, MNP Tower, 320 Granville St, are designed and constructed by decentralized HRV systems taking advantage of this approach.

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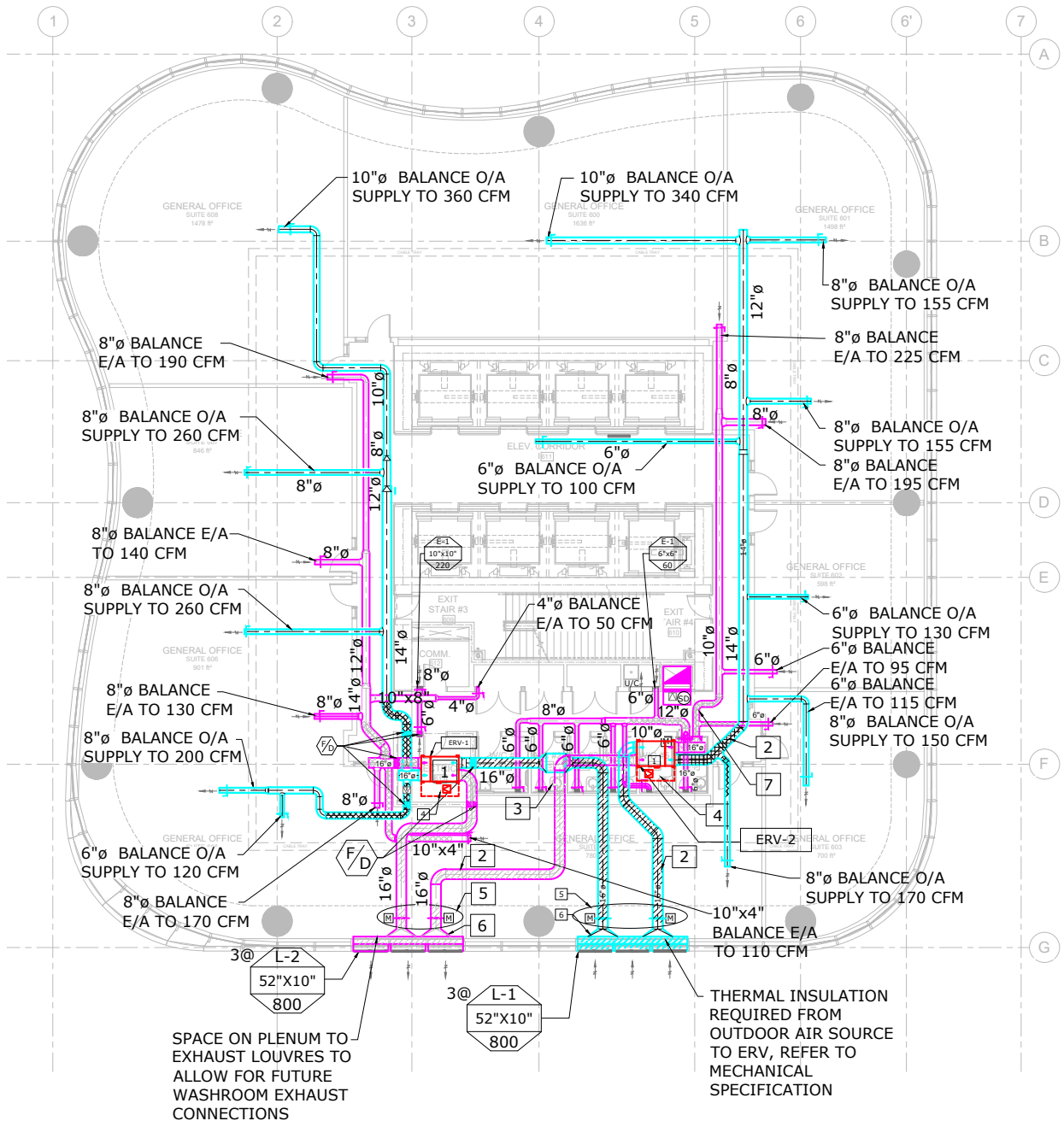
# DESIGN

## Typical Centralized HVAC Plan: Central AHU on Roof



# DESIGN

## Typical Decentralized HVAC Plan: ERV on Floor Level



### Notes

1. Ceiling mounted ERV (typical) in 36" deep bulkhead.
2. All ERV supply and intake ducts to be insulated, typical.
3. 16"Ø to 8" x 30" square transition to maintain maximum ceiling height.
4. Provide 50" x 45" access panel for ERV. Refer to drawing M-414 for details.
5. Provide low leakage motorized damper as shown/signal position the damper via the ERV and connect to DDC.
6. Transition for both ducts from 16" Ø to 48" x 10" to connect louver plenum
7. Duct sized at 10" Ø to increase static pressure.

0 1 2 4 8 16  
SCALE: 1/8" = 1'-0"

ERV-1	1200cfm@0.75" ESP, 208v/1phase, MERV 13 filter, CO2 sensor, ECM motor
ERV-2	1200cfm@0.75" ESP, 208v/1phase, MERV 13 filter, CO2 sensor, ECM motor

### LEGEND:

- SUPPLY AIR DUCT
- EXHAUST AIR DUCT

TYPICAL HVAC PLAN  
- ERV ON FLOOR LEVEL  
DECENTRALIZED  
OPTION



# DESIGN

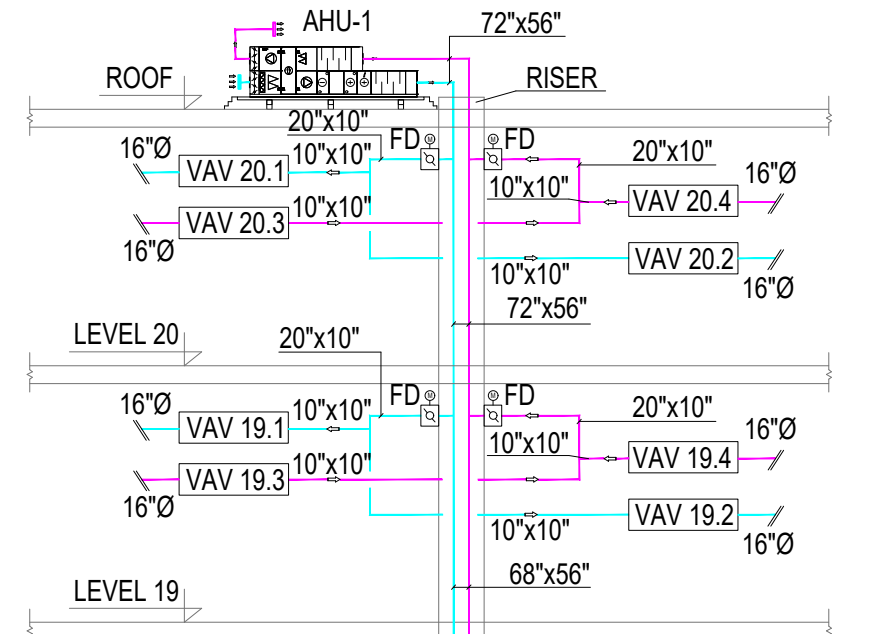
Schematics for Decentralized (M-1) and Centralized (M-2) HVAC Plan



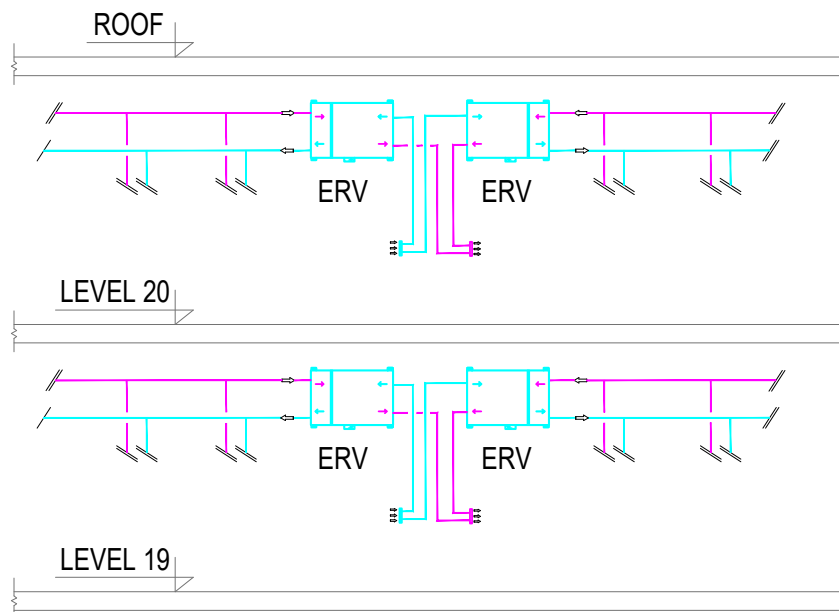
# DESIGN

## Schematics for Centralized and Decentralized HVAC Plan

### CENTRALIZED OPTION



### DECENTRALIZED OPTION



# COST

## Cost-Comparison Chart

	Centralized Ventilation	Decentralized Ventilation
HRV/ERV Equipment Cost	\$350,000	\$440,000
Additional Equipment and Ductwork Cost (VAV, Fire Dampers, Motorized Dampers, Louvers, Ductwork)	\$350,000	\$140,000
Installation Cost with Thermal/Acoustic Insulation	\$780,000	\$960,000
<b>Totals</b>	<b>\$1,490,000</b>	<b>\$1,540,000</b>

## Construction Cost

The prices for Centralized and Decentralized are per floor. To get the total for the whole tower we had to multiply it by the number of floors. The results were quite similar, with the decentralized option costing \$50,000 more.

## Centralized

Total construction cost for the ventilation system	\$1,490,000		
Installation cost per floor	\$32,000 x 20	=	\$640K
<ul style="list-style-type: none"> <li>Ductwork</li> <li>Thermal insulation on fresh air lines</li> <li>Installation of only VAV.1 to VAV.4</li> <li>Installation of only fire dampers</li> </ul>			
Equipment cost per floor			
<ul style="list-style-type: none"> <li>Supply of VAVs</li> <li>Supply of fire dampers</li> </ul>	\$4,000 x 20 \$2,000 x 20	=	\$80K \$40K
Central System Ventilation Cost			
<ul style="list-style-type: none"> <li>Rooftop ductwork</li> <li>Central Air Handling Unit Cost</li> <li>Central Air Handling Unit Installation</li> <li>Riser Cost (179,219.66)</li> </ul>	\$50,000 \$350,000 \$150,000 \$180,000		
	<b>\$730,000</b>	=	<b>\$730K</b>
			<b>Total \$1,490,000</b>



# COST

## Decentralized

Total construction cost for the ventilation system	\$1,540,000		
Installation cost per floor	\$48,000 x 20	=	\$960K

Includes:

- Thermal insulation on Fresh Air lines
- Thermal building insulation on last 10' of exhaust runs penetrating outside of the building
- Installation only of 2 ERVs per floor
- Installation only of fire dampers
- Installation only of motorized dampers
- Installation only of louvers

Equipment Cost

• Supply of ERVs	\$22,000		
• Supply of fire dampers	N/A		
• Motorized dampers	\$2,000		
• Louvers	\$5,000		
	<b>\$29,000 x 20</b>	=	<b>\$580K</b>
			<b>Total \$1,540,000</b>

## Cost Summary

HRV/ERV equipment and installation in the decentralized system is cost more, \$440k vs. \$350k (equipment) and \$960k vs. \$780k; however, money is saved on fire dampers, VAV and risers: \$140k vs. \$350k)

# REVENUE

**The average duct enclosure area for 2 ducts based on 1800 fpm velocity:**

100 sq.ft. per floor @ \$50/sq.ft. @ 20 floors @ 50 years = \$5,000,000

**Rooftop unit with ductwork and service requirements:**

100 sq.ft. @ \$50/sq.ft. @ 50 years = \$2,500,000

### M-1 Centralized

Lost leasable area for the Centralized System is \$7,500,000 over 50 years.

### M-2 Decentralized

The Decentralized option provides \$7,500,000 in additional revenue over 50 years (\$150,000 annually)

# MAINTENANCE

The Decentralized option costs \$200K more over 50 years.

The major cost difference is the filter replacement and time required to service ERVs on floor level twice a year.

Difference: 2 hr @ 20 floors @ \$100 @ 50 years = \$200K