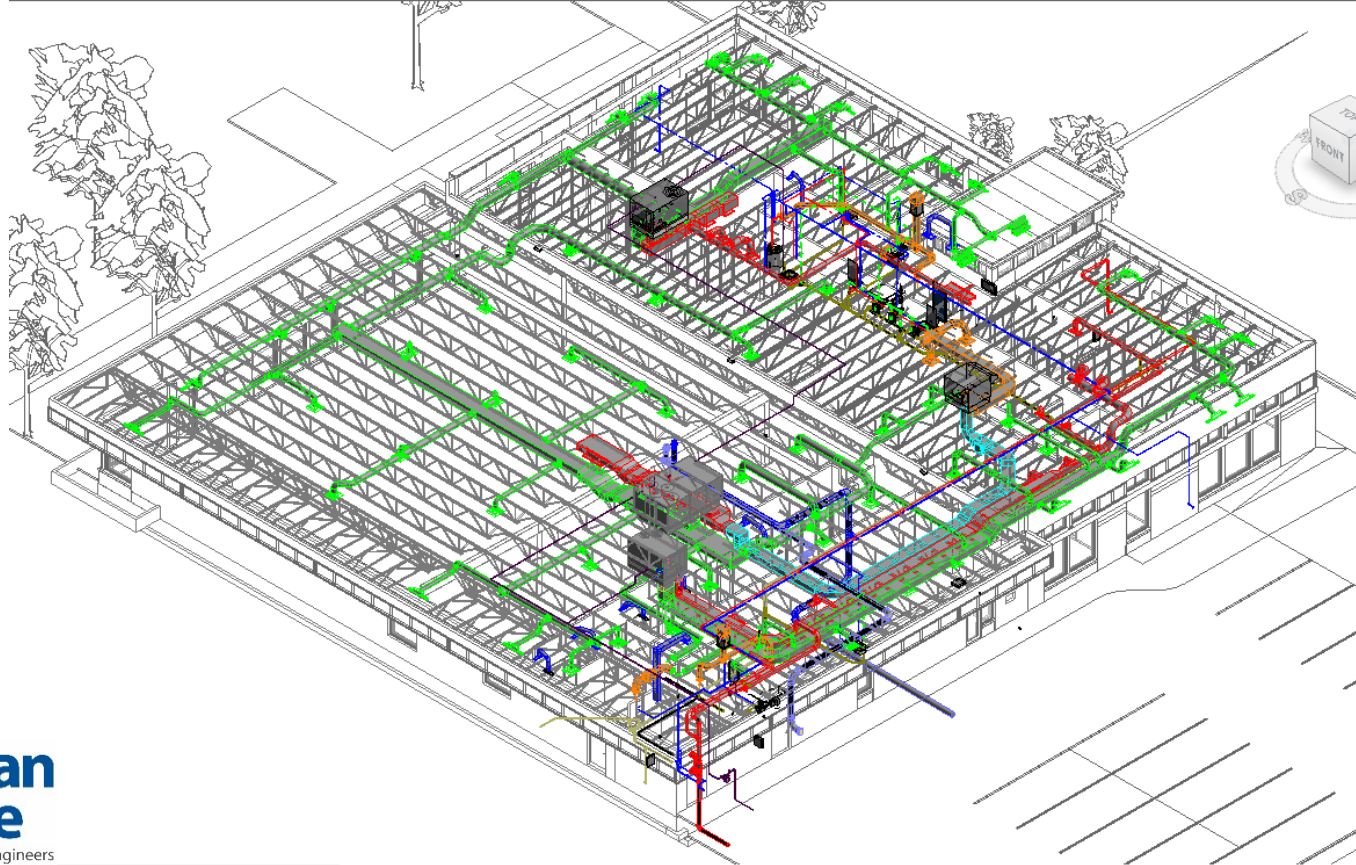


Enhancing Mechanical Engineering Productivity with Revit

Blake D. Guither, PE, BEMP, LEED AP O+M



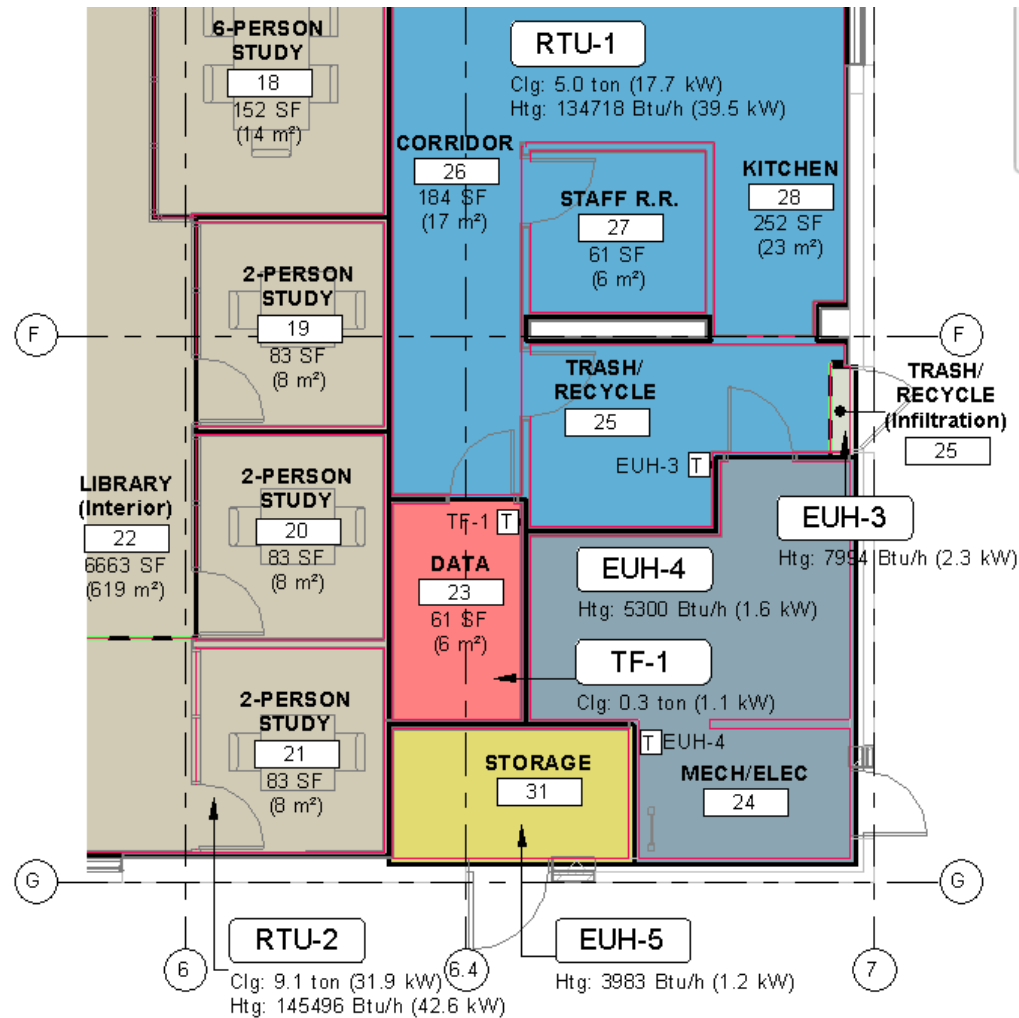
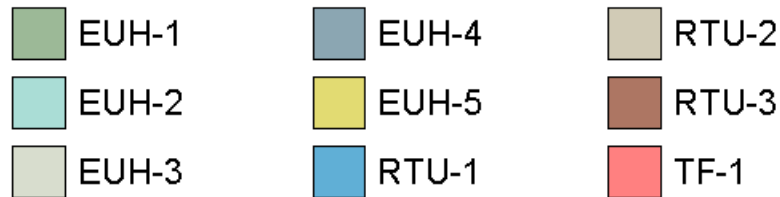
**Gausman
& Moore**
Mechanical and Electrical Engineers

Agenda

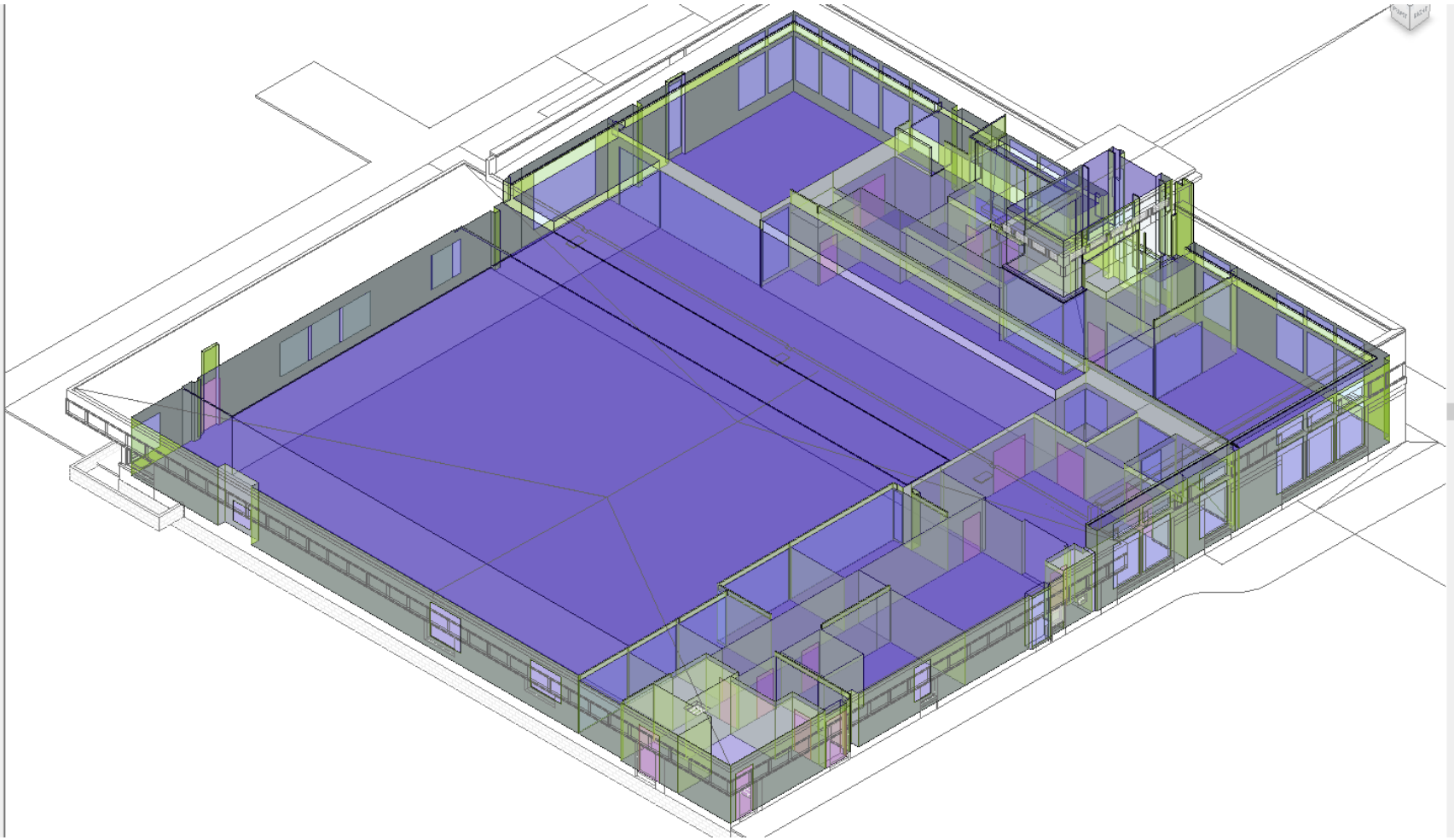
1. *Spaces & HVAC Zones*
2. *Load Calculations and Energy Modeling*
3. *Space Airflow*
4. *Flow Propagation Methodologies*
5. *Ductwork Design and Review*
6. *ASHRAE 62.1 Ventilation Calculations*
7. *Gas Flow Propagation*
8. *Equipment Selections and Manufacturer Families*
9. *The Future ...*

Spaces & HVAC Zones

- Spaces Properties
- The Thermal Zone Diagram
- Control Points
- Dual Units in Tags?



The Analytical Model

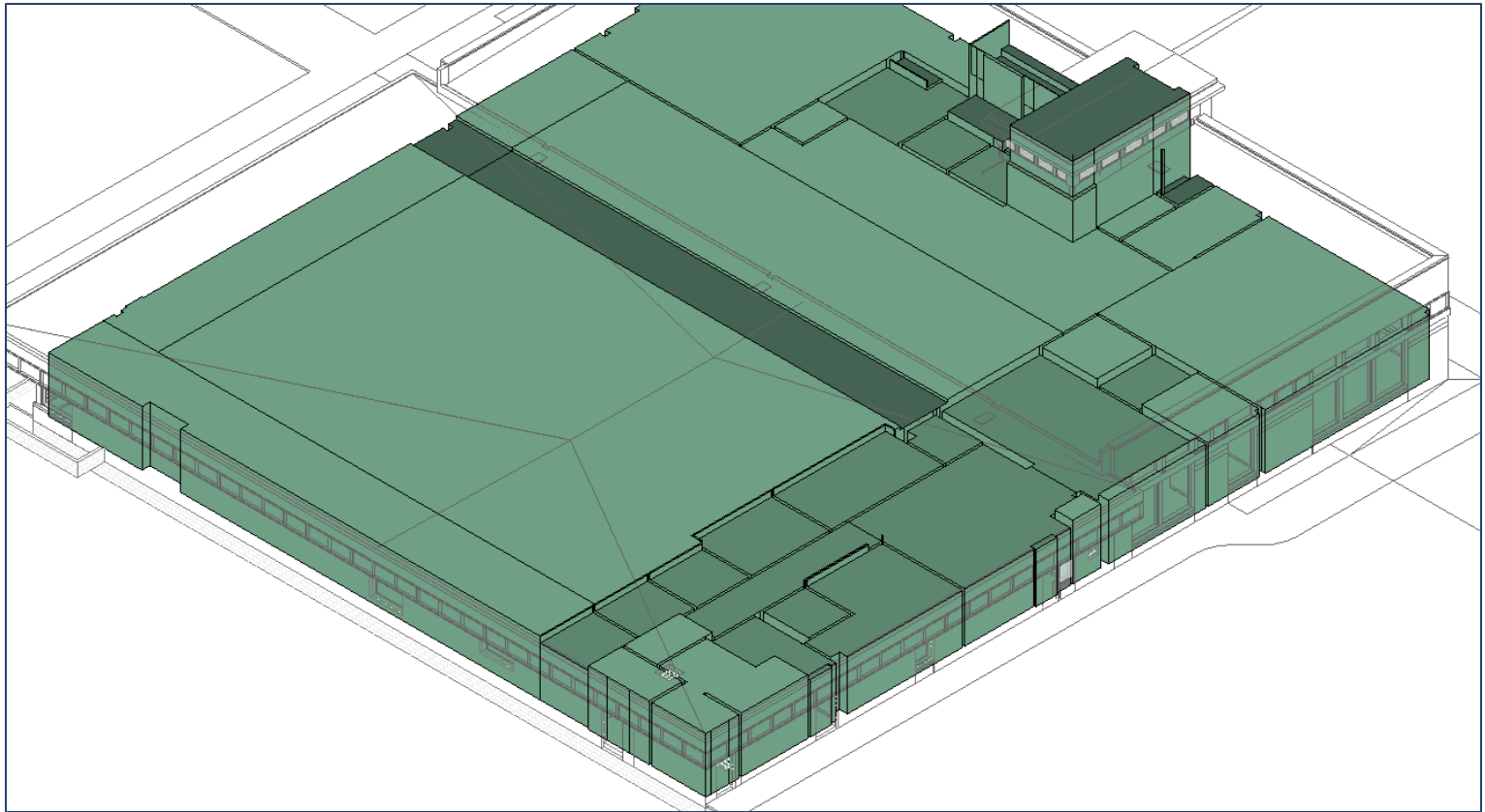


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Load Calculations & Energy Modeling

Internal load calculation engine within Revit Vs

Exporting Space and HVAC zone properties



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gbXML and Imported Results

- The Green Building XML

Spaces (1) Edit Type	
Constraints	
Electrical - Lighting	
Electrical - Loads	
Mechanical - Flow	
Specified Supply Airflow	2136.80 CFM
Calculated Supply Airflow	2136.80 CFM
Actual Supply Airflow	2040.00 CFM
Return Airflow	Specified
Specified Return Airflow	0.00 CFM
Actual Return Airflow	0.00 CFM
Specified Exhaust Airflow	0.00 CFM
Actual Exhaust Airflow	0.00 CFM
ASHRAE Outdoor Airflow Rate Per Unit Area	0 CFM/SF
ASHRAE Outdoor Airflow Rate Per Person	5.00 CFM
ASHRAE Zone Air Distribution Effectiveness	0.800000

Energy Analysis	
Zone	RTU-3
Plenum	<input type="checkbox"/>
Occupiable	<input checked="" type="checkbox"/>
Condition Type	Heated and cooled
Space Type	<Building>
Construction Type	<Building>
People	Edit...
Electrical Loads	Edit...
Calculated Heating Load	58475.97 Btu/h
Design Heating Load	58475.97 Btu/h
Calculated Cooling Load	46667.81 Btu/h
Design Cooling Load	46667.81 Btu/h
ASHRAE Default Occupant Density	50.000000
Number of People	50.000000

Space Airflow

SPACE AIRFLOW SCHEDULE					
A	B	C	D	E	F
SPACE PROPERTIES					
LOCATION			SUPPLY AIRFLOW		
NO.	NAME	AREA	ACTUAL	CALCULATED	DIFFERENCE (%)
EMBEDDED AIR TERMINAL SCHEDULE					
SYMBOL	DESCRIPTION	Model	AIRFLOW		
1	ENTRY	471.6 SF	400 CFM	399 CFM	0
I	LINEAR BAR DIFFUSER	CT-481	100 CFM		
I	LINEAR BAR DIFFUSER	CT-481	100 CFM		
J	LINEAR SLOT DIFFUS	ML-38	100 CFM		
J	LINEAR SLOT DIFFUS	ML-38	100 CFM		
2	COMMUNITY ROOM	1199.7 SF	2160 CFM	2137 CFM	1
J	LINEAR SLOT DIFFUS	ML-38	360 CFM		
J	LINEAR SLOT DIFFUS	ML-38	360 CFM		
J	LINEAR SLOT DIFFUS	ML-38	360 CFM		
J	LINEAR SLOT DIFFUS	ML-38	360 CFM		
J	LINEAR SLOT DIFFUS	ML-38	360 CFM		
J	LINEAR SLOT DIFFUS	ML-38	360 CFM		
3	STORAGE	170.7 SF	55 CFM	54 CFM	2
A	CEILING DIFFUSER	TMSA	55 CFM		
4	MEN	64.7 SF	25 CFM	25 CFM	-1
B	CEILING DIFFUSER	TMSA	25 CFM		
5	WOMEN	137.6 SF	55 CFM	54 CFM	2
B	CEILING DIFFUSER	TMSA	55 CFM		
9	6-PERSON STUDY	157.0 SF	200 CFM	195 CFM	3
J	LINEAR SLOT DIFFUS	ML-38	200 CFM		
10	LOBBY	869.8 SF	300 CFM	298 CFM	1
A	CEILING DIFFUSER	TMSA	300 CFM		

- Embedded Air Terminal Schedule
- Balance Entire Building
- Sequence

Flow Propagation

Supply Air Terminal

Connector Element (1) ▼ Edit Type	
Mechanical ⌵	
Flow Factor	0.000000
Loss Coefficient	0.000000
Flow Configuration	Preset
Flow Direction	In
System Classification	Supply Air
Loss Method	Specific Loss
Mechanical - Flow ⌵	
Pressure Drop	0.0730 in-wg
Flow	300.00 CFM
Dimensions ⌵	
Shape	Round
Height	1' 0"
Width	1' 0"
Diameter	0' 10"
Identity Data ⌵	
Utility	<input type="checkbox"/>
Connector Description	Supply Air Terminal

Supply Fan

Connector Element (1) ▼ Edit Type	
Mechanical ⌵	
Flow Factor	0.000000
Loss Coefficient	0.000000
Flow Configuration	Calculated
Flow Direction	Out
System Classification	Supply Air
Loss Method	Specific Loss
Mechanical - Flow ⌵	
Pressure Drop	0.0730 in-wg
Flow	300.00 CFM
Dimensions ⌵	
Shape	Round
Height	1' 0"
Width	1' 0"
Diameter	0' 10"
Identity Data ⌵	
Utility	<input type="checkbox"/>
Connector Description	Supply Fan Out

Flow Propagation

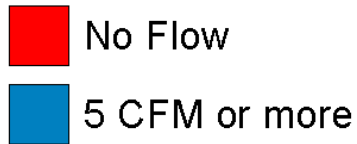
AHU Heating Coil

Connector Element (1) ▼ 🔗 Edit Type	
Mechanical ⤴	
K Coefficient	0.000000
Flow Factor	0.000000
Flow Configuration	Preset
Flow Direction	In
Loss Method	Not Defined
Allow Slope Adjustments	<input type="checkbox"/>
System Classification	Hydronic Supply
Mechanical - Flow ⤴	
Flow	0.000 GPM
Pressure Drop	0.000 psi
Dimensions ⤴	
Diameter	0' 1 1/4"
Identity Data ⤴	
Utility	<input type="checkbox"/>
Connector Description	Coil Heating Water Supply

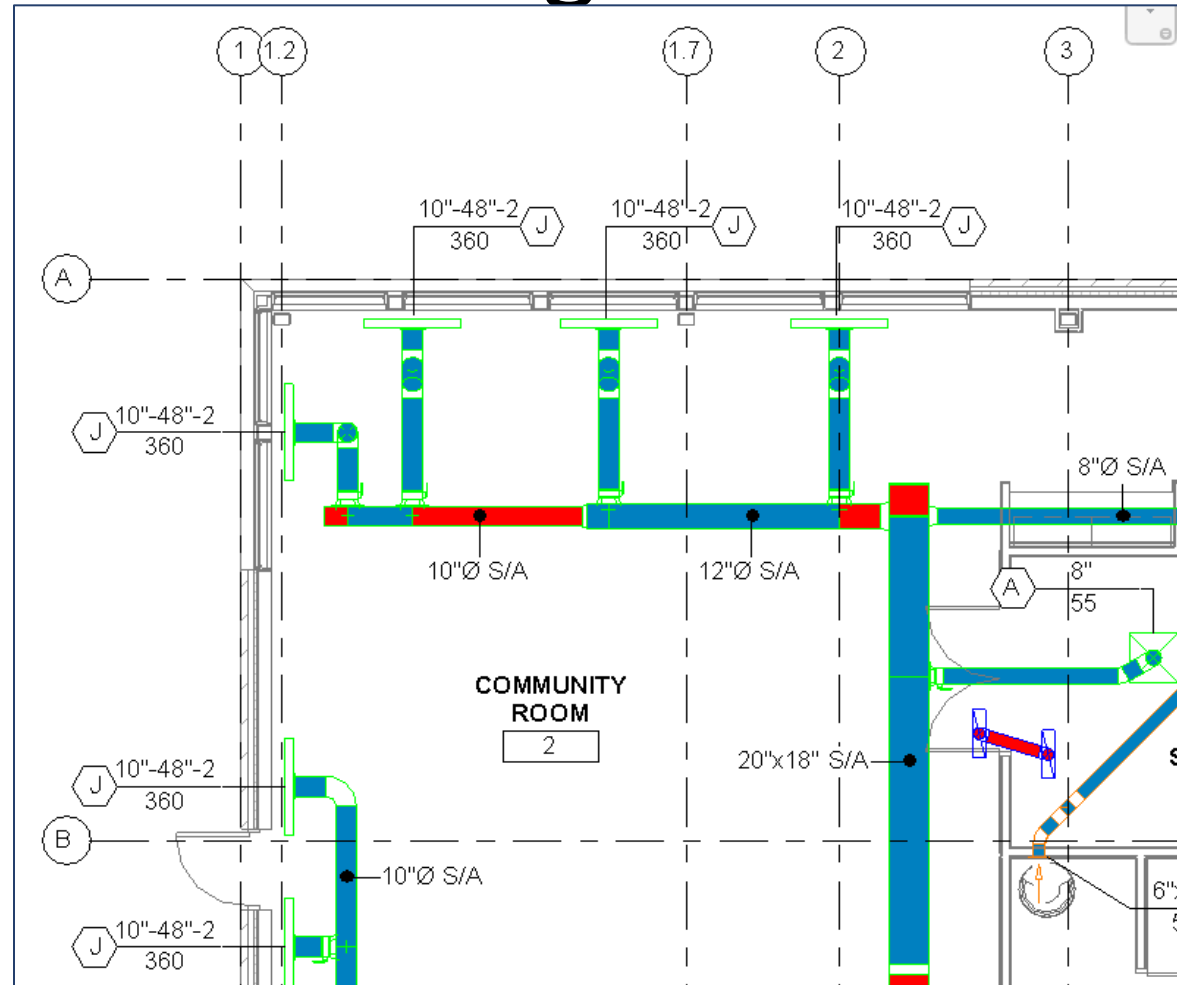
Boiler

Connector Element (1) ▼ 🔗 Edit Type	
Mechanical ⤴	
K Coefficient	0.000000
Flow Factor	0.000000
Flow Configuration	Calculated
Flow Direction	Out
Loss Method	Not Defined
Allow Slope Adjustments	<input type="checkbox"/>
System Classification	Hydronic Supply
Mechanical - Flow ⤴	
Flow	0.000 GPM
Pressure Drop	0.000 psi
Dimensions ⤴	
Diameter	0' 1 1/4"
Identity Data ⤴	
Utility	<input type="checkbox"/>
Connector Description	Boiler Supply Out

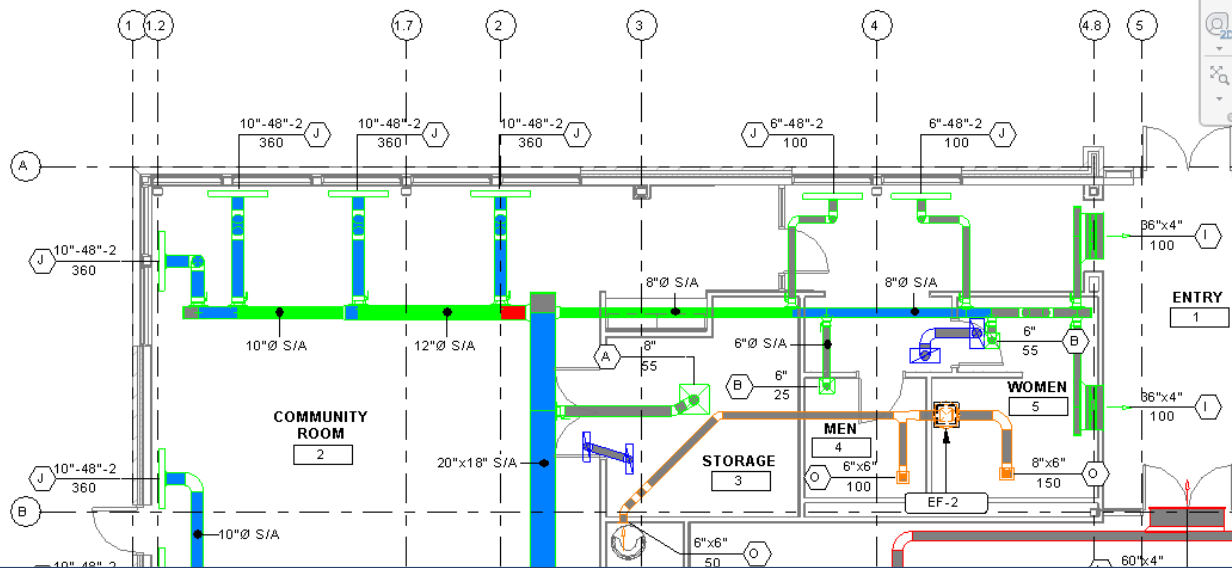
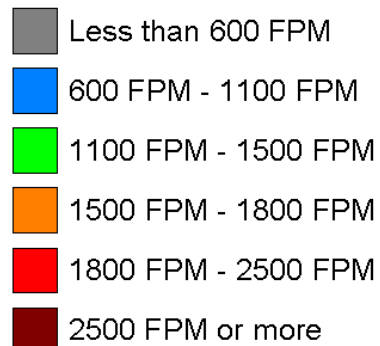
Ductwork Design



- Methods: Velocity, Friction, Equal Friction, or Static Regain
- Size sections or Entire Systems



Ductwork Design Review



EQUIPMENT SUPPLY AIRFLOW VERIFICATION

A	B	C	D	E	F	G	H
	UNIT NO.	DESCRIPTION	LOCATION NAME	NO.	SCHEDULED SUPPLY FAN AIRFLOW	EXT. STATIC PRESSURE	CONNECTED SUPPLY AIRFLOW
(E)	RTU-1	ROOFTOP UNIT	ROOF	-	2735 CFM	1.00 in-wg	2735 CFM
(E)	RTU-2	ROOFTOP UNIT	ROOF	-	5100 CFM	1.00 in-wg	5030 CFM
	RTU-3	ROOFTOP UNIT	ROOF	-	3995 CFM	1.00 in-wg	3995 CFM
	TF-1	TRANSFER FAN			340 CFM	0.38 in-wg	340 CFM

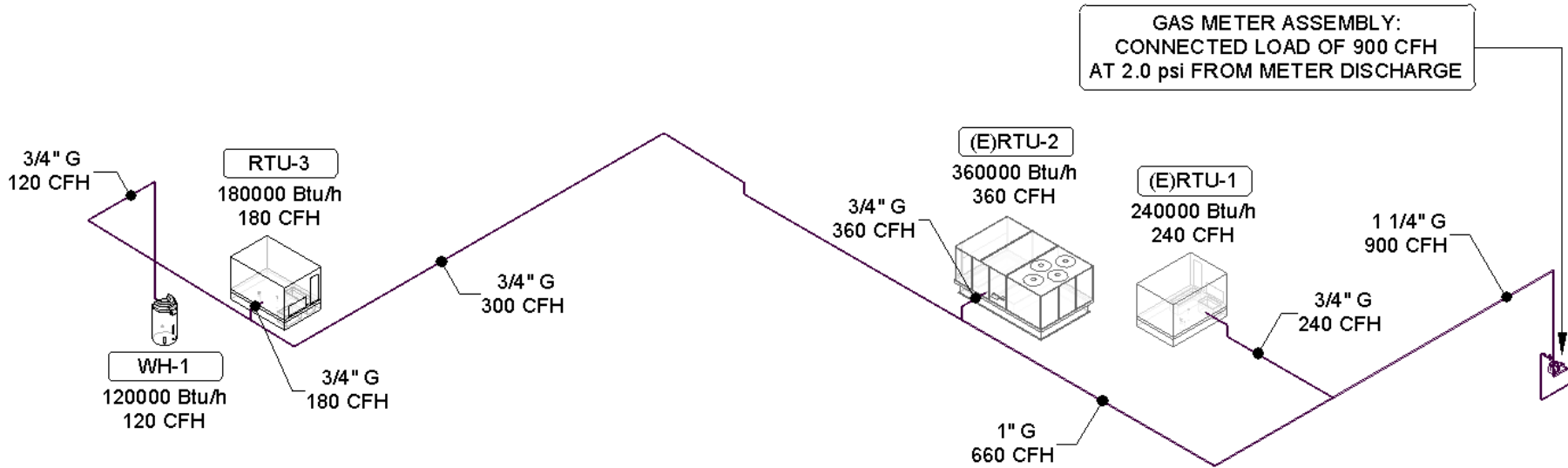
ASHRAE 62.1 Ventilation Calculations

- Constant volume Single-Zone system
- Key Schedule for Table 6-1 from the Standard
- Error Check Scheduled Airflow
- Permitting Requirements
- Dedicated Outdoor Air Systems (DOAS)

ASHRAE 62.1 VENTILATION RATE PROCEDURE SUMMARY

A	B	C	D	E	F	G	H	I
NO.	LOCATION NAME	Occupancy Category	Area, Az	Outdoor Airflow Rate Per Person, R	Outdoor Airflow Rate Per Unit Area, Ra	Breathing Zone Outdoor Airflow, V	Zone Air Distribution Effectiveness, Ez	Required Outdoor Air Intake Flow, Vot
9	6-PERSON STUDY	Conference/meeti	157 SF	5.0 CFM	0.06 CFM/SF	39 CFM	0.8	49 CFM
11	TEEN	Libraries	926 SF	5.0 CFM	0.12 CFM/SF	171 CFM	0.8	214 CFM
12	OFFICE	Office space	120 SF	5.0 CFM	0.06 CFM/SF	12 CFM	0.8	15 CFM
13	2-PERSON STUDY	Conference/meeti	73 SF	5.0 CFM	0.06 CFM/SF	14 CFM	0.8	18 CFM
14	OFFICE	Office space	99 SF	5.0 CFM	0.06 CFM/SF	11 CFM	0.8	14 CFM
15	CIRCULATION WOR	Office space	537 SF	5.0 CFM	0.06 CFM/SF	52 CFM	0.8	65 CFM
16	STORAGE	Storage rooms	54 SF	0.0 CFM	0.12 CFM/SF	7 CFM	0.8	8 CFM
25	TRASH/ RECYCLE	Storage rooms	100 SF	0.0 CFM	0.12 CFM/SF	12 CFM	0.8	15 CFM
26	CORRIDOR	Corridors	184 SF	0.0 CFM	0.06 CFM/SF	11 CFM	0.8	14 CFM
27	STAFF R.R.	Toilets (public)	61 SF					
28	KITCHEN	Break rooms	252 SF	5.0 CFM	0.06 CFM/SF	45 CFM	0.8	56 CFM
29	LIBRARIAN WORK R	Office space	498 SF	5.0 CFM	0.06 CFM/SF	50 CFM	0.8	62 CFM
30	BOOK DROP	Non-Occupiable	17 SF					
RTU-1			3078 S					531 CFM

Gas Flow Propagation



GAS LOADS SUMMARY

	UNIT NO.	DESCRIPTION	LOCATION		MANUFACTURER	MODEL	GAS LOAD INPUT	GAS HEATING VALUE (Btu/CF)	GAS FLOW (CFH)
			NAME	NO.					
(E)	RTU-1	ROOFTOP UNIT	ROOF	-	CARRIER	48TFE008	240000 Btu/h	1000	240
(E)	RTU-2	ROOFTOP UNIT	ROOF	-	CARRIER	48TJD024	360000 Btu/h	1000	360
	RTU-3	ROOFTOP UNIT	ROOF	-	CARRIER	48HCRE12B2M5	180000 Btu/h	1000	180
	WH-1	WATER HEATER	JANITOR	7	A. O. Smith	BTH-120	120000 Btu/h	1000	120

Grand total: 4

900

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Equipment Selections & Manufacturer Families

- Selection Process
- Manufacturer Content
- Third party add-in tools
- How about an industry standard mechanical shared parameter file?
- The discussion with Manufacturers has already begun

LIVE Demo Part ...

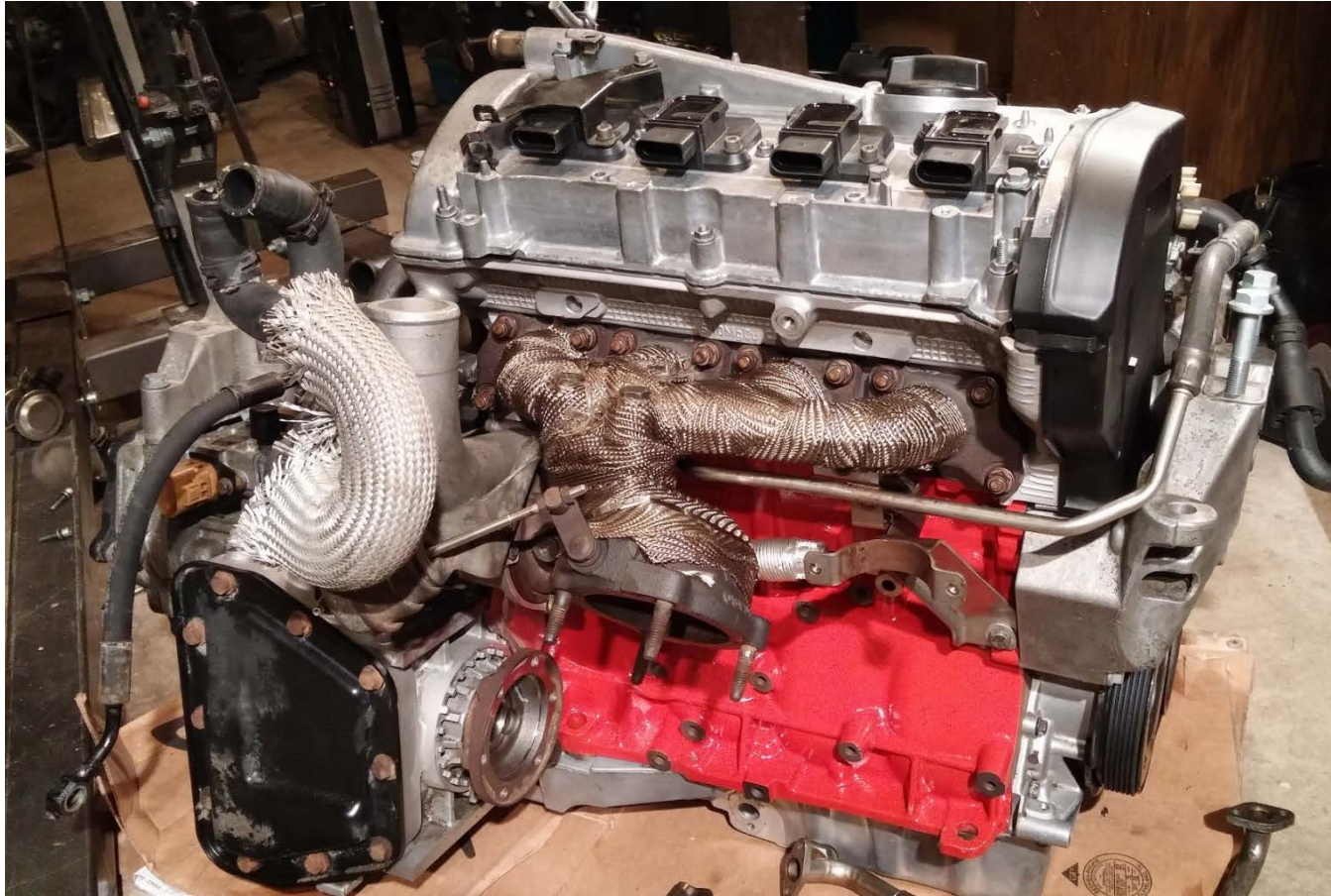


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Conclusion

- Integrative Design
- Engineering Calculations
- Starter Project defined for consistent productivity, enhanced coordination, & quality control
- Industry Standard Shared Parameters

Questions



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