

#### Understanding the Residential Energy Code Requirements for Mechanical Systems

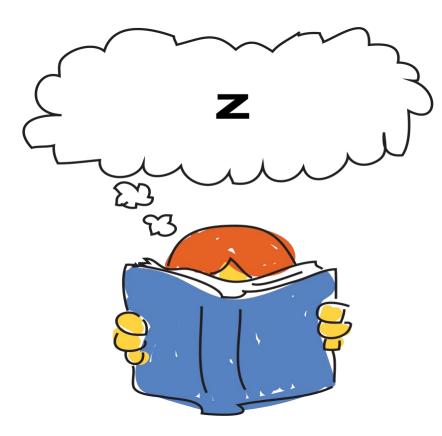
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#### **Coffee Breaks**





#### **Continuing Educational Credits Available**

• In accordance with the Department of Labor and Industry's statute 326.0981, Subd. 11,

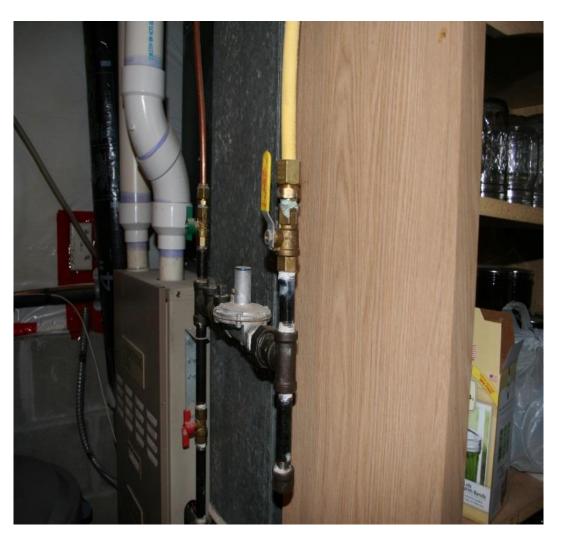
"This educational offering is recognized by the Minnesota Department of Labor and Industry as satisfying **4 hours** of credit toward **Building Officials and Residential Contractors** continuing education requirements", **including the 1 Hour Energy Credit** 

• For additional continuing education approvals, please see your credit tracking card.

#### • Calculate Heat loss for Building



- Calculate Heat loss for Building
- Size the Furnace for the Building
  - Including Oversizing



- Calculate Heat loss for Building
- Size the Furnace for the Building
- Calculate the Make up air requirements
  - Table 501.4.1

		Table 501.4.1		
Procedure		Air Quantity for Exhaust		
	One or Multiple power vent or direct vent appliances or no combustion appliances <sup>A</sup>	One or multiple fan- assisted appliances and power vent or direct appliances <sup>B</sup>	One atmospherically vented gas or oil appliance or one solid vent fuel appliance <sup>c</sup>	Mulltiple atmospherically vented gas or oil appliance or solid vent fuel appliance <sup>D</sup>
1 a) pressure factor (cfm/sf)	0.15	0.09	0.06	0.03
<ul> <li>b) conditioned floor area (sf) (including unfinished basements)</li> </ul>				
Estimated House Infiltration (cfm): [1a x 1b]				
2 Exhaust Capacity				
<ul> <li>a) continuous exhaust only ventilation system (not applicable to balanced ventilation systems such as HRV)</li> </ul>				
b) clothes dryer	135	135	135	135
<li>c) 80% of largest exhaust rating (cfm): (not applicable if recirculating system or if powered makeup air is electrically interlocked and matched to exhaust)</li>				
<li>d) 80% of next largest exhaust rating (cfm): (not applicable if recirculating system or if powered makeup air is electrically interlocked and matched to exhaust)</li>	not applicable			
Total Exhaust Capacity (cfm): [2a+2b+2c+2d]				
3 Makeup Air Requirement				
<ul> <li>a) Total Exhaust Capacity (from Above)</li> </ul>				
b) Estimated House Infiltration (from Above)				
Makeup Air quanity (cfm): [3a - 3b] (if value is negative, no makeup air is needed)				
4 For Makeup Air Opening Sizing, refer to Table 501.3.2				

- Calculate Heat loss for Building
- Size the Furnace for the Building
- Calculate the Make up air requirements
  - Sizing table 501.4.2 for passive or powered MUA

							Table 5	601.4.2						
-					Makeu	D/	Air Openir	ng Sizing	Та	ble for				
								ting Dwelli						
		One or N	/lul	tiple	One or m			One atmo	osp	oherically	Mulltiple			Passive makeup
		power ve	nt	or direct	assisted	ар	pliances	vented ga	as	or oil	atmosphe	erio	cally	air opening duct
		vent appl	iar	nces or	and powe	er i	vent or	appliance	e o	or one	vented ga	as	or oil	diameter E,F & G
	pe of opening or													
sys	stem	(0	cfr	n)	(0	cfn	n)	(•	cfn	<u>n)</u>	()	cfr	<u>n)</u>	(inches)
Pa	ssive Opening	1	-	36	1	-	22	1	-	15	1	-	9	3
Pa	ssive Opening	37	-	66	23	-	41	16	-	28	10	-	17	4
Pa	ssive Opening	67	-	109	42	-	66	29	-	46	18	-	28	5
Pa	ssive Opening	110	-	163	67	-	100	47	-	69	29	-	42	6
Pa	ssive Opening	164	-	232	101	-	143	70	-	99	43	-	61	7
Pa	ssive Opening	233	-	317	144	-	195	100	-	135	62	-	83	8
Pa	ssive Opening	318	-	419	196	-	258	136	-	179	84	-	110	9
Pa	ssive Opening	420	-	539	259	-	332	180	-	230	111	-	142	10
	ssive Opening with torized Damper	540	-	679	333	-	419	231	-	290	143	-	179	11
Po	wered Makeup Air <sup>H</sup>		>	679		>	419		>	290		>	179	Not applicable
A	Use this column if the combustion appliance		oth	er than fa	n-assisted	d o	r atmosp	herically \	/en	ited gas o	r oil applia	ano	ces or if th	nere are no
В	Use this column if the may also be include		e f	an-assist	ed appliar	nce	e per vent	ting syster	n.	Other that	an atmosp	he	rically ver	nted appliances
С	Use this column if th one solid fuel applia		e a	atmosphe	rically ven	teo	d (other t	han fan-a	ssi	sted) gas	or oil app	lia	nce per ve	enting system or
D	Use this column if the atmospherically ven	nere are r								iances us	ing a com	m	on vent or	if there are
E	An equivalent length for each 90-degree	of 100 fe	eet	of round	smooth m	eta	al ductis	assumed	. 5			the	e exterior	hood and ten feet
F	If flexible duct is use						•					d	with minin	nal sags.
G													7	
	Barometric dampers	s are proh	nib	ited in pa	ssive mak	eu	p air oper	nings whe	n a	any atmos	pherically	VE	ented <sup>7</sup> appli	iance is installed.
н	Powered makeup ai	r shall be	el	ectrically	interlocke	d١	vith the la	argest exh	au	st system.	-			

- Calculate Heat loss for Building
- Size the Furnace for the Building
- Calculate the Make up air requirements
- Calculate the Combustion air requirements

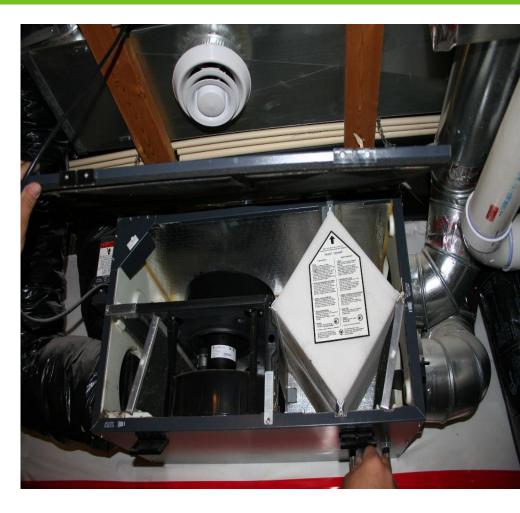




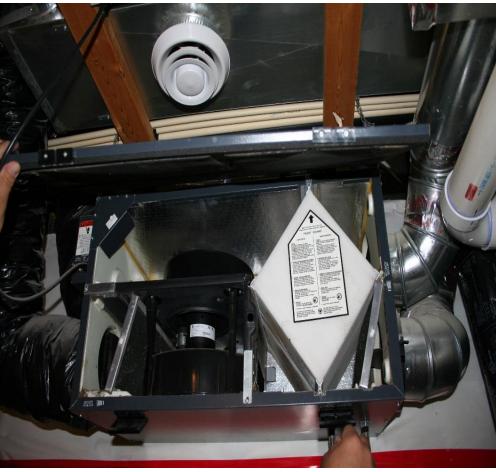
- Calculate Heat loss for Building
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- Calculate the Combustion air requirements
  - IFGC Appendix E

	IFGC Appendix E, Worksheet E-1
	Residential Combustion Air Calculation Method (for Furnace, Boiler, and/or Water Heater in the Same Space)
Step 1: Com	lete vented combution appliace information:
Furnace/Boile Draft Hoo (Not fan Assis	d Fan Assisted Direct Vent Input:Btu/hr ted) & Power Vent
Water Heater Draft Hoo ( Not fan Assis	d Fan Assisted Direct Vent Input:Btu/hr
Step 2: Calcu	ate the volume of the Combustion Appliance Space (CAS) containing combustion appliances.
The CAS inclu	Ides all spaces connected to one another by code compliant openings. CAS volume:ft <sup>3</sup>
	nine air Changes per Hour (ACH) <sup>1</sup>
or ACH is no	values have been incorporated into Table E-1 for use with Method 4b (KAIR Method). If the year of construction t known, use method 4a (Standard Method).
	nine Required Volume for Combustion Air.
	ard Method
	out of all combustion appliances (DO NOT COUNT DIRECT VENT APPLIANCES) Input:Btu/hr
	Method column in Table E-1 to find Total Required Volume (TRV) TRV:ft <sup>3</sup>
	(from Step 2) is greater than TRV then no outdoor openings are needed.
	(from Step 2) is less than TRV then go to STEP 5.
Total Btu/hr in	Air Infiltration Rate (KAIR) Method out of all fan-assisted and power vent appliances INT DIRECT VENT APPLIANCES) Input:Btu/hr
	ted Appliances column in Table E-1 to find ne Fan Assisted (RVFA) RVFA:ft <sup>3</sup>
Total Btu/hr ing	ut of all non-fan-assisted appliances Input: Btu/hr
	Assisted Appliances column in Table E-1 to find ne Non-Fan-Assisted (RVNFA) RVNFA: ft <sup>3</sup>
Total Required	Volume (TRV) = RVFA + RVNFA TRV = + = ft <sup>3</sup>
	(from Step 2) is greater than TRV then no outdoor openings are needed.
If CAS Volume	(from Step 2) is less than TRV then go to STEP 5.
Step 5: Calcula	te the ratio of available interior volume to the total required volume.
Ratio = CAS Vo	lume (from Step 2) divided by TRV (from Step 4a or Step 4b) Ratio = / =
	te Reduction Factor (RF).
RF = 1 minus I	
	te single outdoor opening as if all combustion air is from outside.
	ut of all Combustion Appliances in the same CAS (EXCEPT DIRECT VENT) Input:Btu/hr
Total Bfu/br div	Opening Area (CAOA): ided by 3000 Btu/hr per in²
	te Minimum CAOA.
	= CAOA <i>multiplied by</i> RF Minimum CAOA ≔ x = in <sup>2</sup>
	te Combustion Air Opening Diameter (CAOD)

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- Calculate the Combustion air requirements
- Calculate and design the ventilation system
  - R 403.5.3 Continuous ventilation



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  - R 403.5.3 Continuous ventilation
  - R 403.5.2 Total Ventilation (continuous + intermittent)



- Calculate Heat loss for Building
- Size the Furnace for the Building
- Calculate the Make up air requirements
- Calculate the Combustion air requirements
- Calculate and design the ventilation system
  - Continuous ventilation
  - Total Ventilation (continuous + intermittent)
- Discussion on the Service water heating System and the Energy code Requirements R 403.4.2

2/27/2019



- Calculate Heat loss for Building
- Size the Furnace for the Building
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  - Total Ventilation (continuous + intermittent)





- Discussion on the Service water heating System and the Energy code Requirements
- Discussion on Electrical requirements and the Energy Code Requirements R R404 2/27/2019

#### Disclaimer

• Information in this seminar may contain code language which has been paraphrased or summarized in order to provide more clarity for instruction purposes. When inquiries arise in the field, reference must be made to the actual code language contained in the appropriate Rule Chapter of the Minnesota State Building Code.

• Heating and Cooling Systems and calculated heat loss requirements

#### Lets calculate a simple Heat loss of a wall

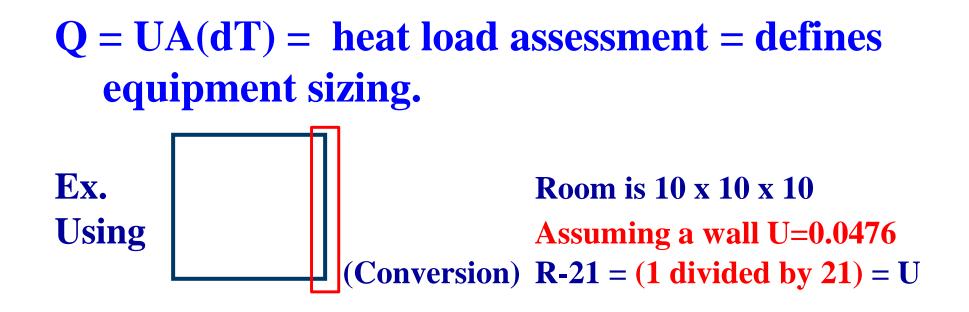
#### Lets calculate a simple Heat loss of a wall

• Here is a simple example of a wall and then the same wall with a window

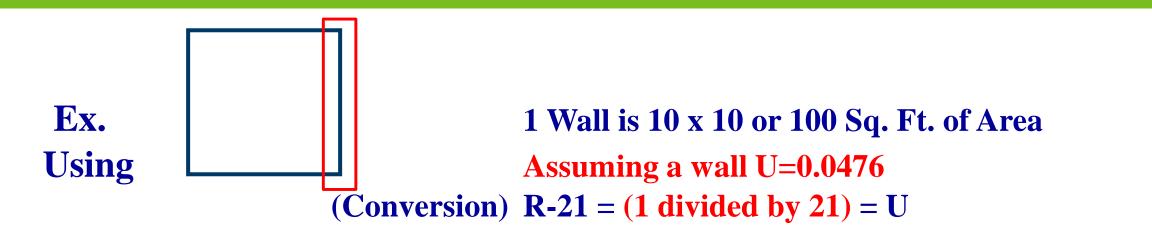
#### Lets calculate a simple Heat loss of a wall

- Here is a simple example of a wall and then the same wall with a window
- Note the changes in heat loss with the window

## Do the Math



## Q = UA(dT) =



#### Q= 0.0476 (U) x 100 (A) x 90 (dT) = 428.4 (or 429) Btu per hour of heat loss on each wall (assuming no windows)

# What is the total for the building in Heat Loss (Btu's)

 Adding in all 4 walls at the exact same Btu's for each wall (4 x 429) would require a heating appliance capable of supplying a minimum of 1,716 Btu's What is the total for the building in Heat Loss (Btu's) when we add a 4 x 4 window meeting code to one wall?

• Wall #4 was 100 Sq. Ft. at .0476 U- Factor. Now it is only 84 Sq. Ft. at the .0476 U-Factor + 16 Square foot at a 0.30 U-Factor to accommodate the window.

- Wall 1 = .0476 x 100 x 90 = 429 Btu's
- Wall 2 = .0476 x 100 x 90 = 429 Btu's
- Wall 3 = .0476 x 100 x 90 = 429 Btu's
- Wall 4 = .0476 x 84 y 90 = 360 Btu's
- Window 1 In wall 4=

<u>.30 x 16 x 90 = 432 Btu's</u>

Total Btu's now are

2079 total Btu's

-1716 Wall w/out Window

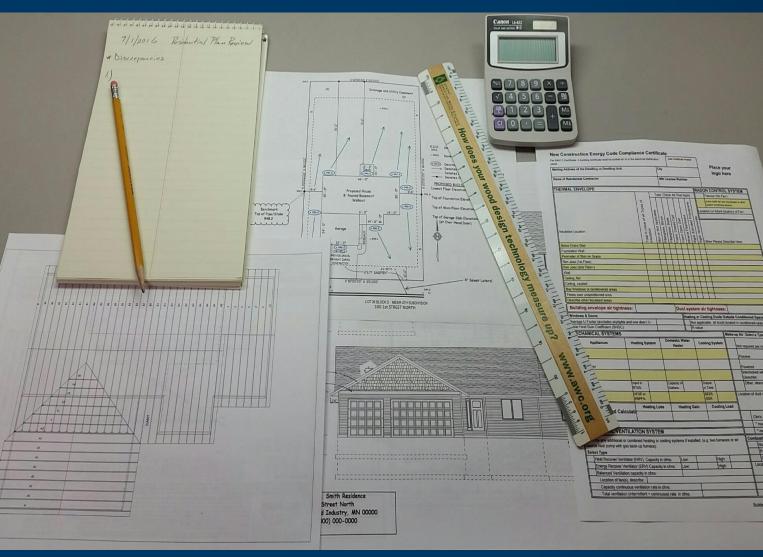
**Difference of** 

+ 363 Btu's (adding the window)

This can make a big difference in heating and cooling appliances depending on Number of windows and their U-factors

## **Classroom Exercise**

• Grab the Plans and Lets calculate this home together



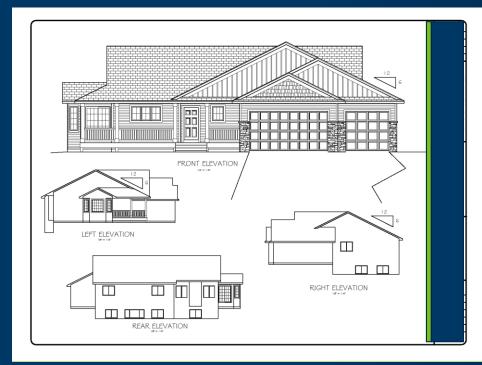
#### **4** Pages of the Plans

**Elevations Page** 

Type of foundation

Walk out (8' Grade Differential) Look out (4' Grade Differential)

Full Basement (No Grade Differential)



**4** Pages of the Plans

**Elevations Page** 

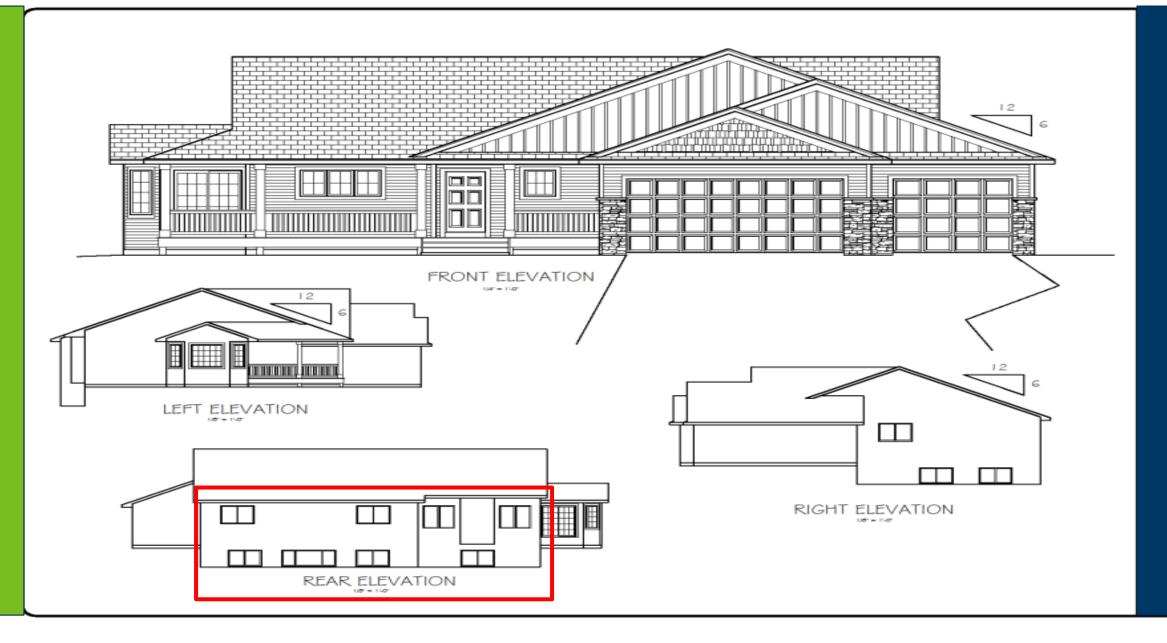
type of foundation

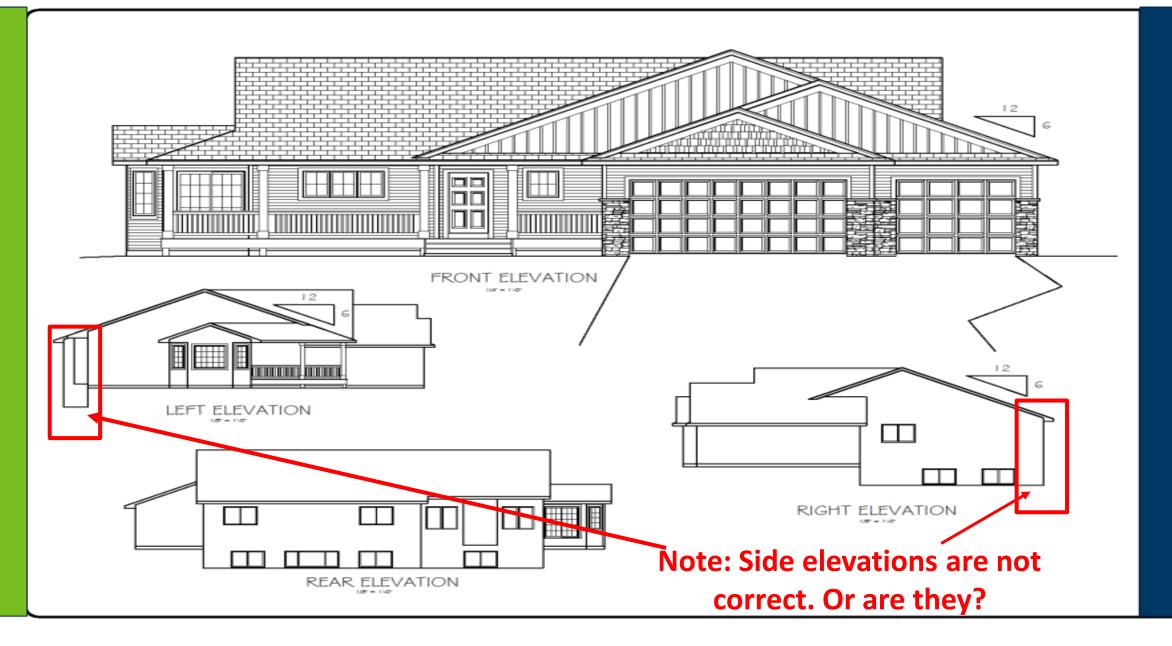
Walk out (8' Grade Differential)

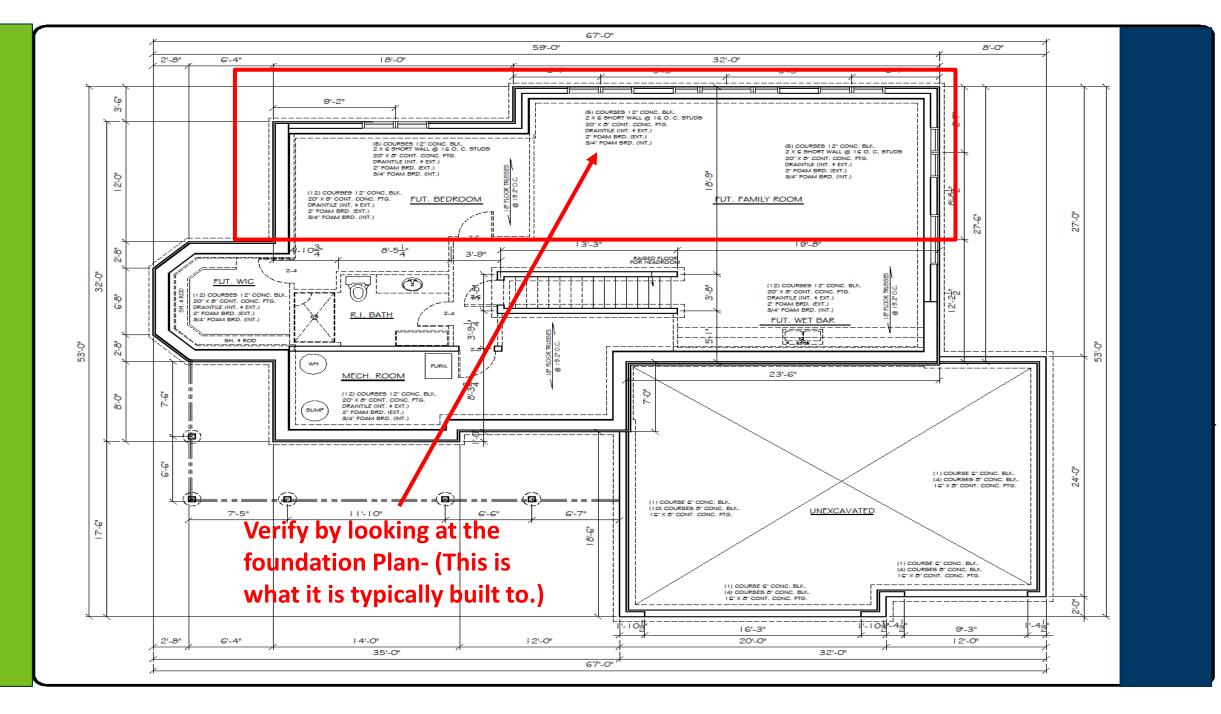
Look out (4' Grade Differential)

Full Basement (No Grade Differential)

What does this tell us about the Back wall(s) of the home?







**4 Pages of the Plans** 

Main Floor Page

Where is the Building Envelope?

What does it consist of Wood Framed- Masonry Etc..?

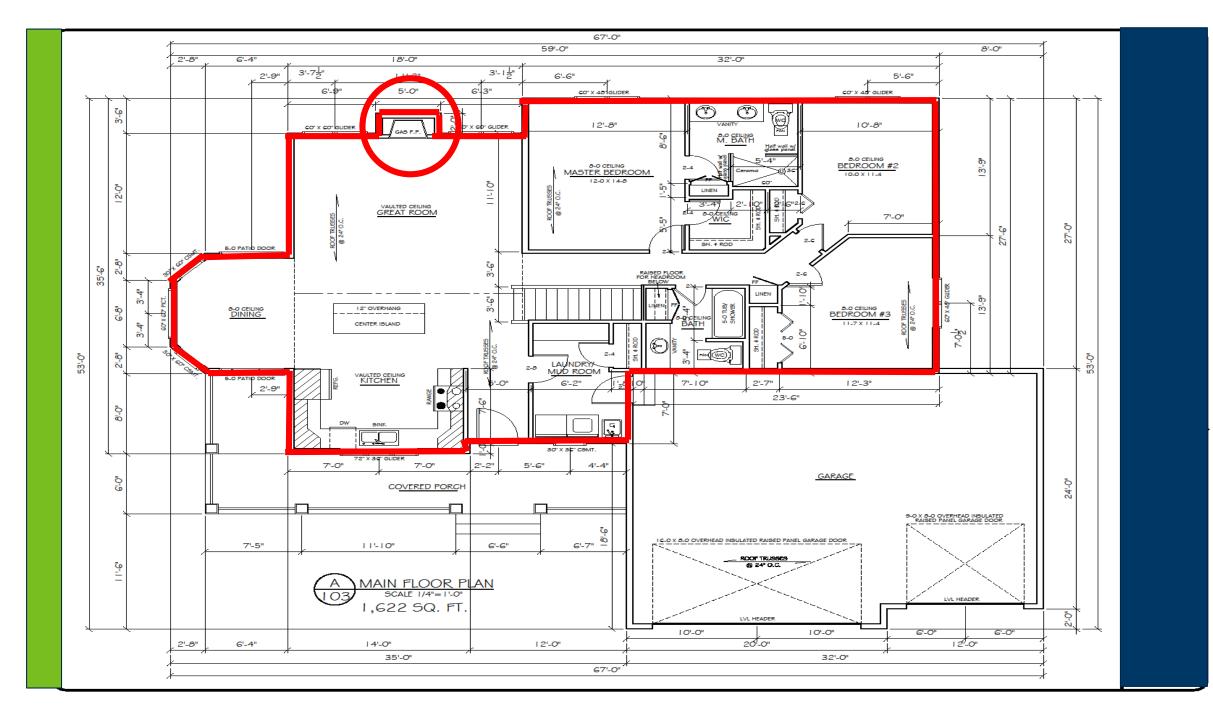
**4 Pages of the Plans** 

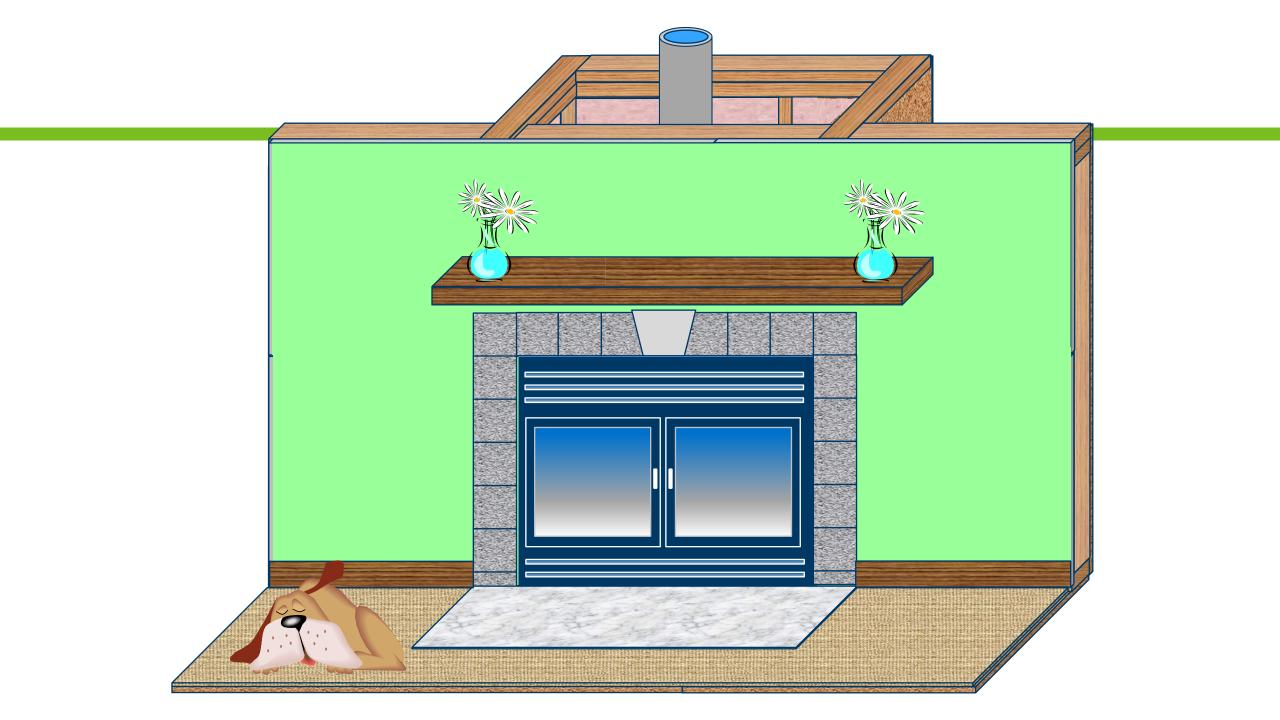
Main Floor Page

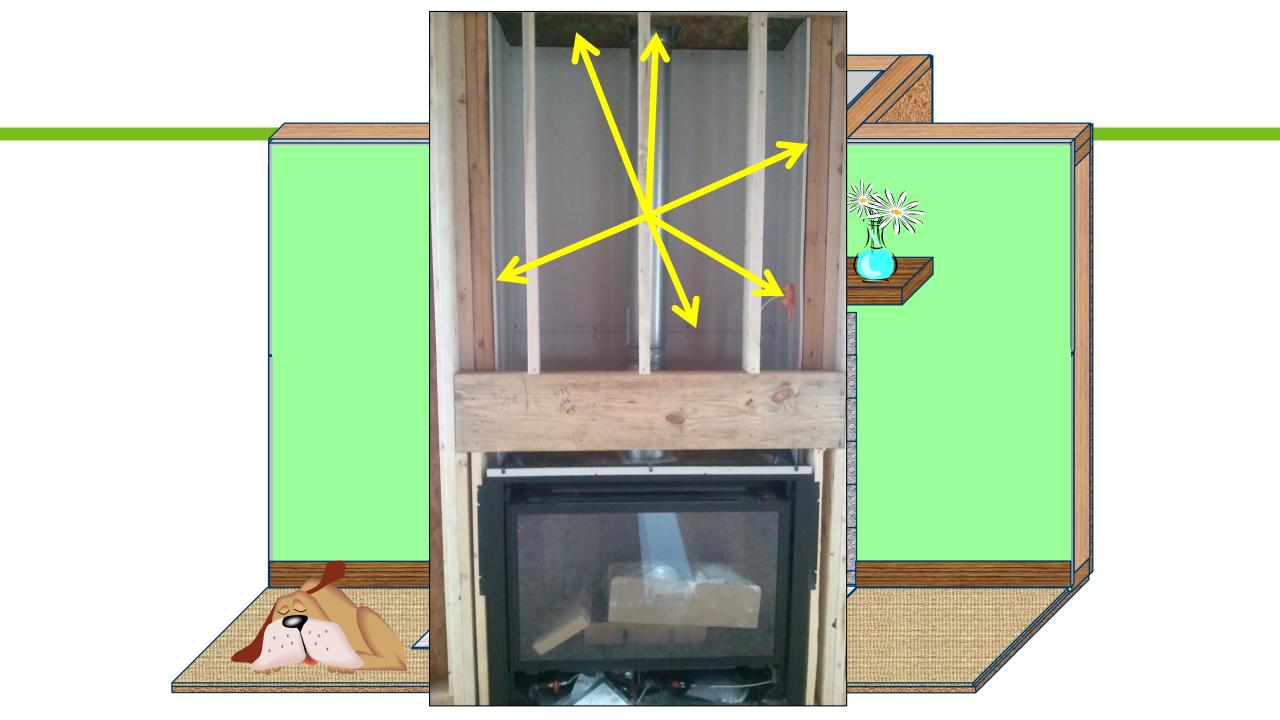
Where is the Building Envelope?

What does it consist of Wood Framed- Masonry Etc..?

Are there any cantilevers or Bump-Outs?







**4 Pages of the Plans** 

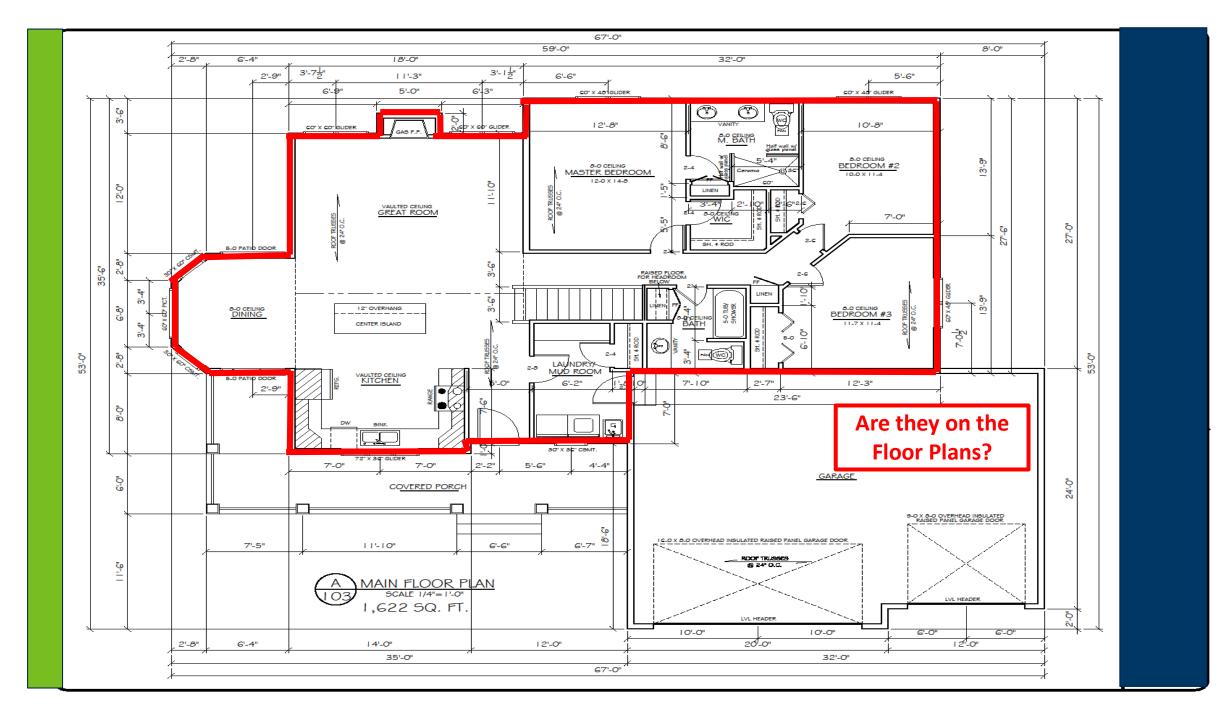
**Main Floor Page** 

Where is the Building Envelope?

What does it consist of Wood Framed- Masonry Etc..?

Are there any cantilevers or Bump-Outs?

What Are the R values and where do I find them?



#### ENERGY CODE NOTE:

CONTRACTOR AND SUB-CONTRACTOR ARE RESPOSIBLE FOR COMPLIANCE OF THE CURRENT CODE AS REQUIRED. 1. INTERIOR VAPOR RETARDER ON INSULATED CEILINGS, WALL AND FLOORS. 2. CONTINIOUS AIR BARRIER AT ALL FLUMBING AND HEATING PENETRATIONS.

3. FIRE STOPS MUST BE INSTALLED TO BLOCK AIR MOVEMENT INTO ATTIC.

4. PENETRATIONS IN THE BUILDING ENEVELOPE FOR ELECTRICAL AND TELECOMMICATIONS (EXCEPT FOR ELECTRICAL BOXES AND FAN HOUSINGS) MUST BE SEALED TO PREVENT AIR LEAKAGE.

Are they On this Cross

**Section Page?** 

5. WIND WASH BARRIER REQUIRED AT THE EXTERIOR EDGE OF ATTIC INSULATION.

6. WIND WASH BARRIER REQUIRED AT OVERHANG SUCH AS CANTILEVERED FLOORS AND BAY WINDOWS.

7. WINDOW AND DOOR FRAMES MUST BE SEALED.
 8. ALL EXTERIOR JOINTS THAT MAY BE A SOURCE OF AIR.

INTRUSION MUST BE SEALED.

9. RIM JOISTS MUST DE SEALED TO PREVENT AIR LEAKAGE.

I O. TOPS OF INTERIOR PARTITION WALLS MUST BE SEALED TO PREVENT AIR LEAKAGE.

11. ELECTRICAL BOXES AND FANS MUST BE SEALED TO PREVENT AIR LEAKAGE.

I 2. BETWEEN WALL ASSEMBLIES, RIM JOISTS, AND FOUNDATIONS MUST BE SEALED TO PREVENT AIR LEAKAGE.

I 3. A MECHANICAL VENTILATION SYSTEM WHICH REPLACES, BY DIRECT OR INDIRECT MEANS, AIR FROM HABITABLE ROOMS

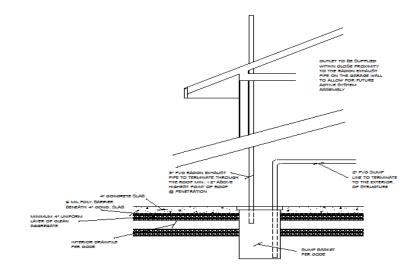
WITH OUTDOOR AIR (THIS WOULD ALLOW EXHAUST ONLY. AIR EXCHANGER OR HEAT RECOVERY VENTILATOR-HRV)

14. DIRECT VENT, POWER VENT, OR SEALED COMBUSTION

FURNACE, WATER HEATER, OR GAS FIREPLACE.

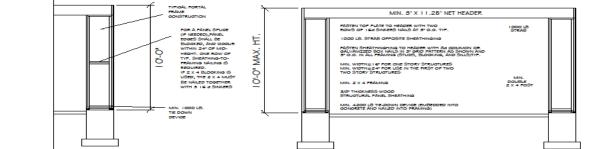
I 5. IF ANY SINGLE EXHAUST DEVICE (E.G. KITCHEN FAN OR DRYER) OVER 300 CFM IS INSTALLED. A SEALED COMBUSTION FURNACE MUST BE USED OR AN ALTERNATIVE MAKE UP AIR SOURCE

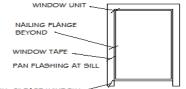
MUST BE USED.



RADON DETAIL

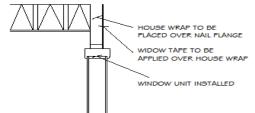




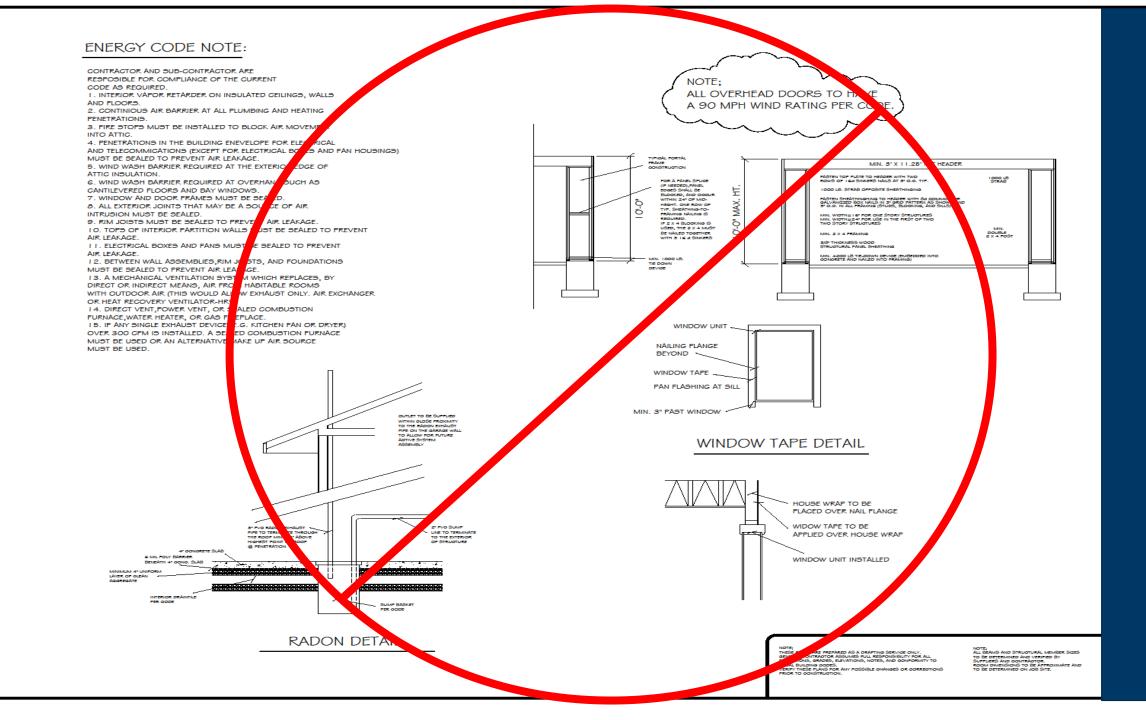


MIN. 3" PAST WINDOW

WINDOW TAPE DETAIL



NOTE: THESE FLANS ARE FREPARED AS A DRAFTING SERVICE ONLY. GENERAL CONTRACTOR ASSUMES FULL RESPONSIBILITY FOR ALL DIMENSIONES, GRADES, LEVATIONS, NOTES, AND CONFORMITY TO LOURING TO BOOK MADE ANY FOSSIBLE ONANGES OR DORRECTIONS FROM TO DOMSTRUCTION. NOTE: ALL BRANS AND STRUCTURAL MEMBER SIZES TO BE DETERMINED AND VERIFIED BY SUFFLIERS AND GOATMANTER MOON DIMENSIONS TO BE AFFROMMATE AND TO BE DETERMINED ON JOB STR.



#### New Construction Energy Code Compliance Checklist/Certificate

Mailing Address of the Dwelling or Dwelling Unit							City							DEPARTMENT OF			
1234 Any Street						Any town Mn											
Name of Residential Con						MN License Number											
<u> Iohn Doe Construct</u>	tion Inc.						00	001	<u>234</u>	<u>56</u>							
THERMAL ENVELOPE								F				RADO	Ν	CONTROL SYSTEM			
				Т	Check	all T	II That App		ly		х	1	Passive (No Fan)				
			oť							Ø				Active (With fan and monometer or other system monitoring device)			
			Sec	ł						rene		Locatio	n (c	or future location) of Fan:			
	Type	ple						ysty		Attic							
			ofal	olica	ş	tts	Cell	=	bard	I Pol	ate		-				
Insulation Location			Total R-Value of all Types I nsulation	Non or Not Applicabl	Fiberglass, Blown	Fiberglass, Batts	Foam, Closed Cell	Foam Open Cell	Mineral Fiberboard	Rigid, Extruded Polystyrene	Rigid, Isocynurate	Other P	Please Describe Here				
Below Entire Slab			62														
Below Entire Slab Foundation Wall							х				R-10	Using E	Exte	erior Closed cell Foam			
Perimeter of Slab on Grade				N/A													
Rim Joist (1st Floor)				R-21			х					Using F	2-21	Foam Insulation. Closed cell			
Rim Joist (2nd Floor+)				N/A													
Wall				R-21		х						Using F	ric	tion Fit Fiberglass Batt Insulation			
Ceiling, flat				R-49													
Ceiling, vaulted				R-49	х	×											
Bay Windows or cantilevered areas				R-49		х											
-				D 20													
Floors over unconditioned an Describe other insulated area	ea as	Be Testing to	N/A a Maxim	R-30	of 2.6	x	Ict S	Svst	em	∆ir 1	<b>Fight</b>	ness:					
Floors over unconditioned are Describe other insulated area Building Envelope Ai Tightness: Windows & Doors	ea as ir Will Fina	Be Testing to Il Test = ?	a Maxim	1	f 2.6	x	_	ating	or C	oolin	g Duc			Conditioned Spaces			
Floors over unconditioned an Describe other insulated area Building Envelope Ai Tightness: Windows & Doors Average U-Factor (excludes	ea as ir Will Fina skylights and o	Il Test =?	a Maxim	1	f 2.6	x	_	ating Not a	or C appli	oolin cable	g Duc e, all d	ts Outs ucts lo	cate	ed in conditioned space			
Floors over unconditioned an Describe other insulated area Building Envelope Ai Tightness: Windows & Doors Average U-Factor (excludes Solar Heat Gain Coefficient (	ea as ir Will Fina skylights and d (SHGC):	Il Test =?	a Maxim	1	f 2.6	x	_	ating Not a	or C appli	oolin cable	g Duc e, all d	ts Outs ucts loo f ducts	cate are	Conditioned Spaces ad in conditioned space in exterior walls) N/A			
Floors over unconditioned an Describe other insulated area Building Envelope Ai Tightness: Windows & Doors Average U-Factor (excludes	ea as ir Will Fina skylights and d (SHGC):	Il Test =?	a Maxim	1	f 2.6	x	_	ating Not a	or C appli	oolin cable	g Duc e, all d	ts Outs ucts loo f ducts	are are	Conditioned Spaces ed in conditioned space in exterior walls) N/A Air Select a Type			
Floors over unconditioned an Describe other insulated area Building Envelope Ai Tightness: Windows & Doors Average U-Factor (excludes Solar Heat Gain Coefficient (	ea as ir Will Fina skylights and a SHGC): EMS Heating S	Il Test =? one door) U: System	a Maxim .30 .35 Dome	num o	/ater	X Du Heat	He	eating Not a R-va	or C appli	oolin cable need	g Duc e, all d This i	ts Outs ucts loo f ducts	are are	Conditioned Spaces ad in conditioned space in exterior walls) N/A			
Floors over unconditioned an Describe other insulated area Building Envelope Ai Tightness: Windows & Doors Average U-Factor ( <i>excludes</i> Solar Heat Gain Coefficient ( MECHANICAL SYSTE	ea as ir Will Fina skylights and o (SHGC): EMS Heating S Gas Forced A Sealed Comb	Il Test =? Done door) U: System Air furnace	.30 .35 Dome Gas- Fa	num o	/ater	X Du Heat	er	eating Not a R-va Co Elec	or Co applie lue (r oling	oolin cable need	g Duc e, all d This i	ts Outs ucts loo f ducts	are -up No	Conditioned Spaces ed in conditioned space in exterior walls) N/A Air Select a Type			
Floors over unconditioned are Describe other insulated area Building Envelope Ai Tightness: Windows & Doors Average U-Factor ( <i>excludes</i> Solar Heat Gain Coefficient ( MECHANICAL SYSTE Appliances	ea as ir Will Fina Skylights and d (SHGC): EMS Heating S Gas Forced A	Il Test =? Done door) U: System Air furnace	a Maxim .30 .35 Dome	num o	/ater	X Du Heat	er	eating Not a R-va	or Co applie lue (r oling	oolin cable need	g Duc e, all d This i	ts Outs ucts loo f ducts Make	are -up No Pa	Conditioned Spaces ed in conditioned space in exterior walls) N/A o Air Select a Type It required per mech. code			
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Floors over unconditioned an Describe other insulated area Building Envelope Ai Tightness: Windows & Doors Average U-Factor ( <i>excludes</i> Solar Heat Gain Coefficient ( MECHANICAL SYSTE Appliances Fuel Type Manufacturer Model Rating or Size	ea as ir Will Fina Skylights and ( SHGC): EMS Heating S Gas Forced / Sealed Comt Lennox.	al Test =?	a Maxim .30 .35 Dome Gas- Fa State CV 30 N	stic V n Ass NSRT Btu's	Vater sistec	X Du Heat	er	R-va	or Cd appli llue (r oling D-042	oolin cable need Syst	g Duc o, all d This i eem	ts Outs ucts loo f ducts Make X N/A N/A X	Pa Po Ot	Conditioned Spaces ed in conditioned space in exterior walls) N/A o Air Select a Type et required per mech. code ssive wered erlocked with exhaust device. sscribe: her, describe: Flex Duct			
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## **Calculating Heat Loss**

• Now that we have found the information on the plans. How do we calculate heat loss?

## **Calculating Heat Loss**

- Now that we have found the information on the plans. How do we calculate heat loss?
- What are all the parts of the structure we need to look at?



#### Residential Load Calculation

MANUAL



## OR



### **Calculating Heat Loss can be done Either way**



#### • What exactly is this equation?.... and why do we need to understand it?

• Q = what we are trying to define (Btu's lost Per hour)

- Q = what we are trying to define
- U = the U-value of the wall

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- U = the U-value of the wall
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- (dt) = Delta T or temperature difference...

- Q = what we are trying to define
- U = the U-value of the wall
- A = Area of the wall
- (dT) = Delta T or temperature difference...

#### Or as it looks in a mathematical equation **Q** = UA(dT)

### Did we miss anything on the plans?

#### **4 Pages of the Plans**

**Main Floor Page** 

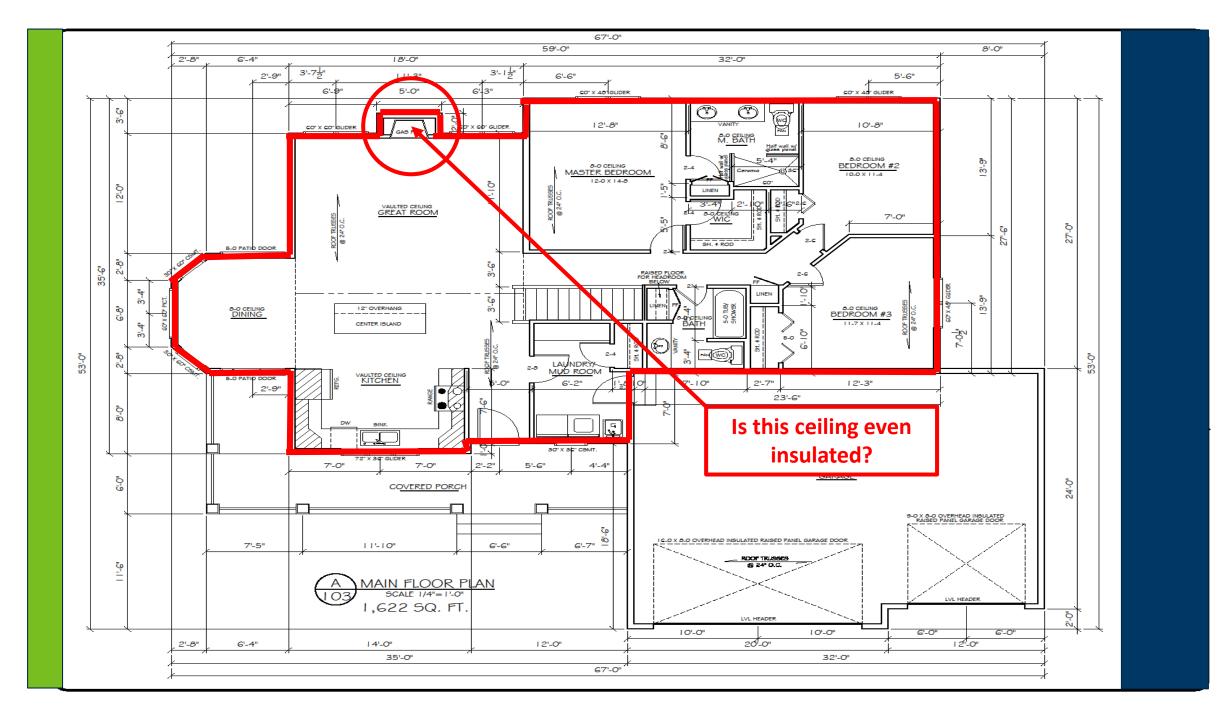
Where is the Building Envelope?

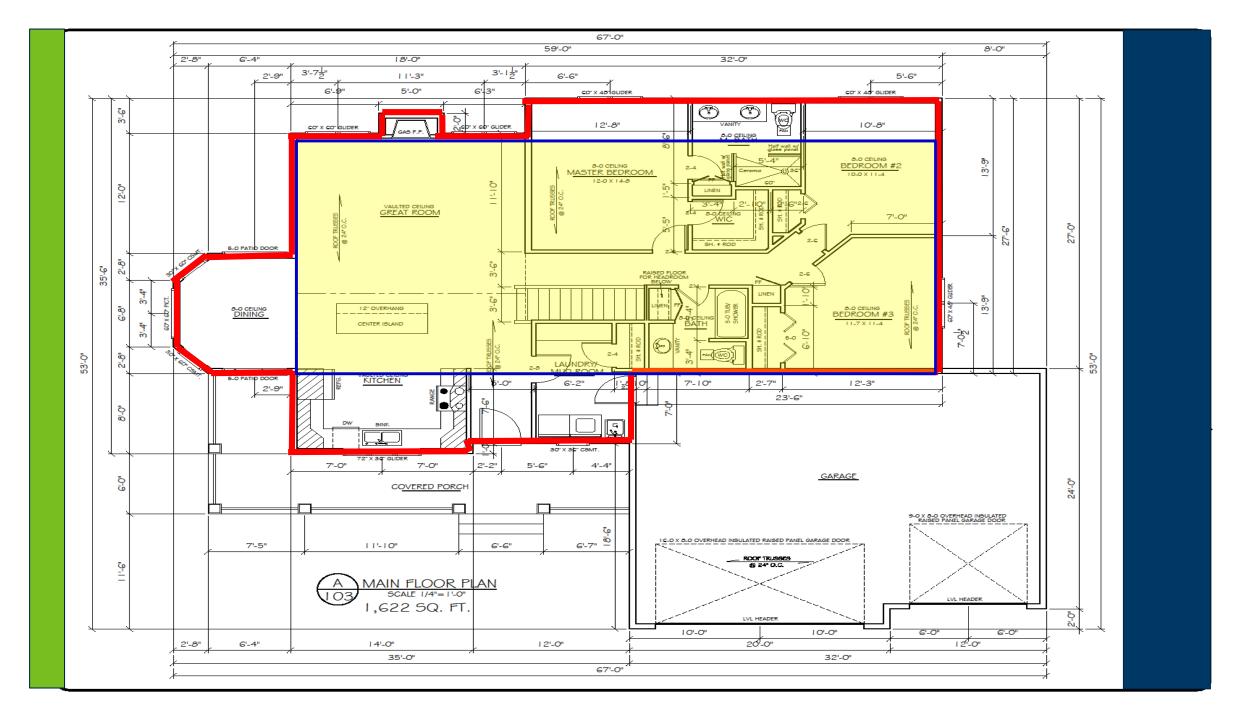
What does it consist of Wood Framed- Masonry Etc..?

Are there any cantilevers or Bump-Outs?

What is the Ceiling Area (Square Footage)?

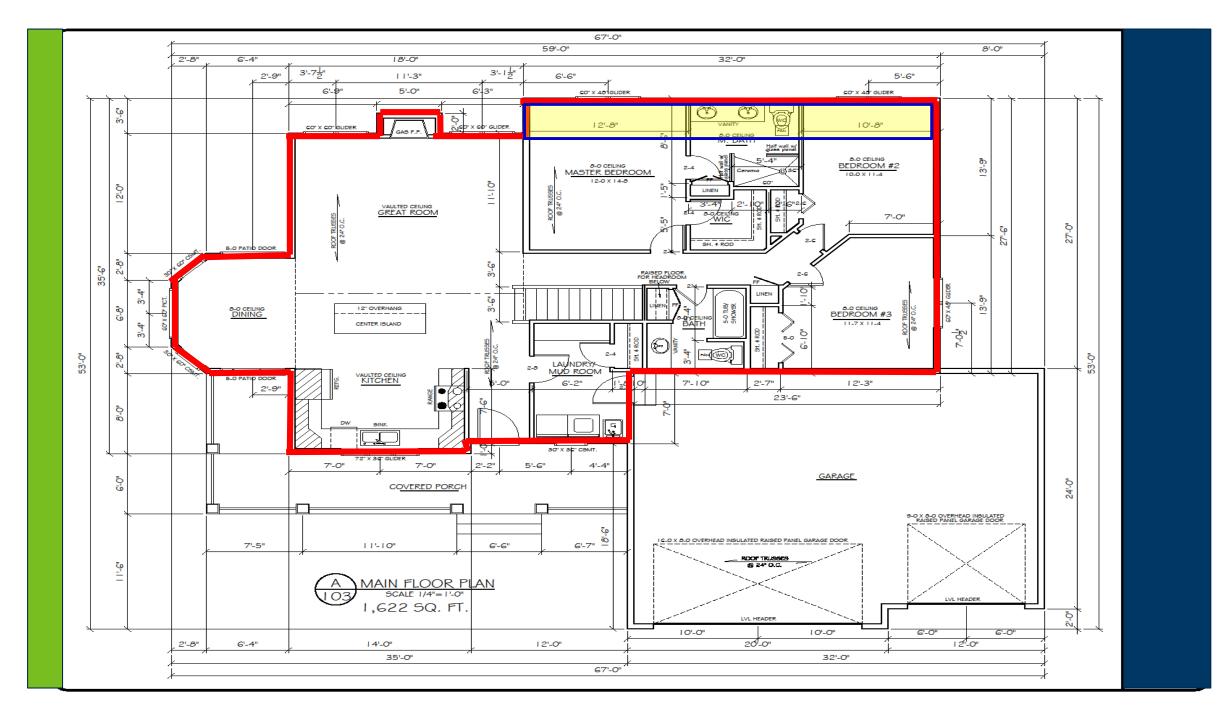
What is the Ceiling R Value



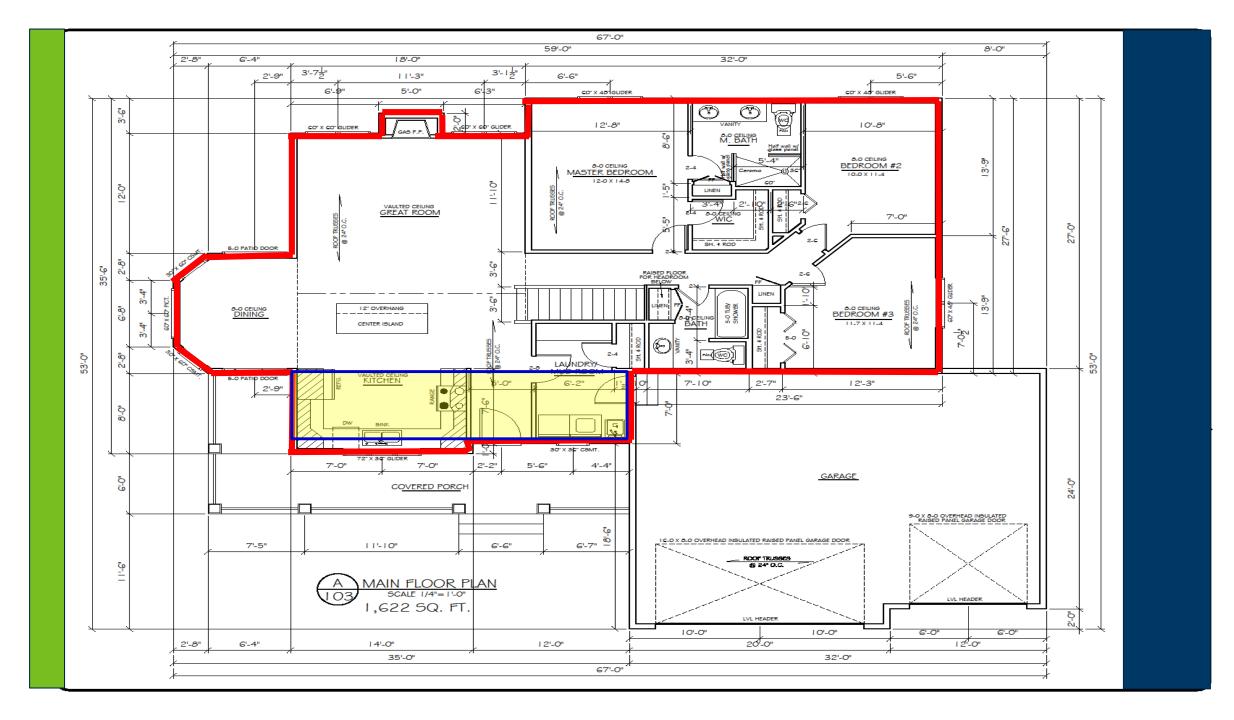


## Using the Q = UA (delta T) Method

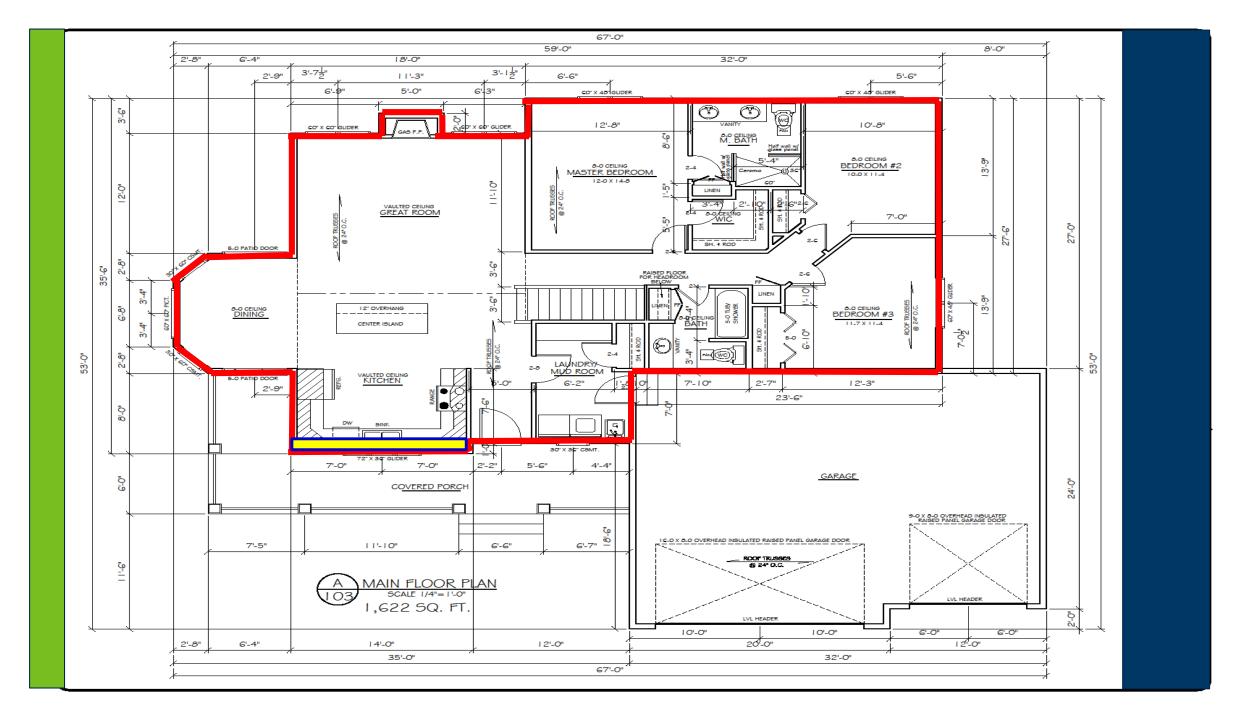
- Ceiling Heat Loss
  - 24 x 50 = 1200



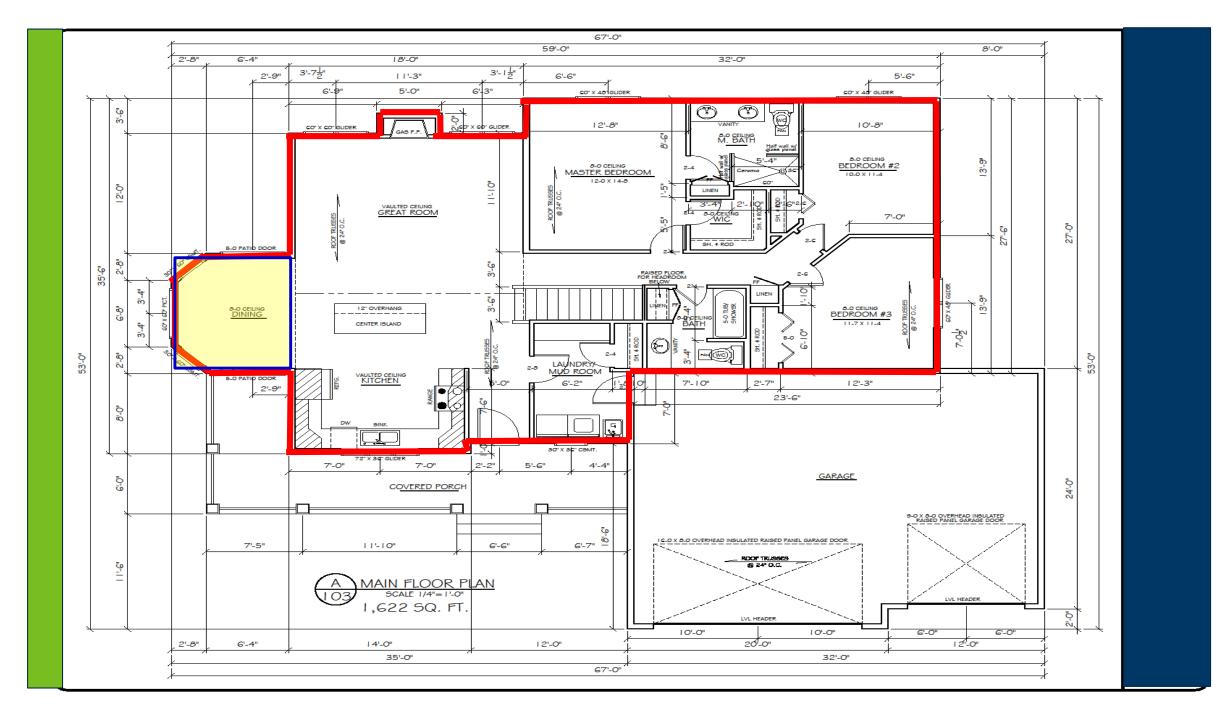
- 24 x 50 = 1200
- 3.5 x 32 = 112



- 24 x 50 = 1200 Sq. Ft.
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- 3.5 x 32 = 112 Sq. Ft.
- 7 x 26 = 182 Sq. Ft.
- 1 x 12 = 12 Sq. Ft.
- 9 x 12 = 108 Sq. Ft.

- Ceiling Heat Loss (using a R-49 Ceiling insulation)
  - 24 x 50 = 1200 Sq. Ft.
  - 3.5 x 32 = 112 Sq. Ft.
  - 7 x 26 = 182 Sq. Ft.
  - 1 x 12 = 12 Sq. Ft.
  - <u>9 x 12 = 108 Sq. Ft.</u>
  - Total Sq. Ft. = 1614 Sq. Ft of Area (A) at R-49

- 24 x 50 = 1200 Sq. Ft.
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- 7 x 26 = 182 Sq. Ft.
- 1 x 12 = 12 Sq. Ft.
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- Total Sq. Ft. = 1614 Sq. Ft of Area (A) at R-49

#### Q = U x A x 90 (delta T) or Heat Loss (Q) = .0204 (R-49) x 1614 (Area) x 90 (delta T) = Ceiling Heat Loss of 2,963.3 or 2964 Btu's of Heat Loss

- 24 x 50 = 1200 Sq. Ft.
- 3.5 x 32 = 112 Sq. Ft.
- 7 x 26 = 182 Sq. Ft.
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• + Fireplace bump out Ceiling at R-30 and an Area Of 10 Sq. Ft. =

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- + Fireplace bump out Ceiling at R-30 and a Area Of 10 Sq. Ft. = Calculate this and tell Me what you get for Heat Loss
- -Remember Q = UA(deltaT)

- 24 x 50 = 1200 Sq. Ft.
- 3.5 x 32 = 112 Sq. Ft.
- 7 x 26 = 182 Sq. Ft.
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• + Fireplace bump out Ceiling at R-30 and a Area Of 10 Sq. Ft. = Btu's = .0333 x 10 x 90 = 29.97 or 30 Btu's of Heat loss

- 24 x 50 = 1200 Sq. Ft.
- 3.5 x 32 = 112 Sq. Ft.
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• + Fireplace bump out Ceiling at R-30 and a Area Of 10 Sq. Ft. = Btu's = .0333 x 10 x 90 = 29.97 or 30 Btu's of Heat loss

Adding them all up we get 2964 + 30 = 2994 total Btu's of Heat Loss for Ceilings- Write this down and save it for later- we will need it

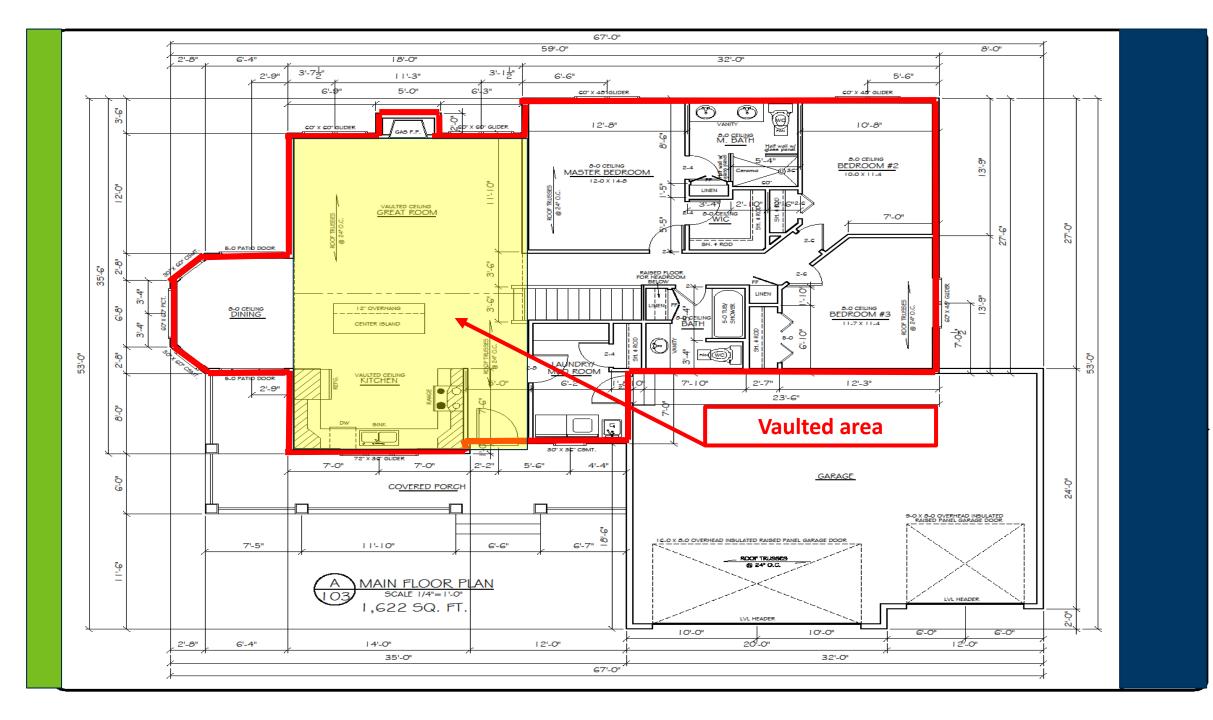
## First of all do you have everything on the plans?

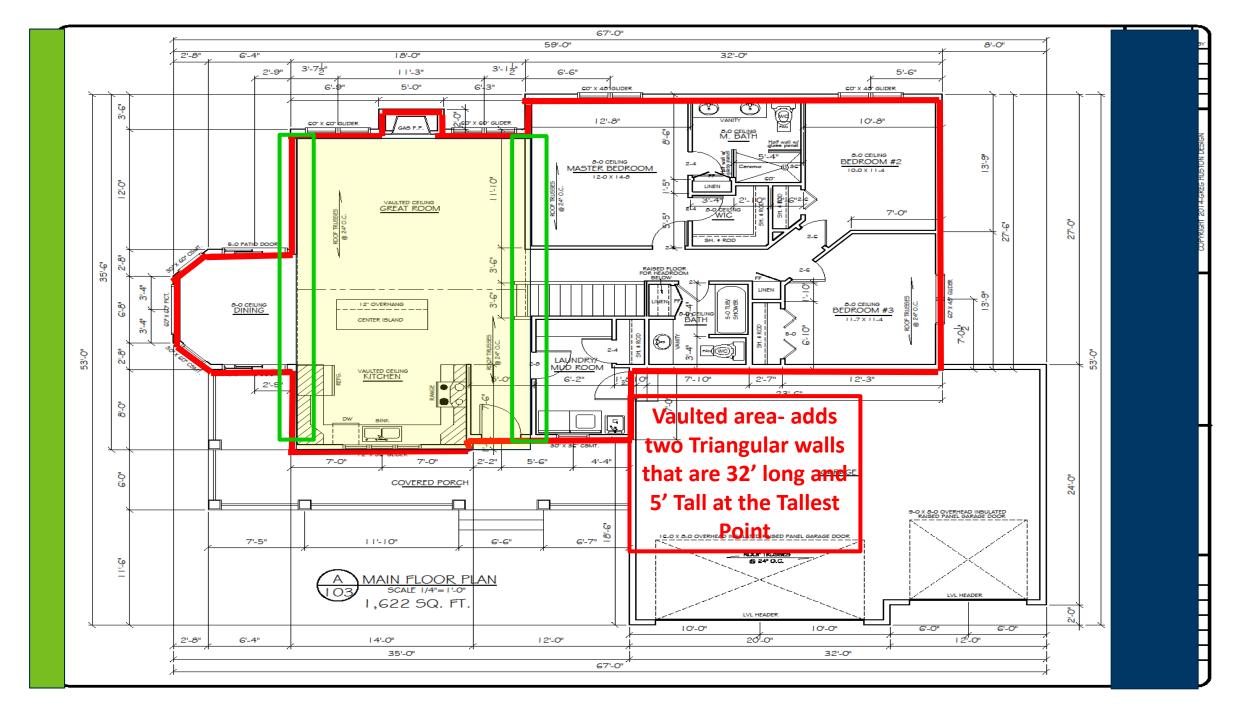
#### **4 Pages of the Plans**

Main Floor Page

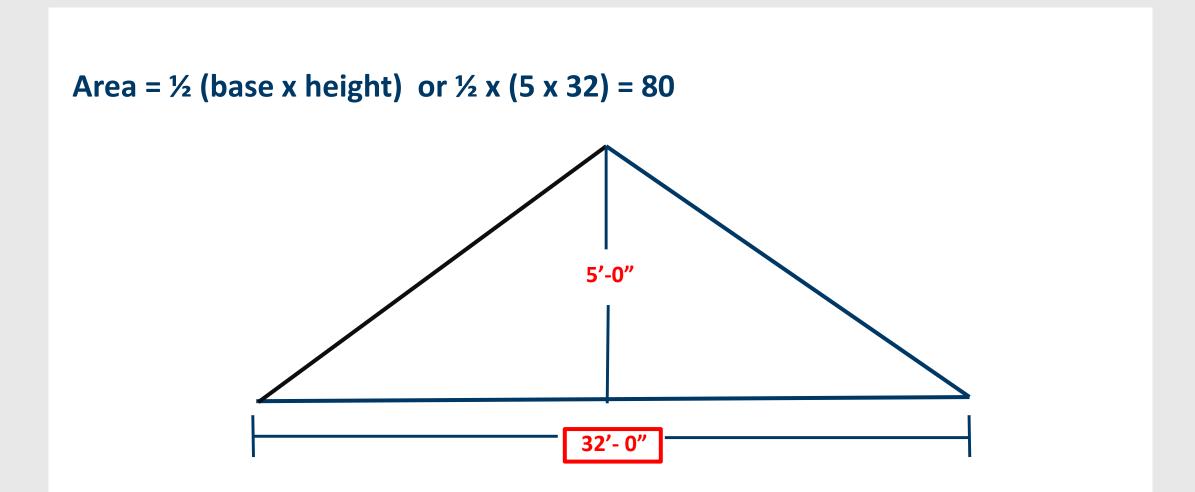
Where is the Building Envelope? What does it consist of Wood Framed- Masonry Etc..? Are there any cantilevers or Bump-Outs? What is the Ceiling Area (Square Footage)? What is the Ceiling R Value

Is there a Vaulted area that adds wall area to our envelope?



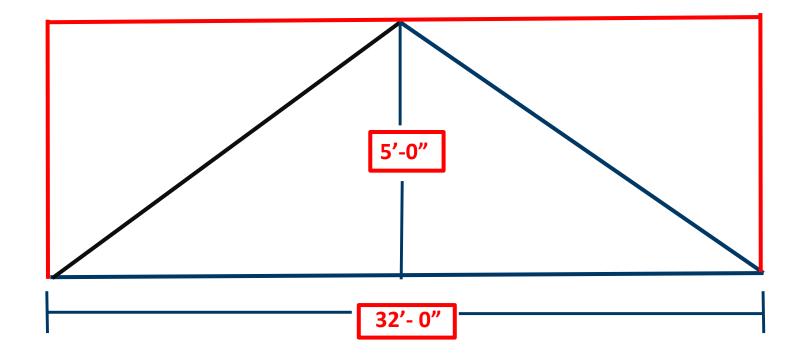


### Calculate the Area of A triangle "Geometry"



### Calculate the Area of A Rectangle and divide by 2 "Geometry"

Here is a simpler way (in my opinion). L x W / 2 (or 32 X 5 = 160 / 2 = 80)



- Ceiling Vaulted Area Side Walls
  - Side #1 = 80 Sq. Ft.
  - <u>Side #2 = 80 Sq. Ft.</u>
  - Total Sq. Ft. = 160 Sq. Ft of Area (A) at R-21

Q = U x A x 90 (delta T) or Heat Loss (Q) = .0476 (R-21) x 160 (Area) x 90 (delta T) = Ceiling Heat Loss of 685.44 or 686 Btu's of Heat Loss

There are no windows in these walls so our heat loss ends there but make a note of it.

## Running total of Btu's of Heat Loss for Our Home

- Ceiling Area
- Ceiling Vaulted Area Side Walls

=

=

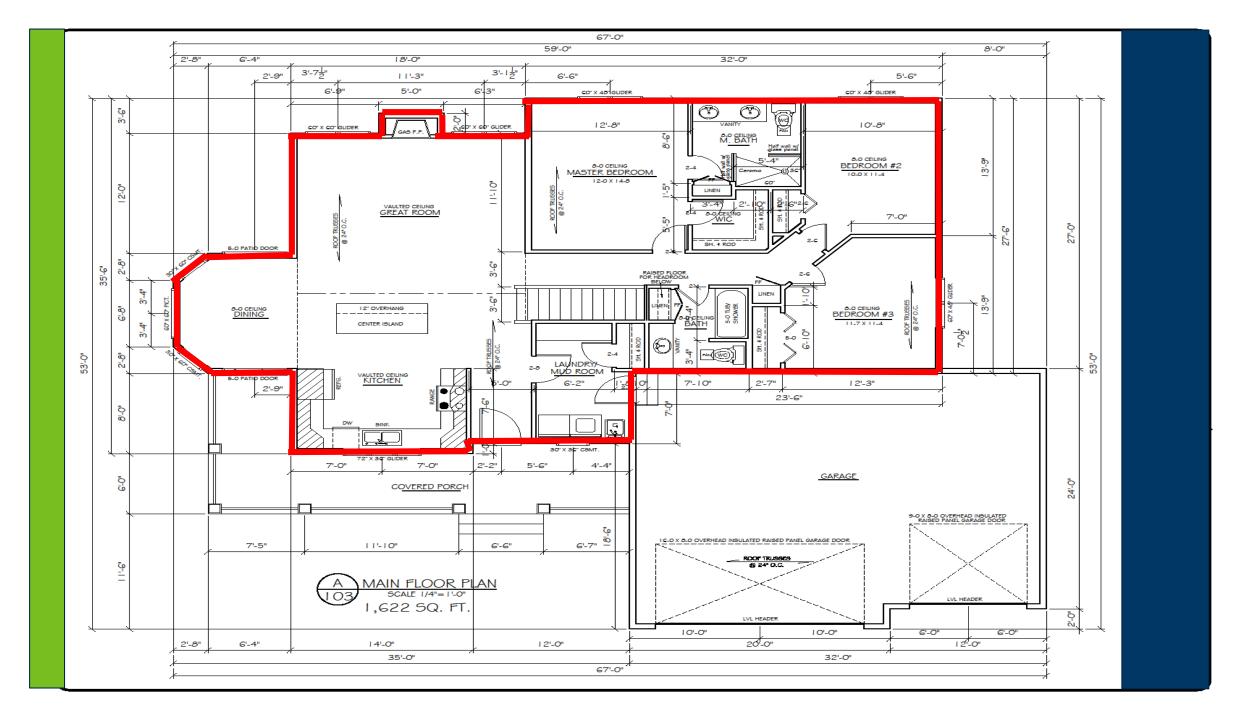
2994 Btu's of Heat loss

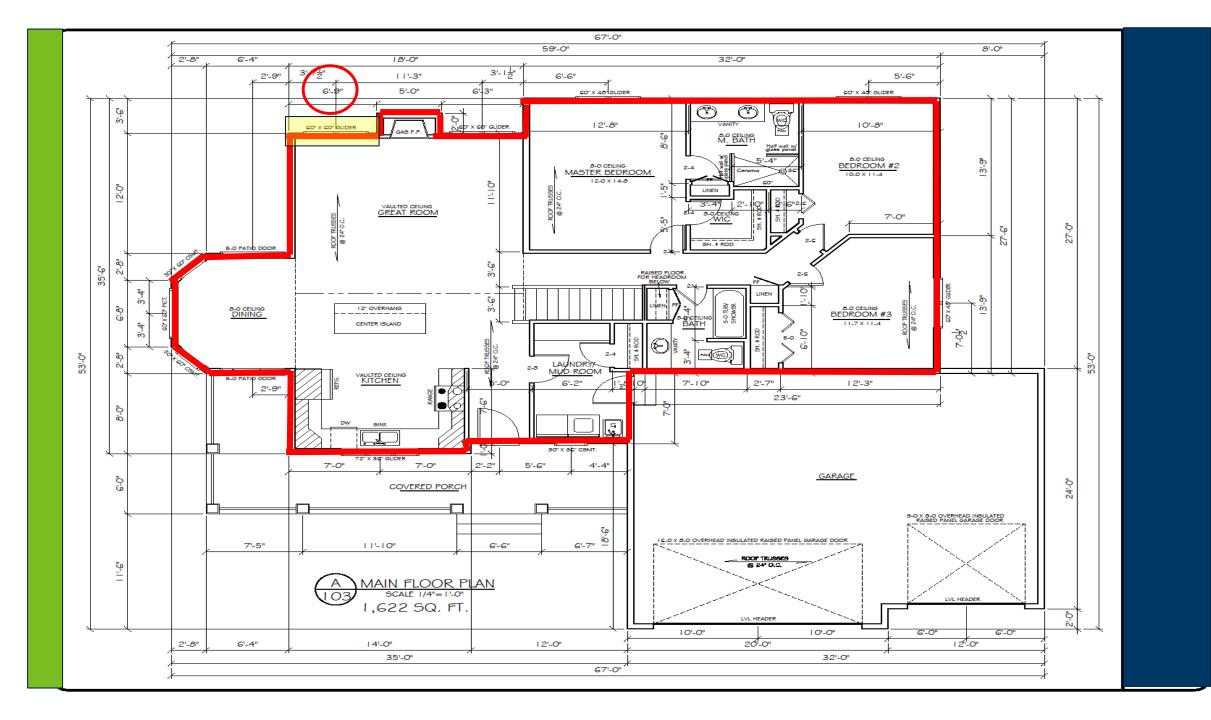
686 Btu's of Heat Loss

## Main Floor Exterior Walls

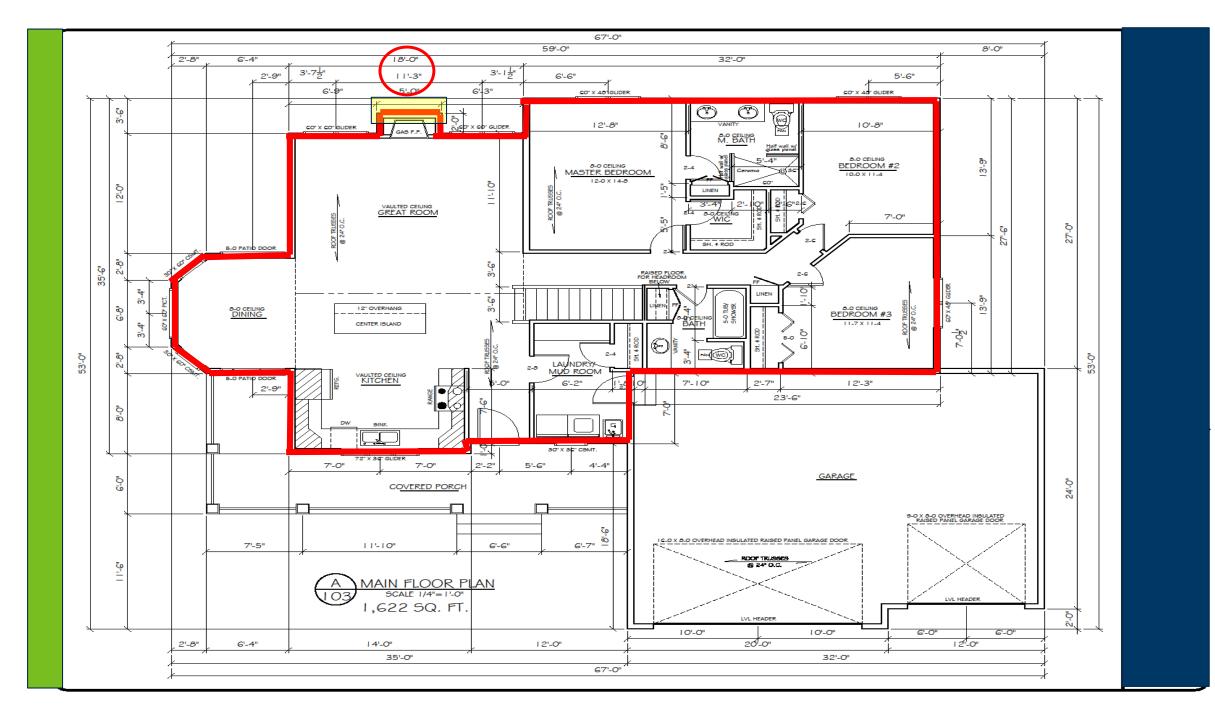


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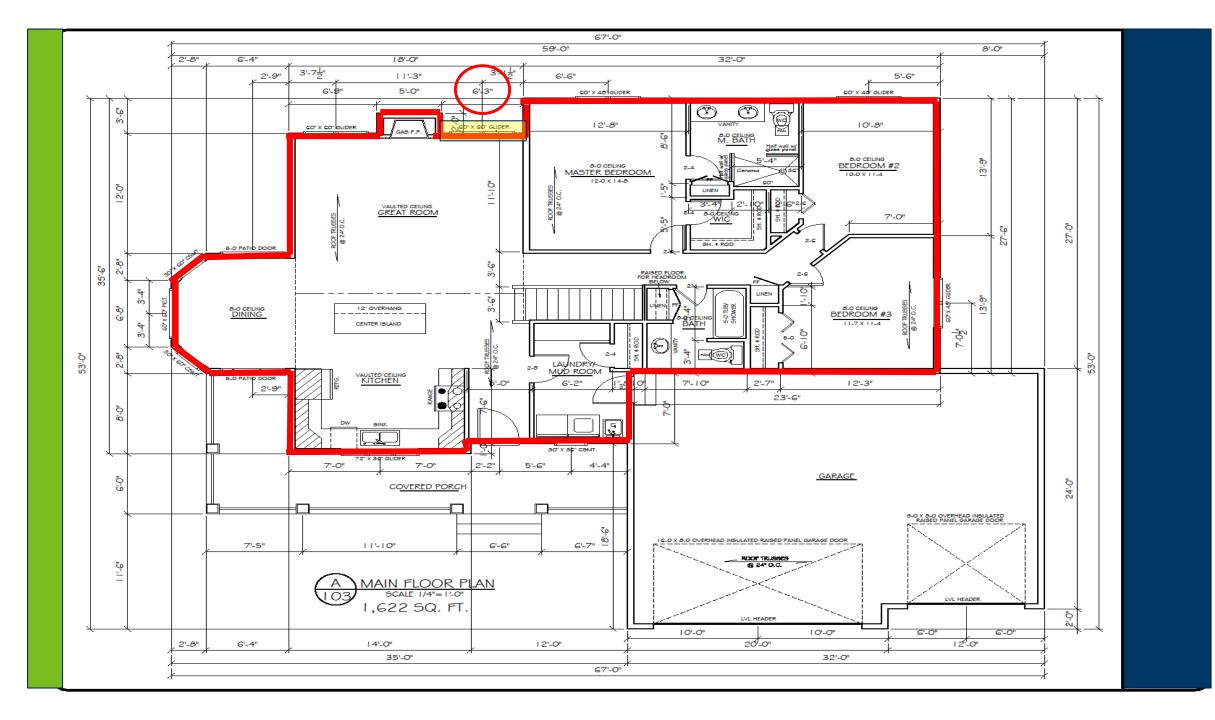




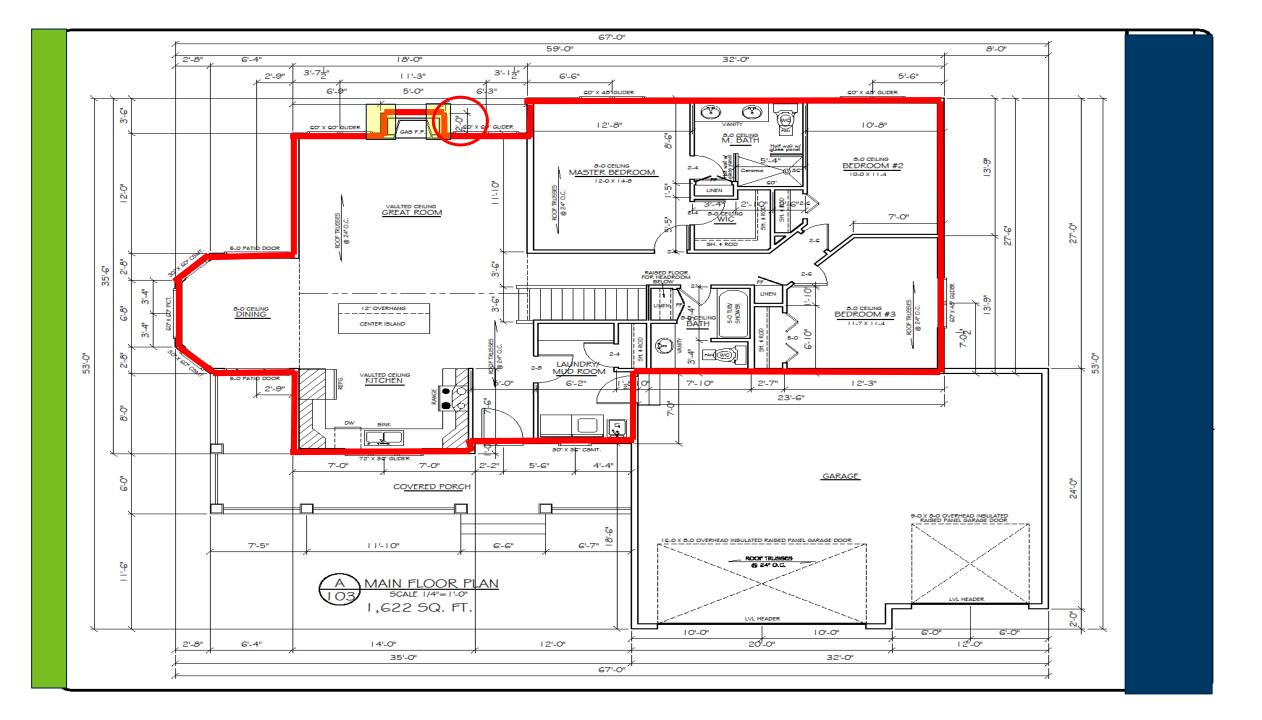
6.75 +



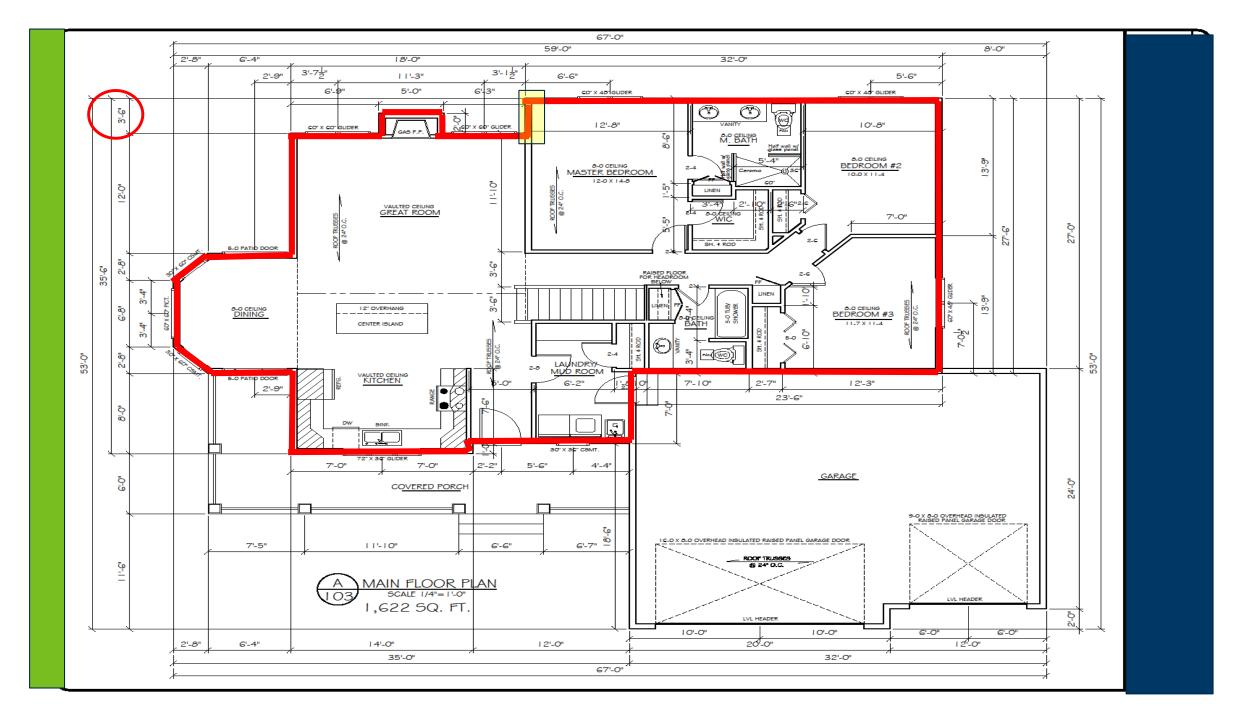
- Main Floor Walls with a R Value of R 21 (Or 1/21 = .0476 U-factor)
  - 6.75 + 11.25 +



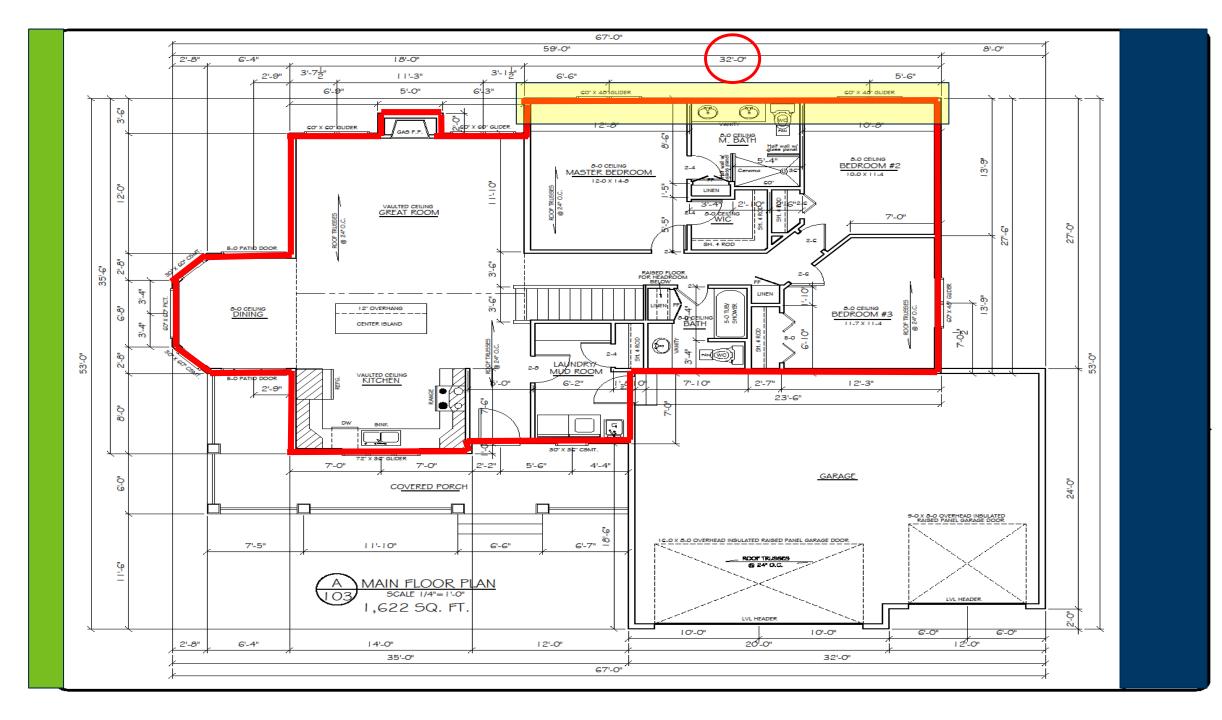
- Main Floor Walls with a R Value of R 21 (Or 1/21 = .0476 U-factor)
  - 6.75 + 11.25 + 6.25 +



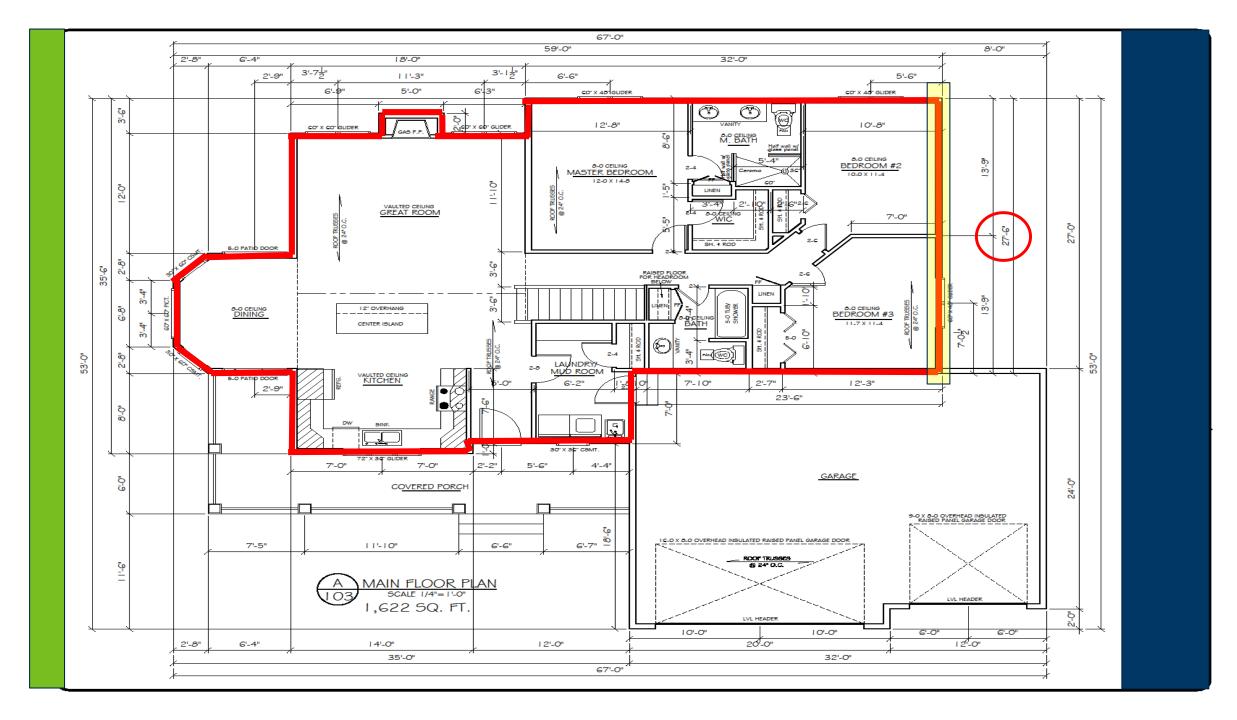
- Main Floor Walls with a R Value of R 21 (Or 1/21 = .0476 U-factor)
  - 6.75 + 11.25 + 6.25 + 4 (2 x 2) +



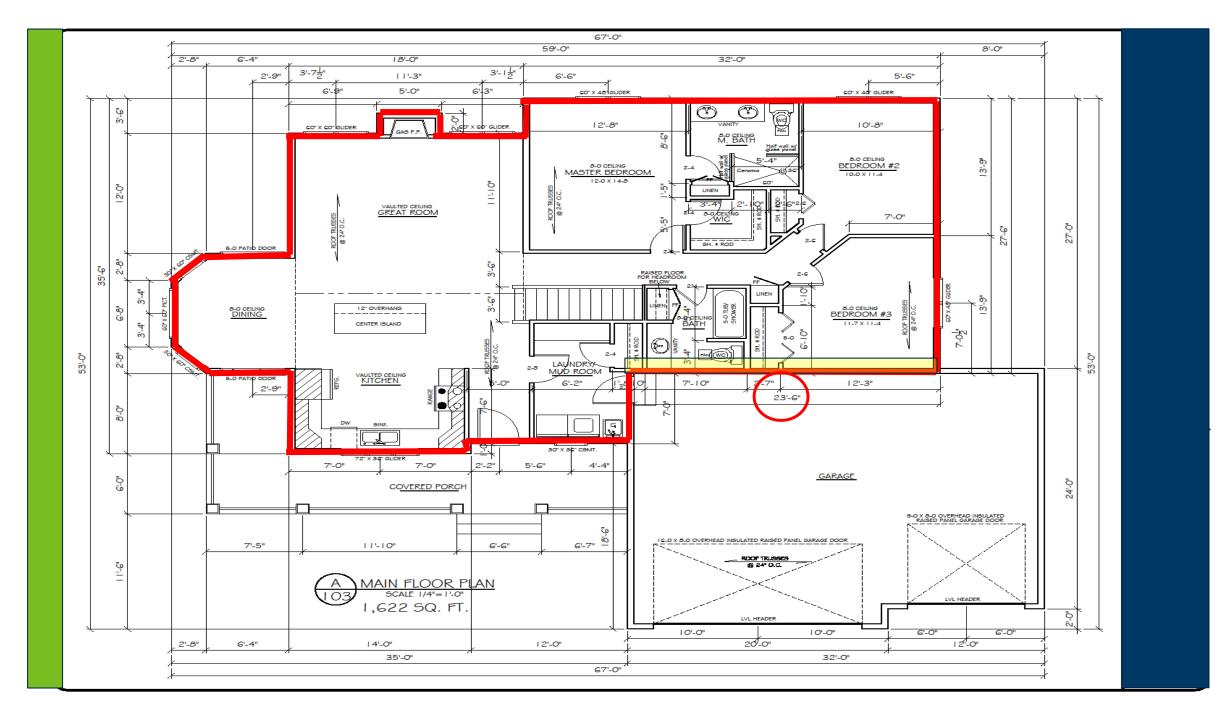
- Main Floor Walls with a R Value of R 21 (Or 1/21 = .0476 U-factor)
  - 6.75 + 11.25 + 6.25 + 4 (2 x 2) + 3.5 +



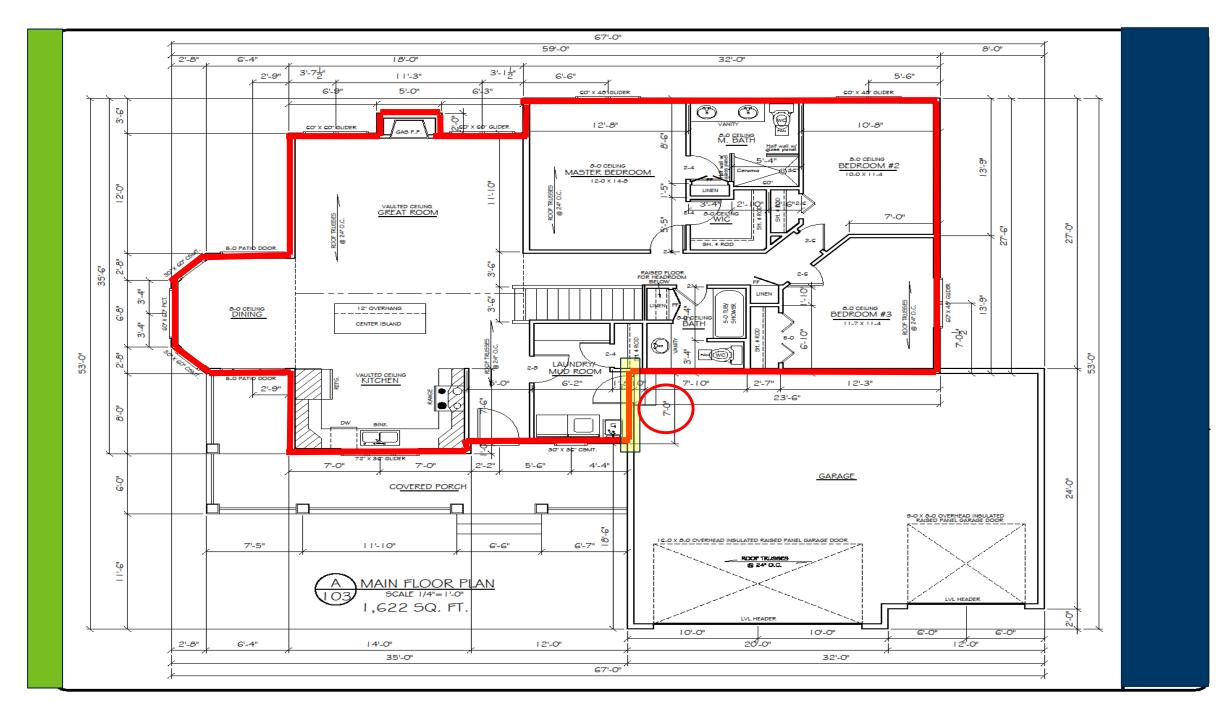
- Main Floor Walls with a R Value of R 21 (Or 1/21 = .0476 U-factor)
  - 6.75 + 11.25 + 6.25 + 4 (2 x 2) + 3.5 + 32 +



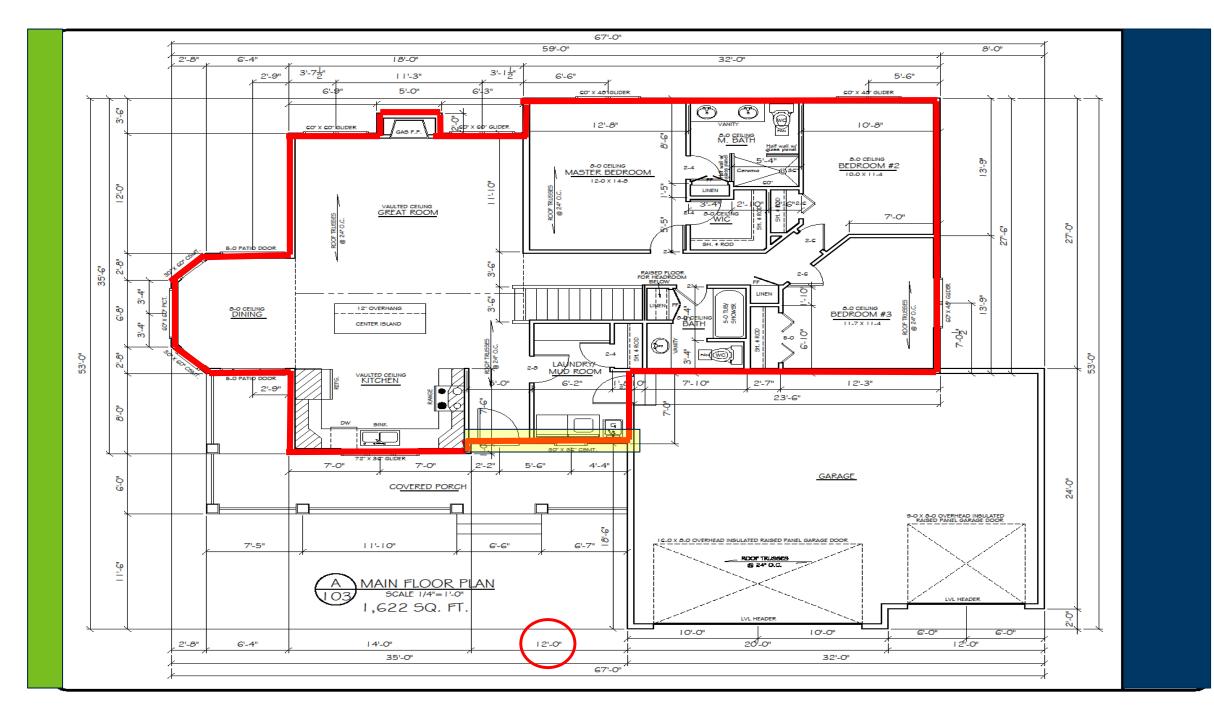
- Main Floor Walls with a R Value of R 21 (Or 1/21 = .0476 U-factor)
  - 6.75 + 11.25 + 6.25 + 4 (2 x 2) + 3.5 + 32 + 27.5 +



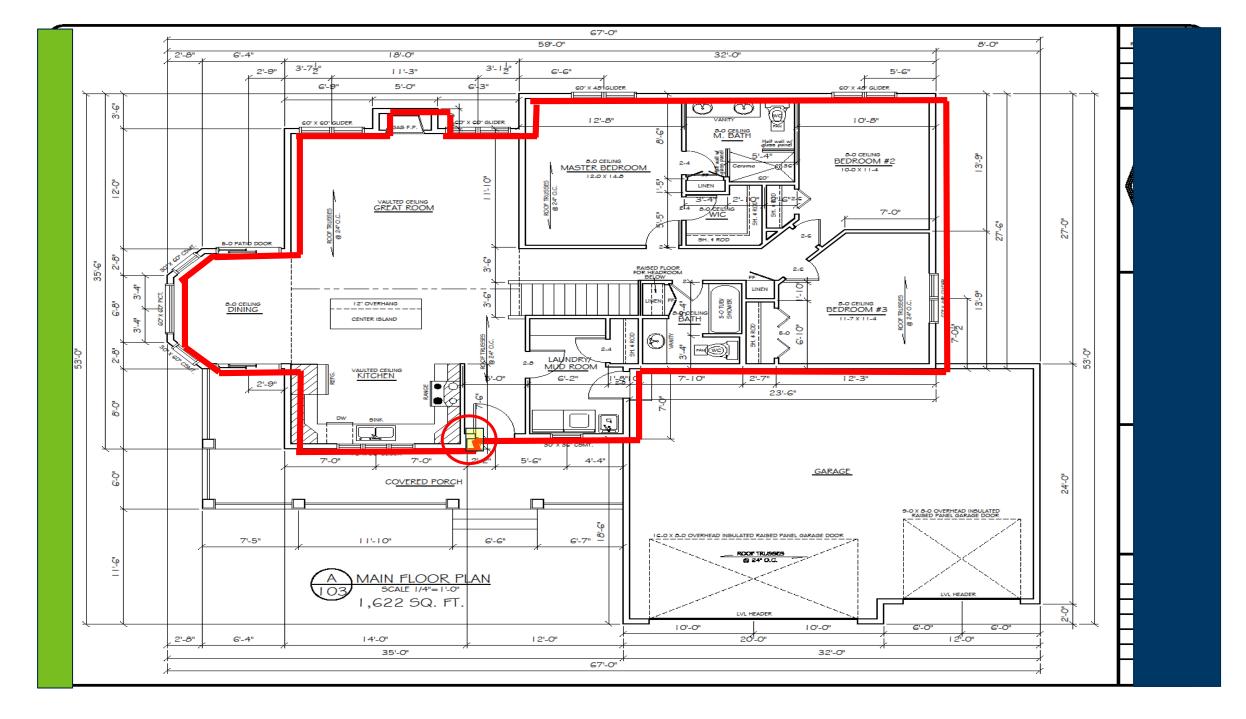
- Main Floor Walls with a R Value of R 21 (Or 1/21 = .0476 U-factor)
  - 6.75 + 11.25 + 6.25 + 4 (2 x 2) + 3.5 + 32 + 27.5 + 23.5 +



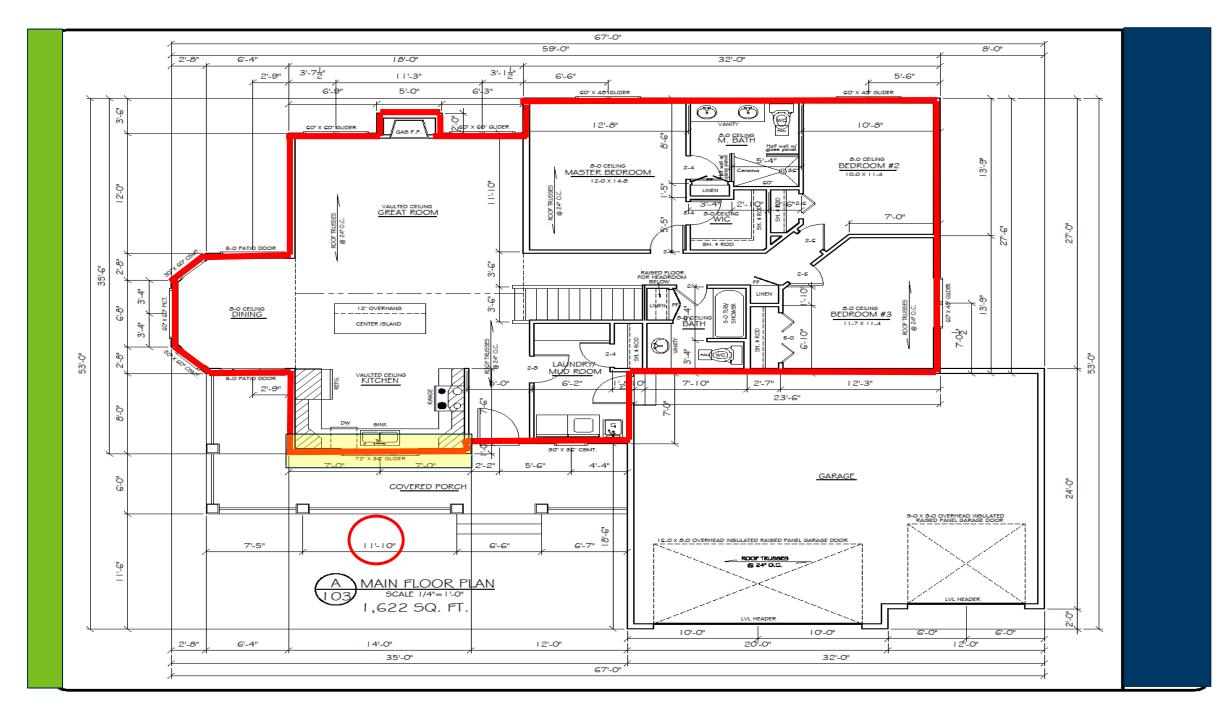
- Main Floor Walls with a R Value of R 21 (Or 1/21 = .0476 U-factor)
  - 6.75 + 11.25 + 6.25 + 4 (2 x 2) + 3.5 + 32 + 27.5 + 23.5 + 7 +



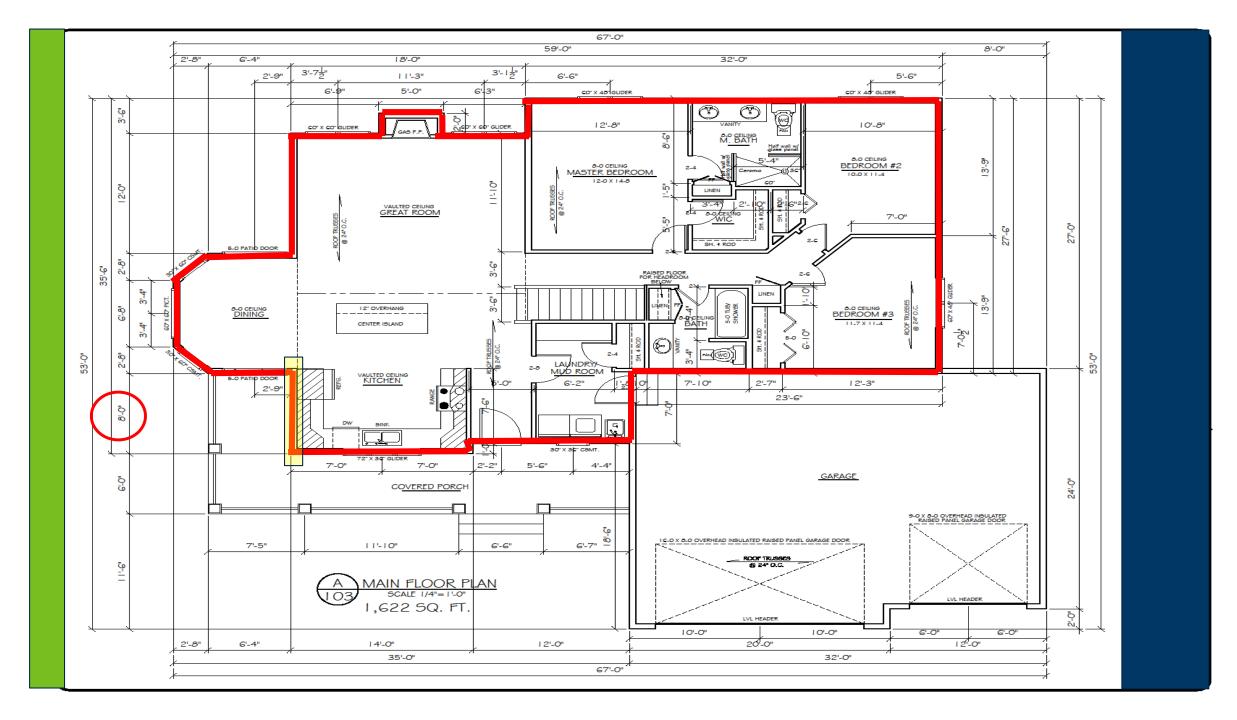
6.75 + 11.25 + 6.25 + 4 (2 x 2) + 3.5 + 32 + 27.5 + 23.5 + 7 + 12+



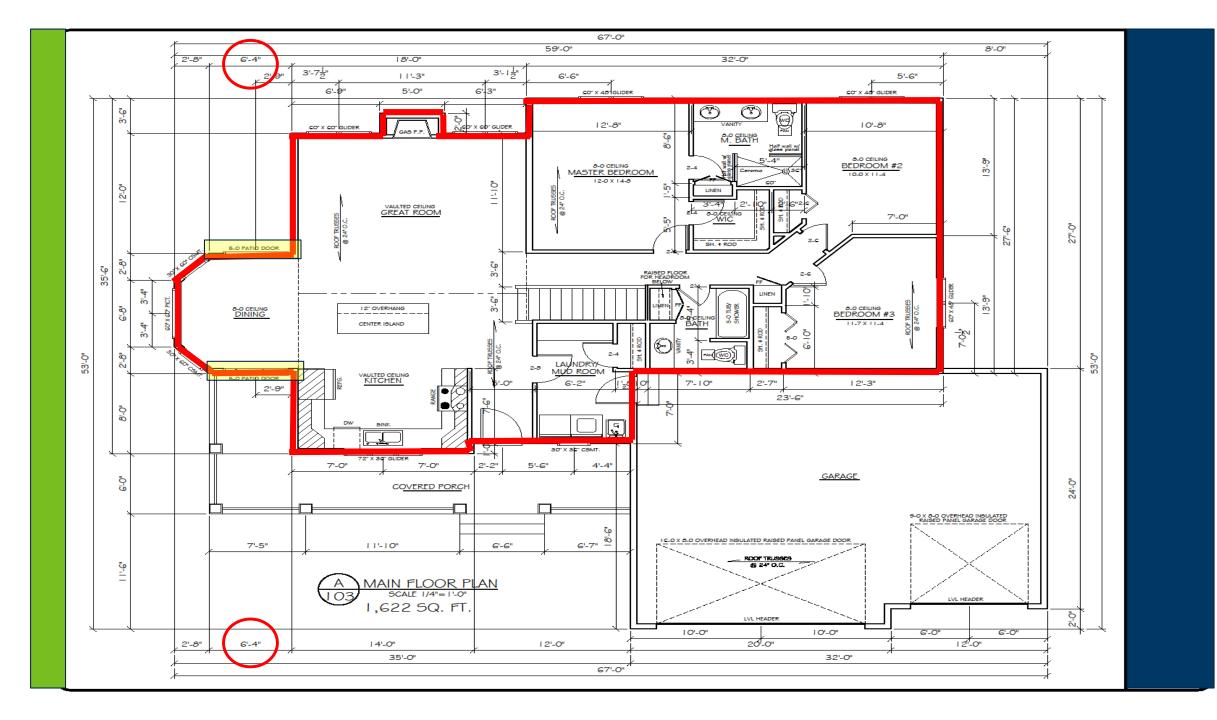
6.75 + 11.25 + 6.25 + 4 (2 x 2) + 3.5 + 32 + 27.5 + 23.5 + 7 + 12 + 1 +



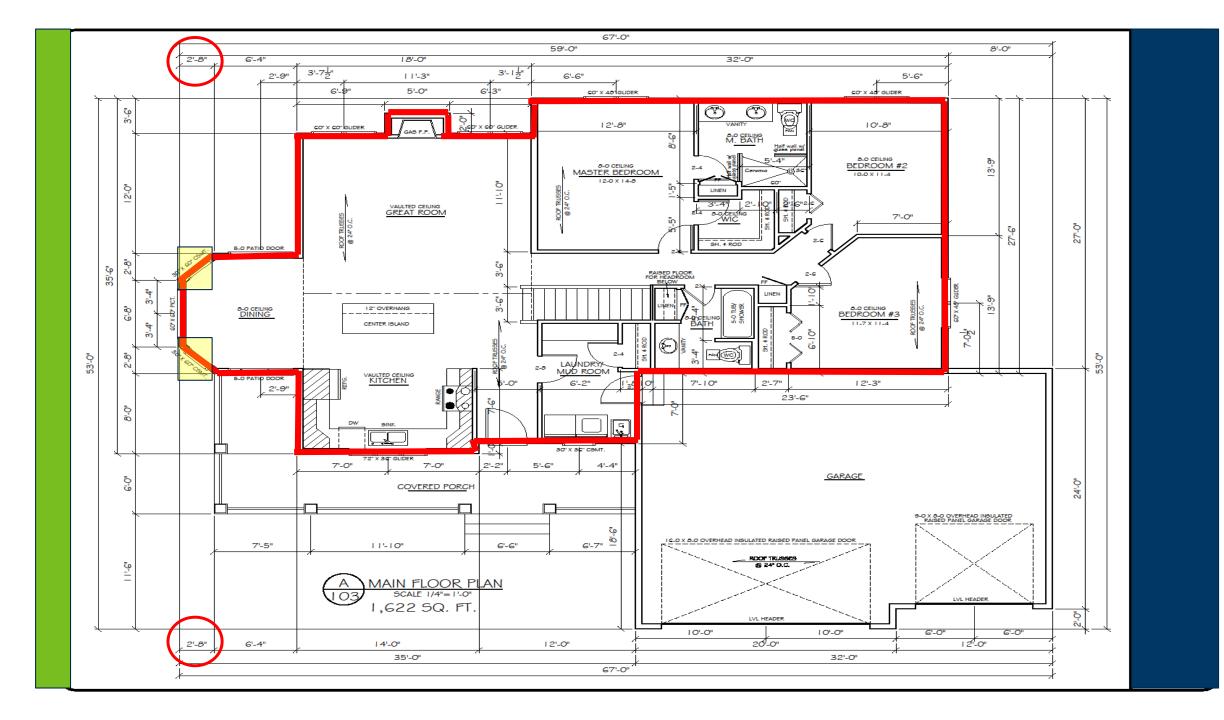
6.75 + 11.25 + 6.25 + 4 (2 x 2) + 3.5 + 32 + 27.5 + 23.5 + 7 + 12 + 1 + 11.75



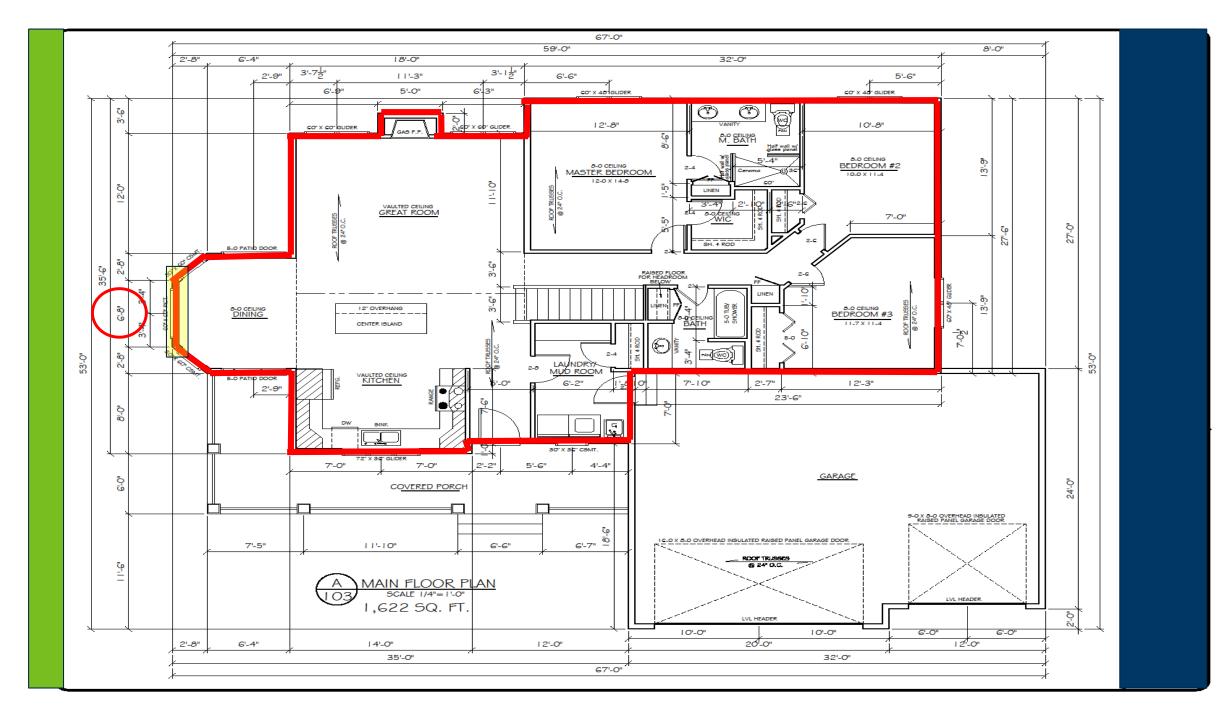
6.75 + 11.25 + 6.25 + 4 (2 x 2) + 3.5 + 32 + 27.5 + 23.5 + 7 + 12 + 1 + 11.75 + 8 +



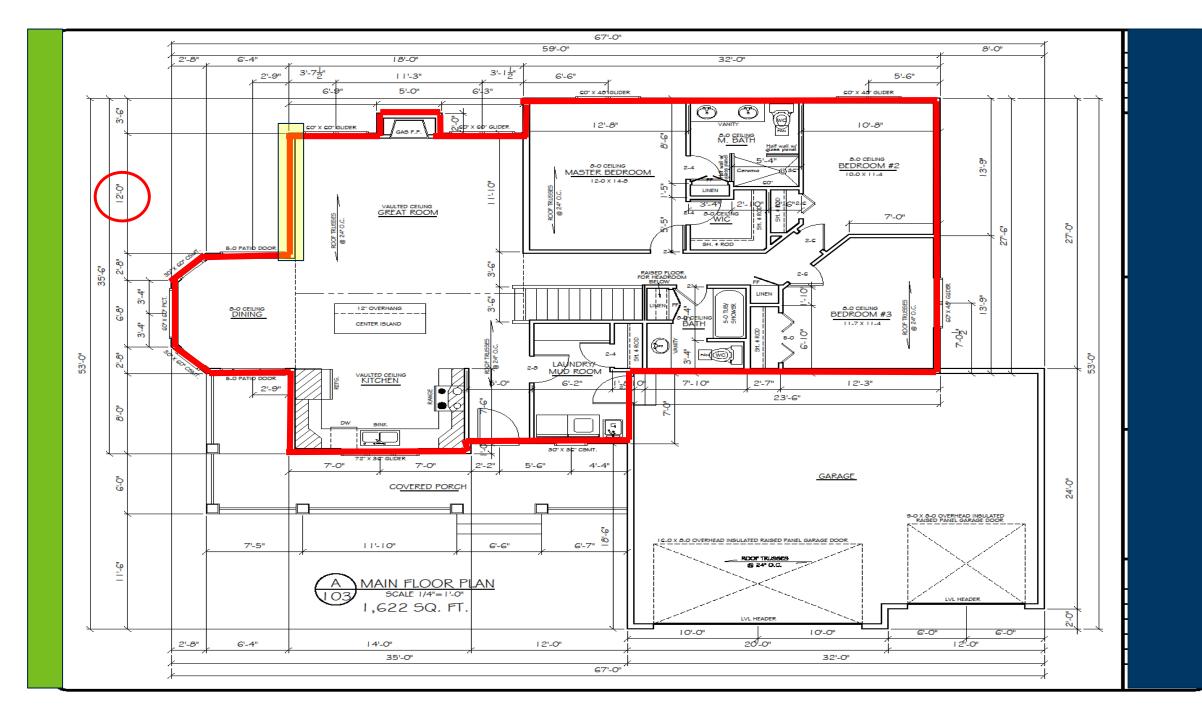
6.75 + 11.25 + 6.25 + 4 (2 x 2) + 3.5 + 32 + 27.5 + 23.5 + 7 + 12 + 1 + 11.75 + 8 + 12.5 (6.25 x 2) +



6.75 + 11.25 + 6.25 + 4 (2 x 2) + 3.5 + 32 + 27.5 + 23.5 + 7 + 12 + 1 + 11.75 + 8 + 12.5 (6.25 x 2) + 5.5 (2.75 x 2) +



6.75 + 11.25 + 6.25 + 4 (2 x 2) + 3.5 + 32 + 27.5 + 23.5 + 7 + 12 + 1 + 11.75 + 8 + 12.5 (6.25 x 2) + 5.5 (2.75 x 2) + 6.75 +



• Main Floor Walls with a R Value of R 21 (Or 1/21 = .0476 U-factor)

6.75 + 11.25 + 6.25 + 4 (2 x 2) + 3.5 + 32 + 27.5 + 23.5 + 7 + 12 + 1 + 11.75 + 8 + 12.5 (6.25 x 2) + 5.5 (2.75 x 2) + 6.75 + 12 = <u>191.25 Lin Ft</u>

• Main Floor Walls with a R Value of R 21 (Or 1/21 = .0476 U-factor)

6.75 + 11.25 + 6.25 + 4 (2 x 2) + 3.5 + 32 + 27.5 + 23.5 + 7 + 12 + 1 + 11.75 + 8 + 12.5 (6.25 x 2) + 5.5 (2.75 x 2) + 6.75 + 12 = <u>191.25 Lin Ft</u> 191.25 x 8 = 1530 Sq. Ft of Area • Main Floor Walls with a R Value of R 21 (Or 1/21 = .0476 U-factor) and a delta T of 90

 $6.75 + 11.25 + 6.25 + 4 (2 \times 2) + 3.5 + 32 + 27.5 + 23.5 + 7 + 12 + 1 + 11.75 + 8 + 12.5 (6.25 \times 2) + 5.5 (2.75 \times 2) + 6.75 + 12 = 191.25 \text{ Lin Ft}$ 

- 191.25 x 8 = 1530 Sq. Ft of Area
- Q = UA (delta T) Do the Math on this one

• Main Floor Walls with a R Value of R 21 (Or 1/21 = .0476 U-factor)

 $6.75 + 11.25 + 6.25 + 4 (2 \times 2) + 3.5 + 32 + 27.5 + 23.5 + 7 + 12 + 1 + 11.75 + 8 + 12.5 (6.25 \times 2) + 5.5 (2.75 \times 2) + 6.75 + 12 = 191.25 \text{ Lin Ft}$ 

191.25 x 8 = 1530 Sq. Ft of Area

Q = UA (delta T)

Q = .0476 x 1530 x 90 = (6554.52 Btu's Per hour) Rounded up to 6555 Btu's of Heat Loss per hour

Make a note of it.

- Ceiling Area
- Ceiling Vaulted Area Side Walls
- Main Floor Exterior Walls

=

- 2994 Btu's of Heat loss 686 Btu's of Heat Loss
- 6555 Btu's of Heat Loss

#### **Basement wall -Knee Walls**



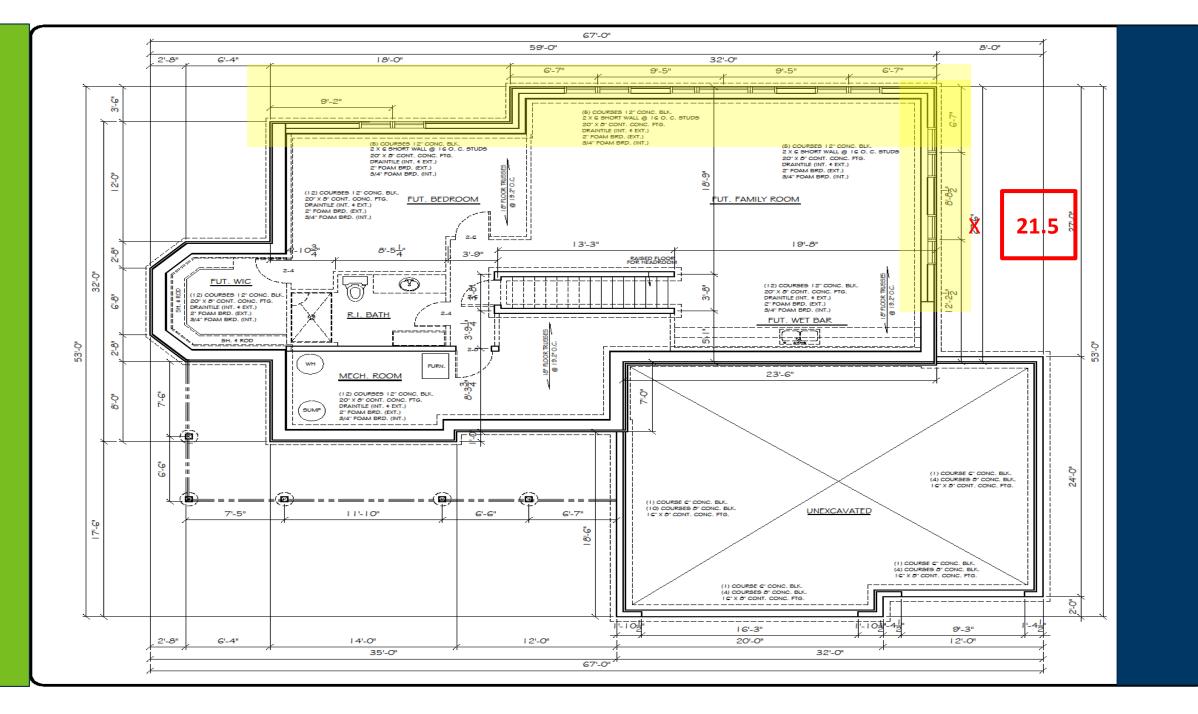
#### **Basement wall -Knee Walls**



# Your Turn - Calculate the Framing wall for the Homes Knee walls.

# **Assume The Following**

-Total Wall Height of 4.5 Feet -R Value of 21 -Knee wall behind Garage = 21.5 Ft. Long



- Basement wall -Knee Walls with a R Value of R 21 (Or 1/21 = .0476 U-factor)
  - 18 + 3.5 + 32 + 21.5 = <u>75 Lin Ft</u>
  - 75 x 4.5 = 337.5 Sq. Ft of Area
  - Q = UA (delta T)
  - Q = .0476 x 337.5 x 90 = (1445.85) Rounded Up to 1446 Btu's of heat loss per hour
    - Make a Note of it- We will need it later

2994 Btu's of Heat loss **Ceiling Area** = ٠ **Ceiling Vaulted Area Side Walls** 686 Btu's of Heat Loss ٠ = Main Floor Exterior Walls 6555 Btu's of Heat Loss ٠ = **Basement Knee walls** 1446 Btu's of Heat Loss ٠ =

# **Foundation Walls**



#### First of all do you have everything on the plans?

**4 Pages of the Plans** 

**Foundation Page** 

Where is the Building Envelope

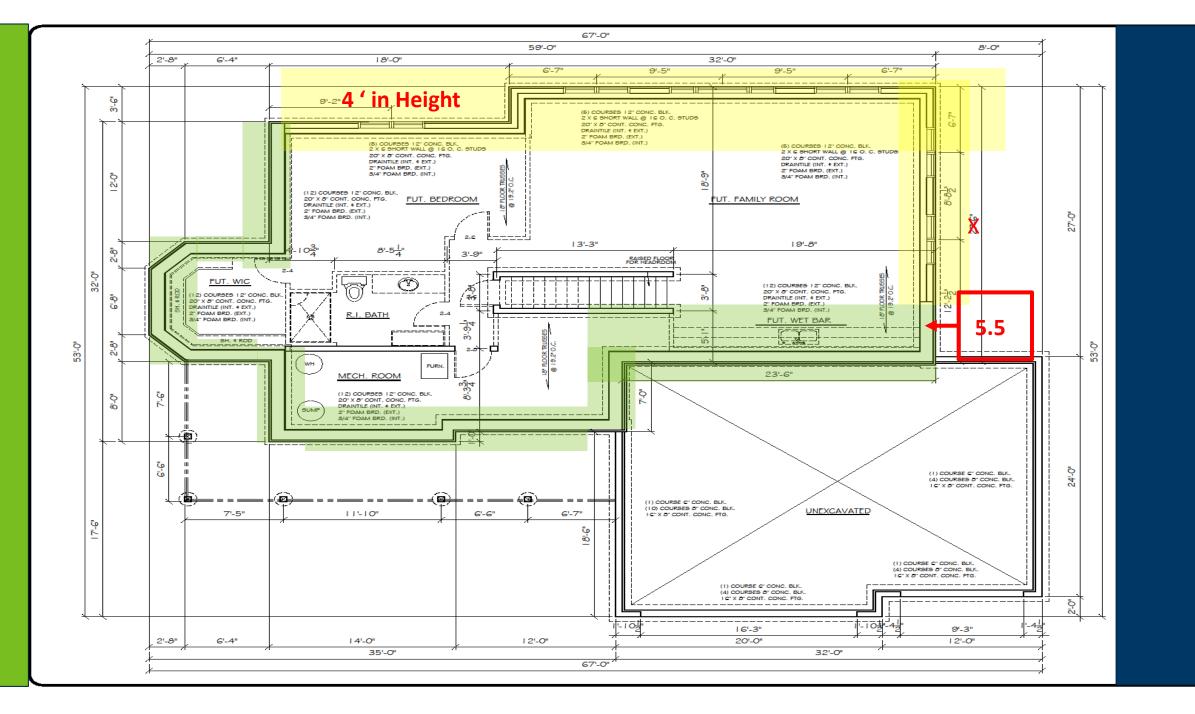
What does it consist of Wood Framed- Masonry Etc..

# **Foundation Walls**

#### • Assume the Following:

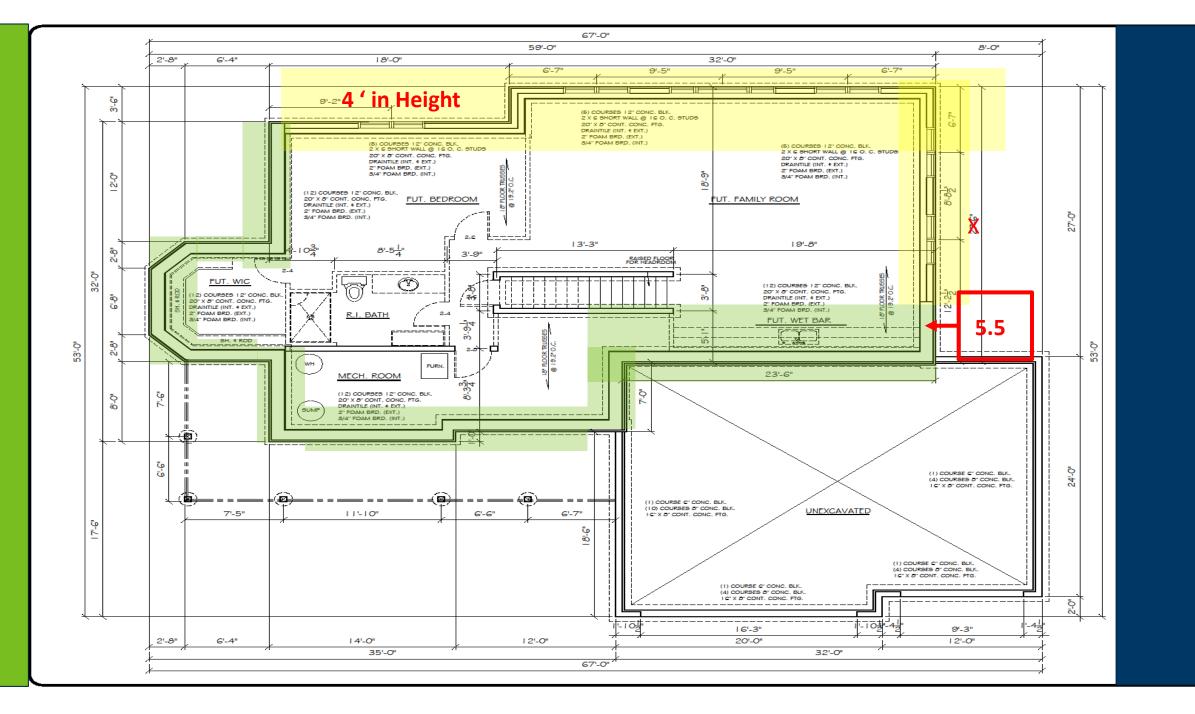
- Foundation wall is insulated on the Exterior with a R Value Of 15
- There is no Interior insulation installed
- T1 (outside temperature ) = -20 Degrees F at top of foundation wall and 50 Degrees F at bottom of Foundation wall (or an Average of 35 Degrees F) for a (delta T of 55)
- "Tip #1" Don't forget the 5.5 Lin. Ft of wall behind the Garage
- "Tip #2" Some walls are 8 ft in height and others are 4 ft. in height

#### Calculate all the foundation walls Remember Q = UA (deltaT)



- 4' Tall Basement wall Walls with a R Value of R 15 (Or 1/15 = .0666 U-factor)
  - 18 + 3.5+ 32 + 21.5 = <u>75 Lin Ft</u>
  - 75 x 4.0 = 300 Sq. Ft of Area
  - Q = UA (delta T)
  - Q = .0666 x 300 x 55 = (1098.90) Rounded Up to 1099 Btu's of heat loss per hour
    - Make a Note of it

2994 Btu's of Heat loss **Ceiling Area** = ٠ **Ceiling Vaulted Area Side Walls** 686 Btu's of Heat Loss = ٠ Main Floor Exterior Walls 6555 Btu's of Heat Loss ٠ = **Basement Knee walls** 1446 Btu's of Heat Loss ٠ = 4' Foundation Walls 1099 Btu's of Heat Loss ٠ =



• 8' Tall Basement wall - Walls with a R Value of R 15 (Or 1/15 = .0666 U-factor)

5.5 + 23.5 + 7 + 12 + 1 + 12 + 7.5 + 2.75 + 6.75 + 2.75 + 6.25 + 12 = <u>99 Lin Ft</u>

99 x 8.0 = 792 Sq. Ft of Area

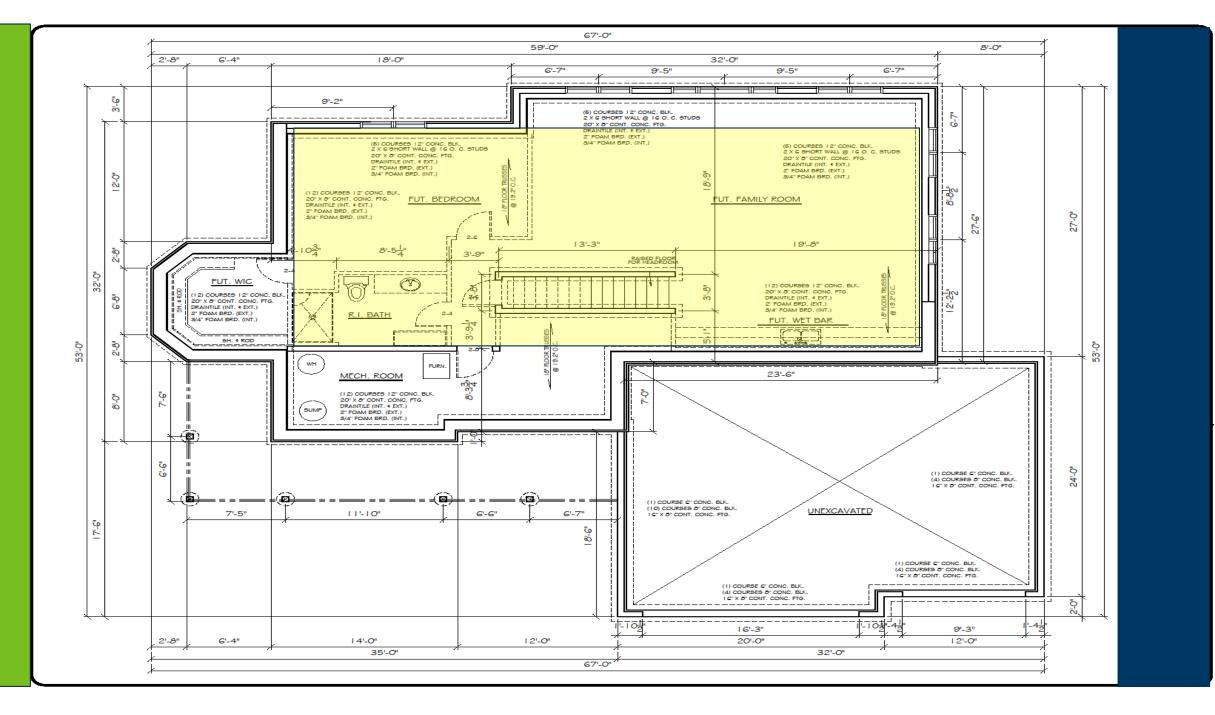
Q = UA (delta T)

Q = .0666 x 792 x 55 = (2901.09) Rounded Up to 2902 Btu's of heat loss per hour

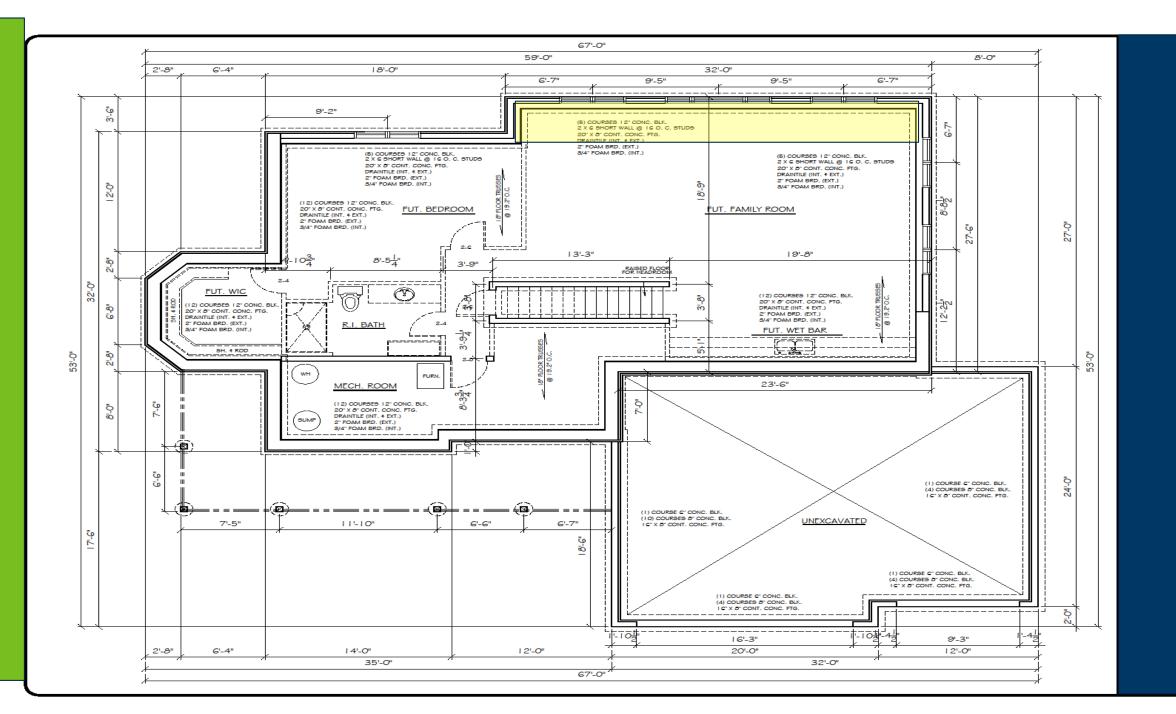
Make a Note of it

•	Ceiling Area	=	2994 Btu's of Heat loss
•	Ceiling Vaulted Area Side Walls	=	686 Btu's of Heat Loss
•	Main Floor Exterior Walls	=	6555 Btu's of Heat Loss
•	Basement Knee walls	=	1446 Btu's of Heat Loss
•	4' Foundation Walls	=	1099 Btu's of Heat Loss
•	8' Foundation Walls	=	2,902 Btu's of Heat Loss

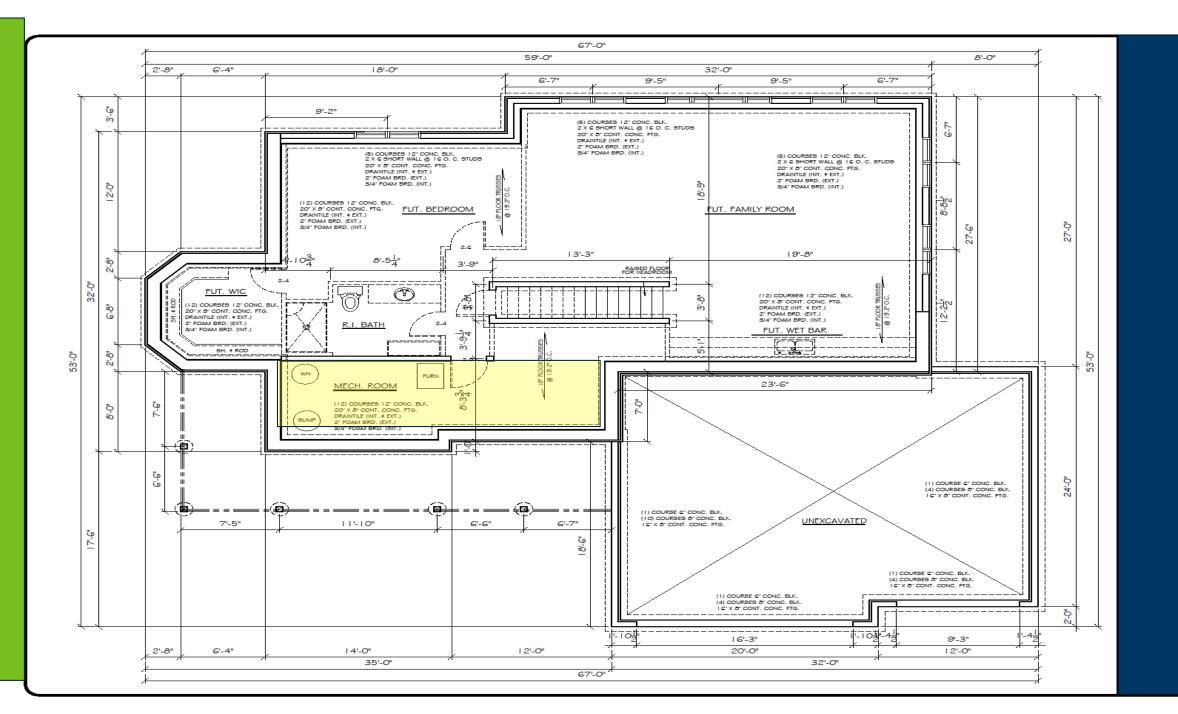
• Basement Floor Heat Loss



- Basement Floor Heat Loss
  - 24 x 50 = 1200

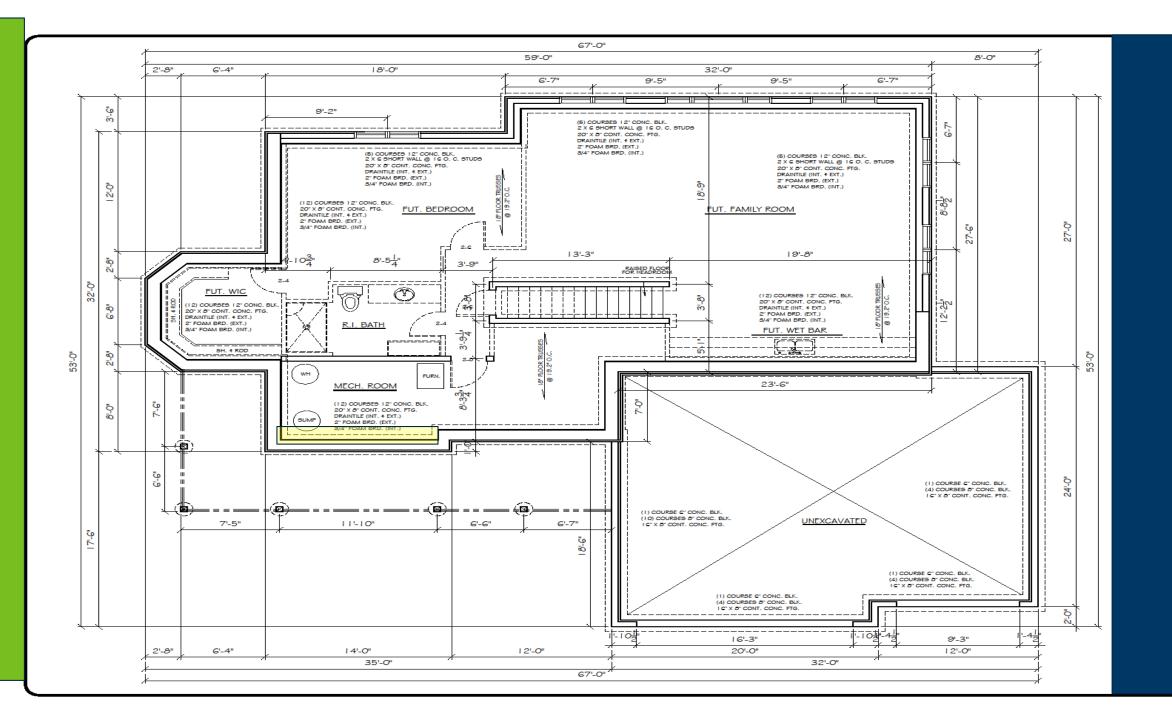


- Basement Floor Heat Loss
  - 24 x 50 = 1200 Sq. Ft
  - 32 x 3.5 = 112 Sq. Ft



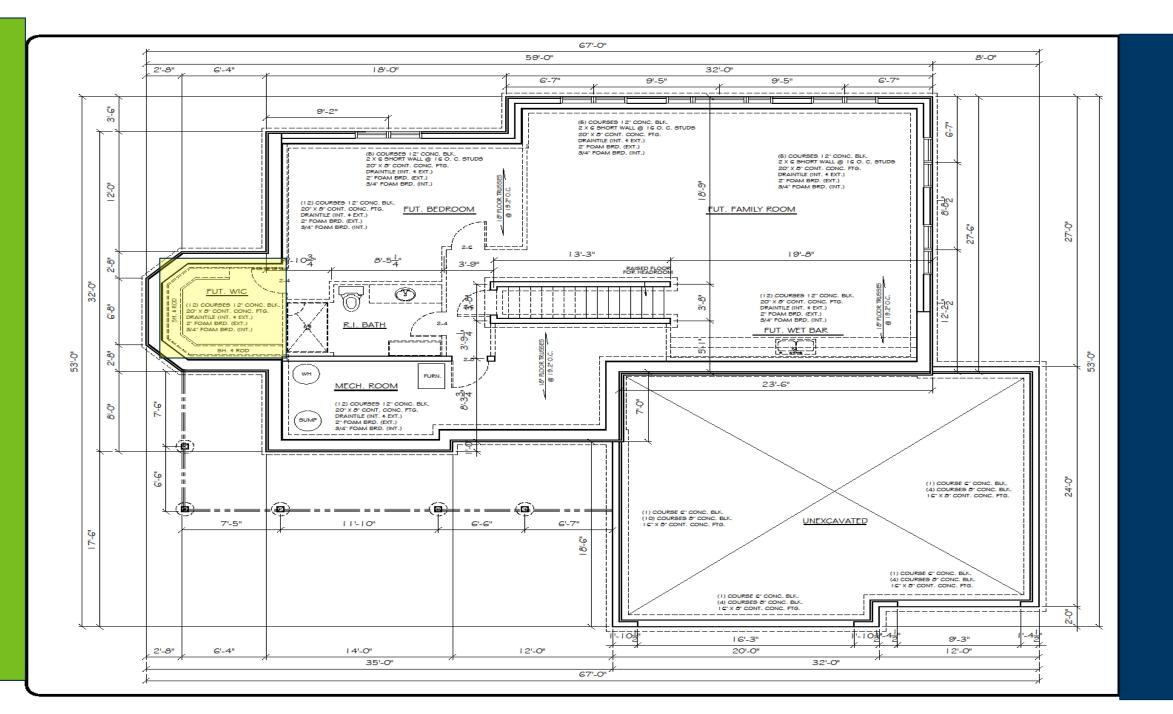
#### Basement Floor Heat Loss

- 24 x 50 = 1200 Sq. Ft
- 32 x 3.5 = 112 Sq. Ft
- 7 x 26 = 182 Sq. Ft



#### Basement Floor Heat Loss

- 24 x 50 = 1200 Sq. Ft
- 32 x 3.5 = 112 Sq. Ft
- 7 x 26 = 182 Sq. Ft
- 12 x 1 = 12 Sq. Ft



- Basement Floor Heat Loss
  - 24 x 50 = 1200 Sq. Ft
  - 32 x 3.5 = 112 Sq. Ft
  - 7 x 26 = 182 Sq. Ft
  - 12 x 1 = 12 Sq. Ft
  - <u>9 x 12 = 108 Sq Ft</u>
    - 1614 Total Sq. Ft of basement Floor Area at a R value of 2 (Concrete is .5 per inch, so 4" x .5 = 2)
    - Ground Temperature 8 Feet down is approx. 55 degrees
    - Interior temperature is 70 degrees What is the heat loss of the Basement Floor? Calculate it out

- 1614 Total Sq. Ft of basement Floor Area at a R value of 2 (Concrete is .5 per inch, so 4" x .5 =2)
- So the U factor of the Floor is .50
- Ground Temperature 8 Feet down is approx. 55 degrees
- Interior temperature is 70 degrees What is the heat loss of the Basement Floor?
- The delta T is (70-55) = 15 degrees
- So Q = UA(deltaT)
- Q = .50 x 1614 x 15 or 12,105 Btu's of Heat Loss

#### Make a note of it

•	Ceiling Area	=	2994 Btu's of Heat loss
•	Ceiling Vaulted Area Side Walls	=	686 Btu's of Heat Loss
•	Main Floor Exterior Walls	=	6555 Btu's of Heat Loss
•	Basement Knee walls	=	1446 Btu's of Heat Loss
•	4' Foundation Walls	=	1099 Btu's of Heat Loss
•	8' Foundation Walls	=	2902 Btu's of Heat Loss
•	Basement Floor	=	12,105 Btu's of Heat Loss

• Total Heat loss of building Envelope (not including Windows) =

27,787 Btu's of Heat loss

2/27/2019

• Did we forget anything?

- Did we forget anything?
  - What about the Floor over a Unconditioned space at the fireplace bump out? And...
  - What about the Rim Joist area Which is a 12" tall wall at a R-value of 21 around the entire perimeter?

• You Do the math and Figure these out.

- Floor at Fireplace 2 x 5 = 10 Square foot of area at a R value of R -30 Min per code
  - Q = .0476 (1/30) x 10 x 90 = 29.97 Btu's of Heat Loss or Rounding up = 30 Btu's

- Rim area of 191.25 Lin. Ft. at a R value of 21 121.25 x 1 = 121.75 Sq. Ft.
  - Q = .0476 (1/21) 121.75 x 90 = 521.57 Btu's of Heat loss or rounding up = 522 Btu's

•	Ceiling Area	=	2994 Btu's of Heat loss
•	Ceiling Vaulted Area Side Walls	=	686 Btu's of Heat Loss
•	Main Floor Exterior Walls	=	6555 Btu's of Heat Loss
•	Basement Knee walls	=	1446 Btu's of Heat Loss
•	4' Foundation Walls	=	1099 Btu's of Heat Loss
•	8' Foundation Walls	=	2902 Btu's of Heat Loss
•	Basement Floor	=	12,105 Btu's of Heat Loss
•	Total Heat loss of building Envelope (not including Windows)	=	27,787 Btu's of Heat loss
•	Add 30 for Floor over Unconditioned Space and 522 for rim are	of home 27787 + 552 =	28,339 Btu's of Heat loss (So far)

# Windows



<u>Windows</u>

Window or door unit	Sq. Inches	Divided by 144= Sq Ft	U Factor (e	dT)	Btu's Heat Loss
---------------------	------------	-----------------------	-------------	-----	-----------------

### Create a very Simple Spread Sheet or take a look at the window Schedule if one is provided

# **Energy Efficiency of Windows are based on U-factors**

NFRC PRODUCT CERTIFICATION PROGRAM World's Best Window Co. Millenview Product World's Best Window Co. Millenview Product Road Product R		
NFRC Label Certificate for Site- Built Products Vable Tanseitance Vable Tanseitance Ar Laskage (U.S.A.P) O.51 O.2		
Project Location Notice and the second secon	World's Best	
Street Address:	Window Co.	
City:         State:         Zip Code:           Project Name         Designer           (Optional):         (Optional):	National Fenestration Winyl-Clad Wood Frame	
Product Line Information           Operator Type (per Table 4-3 of NFRC 100)           Product Line ID No.           Individual Product ID No.	Rating Council     Double Glazing • Argon Fill • Low E       CEPTIFIED     Product Type: Vertical Slider	
How many of this Location in building individual product	ENERGY PERFORMANCE RATINGS	
Elevation drawing Fenestration (window & door) schedule page	U-Factor (U.S./I-P) Solar Heat Gain Coefficient	
Frame Material Supplier Company name:	0.34 0.25	THE REAL PROPERTY AND A DESCRIPTION OF
City: State: Zip Code:	0.0.0	
Street Address:	ADDITIONAL PERFORMANCE RATINGS	
Contact: Phone: Fax:	Visible Transmittance Air Leakage (U.S./I-P)	
Glazing Material Supplier Company name:		Line First Right in the second
City: State: Zip Code:	0.41 0.2	
Street Address:	Manufactures effortubes that these entropy and from to any Pacific MEDP area down for determining whole	
Glazing Contractor/Installer Comp. name:	Manufacturer stipulates that these ratings conform to applicable NFRC procedures for determining whole product performance. NFRC ratings are determined for a fixed set of environmental conditions and a	
City: State: Zip Code:	specific product size. Consult manufacturer's literature for other product performance information. www.nfrc.org	
Street Address:	THREAD ST	
Contact: Phone: Fax:		
Certification Authorization		
Independent Certification & Inspection Agency (IA): Date Certification Authorization Issued:		

2/27/2019

# Using the Q = UA (delta T) Method

- Calculated Square foot of all windows as per plan.
- All windows and doors having a U factor of .30 per Certificate

#### New Construction Energy Code Compliance Checklist/Certificate

							-							Place your
Mailing Address of the D	welling or	Dwelling Unit					Cit	-						logo here
1234 Any Street								ny t						
Name of Residential Cor											nber			
John Doe Construc							UU	001	234	50				
THERMAL ENVELOPE	-		-									RADO	DN	CONTROL SYSTEM
				Т	ype:	Chec	K All T	That A	pply			x		Passive (No Fan)
			oť							e				Active (With fan and monometer o other system monitoring device)
			bes	İ.				1		vren	ľ	Locati	on (	or future location) of Fan:
			1 T	able				İ	-	lyst	ľ	Att	ic	
Insulation Location			Fotal R-Value of all Types nsulation	Von or Not Applicable	Fiberglass, Blown	Fiberglass, Batts	Foam, Closed Cel	oam Open Cell	Mineral Fiberboard	Rigid, Extruded Polystyrene	Rigid, Isocynurate	Other F	Plea	se Describe Here
			<u> </u>	-	Ϊ.	Ē	щ	щ	Σ	Ř	Ř			
Below Entire Slab Foundation Wall				N/A			х				D 10	Heine	Evt	erior Closed cell Foam
Perimeter of Slab on Grade				N/A			x				R-10	Using	EXI	erior Closed cell Foam
Rim Joist (1st Floor)				R-21			х					Using	R-2	1 Foam Insulation. Closed cell
Rim Joist (2nd Floor+)				N/A								g		
Wall				R-21		х						Using	Fric	tion Fit Fiberglass Batt Insulation
Ceiling, flat				R-49	х							J		
Ceiling, vaulted				R-49	х									
Bay Windows or cantilevered	d areas			R-49		х								
Electron and an and a second second								-						
Floors over unconditioned ar				R-30		х								
Describe other insulated are	as	/ill Be Testing t	N/A p a Maxim		f 2.6			Svst	em	∆ir 1	Fight	tness:		
	as ir <sup>M</sup>	fill Be Testing t inal Test =?	o a Maxim		f 2.6						-	tness:		N/A-Ducts will be inside envelo conditioned Spaces
Describe other insulated are Building Envelope A Tightness:	as ir M F	inal Test =?			f 2.6			eating	or C	oolin	g Duo	cts Out	side	
Describe other insulated are Building Envelope A Tightness: Windows & Doors	as ir M F	inal Test =?	o a Maxim		f 2.6			eating	or Co appli	oolin cable	g Duo e, all c	cts Outs lucts lo	side	Conditioned Spaces
Describe other insulated are Building Envelope A Tightness: Windows & Doors Average U-Factor ( <i>excludes</i>	as ir M F s skylights ar (SHGC):	inal Test =?	o a Maxim .30		f 2.6			eating	or Co appli	oolin cable	g Duo e, all c	cts Outs lucts lo if ducts	side ocat s ar	Conditioned Spaces ed in conditioned space
Describe other insulated are Building Envelope A Tightness: Windows & Doors Average U-Factor ( <i>excludes</i> Solar Heat Gain Coefficient	as ir W s skylights ar (SHGC): EMS	inal Test =?	o a Maxim .30	num o		D		R-va	or Co appli	oolin cable need	g Duo a, all c This	cts Outs lucts lo if ducts	side ocat s ar e-u	Conditioned Spaces ed in conditioned space e in exterior walls) N/A
Describe other insulated are Building Envelope A Tightness: Windows & Doors Average U-Factor (excludes Solar Heat Gain Coefficient MECHANICAL SYSTE	as ir W s skylights ar (SHGC): EMS Heating Gas Force Sealed Co	inal Test =? d one door) U: g System d Air furnace	.30 .30 .35 Dome Gas- Fa	num o stic V	/ater	Heat	ter	eating Not R-va Co Elec	oling	oolin cable need	g Duo a, all c This	cts Outs lucts lo if ducts	side ocat s ar e-u	Conditioned Spaces ed in conditioned space e in exterior walls) N/A p Air Select a Type
Describe other insulated are Building Envelope A Tightness: Windows & Doors Average U-Factor (excludes Solar Heat Gain Coefficient MECHANICAL SYSTE Appliances	as ir M s skylights ar (SHGC): EMS Heating Gas Force	inal Test =? d one door) U: g System d Air furnace	.30 .30 .30	num o stic V	/ater	Heat	ter	eating Not R-va	oling	oolin cable need	g Duo a, all c This	cts Outs lucts lo if ducts Mak	side ocat s ar e-u No Pa	Conditioned Spaces ed in conditioned space e in exterior walls) N/A p Air Select a Type ot required per mech. code
Describe other insulated are Building Envelope A Tightness: Windows & Doors Average U-Factor ( <i>excludes</i> Solar Heat Gain Coefficient MECHANICAL SYSTE Appliances Fuel Type	as ir M F Skylights ar (SHGC): EMS Heating Gas Force Sealed Co Lennox. G26Q3-75-	d one door) U: g System d Air furnace mbustion	.30           .33           .35           Dome           Gas- Fa           State           CV 30 1           33,000	num o stic V n Ass NSRTi Btu's	/ater iistec	Heat	ter	RUUE	oling	oolin cable need Syst	g Duo a, all c This	tts Out: lucts lo if ducts Make X	side cat s ar e-u Pa Pa In D	Conditioned Spaces ed in conditioned space in exterior walls) N/A p Air Select a Type ot required per mech. code assive owered terlocked with exhaust device. escribe:
Describe other insulated are Building Envelope A Tightness: Windows & Doors Average U-Factor (excludes Solar Heat Gain Coefficient MECHANICAL SYSTE Appliances Fuel Type Manufacturer Model Rating or Size	as ir W skylights ar (SHGC): EMS Heating Gas Force Sealed Co Lennox.	d one door) U: g System d Air furnace mbustion 5 70,000	.30 .30 .35 Dome Gas-Fa State CV 30 I	stic V n Ass NSRT Btu's	/ater istec	Heat	ter	R-va	oling	oolin cable need syst	g Duc a, all c This eem	tts Out: ducts lo if ducts Mak X N/A N/A X	side cat s ar e-u Pa Pa D O	Conditioned Spaces ed in conditioned space e in exterior walls) N/A p Air Select a Type ot required per mech. code assive owered terlocked with exhaust device. escribe: ther, describe: Flex Duct
Describe other insulated are Building Envelope A Tightness: Windows & Doors Average U-Factor (excludes Solar Heat Gain Coefficient MECHANICAL SYSTE Appliances Fuel Type Manufacturer Model	as ir MFF s skylights ar (SHGC): EMS Heating Gas Force Sealed Co Lennox. G26Q3-75- Input in BTUS:	inal Test =? id one door) U: g System d Air furnace mbustion 5 70,000 92%	30 330 335 Dome Gas-Fa State CV 30 f 33,000 Capacity	stic V n Ass NSRT Btu's	/ater iistec	Heat t	ter	R-va Co Elec UANE UANE Outpoin To SEEF //EER	oling	oolin cable need i Syst JAZ 3 1	g Duc a, all c This em	Cts Outs Jucts Ic if ducts Make X N/A N/A X Loc	side cat s ar e-u Pr Pr D O atio	Conditioned Spaces ed in conditioned space ed in conditioned space e in exterior walls) N/A p Air Select a Type ot required per mech. code assive owered terlocked with exhaust device. escribe: ther, describe: Flex Duct n of duct or system:
Describe other insulated are Building Envelope A Tightness: Windows & Doors Average U-Factor ( <i>excludes</i> Solar Heat Gain Coefficient MECHANICAL SYSTE Appliances Fuel Type Manufacturer Model Rating or Size Efficiency Residential Load	as ir Kylights ar (SHGC): EMS Heating Gas Force Sealed Co Lennox. G2603-75- Input in BTUS: Heatin	inal Test =? id one door) U: g System d Air furnace mbustion 5 70,000 92% ig Loss	30 330 335 Dome Gas-Fa State CV 30 f 33,000 Capacity	stic V n Ass NSRT Btu's	/ater istec	Heat t	ter	R-va Co Elec UANE UANE Outpoin To SEEF //EER	oling	oolin cable need s Syst JAZ 3 1 g Loa	g Duc a, all c This em	ts Out: ducts lo if ducts Mak X N/A N/A X Loca In I	side cat ar e-u Pa Pa In D O atio	Conditioned Spaces ed in conditioned space e in exterior walls) N/A p Air Select a Type ot required per mech. code assive owered terlocked with exhaust device. escribe: ther, describe: Flex Duct
Describe other insulated are Building Envelope A Tightness: Windows & Doors Average U-Factor ( <i>excludes</i> Solar Heat Gain Coefficient MECHANICAL SYSTE Appliances Fuel Type Manufacturer Model Rating or Size Efficiency	as ir Kylights ar (SHGC): EMS Heating Gas Force Sealed Co Lennox. G2603-75- Input in BTUS: Heatin	inal Test =? id one door) U: g System d Air furnace mbustion 5 70,000 92%	30 330 335 Dome Gas-Fa State CV 30 f 33,000 Capacity	stic V n Ass NSRT Btu's	/ater istec	Heat t	ter	R-va Co Elec UANE UANE Outpoin To SEEF //EER	oling	oolin cable need i Syst JAZ 3 1	g Duc a, all c This em	Cts Outs Jucts Ic if ducts Make X N/A N/A X Loc	side cat s ar e-u Pr Pr In D O O atio	Conditioned Spaces ed in conditioned space ed in conditioned space e in exterior walls) N/A p Air Select a Type ot required per mech. code assive owered terlocked with exhaust device. escribe: ther, describe: Flex Duct n of duct or system:
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# Using the Q = UA (delta T) Method

- Calculated Square foot of all windows as per plan.
- All windows and doors having a U factor of .30 per Certificate
- Interior temperature is 70 degrees
- The delta T is = 90 degrees
- So Q = UA(deltaT)
- Let's Give it a Shot and see what we Come Up with.
  - Here is the first window as a example.

Window or door unit	Sq. Inches	Divided by 144= Sq Ft	<b>U</b> Factor	(dT)	<b>Btu's Heat Loss</b>
Great Rm Window #1	60 x 60 = 5760	Divide by $144 = 25$ Sq. Ft x	.30	x 90 =	675 Btu's

### Windows and Doors (Main Floor)

Window or door unit	Sq. Inches	Divided by 144= Sq Ft	<b>U</b> Factor	(dT)	Btu's Heat Loss
Great Rm Window #1	60 x 60 = 5760	Divide by 144 = 25 Sq. Ft x	.30	x 90 =	675 Btu's
Great Rm Window #2	60 x 60 = 5760	Divide by 144 = 25 Sq. Ft x	.30	x 90 =	675 Btu's
Master B. R.	60 x 48 = 2880	Divide by 144 = 20 Sq. Ft x	.30	x 90 =	540 Btu's
Bedroom #2	60 x 48 = 2880	Divide by 144 = 20 Sq. Ft x	.30	x 90 =	540 Btu's
Bedroom #3	60 x 48 = 2880	Divide by 144 = 20 Sq. Ft x	.30	x 90 =	540 Btu's
Dr. to Gar.	32 x 80 = 2560	Divide by 144 = 17.8 Sq. Ftx	.30	x 90 =	481 Btu's
Front Dr.	48 x 80 = 3840	Divide by 144 = 26.7 Sq. Ftx	.30	x 90 =	721 Btu's
Laundry Rm.	30 x 36 = 1080	Divide by 144 = 7.5 Sq. Ft x	.30	x 90 =	203 Btu's
Kitchen	72 x 36 = 2592	Divide by 144 = 18 Sq. Ft x	.30	x 90 =	486 Btu's
Patio Doors (#1)	60 x 80 = 4800	Divide by 144 = 33.4 Sq. Ft x	.30	x 90 =	902 Btu's
Patio Doors (#2)	60 x 80 = 4800	Divide by 144 = 33.4 Sq. Ft x	.30	x 90 =	902 Btu's
Dining room (#1)	30 x 60 = 180	Divide by 144 = 12.5 Sq. Ft x	.30	x 90 =	338 Btu's
Dining room (#2)	30 x 60 = 180	Divide by 144 = 12.5 Sq. Ft x	.30	x 90 =	338 Btu's
Dining room	60 x 60 = 3600	Divide by 144 = 25.0 Sq. Ft x	.30	x 90 =	<u>675 Btu's</u>

Window or door unit	Sq. Inches	Divided by 144= Sq F	t U Factor	(dT)	Btu's Hea	t Loss
Great Rm Window #1	60 x 60 = 5760	Divide by 144 = 25 Sq. Ft	x	.30	x 90 =	675 Btu's
Great Rm Window #2	60 x 60 = 5760	Divide by 144 = 25 Sq. Ft	x	.30	x 90 =	675 Btu's
Master B. R.	60 x 48 = 2880	Divide by 144 = 20 Sq. Ft	x	.30	x 90 =	540 Btu's
Bedroom #2	60 x 48 = 2880	Divide by 144 = 20 Sq. Ft	x	.30	x 90 =	540 Btu's
Bedroom #3	60 x 48 = 2880	Divide by 144 = 20 Sq. Ft	x	.30	x 90 =	540 Btu's
Dr. to Gar.	32 x 80 = 2560	Divide by 144 = 17.8 Sq. Ft	x	.30	x 90 =	481 Btu's
Front Dr.	48 x 80 = 3840	Divide by 144 = 26.7 Sq. Ft	x	.30	x 90 =	721 Btu's
Laundry Rm.	30 x 36 = 1080	Divide by 144 = 7.5 Sq. Ft	x	.30	x 90 =	203 Btu's
Kitchen	72 x 36 = 2592	Divide by 144 = 18 Sq. Ft	х	.30	x 90 =	486 Btu's
Patio Doors (#1)	60 x 80 = 4800	Divide by 144 = 33.4 Sq. Ft	x	.30	x 90 =	902 Btu's
Patio Doors (#2)	60 x 80 = 4800	Divide by 144 = 33.4 Sq. Ft	x	.30	x 90 =	902 Btu's
Dining room (#1)	30 x 60 = 180	Divide by 144 = 12.5 Sq. Ft	x	.30	x 90 =	338 Btu's
Dining room (#2)	30 x 60 = 180	Divide by 144 = 12.5 Sq. Ft	x	.30	x 90 =	338 Btu's
Dining room	60 x 60 = 3600	Divide by 144 = 25.0 Sq. Ft	x	.30	x 90 =	675 Btu's
Main Floor Totals		296.8 Sq. Ft (Main F	loor)			8,016 Btu's

### Windows and Doors (Basement Level)

Window or door unit	Sq. Inches	Divided by 144= Sq Ft	U Factor	(dT)	<b>Btu's Heat Loss</b>
Future BR	48 x 42= 2016	Divide by 144 = 14 Sq. Ft x	.30	x 90 =	378 Btu's
Future Family Rm	48 x 42= 2016	Divide by 144 = 14 Sq. Ft x	.30	x 90 =	378 Btu's
Future Family Rm	60 x 42 = 2520	Divide by 144 = 17.5 Sq. Ftx	.30	x 90 =	473 Btu's
Future Family Rm	48 x 42= 2016	Divide by 144 = 14 Sq. Ft x	.30	x 90 =	378 Btu's
Future Family Rm	48 x 42= 2016	Divide by 144 = 14 Sq. Ft x	.30	x 90 =	378 Btu's
Future Wet Bar Area	48 x 42 = 2016	Divide by 144 = 14 Sq. Ft x	.30	x 90 =	<u>378 Btu's</u>
Basement Level Totals		87.58 Sq. Ft (Main Floor)			2,363 Btu's
Main Floor Totals		296.8 Sq. Ft (Main Floor)			8,016 Btu's
<b>Overall Window totals</b>		384.38			10,379 Btu's

**Note:** Total Sq. Ft of window area 151.6 @ a U factor of .0526 needs to be subtracted from wall area Btu's So...

# Running total of Btu's of Heat Loss for Our Home

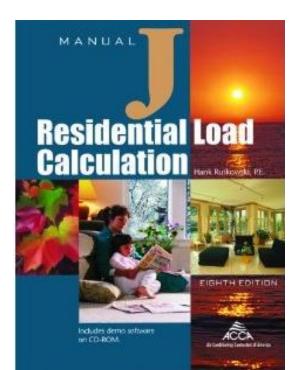
•	Ceiling Area	=	2994 Btu's of Heat loss
•	Ceiling Vaulted Area Side Walls	=	686 Btu's of Heat Loss
•	Main Floor Exterior Walls	=	6,555 Btu's of Heat Loss
•	Basement Knee walls	=	1,446 Btu's of Heat Loss
•	4' Foundation Walls	=	1,099 Btu's of Heat Loss
•	8' Foundation Walls	=	2902 Btu's of Heat Loss
•	Basement Floor	=	12,105 Btu's of Heat Loss
•	F-place bump out and Rim Area	=	552 Btus of Heat Loss
•	Windows and Doors	=	10,379 Btu's of Heat Loss
•	Total Heat loss of building Envelope (including Windows)	=	38,718 Btu's of Heat loss

# Running total of Btu's of Heat Loss for Our Home

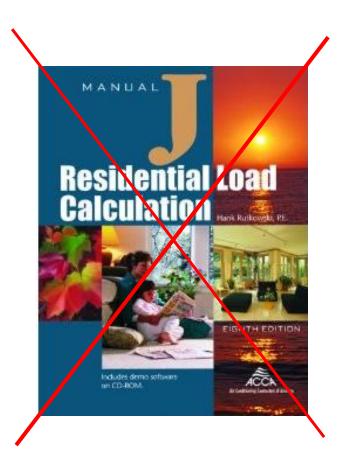
•	Ceiling Area	=	2994 Btu's of Heat loss
•	Ceiling Vaulted Area Side Walls	=	686 Btu's of Heat Loss
•	Main Floor Exterior Walls	=	6,555 Btu's of Heat Loss
•	Basement Knee walls	=	1,446 Btu's of Heat Loss
•	4' Foundation Walls	=	1,099 Btu's of Heat Loss
•	8' Foundation Walls	=	29,598 Btu's of Heat Loss
•	Basement Floor	=	12,105 Btu's of Heat Loss
•	Fire Place bump out and rim Area	=	552 Btu's of Heat Loss
•	Windows and Doors	=	10,379 Btu's of Heat Loss
•	Sub-Total Heat loss of building Envelope	=	38,78 Btu's of Heat loss
•	(-) Area of windows figured as R21 walls Or 384.38 x .0476 x 90	=	(1,647 Btu's of Heat Loss)
•	Grand Total of Building Heat Loss 2/27/2019	=	<b>36,071 Btu's of Heat loss for the Building</b> 156

•Sizing the Mechanical Equipment

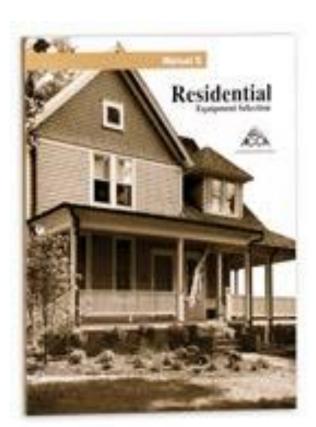
• Heating and cooling equipment will be sized in accordance with ACCA *Manual S* based on building loads calculated in accordance with ACCA *Manual J*...



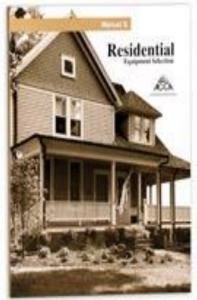
# Or Other accepted and established method for sizing Ex. Q=UA (dT) and Manual S (or Manufactures Tables



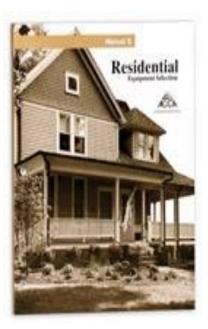
# • Manual J 8<sup>th</sup> is only used to calculate the residential heating and cooling loads.



- *Manual J8<sup>th</sup>* is only used to calculate the residential heating and cooling loads.
- Manual J 8<sup>th</sup> guides HVAC designers to use ACCA Manual S to select equipment that is the right size.



- *Manual J 8<sup>th</sup>* is only used to calculate the residential heating and cooling loads.
- Manual J 8<sup>th</sup> guides HVAC designers to use ACCA Manual S to select equipment that is the right size (see§10-4 of Manual S).
- *Manual S* sets equipment sizing limits, as summarized in Table 1.



# **ACCA Manual S= Sizing of Equipment**

Equipment	Sizing Limits	Reference
Furnaces	100% - 140% of total heating load	Section 2-2
Boilers	100% - 140% of total heating load	Section 2-2
Air conditioners	115% of total cooling load*	Section 3-4
Heat pumps	115% or 125% of total cooling load*	Section 4-4
Supplemental heat (heat pumps)		
Electric	Based on equipment balance point	Section 4-8
<ul> <li>Dual fuel</li> </ul>	100% - 140% of total heating load	Section 6-8
Emergency Heat (heat pumps)	Based on local codes	Section 4-9
Manual S In	put for Design Air Flow (Manual L	))
Mode of Operation	Requirement	Reference
<ul> <li>Heating</li> </ul>	Temperature rise requirement	Section 2-6
Cooling	Air flow associated with the selected equipment's capacity	Section 3-11
<sup>2</sup> Heat pumps in a heating domination	it climate are allowed to be 115% of the cooling in climate are allowed to be 125% of the cooling in must be based on the same temperature and h	g load.

• Select a furnace for a home with a 63,215 Btu/h output heating requirement based on Q=UA delta T or ACCA Manual J.

- Select a furnace for a home with a 63215 Btu/h output heating requirement based on Q=UA delta T or ACCA Manual J.
- Furnace <u>must</u> deliver as least **63,215 Btu/h** to maintain the interior design temperature (T-1) in the home (70) when the outdoor temperature (T-2) dips to design temperature. (-20)

- Select a furnace for a home with a 63,215 Btu/h output heating requirement based on Q=UA delta T or ACCA Manual J.
- Furnace must deliver as least **63,215 Btu/h** to maintain the interior design temperature (T-1) in the home (70) when the outdoor temperature (T-2) dips to design temp.
- Manual S sets a sizing limit for furnaces using Table.

# **ACCA Manual S= Sizing of Equipment**

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<ul> <li>Heating</li> </ul>	Temperature rise requirement	Section 2-6
Cooling	Air flow associated with the selected equipment's capacity	Section 3-11
<sup>2</sup> Heat pumps in a heating domination	it climate are allowed to be 115% of the cooling in climate are allowed to be 125% of the cooling in must be based on the same temperature and h	g load.

- Select a furnace for a home with a minimum **63,215 Btu/h** output heating requirement based on **Q=UA delta T or ACCA Manual J.**
- Furnace must deliver as least **63,215 Btu/h** to maintain the interior design temperature (T-1) in the home when the outdoor temperature (T-2) dips to design temp.
- Manual S sets a sizing limit for furnaces using Table.
- Furnace shall have a capacity no larger than 140% of heating load.
  - (140% x 63,215 = 88,501 Btu/h)

- Select a furnace for a home with a 63,215 Btu/h output heating requirement based on Q=UA delta T or ACCA Manual J.
- Furnace must deliver as least **63,215 Btu/h** to maintain the interior design temperature (T-1) in the home when the outdoor temperature (T-2) dips to design temp.
- *Manual S* sets a sizing limit for furnaces using Table.
- Furnace shall have a capacity no larger than 140% of heating load.
  - (140% x 62,515 = 88,501 Btu/h)
- Based on home's load and sizing limitations, the furnace must produce a minimum of 62,515 Btu/h ≤ heating requirement for the home but can not produce more than ≤ 88,501 Btu/h.





# Make – Up Air

# What is a make up air system



# How much make up air is required in (new dwellings)

- MN 1346.501.4.1 Makeup air in new dwelling units.
  - Determined by using IMC Table 501.4.1
  - Needs to be supplied in accordance with IMC section 501.4.2

	ONE OR MULTIPLE POWER	ONE OR MULTIPLE	ONE ATMOSPHERICALLY	MULTIPLE APPLIANCES THAT
	VENT OR DIRECT VENT	FAN-ASSISTED	VENTED GAS OR OIL	ARE ATMOSPHERICALLY
	APPLIANCES OR NO COMBUSTION	APPLIANCES AND POWER VENT OR	APPLIANCE OR ONE SOLID	VENTED GAS OR OIL APPLIANCES OR SOLID FUEL
	APPLIANCES <sup>A</sup>	DIRECT VENT APPLIANCES <sup>B</sup>		
	Column to Estimate House Infiltr			
a) pressure factor (cfm/sf)	0.15	0.09	0.06	0.03
b) conditioned floor area (sf)		_		
(including unfinished ba	isements)			
Estimated House Infiltration (cfm): [1a × 1b]	—	—	—	—
2. Exhaust Capacity				
a) clothes dryer	135	135	135	135
b) 80% of largest exhaust rating (cfm):	—	—	—	—
		keup air is electrically interlocked	and matched to exhaust)	-
c) 80% of next largest exhaust rating (cfm):		_	—	—
	lating system or if powered mak	keup air is electrically interlocked	and matched to exhaust)	-
Total Exhaust Capacity (cfm): [2a+2b+2c]	—	_	_	—
3. Makeup Air Requiren	nent			
a) Total Exhaust Capacity (from above)		_	—	—
b) Estimated House Infiltration (from above)				
Makeup Air Quality (cfm): [3a - 3b]		_	_	_
(if value is negative, no				
4. For Makeup Air Oper	ning Sizing, refer to Table 501.4.	.2.		

A. Use this column if there are other than fan-assisted or atmospherically vented gas or oil appliances or if there are no combustion appliances.

B. Use this column if there is one fan-assisted appliance per venting system. Other than atmospherically vented appliances may also be included.

C. Use this column if there is one atmospherically vented (other than fan-assisted) gas or oil appliance per venting system or one solid fuel appliance.

D. Use this column if there are multiple atmospherically vented gas or oil *appliances* using a common vent or if there are atmospherically vented gas or oil *appliances* and solid fuel *appliances*.

- **1. Sealed Combustion Furnace**
- 2. A Fan Assisted Water Heater
- 3. Direct vent Fireplace
- 4. HRV System Balanced
- 5. 2- 50 CFM Bath Fans

	ONE OR MULTIPLE POWER VENT OR DIRECT VENT APPLIANCES OR NO COMBUSTION APPLIANCES <sup>A</sup>	ONE OR MULTIPLE FAN-ASSISTED APPLIANCES AND POWER VENT OR DIRECT VENT APPLIANCES <sup>B</sup>	ONE ATMOSPHERICALLY VENTED GAS OR OIL APPLIANCE OR ONE SOLID FUEL APPLIANCE <sup>C</sup>	MULTIPLE APPLIANCES THAT ARE ATMOSPHERICALLY VENTED GAS OR OIL APPLIANCES OR SOLID FUE APPLIANCES <sup>D</sup>
1. Use the Appropriate (	Column to Estimate House Infiltr		1	L
a) pressure factor (cfm/sf)	0.15	0.09	0.06	0.03
b) conditioned floor area (sf)				_
(including unfinished ba	isements)			
Estimated House Infiltration (cfm): [1a × 1b]				_
2. Exhaust Capacity				
a) clothes dryer	135	135	135	135
b) 80% of largest exhaust rating (cfm):		—	—	_
		keup air is electrically interlocked	and matched to exhaust)	
c) 80% of next largest exhaust rating (cfm):			_	
	lating system or if powered mak	keup air is electrically interlocked	and matched to exhaust)	
Total Exhaust Capacity (cfm): [2a+2b+2c]		_	_	_
3. Makeup Air Requirem	nent			
a) Total Exhaust Capacity (from above)		_	_	_
b) Estimated House Infiltration (from above)				_
Makeup Air Quality (cfm): [3a - 3b]				_
(if value is negative, no	makeup air is needed			
4. For Makeup Air Open	ning Sizing, refer to Table 501.4.	.2.		

A. Use this column if there are other than fan-assisted or atmospherically vented gas or oil appliances or if there are no combustion appliances.

B. Use this column if there is one fan-assisted appliance per venting system. Other than atmospherically vented appliances may also be included.

C. Use this column if there is one atmospherically vented (other than fan-assisted) gas or oil appliance per venting system or one solid fuel appliance

D. Use this column if there are multiple atmospherically vented gas or oil appliances using a common vent or if there are atmospherically vented gas or oil appliances and solid fuel appliances.

- **1. Sealed Combustion Furnace**
- 2. A Fan Assisted Water Heater
- **3.** Direct vent Fireplace
- 4. HRV System Balanced
- 5. 2- 50 CFM Bath Fans

	ONE OR MULTIPLE POWER VENT OR DIRECT VENT APPLIANCES OR NO COMBUSTION APPLIANCES <sup>A</sup>	ONE OR MULTIPLE FAN-ASSISTED APPLIANCES AND POWER VENT OR DIRECT VENT APPLIANCES <sup>B</sup>	ONE ATMOSPHERICALLY VENTED GAS OR OIL APPLIANCE OR ONE SOLID FUEL APPLIANCE <sup>C</sup>	MULTIPLE APPLIANCES THAT ARE ATMOSPHERICALLY VENTED GAS OR OIL APPLIANCES OR SOLID FUEL APPLIANCES <sup>D</sup>
1. Use the Appropriate	Column to Estimate House Infiltr	ation		
a) pressure factor (cfm/sf)	0.15	0.09	0.06	0.03
b) conditioned floor area (sf)	—		—	—
(including unfinished ba	asements)	_		
Estimated House Infiltration (cfm): [1a × 1b]		_	—	—
2. Exhaust Capacity				
a) clothes dryer	135	135	135	135
b) 80% of largest exhaust rating (cfm):	—	—	—	—
		eup air is electrically interlocked	and matched to exhaust)	
c) 80% of next largest exhaust rating (cfm):		_	—	—
	lating system or if powered mak	eup air is electrically interlocked	and matched to exhaust)	
Total Exhaust Capacity (cfm): [2a+2b+2c]	—	_	_	—
3. Makeup Air Requirer	nent			
a) Total Exhaust Capacity (from above)	—	_	—	—
b) Estimated House Infiltration (from above)		_		_
Makeup Air Quality (cfm): [3a - 3b]				—
	(if value is negative, no makeup air is needed			
4. For Makeup Air Opening Sizing, refer to Table 501.4.2.				

A. Use this column if there are other than fan-assisted or atmospherically vented gas or oil appliances or if there are no combustion appliances.

B. Use this column if there is one fan-assisted appliance per venting system. Other than atmospherically vented appliances may also be included.

C. Use this column if there is one atmospherically vented (other than fan-assisted) gas or oil appliance per venting system or one solid fuel appliance.

D. Use this column if there are multiple atmospherically vented gas or oil *appliances* using a common vent or if there are atmospherically vented gas or oil *appliances* and solid fuel *appliances*.

- **1. Sealed Combustion Furnace**
- 2. A Fan Assisted Water Heater
- 3. Direct vent Fireplace
- 4. HRV System Balanced
- 5. 2-50 CFM Bath Fans

	ONE OR MULTIPLE POWER VENT OR DIRECT VENT APPLIANCES OR NO COMBUSTION APPLIANCES <sup>A</sup>	ONE OR MULTIPLE FAN-ASSISTED APPLIANCES AND POWER VENT OR DIRECT VENT APPLIANCES <sup>B</sup>	ONE ATMOSPHERICALLY VENTED GAS OR OIL APPLIANCE OR ONE SOLID FUEL APPLIANCE <sup>C</sup>	MULTIPLE APPLIANCES THAT ARE ATMOSPHERICALLY VENTED GAS OR OIL APPLIANCES OR SOLID FUEL APPLIANCES <sup>D</sup>
1. Use the Appropriate	Column to Estimate House Infiltr	ation		
a) pressure factor (cfm/sf)	0.15	0.09	0.06	0.03
b) conditioned floor area (sf)	—	3224	—	—
(including unfinished ba	sements)	-		
Estimated House Infiltration (cfm): [1a × 1b]	—	—	—	—
2. Exhaust Capacity				
a) clothes dryer	135	135	135	135
b) 80% of largest exhaust rating (cfm):	—	—	_	—
		eup air is electrically interlocked	and matched to exhaust)	
c) 80% of next largest exhaust rating (cfm):	not applicable	—	_	—
	lating system or if powered mak	eup air is electrically interlocked	and matched to exhaust)	
Total Exhaust Capacity (cfm): [2a+2b+2c]				—
3. Makeup Air Requirer	nent			
a) Total Exhaust Capacity (from above)	_			—
b) Estimated House Infiltration (from above)				_
Makeup Air Quality (cfm): [3a - 3b]			_	_
(if value is negative, no	(if value is negative, no makeup air is needed			
4. For Makeup Air Opening Sizing, refer to Table 501.4.2.				

A. Use this column if there are other than fan-assisted or atmospherically vented gas or oil appliances or if there are no combustion appliances.

B. Use this column if there is one fan-assisted appliance per venting system. Other than atmospherically vented appliances may also be included.

C. Use this column if there is one atmospherically vented (other than fan-assisted) gas or oil appliance per venting system or one solid fuel appliance.

D. Use this column if there are multiple atmospherically vented gas or oil *appliances* using a common vent or if there are atmospherically vented gas or oil *appliances* and solid fuel *appliances*.

- **1. Sealed Combustion Furnace**
- 2. A Fan Assisted Water Heater
- 3. Direct vent Fireplace
- 4. HRV System Balanced
- 5. 2- 50 CFM Bath Fans

VENT OR DIRECT APPLIANCES OR COMBUSTION APPLIANCES	AND POWER VENT OR DIRECT VENT APPLIANCES <sup>B</sup>	ONE ATMOSPHERICALLY VENTED GAS OR OIL APPLIANCE OR ONE SOLID FUEL APPLIANCE <sup>C</sup>	THAT ARE ATMOSPHERICALLY VENTED GAS OR OIL APPLIANCES OR SOLID FUEL APPLIANCES <sup>D</sup>
1. Use the Appropriate Column to Estimate Ho			
a) pressure factor 0.15 (cfm/sf)	0.09	0.06	0.03
b) conditioned floor — area (sf)	3224	—	—
(including unfinished basements)			
Estimated House — Infiltration (cfm): [1a × 1b]	193	_	—
2. Exhaust Capacity			
a) clothes dryer 135	135	135	135
b) 80% of largest	-	_	—
(not applicable if recirculating system or if pow	ered makeup air is electrically interlocked	and matched to exhaust)	
c) 80% of next largest not applicable exhaust rating (cfm):		—	—
(not applicable if recirculating system or if power	ered makeup air is electrically interlocked	and matched to exhaust)	
Total Exhaust — Capacity (cfm): [2a+2b+2c]	_		_
3. Makeup Air Requirement			
a) Total Exhaust — Capacity (from above)	_	_	_
b) Estimated House — Infiltration (from above)	_		—
Makeup Air — Quality (cfm): [3a - 3b]	_		_
(if value is negative, no makeup air is needed			
4. For Makeup Air Opening Sizing, refer to Tab	ble 501.4.2.		

A. Use this column if there are other than fan-assisted or atmospherically vented gas or oil appliances or if there are no combustion appliances.

B. Use this column if there is one fan-assisted appliance per venting system. Other than atmospherically vented appliances may also be included.

C. Use this column if there is one atmospherically vented (other than fan-assisted) gas or oil appliance per venting system or one solid fuel appliance.

D. Use this column if there are multiple atmospherically vented gas or oil *appliances* using a common vent or if there are atmospherically vented gas or oil *appliances* and solid fuel *appliances*.

- **1. Sealed Combustion Furnace**
- **A Fan Assisted Water Heater** 2.
- **Direct vent Fireplace** 3.
- 4. HRV System Balanced
- 5. 2-50 CFM Bath Fans

			ONE ATMOSPHERICALLY	MULTIPLE APPLIANCES THAT
	VENT OR DIRECT VENT APPLIANCES OR NO	FAN-ASSISTED APPLIANCES	VENTED GAS OR OIL APPLIANCE OR ONE	ARE ATMOSPHERICALLY VENTED GAS OR OIL
	COMBUSTION	AND POWER VENT OR	SOLID	APPLIANCES OR SOLID FUEL
	APPLIANCESA	DIRECT VENT APPLIANCES <sup>B</sup>	FUEL APPLIANCE <sup>C</sup>	APPLIANCESD
	Column to Estimate House Infiltration			
a) pressure factor (cfm/sf)	0.15	0.09	0.06	0.03
b) conditioned floor area (sf)		3224		
(including unfinished ba	sements)			·
Estimated House Infiltration (cfm): [1a × 1b]		193		_
2. Exhaust Capacity				·
a) clothes dryer	135	135	<u>1</u> 35	135
b) 80% of largest exhaust rating (cfm):	—	40	_	—
		eup air is electrically interlocked	and matched to exhaust)	
c) 80% of next largest exhaust rating (cfm):	not applicable	—	_	—
	lating system or if powered mak	eup air is electrically interlocked	and matched to exhaust)	1
Total Exhaust Capacity (cfm): [2a+2b+2c]	—	—		_
3. Makeup Air Requirem	nent			1
a) Total Exhaust Capacity (from above)	—	_	_	—
b) Estimated House Infiltration (from above)	_			
Makeup Air Quality (cfm): [3a - 3b]	—	_		_
	(if value is negative, no makeup air is needed			
4. For Makeup Air Open	ning Sizing, refer to Table 501.4.2	2.		

- **1. Sealed Combustion Furnace**
- 2. A Fan Assisted Water Heater
- **3. Direct vent Fireplace**
- 4. HRV System Balanced
- 5. 2- 50 CFM Bath Fans

	ONE OR MULTIPLE POWER VENT OR DIRECT VENT APPLIANCES OR NO COMBUSTION APPLIANCES <sup>A</sup>	ONE OR MULTIPLE FAN-ASSISTED APPLIANCES AND POWER VENT OR DIRECT VENT APPLIANCES <sup>B</sup>	ONE ATMOSPHERICALLY VENTED GAS OR OIL APPLIANCE OR ONE SOLID FUEL APPLIANCE <sup>C</sup>	MULTIPLE APPLIANCES THAT ARE ATMOSPHERICALLY VENTED GAS OR OIL APPLIANCES OR SOLID FUEL APPLIANCES <sup>D</sup>
1. Use the Appropriate	Column to Estimate House Infiltr	ration		
a) pressure factor (cfm/sf)	0.15	0.09	0.06	0.03
b) conditioned floor area (sf)	—	3224	—	—
(including unfinished ba	asements)	-		
Estimated House Infiltration (cfm): [1a × 1b]		193		—
2. Exhaust Capacity		•		
a) clothes dryer	135	135	135	135
b) 80% of largest exhaust rating (cfm):	_	40		_
(not applicable if recircu	ulating system or if powered mak	ceup air is electrically interlocked	and matched to exhaust)	
c) 80% of next largest exhaust rating (cfm):	not applicable	40		_
	ulating system or if powered mak	ceup air is electrically interlocked	and matched to exhaust)	
Total Exhaust Capacity (cfm): [2a+2b+2c]				_
3. Makeup Air Requirer	nent	•		
a) Total Exhaust Capacity (from above)	_	_	_	_
b) Estimated House Infiltration (from above)				_
Makeup Air Quality (cfm): [3a - 3b]			_	_
(if value is negative, no	makeup air is needed			
4. For Makeup Air Opening Sizing, refer to Table 501.4.2.				

- **1. Sealed Combustion Furnace**
- 2. A Fan Assisted Water Heater
- **3.** Direct vent Fireplace
- 4. HRV System Balanced
- 5. 2- 50 CFM Bath Fans

	ONE OR MULTIPLE POWER VENT OR DIRECT VENT APPLIANCES OR NO COMBUSTION APPLIANCES <sup>A</sup>	ONE OR MULTIPLE FAN-ASSISTED APPLIANCES AND POWER VENT OR DIRECT VENT APPLIANCES <sup>B</sup>	ONE ATMOSPHERICALLY VENTED GAS OR OIL APPLIANCE OR ONE SOLID FUEL APPLIANCE <sup>C</sup>	MULTIPLE APPLIANCES THAT ARE ATMOSPHERICALLY VENTED GAS OR OIL APPLIANCES OR SOLID FUEL APPLIANCES <sup>D</sup>
1. Use the Appropriate	Column to Estimate House Infiltr			
a) pressure factor (cfm/sf)	0.15	0.09	0.06	0.03
b) conditioned floor area (sf)	_	3224	_	_
(including unfinished ba	asements)	-		
Estimated House Infiltration (cfm): [1a × 1b]	—	193	—	—
2. Exhaust Capacity				
a) clothes dryer	135	135	135	135
b) 80% of largest exhaust rating (cfm):	—	40		—
		eup air is electrically interlocked	and matched to exhaust)	
c) 80% of next largest exhaust rating (cfm):		40		_
· · · ·	lating system or if powered mak	eup air is electrically interlocked	and matched to exhaust)	
Total Exhaust Capacity (cfm): [2a+2b+2c]		215		_
3. Makeup Air Requiren	nent			
a) Total Exhaust Capacity (from above)				_
b) Estimated House Infiltration (from above)				_
Makeup Air Quality (cfm): [3a - 3b]				_
(if value is negative, no	· · · · · · · · · · · · · · · · · · ·			
4. For Makeup Air Oper	ning Sizing, refer to Table 501.4.	2.		

- **1. Sealed Combustion Furnace**
- 2. A Fan Assisted Water Heater
- **Direct vent Fireplace** 3.
- 4. HRV System Balanced
- 5. 2- 50 CFM Bath Fans

	ONE OR MULTIPLE POWER	ONE OR MULTIPLE	ONE ATMOSPHERICALLY	MULTIPLE APPLIANCES THAT
	VENT OR DIRECT VENT	FAN-ASSISTED	VENTED GAS OR OIL	ARE ATMOSPHERICALLY
	APPLIANCES OR NO	APPLIANCES	APPLIANCE OR ONE	VENTED GAS OR OIL
	COMBUSTION	AND POWER VENT OR	SOLID	APPLIANCES OR SOLID FUEL
	APPLIANCESA	DIRECT VENT APPLIANCES <sup>B</sup>	FUEL APPLIANCE <sup>C</sup>	APPLIANCESD
	Column to Estimate House Infiltr		·	
a) pressure factor (cfm/sf)	0.15	0.09 <b>3224</b>	0.06	0.03
b) conditioned floor area (sf)		193	_	_
(including unfinished ba	asements)			<u></u>
Estimated House Infiltration (cfm): [1a × 1b]	—	40	_	—
2. Exhaust Capacity				
a) clothes dryer	135	135	135	135
b) 80% of largest exhaust rating (cfm):		_		_
(not applicable if recircu	lating system or if powered mak	keup air is electrically interlocked	and matched to exhaust)	
c) 80% of next largest exhaust rating (cfm):		40		
S 11	lating system or if powered mak	keup air is electrically interlocked	and matched to exhaust)	
Total Exhaust		—		_
Capacity		215		
(cfm):				
[2a+2b+2c]	<u> </u>			L
3. Makeup Air Requiren	nent	1	1	
a) Total Exhaust Capacity (from above)	_	215	_	_
b) Estimated House Infiltration (from above)	_	_		_
Makeup Air Quality (cfm): [3a - 3b]			_	_
(if value is negative, no	-			
4. For Makeup Air Oper	ning Sizing, refer to Table 501.4.	.2.		

- **1. Sealed Combustion Furnace**
- 2. A Fan Assisted Water Heater
- **Direct vent Fireplace** 3.
- 4. HRV System Balanced
- 5. 2- 50 CFM Bath Fans

	ONE OR MULTIPLE POWER	ONE OR MULTIPLE	ONE ATMOSPHERICALLY	MULTIPLE APPLIANCES THAT
	VENT OR DIRECT VENT	FAN-ASSISTED	VENTED GAS OR OIL	ARE ATMOSPHERICALLY
	APPLIANCES OR NO	APPLIANCES	APPLIANCE OR ONE	VENTED GAS OR OIL
	COMBUSTION	AND POWER VENT OR	SOLID	APPLIANCES OR SOLID FUEL
	APPLIANCESA	DIRECT VENT APPLIANCES <sup>B</sup>	FUEL APPLIANCE <sup>C</sup>	APPLIANCESD
	Column to Estimate House Infiltr			
a) pressure factor (cfm/sf)	0.15	0.09	0.06	0.03
b) conditioned floor area (sf)	_	3224	_	_
(including unfinished b	asements)			
Estimated House Infiltration (cfm): [1a × 1b]	_	193	_	_
2. Exhaust Capacity				
a) clothes dryer	135	135	135	135
b) 80% of largest exhaust rating (cfm):	_	40		_
	ulating system or if powered mak	ceup air is electrically interlocked	and matched to exhaust)	
c) 80% of next largest exhaust rating (cfm):		40		_
	ulating system or if powered mak	ceup air is electrically interlocked	and matched to exhaust)	
Total Exhaust				—
Capacity	,	215		
(cfm):	,			
[2a+2b+2c]				L
3. Makeup Air Require	ment	1	1	
a) Total Exhaust Capacity (from above)	_	215	_	_
b) Estimated House Infiltration (from above)	_	193		_
Makeup Air Quality (cfm): [3a - 3b]	_	—	-	-
	o makeup air is needed			
4. For Makeup Air Ope	ening Sizing, refer to Table 501.4.	.2.		

- **1. Sealed Combustion Furnace**
- 2. A Fan Assisted Water Heater
- 3. Direct vent Fireplace
- 4. HRV System Balanced
- 5. 2- 50 CFM Bath Fans

	ONE OR MULTIPLE POWER VENT OR DIRECT VENT APPLIANCES OR NO COMBUSTION APPLIANCES <sup>A</sup>	ONE OR MULTIPLE FAN-ASSISTED APPLIANCES AND POWER VENT OR DIRECT VENT APPLIANCES <sup>B</sup>	ONE ATMOSPHERICALLY VENTED GAS OR OIL APPLIANCE OR ONE SOLID FUEL APPLIANCE <sup>C</sup>	MULTIPLE APPLIANCES THAT ARE ATMOSPHERICALLY VENTED GAS OR OIL APPLIANCES OR SOLID FUEL APPLIANCES <sup>D</sup>
1. Use the Appropriate	Column to Estimate House Infiltr	ation		
a) pressure factor (cfm/sf)	0.15	0.09	0.06	0.03
b) conditioned floor area (sf)	—	3224	—	—
(including unfinished ba	asements)			
Estimated House Infiltration (cfm): [1a × 1b]	_	193		_
2. Exhaust Capacity				
a) clothes dryer	135	135	135	135
b) 80% of largest exhaust rating (cfm):	—	<b>4</b> 0	_	—
		eup air is electrically interlocked	and matched to exhaust)	
c) 80% of next largest exhaust rating (cfm):	not applicable	40	_	—
	lating system or if powered mak	eup air is electrically interlocked	and matched to exhaust)	
Total Exhaust Capacity (cfm): [2a+2b+2c]	_	215	_	_
3. Makeup Air Requiren	nent			
a) Total Exhaust Capacity (from above)	—	215	2.12.1	—
b) Estimated House Infiltration (from above)	—	 193		_
Makeup Air Quality (cfm): [3a - 3b]	—	22		_
(if value is negative, no 4. For <i>Makeup Air</i> Oper	makeup air is needed ning Sizing, refer to Table 501.4.	2.		

A. Use this column if there are other than fan-assisted or atmospherically vented gas or oil appliances or if there are no combustion appliances.

B. Use this column if there is one fan-assisted appliance per venting system. Other than atmospherically vented appliances may also be included.

C. Use this column if there is one atmospherically vented (other than fan-assisted) gas or oil appliance per venting system or one solid fuel appliance.

D. Use this column if there are multiple atmospherically vented gas or oil *appliances* using a common vent or if there are atmospherically vented gas or oil *appliances* and solid fuel *appliances*.

#### Construction Codes & Licensing Division

	· · · · · · · · · · · · · · · · · · ·	ONE OR MULTIPLE	ONE	MULTIPLE APPLIANCES	
	ONE OR MULTIPLE	FAN-	ATMOSPHERICALLY	THAT	
	POWER	ASSISTED	VENTED GAS OR	ARE	
	VENT OR DIRECT VENT	APPLIANCES	OIL	ATMOSPHERICALLY	PASSIVE MAKEUP
	APPLIANCES OR NO	AND POWER VENT OR			AIR
TYPE OF	COMBUSTION		SOLID FUEL		
OPENING	APPLIANCESA	APPLIANCES <sup>B</sup>	APPLIANCE <sup>C</sup>	FUEL APPLIANCESD	DIAMETER <sup>E, F, G</sup>
OR SYSTEM	(cfm)	(cfm)	(cfm)	(cfm)	(inches)
Passive opening	1-36	1-22	1-15	1-9	3
Passive opening	37-66	23-41	16-28	10-17	4
Passive opening	67-109	42-66	29-46	18-28	5
Passive opening	110-163	67-100	47-69	29-42	6
Passive opening	164-232	101-143	70-99	43-61	7
Passive opening	233-317	144-195	100-135	62-83	8
Passive opening	318-419	196-258	136-179	84-110	9
with motorized damper					
Passive opening	420-539	259-332	180-230	111-142	10
with motorized damper	1				
Passive opening	540-679	333-419	231-290	143-179	11
with motorized	340-078	555-415	201-200	145-178	
damper	1 /				
Powered makeup	> 679	> 419	> 290	> 179	Not
air <sup>H</sup>					applicable

A. Use this column if there are other than fan-assisted or atmospherically vented gas or oil appliances or if there are no combustion appliances.

B. Use this column if there is one fan-assisted appliance per venting system. Other than atmospherically vented appliances may also be included.

C. Use this column if there is one atmospherically vented (other than fan-assisted) gas or oil appliance per venting system or one solid fuel appliance.

D. Use this column if there are multiple atmospherically vented gas or oil *appliances* using a common vent or if there are atmospherically vented gas or oil *appliances* and solid fuel *appliances*.

E. An equivalent length of 100 feet of round smooth metal duct is assumed. Subtract 40 feet for the exterior hood and ten feet for each 90-degree elbow to determine the remaining length of straight duct allowable.

F. If flexible duct is used, increase the duct diameter by one inch. Flexible duct shall be stretched with minimal sags.

G. Barometric dampers are prohibited in passive makeup air openings when any atmospherically vented appliance is installed.

TYPE OF OPENING OR SYSTEM	ONE OR MULTIPLE POWER VENT OR DIRECT VENT APPLIANCES OR NO COMBUSTION APPLIANCES <sup>A</sup> (cfm)	ONE OR MULTIPLE FAN- ASSISTED APPLIANCES AND POWER VENT OR DIRECT VENT APPLIANCES <sup>B</sup> (cfm)	ONE ATMOSPHERICALLY VENTED GAS OR OIL APPLIANCE OR ONE SOLID FUEL APPLIANCE <sup>C</sup> (cfm)	ARE ATMOSPHERICALLY	PASSIVE MAKEUP AIR OPENING DUCT DIAMETER <sup>E, F, G</sup> (inches)
Passive opening	1-36	1-22	1-15	1-9	3
Passive opening	37-66	23-41	16-28	10-17	4
Passive opening	67-109	42-66	29-46	18-28	5
Passive opening	110-163	67-100	47-69	29-42	6
Passive opening	164-232	101-143	70-99	43-6 <mark>1</mark>	7
Passive opening	233-317	144-195	100-135	62-83	8
Passive opening with motorized damper	318-419	196-258	136-179	84-110	9
Passive opening with motorized damper	420-539	259-332	180-230	111-142	10
Passive opening with motorized damper	540-679	333-419	231-290	143-179	11
Powered makeup air <sup>H</sup>	> 679	> 419	> 290	> 179	Not applicable

A. Use this column if there are other than fan-assisted or atmospherically vented gas or oil appliances or if there are no combustion appliances.

B. Use this column if there is one fan-assisted appliance per venting system. Other than atmospherically vented appliances may also be included.

C. Use this column if there is one atmospherically vented (other than fan-assisted) gas or oil appliance per venting system or one solid fuel appliance.

D. Use this column if there are multiple atmospherically vented gas or oil *appliances* using a common vent or if there are atmospherically vented gas or oil *appliances* and solid fuel *appliances*.

E. An equivalent length of 100 feet of round smooth metal duct is assumed. Subtract 40 feet for the exterior hood and ten feet for each 90-degree elbow to determine the remaining length of straight duct allowable.

F. If flexible duct is used, increase the duct diameter by one inch. Flexible duct shall be stretched with minimal sags.

G. Barometric dampers are prohibited in passive makeup air openings when any atmospherically vented appliance is installed.

TYPE OF OPENING OR SYSTEM	ONE OR MULTIPLE POWER VENT OR DIRECT VENT APPLIANCES OR NO COMBUSTION APPLIANCES <sup>A</sup> (cfm)	ONE OR MULTIPLE FAN- ASSISTED APPLIANCES AND POWER VENT OR DIRECT VENT APPLIANCES <sup>B</sup>	ONE ATMOSPHERICALLY VENTED GAS OR OIL APPLIANCE OR ONE SOLID FUEL APPLIANCE <sup>C</sup> (cfm)	ARE ATMOSPHERICALLY	PASSIVE MAKEUP AIR OPENING DUCT DIAMETER <sup>E, F, G</sup> (inches)
Passive opening	1-36	1-22	1-15	1-9	3
Passive opening	37-66	23-41	16-28	10-17	4
Passive opening	67-109	42-66	29-46	18-28	5
Passive opening	110-163	67-100	47-69	29-42	6
Passive opening	164-232	101-143	70-99	43-61	7
Passive opening	233-317	144-195	100-135	62-83	8
Passive opening with motorized damper	318-419	196-258	136-179	84-110	9
Passive opening with motorized damper	420-539	259-332	180-230	111-142	10
Passive opening with motorized damper	540-679	333-419	231-290	143-179	11
Powered makeup air <sup>H</sup>	> 679	> 419	> 290	> 179	Not applicable

A. Use this column if there are other than fan-assisted or atmospherically vented gas or oil appliances or if there are no combustion appliances.

B. Use this column if there is one fan-assisted appliance per venting system. Other than atmospherically vented appliances may also be included.

C. Use this column if there is one atmospherically vented (other than fan-assisted) gas or oil appliance per venting system or one solid fuel appliance.

D. Use this column if there are multiple atmospherically vented gas or oil *appliances* using a common vent or if there are atmospherically vented gas or oil *appliances* and solid fuel *appliances*.

E. An equivalent length of 100 feet of round smooth metal duct is assumed. Subtract 40 feet for the exterior hood and ten feet for each 90-degree elbow to determine the remaining length of straight duct allowable.

F. If flexible duct is used, increase the duct diameter by one inch. Flexible duct shall be stretched with minimal sags.

G. Barometric dampers are prohibited in passive makeup air openings when any atmospherically vented appliance is installed.

TYPE OF OPENING OR SYSTEM	ONE OR MULTIPLE POWER VENT OR DIRECT VENT APPLIANCES OR NO COMBUSTION APPLIANCES <sup>A</sup> (cfm)	ASSISTED APPLIANCES AND POWER VENT OR DIRECT VENT APPLIANCES <sup>B</sup>	ONE ATMOSPHERICALLY VENTED GAS OR OIL APPLIANCE OR ONE SOLID FUEL APPLIANCE <sup>C</sup> (cfm)	MULTIPLE APPLIANCES THAT ARE ATMOSPHERICALLY VENTED GAS OR OIL APPLIANCES OR SOLID FUEL APPLIANCES <sup>D</sup> (cfm)	PASSIVE MAKEUP AIR OPENING DUCT DIAMETER <sup>E, F, G</sup> (ipchis)
Passive opening	1-36	1-22	1-15	1-9	3
Passive opening	37-66	23-41	16-28	10-17	4
Passive opening	67-109	42-66	29-46	18-28	5
Passive opening	110-163	67-100	47-69	29-42	6
Passive opening	164-232	101-143	70-99	43-61	7
Passive opening	233-317	144-195	100-135	62-83	8
Passive opening with motorized damper	318-419	196-258	136-179	84-110	9
Passive opening with motorized damper	420-539	259-332	180-230	111-142	10
Passive opening with motorized damper	540-679	333-419	231-290	143-179	11
Powered makeup air <sup>H</sup>	> 679	> 419	> 290	> 179	Not applicable

A. Use this column if there are other than fan-assisted or atmospherically vented gas or oil appliances or if there are no combustion appliances.

B. Use this column if there is one fan-assisted appliance per venting system. Other than atmospherically vented appliances may also be included.

C. Use this column if there is one atmospherically vented (other than fan-assisted) gas or oil appliance per venting system or one solid fuel appliance.

D. Use this column if there are multiple atmospherically vented gas or oil *appliances* using a common vent or if there are atmospherically vented gas or oil *appliances* and solid fuel *appliances*.

E. An equivalent length of 100 feet of round smooth metal duct is assumed. Subtract 40 feet for the exterior hood and ten feet for each 90-degree elbow to determine the remaining length of straight duct allowable.

F. If flexible duct is used, increase the duct diameter by one inch. Flexible duct shall be stretched with minimal sags.

G. Barometric dampers are prohibited in passive makeup air openings when any atmospherically vented appliance is installed.

TYPE OF OPENING OR SYSTEM	ONE OR MULTIPLE POWER VENT OR DIRECT VENT APPLIANCES OR NO COMBUSTION APPLIANCES <sup>A</sup> (cfm)	ASSISTED APPLIANCES AND POWER VENT OR DIRECT VENT APPLIANCES <sup>B</sup>	ONE ATMOSPHERICALLY VENTED GAS OR OIL APPLIANCE OR ONE SOLID FUEL APPLIANCE <sup>C</sup> (cfm)	MULTIPLE APPLIANCES THAT ARE ATMOSPHERICALLY VENTED GAS OR OIL APPLIANCES OR SOLID FUEL APPLIANCES <sup>D</sup> (cfm)	PASSIVE MAKEUP AIR OPENING DUCT DIAMETER <sup>E, F, G</sup> (ipchis)
Passive opening	1-36	1-22	1-15	1-9	3
Passive opening	37-66	23-41	16-28	10-17	4
Passive opening	67-109	42-66	29-46	18-28	5
Passive opening	110-163	67-100	47-69	29-42	6
Passive opening	164-232	101-143	70-99	43-61	7
Passive opening	233-317	144-195	100-135	62-83	8
Passive opening with motorized damper	318-419	196-258	136-179	84-110	9
Passive opening with motorized damper	420-539	259-332	180-230	111-142	10
Passive opening with motorized damper	540-679	333-419	231-290	143-179	11
Powered makeup air <sup>H</sup>	> 679	> 419	> 290	> 179	Not applicable

A. Use this column if there are other than fan-assisted or atmospherically vented gas or oil appliances or if there are no combustion appliances.

B. Use this column if there is one fan-assisted appliance per venting system. Other than atmospherically vented appliances may also be included.

C. Use this column if there is one atmospherically vented (other than fan-assisted) gas or oil appliance per venting system or one solid fuel appliance.

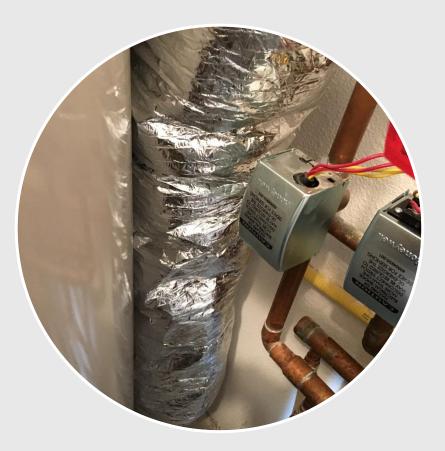
D. Use this column if there are multiple atmospherically vented gas or oil *appliances* using a common vent or if there are atmospherically vented gas or oil *appliances* and solid fuel *appliances*.

E. An equivalent length of 100 feet of round smooth metal duct is assumed. Subtract 40 feet for the exterior hood and ten feet for each 90-degree elbow to determine the remaining length of straight dust allowable.

F. If flexible duct is used, increase the duct diameter by one inch. Flexible duct shall be stretched with minimal sags.

O. Darometric dampers are prohibited in passive makeup air openings when any atmospherically vented appliance is installed.

## **Combustion Air Requirements**





IFGC Appendix E, Worksheet E-1

Residential Combustion Air Calculation Method

(for Furnace, Boiler, and/or Water Heater in the Same Space)

Step 1: Complete vented combustion appliance information.

Furnace/Boiler:

Draft Hood (Not fan assisted)	Fan Assisted & Power Vent	Direct Vent	Input:
· · · · ·			Btu/hr
Water Heater: Draft Hood	Fan Assisted	Direct Vent	Input:
(Not fan assisted)	& Power Vent		Btu/hr

Step 2: Calculate the volume of the Combustion Appliance Space (CAS) containing combustion appliances.

The CAS includes all spaces connected to one another by code CAS volume:  $ft^3$  compliant openings.

Step 3: Determine Air Changes per Hour (ACH)<sup>1</sup>

Default ACH values have been incorporated into Table E-1 for use with Method 4b (KAIR Method). If the year of construction or ACH is not known, use method 4a (Standard Method).

Step 4: Determine Required Volume for Combustion Air.

4a. Standard Method

Total Btu/hr input of all combustion appliances (DO NOT COUNT	Input:	
DIRECT VENT APPLIANCES)	Btu/hr	
Use Standard Method column in Table E-1 to find Total Required	TRV:	ft
Volume (TRV)	3	

If CAS Volume (from Step 2) is greater than TRV then no outdoor openings are needed.

f CAS Volume (from Step 2) is less than TRV then go to STEP 5.

IFGC Appendix E, Worksheet E-1

Residential Combustion Air Calculation Method

(for Furnace, Boiler, and/or Water Heater in the Same Space)

Step 1: Complete vented combustion appliance information.

Furnace/Boiler:

Draft Hood	Fan Assisted	X Direct Vent	Input: 70,000
(Not fan assisted)	& Power Vent		Btu/hr
Water Heater: Draft Hood (Not fan assisted)	Fan Assisted & Power Vent	Direct Vent	Input: 

Step 2: Calculate the volume of the Combustion Appliance Space (CAS) containing combustion appliances.

The CAS includes all spaces connected to one another by code CAS volume: \_\_\_\_\_ft<sup>3</sup> compliant openings.

Step 3: Determine Air Changes per Hour (ACH)<sup>1</sup>

Default ACH values have been incorporated into Table E-1 for use with Method 4b (KAIR Method). If the year of construction or ACH is not known, use method 4a (Standard Method).

Step 4: Determine Required Volume for Combustion Air.

4a. Standard Method

Total Btu/hr input of all combustion appliances (DO NOT COUNT	Input:	
DIRECT VENT APPLIANCES)	Btu/hr	
Use Standard Method column in Table E-1 to find Total Required	TRV:	ft
Volume (TRV)	3	

If CAS Volume (from Step 2) is greater than TRV then no outdoor openings are needed.

f CAS Volume (from Step 2) is less than TRV then go to STEP 5.

IFGC Appendix E, Worksheet E-1

Residential Combustion Air Calculation Method

(for Furnace, Boiler, and/or Water Heater in the Same Space)

Step 1: Complete vented combustion appliance information.

Furnace/Boiler:

Draft Hood (Not fan assisted)	Fan Assisted & Power Vent	X Direct Vent	Input: 70,000 Btu/hr
Water Heater: Draft Hood (Not fan assisted)	X Fan Assisted & Power Vent	Direct Vent	Input: <u>33,000</u> Btu/hr

Step 2: Calculate the volume of the Combustion Appliance Space (CAS) containing combustion appliances.

The CAS includes all spaces connected to one another by code compliant openings.

CAS volume:\_\_\_\_\_ft<sup>3</sup>

Step 3: Determine Air Changes per Hour (ACH)<sup>1</sup>

Default ACH values have been incorporated into Table E-1 for use with Method 4b (KAIR Method). If the year of construction or ACH is not known, use method 4a (Standard Method).

Step 4: Determine Required Volume for Combustion Air.

4a. Standard Method

Total Btu/hr input of all combustion appliances (DO NOT COUNT	
DIRECT VENT APPLIANCES)	
Use Standard Method column in Table E-1 to find Total Required	
Volume (TRV)	

Input: \_\_\_\_\_\_ Btu/hr TRV: \_\_\_\_\_\_ ft

If CAS Volume (from Step 2) is greater than TRV then no outdoor openings are needed.

If CAS Volume (from Step 2) is less than TRV then go to STEP 5.

IFGC Appendix E, Worksheet E-1

Residential Combustion Air Calculation Method

(for Furnace, Boiler, and/or Water Heater in the Same Space)

Step 1: Complete vented combustion appliance information.

Furnace/Boiler:

Draft Hood (Not fan assisted)	Fan Assisted & Power Vent	X Direct Vent	Input: 70,000 Btu/hr
Water Heater: Draft Hood (Not fan assisted)	X Fan Assisted & Power Vent	Direct Vent	Input: <u>33,000</u> Btu/hr

Step 2: Calculate the volume of the Combustion Appliance Space (CAS) containing combustion appliances.

The CAS includes all spaces connected to one another by code	CAS volume: 12,896 ft <sup>3</sup>	(1612 Sq. Ft x 8 = 12896 ft3)
compliant openings.		(,

Step 3: Determine Air Changes per Hour (ACH)<sup>1</sup>

Default ACH values have been incorporated into Table E-1 for use with Method 4b (KAIR Method). If the year of construction or ACH is not known, use method 4a (Standard Method).

Step 4: Determine Required Volume for Combustion Air.

4a. Standard Method

Total Btu/hr input of all combustion appliances (DO NOT COUNT	Input:
DIRECT VENT APPLIANCES)	Btu/hr
Use Standard Method column in Table E-1 to find Total Required	TRV:
Volume (TRV)	3

If CAS Volume (from Step 2) is greater than TRV then no outdoor openings are needed.

If CAS Volume (from Step 2) *is less than* TRV then go to **STEP 5**.

4b. Known Air Infiltration Rate (KAIR) Method

ft

IFGC Appendix E, Worksheet E-1

Residential Combustion Air Calculation Method

(for Furnace, Boiler, and/or Water Heater in the Same Space)

Step 1: Complete vented combustion appliance information.

Furnace/Boiler:

Draft Hood (Not fan assisted)	Fan Assisted & Power Vent	X Direct Vent	Input: 70,000 Btu/hr
Water Heater: Draft Hood (Not fan assisted)	X Fan Assisted & Power Vent	Direct Vent	Input: <u>33,000</u> Btu/hr

Step 2: Calculate the volume of the Combustion Appliance Space (CAS) containing combustion appliances.

The CAS includes all spaces connected to one another by code C compliant openings.

CAS volume: 12,896 ft<sup>3</sup> (1612 Sq. Ft x 8 = 12896 ft3)

#### Step 3: Determine Air Changes per Hour (ACH)<sup>1</sup>

Default ACH values have been incorporated into Table E-1 for use with Method 4b (KAIR Method). If the year of construction or ACH is not known, use method 4a (Standard Method).

Step 4: Determine Required Volume for Combustion Air.

4a. Standard Method

Volume (TRV)

Total Btu/hr input of all combustion appliances (DO NOT COUNT
DIRECT VENT APPLIANCES)
Use Standard Method column in Table E-1 to find Total Required

Input:	
Btu/hr	
TRV:	ft
3	

If CAS Volume (from Step 2) is greater than TRV then no outdoor openings are needed.

If CAS Volume (from Step 2) is less than TRV then go to STEP 5.

IFGC Appendix E, Worksheet E-1

Residential Combustion Air Calculation Method

(for Furnace, Boiler, and/or Water Heater in the Same Space)

Step 1: Complete vented combustion appliance information.

Furnace/Boiler:

Draft Hood (Not fan assisted)	Fan Assisted & Power Vent	X Direct Vent	Input: 70,000 Btu/hr
Water Heater: Draft Hood (Not fan assisted)	X Fan Assisted & Power Vent	Direct Vent	Input: <u>33,000</u> Btu/hr

Step 2: Calculate the volume of the Combustion Appliance Space (CAS) containing combustion appliances.

The CAS includes all spaces connected to one another by code CAS compliant openings.

CAS volume: 12,896 ft<sup>3</sup> (1612 Sq. Ft x 8 = 12896 ft3)

#### Step 3: Determine Air Changes per Hour (ACH)<sup>1</sup>

Default ACH values have been incorporated into Table E-1 for use with Method 4b (KAIR Method). If the year of construction or ACH is not known, use method 4a (Standard Method).

Step 4: Determine Required Volume for Combustion Air.

4a. Standard Method

Total Btu/hr input of all combustion appliances (DO NOT COUNT DIRECT VENT APPLIANCES)

Input:	33,000	
Btu/hr		_
TRV:		ft
3		

Use Standard Method column in Table E-1 to find Total Required Volume (TRV)

If CAS Volume (from Step 2) is greater than TRV then no outdoor openings are needed.

If CAS Volume (from Step 2) is less than TRV then go to STEP 5.

IFGC Appendix E, Worksheet E-1

Residential Combustion Air Calculation Method

(for Furnace, Boiler, and/or Water Heater in the Same Space)

Step 1: Complete vented combustion appliance information.

Furnace/Boiler:

Draft Hood (Not fan assisted)	Fan Assisted & Power Vent	X Direct Vent	Input: 70,000 Btu/hr
Water Heater: Draft Hood (Not fan assisted)	X Fan Assisted & Power Vent	Direct Vent	Input: <u>33,000</u> Btu/hr

Step 2: Calculate the volume of the Combustion Appliance Space (CAS) containing combustion appliances.

The CAS includes all spaces connected to one another by code CAS volution compliant openings.

CAS volume: 12,896 ft<sup>3</sup> (1612 Sq. Ft x 8 = 12896 ft3)

#### Step 3: Determine Air Changes per Hour (ACH)<sup>1</sup>

Default ACH values have been incorporated into Table E-1 for use with Method 4b (KAIR Method). If the year of construction or ACH is not known, use method 4a (Standard Method).

Step 4: Determine Required Volume for Combustion Air.

4a. Standard Method

Total Btu/hr input of all combustion appliances (DO NOT COUNT DIRECT VENT APPLIANCES)

Use Standard Method column in Table E-1 to find Total Required Volume (TRV)

Input:	33,000	
Btu/hr	4750	_
TRV:	1750	f
3		

If CAS Volume (from Step 2) is greater than TRV then no outdoor openings are needed.

If CAS Volume (from Step 2) is less than TRV then go to STEP 5.

IFGC Appendix E, Worksheet E-1

Residential Combustion Air Calculation Method

(for Furnace, Boiler, and/or Water Heater in the Same Space)

Step 1: Complete vented combustion appliance information.

Furnace/Boiler:

Draft Hood (Not fan assisted)	Fan Assisted & Power Vent	X Direct Vent	Input: 70,000 Btu/hr
Water Heater: Draft Hood (Not fan assisted)	X Fan Assisted & Power Vent	Direct Vent	Input: <u>33,000</u> Btu/hr

Step 2: Calculate the volume of the Combustion Appliance Space (CAS) containing combustion appliances.

The CAS includes all spaces connected to one another by code CAS volume: 12,896 compliant openings.

CAS volume: 12,896 ft<sup>3</sup> (1612 Sq. Ft x 8 = 12896 ft3)

#### Step 3: Determine Air Changes per Hour (ACH)<sup>1</sup>

Default ACH values have been incorporated into Table E-1 for use with Method 4b (KAIR Method). If the year of construction or ACH is not known, use method 4a (Standard Method).

Step 4: Determine Required Volume for Combustion Air.

4a. Standard Method

Total Btu/hr input of all combustion appliances (DO NOT COUNT DIRECT VENT APPLIANCES)

Input:	33,000	
Btu/hr	4750	-
TRV:	1750	ft
3		

Use Standard Method column in Table E-1 to find Total Required Volume (TRV)

If CAS Volume (from Step 2) is greater than TRV then no outdoor openings are needed.

If CAS Volume (from Step 2) *is less than* TRV then go to **STEP 5**.

IFGC Appendix E, Worksheet E-1

Residential Combustion Air Calculation Method

(for Furnace, Boiler, and/or Water Heater in the Same Space)

Step 1: Complete vented combustion appliance information.

Furnace/Boiler:

Draft Hood (Not fan assisted)	Fan Assisted & Power Vent	X Direct Vent	Input: 70,000 Btu/hr
Water Heater: Draft Hood (Not fan assisted)	X Fan Assisted & Power Vent	Direct Vent	Input: <u>33,000</u> Btu/hr

Step 2: Calculate the volume of the Combustion Appliance Space (CAS) containing combustion appliances.

The CAS includes all spaces connected to one another by code CAS volume: 12,896 ft<sup>3</sup> (1612 Sq. Ft x 8 = 12896 ft3) compliant openings.

#### Step 3: Determine Air Changes per Hour (ACH)<sup>1</sup>

Default ACH values have been incorporated into Table E-1 for use with Method 4b (KAIR Method). If the year of construction or ACH is not known, use method 4a (Standard Method).

Step 4: Determine Required Volume for Combustion Air.

4a. Standard Method

Volume (TRV)

Total Btu/hr input of all combustion appliances (DO NOT COUNT DIRECT VENT APPLIANCES)

DIRECT VENT APPLIANCES)	Btu/hr
Use Standard Method column in Table E-1 to find Total Required	TRV:
Volume (TRV)	3

Input:

ft

33,000

1750

If CAS Volume (from Step 2) is greater than TRV then no outdoor openings are needed.

If CAS Volume (from Step 2) is less than TRV then go to STEP 5.

IFGC Appendix E, Worksheet E-1

Residential Combustion Air Calculation Method

(for Furnace, Boiler, and/or Water Heater in the Same Space)

Step 1: Complete vented combustion appliance information.

Furnace/Boiler:

Draft Hood (Not fan assisted)	Fan Assisted & Power Vent	Direct Vent	Input: 70,000 Btu/hr
Water Heater: Draft Hood (Not fan assisted)	X Fan Assisted & Power Vent	Direct Vent	Input: <u>33,000</u> Btu/hr

Step 2: Calculate the volume of the Combustion Appliance Space (CAS) containing combustion appliances.

The CAS includes all spaces connected to one another by code CAS volume: 12,896 ft<sup>3</sup> compliant openings.

AS volume: 12,896 ft<sup>3</sup> (1612 Sq. Ft x 8 = 12896 ft3)

#### Step 3: Determine Air Changes per Hour (ACH)<sup>1</sup>

Default ACH values have been incorporated into Table E-1 for use with Method 4b (KAIR Method). If the year of construction or ACH is not known, use method 4a (Standard Method).

Step 4: Determine Required Volume for Combustion Air.

4a. Standard Method

Total Btu/hr input of all combustion appliances (DO NOT COUNT DIRECT VENT APPLIANCES)

Use Standard Method column in	Table	E-1 to	o find	Total	Require	(
Volume (TRV)						

Input:	33,000	
Btu/hr	4750	_
TRV:	1750	ft
3		

If CAS Volume (from Step 2) is greater than TRV then no outdoor openings are needed.

If CAS Volume (from Step 2) is less than TRV then go to STEP 5.

Total Btu/hr input of all fan-assisted and pown NOT COUNT DIRECT VENT APPLIANCES		Input: Btu/hr	33,000	
Use Fan-Assisted Appliances column in Table Volume Fan Assisted (RVFA)	·			ft
Total Btu/hr input of all non-fan-assisted appl	liances	_		
Use Non-Fan-Assisted Appliances column in Required Volume Non-Fan-Assisted (RVNFA				ft
Total Required Volume (TRV) = RVFA + RV	'NFA			
	RV=+	==	=	ft
If CAS Volume (from Step 2) is greater than	n TRV then no outdoor op	enings are needed.		
If CAS Volume (from Step 2) is less than TR	W then go to STEP 5.			
Step 5: Calculate the ratio of available interio	or volume to the total req	uired volume.		
Ratio = CAS Volume (from Step 2) <i>divided</i> <i>by</i> TRV (from Step 4a or Step 4b)	Ratio =	_/	_=	
Step 6: Calculate Reduction Factor (RF).				
RF=1 <i>minus</i> Ratio	RF=1	=		
Step 7: Calculate single outdoor opening as i	f all combustion air is fro	om outside.		
Total Btu/hr input of all Combustion Appliand (EXCEPT DIRECT VENT)	ces in the same CAS	Input: Btu/hr		
Combustion Air Opening Area (CAOA): Total Btu/hr <i>divided by</i> 3000 Btu/hr				
per in <sup>2</sup> CAOA =2	/3000 Btu/ł	$\operatorname{tr}\operatorname{per}\operatorname{in}^2 = \underline{\qquad}$		in
Step 8: Calculate Minimum CAOA.				
Minimum CAOA = CAOA <i>multiplied by</i> RF				
$\underset{2}{\text{Minimum CAOA}} = \_\_$	x	=		in

Total Btu/hr input of all fan-assisted and pow	ver vent appliances (DO		Input:	33,000	
NOT COUNT DIRECT VENT APPLIANCES	\$)		Btu/hr	2625	-
Use Fan-Assisted Appliances column in Tabl Volume Fan Assisted (RVFA)	e E-1 to find Required		RVFA:	2023	ft
Total Btu/hr input of all non-fan-assisted app	liances		-		
			Btu/hr		-
Use Non-Fan-Assisted Appliances column in Required Volume Non-Fan-Assisted (RVNF.			RVNFA:3		ft
Total Required Volume (TRV) = $RVFA + RV$	/NFA				
	RV = 3	+	=	=	ft
f CAS Volume (from Step 2) is greater tha	n TRV then no outdoor	openings a	are needed.		
If CAS Volume (from Step 2) is less than Th	RV then go to STEP 5.				
Step 5: Calculate the ratio of available interi	or volume to the total r	equired vo	lume.		
Ratio = CAS Volume (from Step 2) <i>divided</i> <i>by</i> TRV (from Step 4a or Step 4b)	Ratio =	/		_=	
Step 6: Calculate Reduction Factor (RF).					
RF=1 <i>minus</i> Ratio	RF=1 -		=		
Step 7: Calculate single outdoor opening as	if all combustion air is :	from outsi	ide.		
Total Btu/hr input of all Combustion Applian	ces in the same CAS		Input:		_
(EXCEPT DIRECT VENT)			Btu/hr		_
Combustion Air Opening Area (CAOA): Total Btu/hr <i>divided by</i> 3000 Btu/hr					
per in <sup>2</sup>	12000 71		2		•
$CAOA = \2$	/3000 Btu	vnr per in	-=		in
Step 8: Calculate Minimum CAOA.					
Minimum CAOA = CAOA <i>multiplied by</i> RF					
$\underset{2}{\text{Minimum CAOA}} = \_$	x		=		in

Total Btu/hr input of all fan-assisted and pow		Input:	33,000	_
NOT COUNT DIRECT VENT APPLIANCES Use Fan-Assisted Appliances column in Tabl	·	Btu/hr RVFA:	2625	ft
Volume Fan Assisted (RVFA)	e E-1 to ind Required	3		II
Total Btu/hr input of all non-fan-assisted app	liances	Input:	N/A	_
Use Non-Fan-Assisted Appliances column ir	Table E-1 to find	Btu/hr RVNFA	:	ft
Required Volume Non-Fan-Assisted (RVNF		3		
Total Required Volume (TRV) = $RVFA + RV$	'NFA			
	RV =		_=	ft
	3			
If CAS Volume (from Step 2) is greater that	n TRV then no outdoor of	penings are neede	d.	
If CAS Volume (from Step 2) is less than Th	RV then go to STEP 5.			
Step 5: Calculate the ratio of available interi	or volume to the total rec	puired volume.		
Ratio = CAS Volume (from Step 2) <i>divided</i>	Ratio =	_/	=	
by TRV (from Step 4a or Step 4b)				
Step 6: Calculate Reduction Factor (RF).				
RF=1 minus Ratio	RF = 1 -	=		
Step 7: Calculate single outdoor opening as	if all combustion air is fr	om outside.		
Total Btu/hr input of all Combustion Applian	ces in the same CAS	Input:		
(EXCEPT DIRECT VENT)		Btu/hr		-
Combustion Air Opening Area (CAOA): Total Btu/hr <i>divided by</i> 3000 Btu/hr				
per in <sup>2</sup>		2		
CAOA =	/3000 Btu/	hr per in $^2 = $		in
Step 8: Calculate Minimum CAOA.				
Minimum CAOA = CAOA multiplied by RF				
Minimum CAOA =	X	=		in
2				

Total Btu/hr input of all fan-assisted and pow		Input:	33,000	-
NOT COUNT DIRECT VENT APPLIANCES Use Fan-Assisted Appliances column in Tabl	-	Btu/hr RVFA:	2625	ft
Volume Fan Assisted (RVFA)	le E-1 to find Required	3 KVFA.		n
Total Btu/hr input of all non-fan-assisted app	liances	Input:	N/A	-
Use Non-Fan-Assisted Appliances column in	n Table E-1 to find	Btu/hr	N/A	ft
Required Volume Non-Fan-Assisted (RVNF.		3		n
Total Required Volume $(TRV) = RVFA + RV$	VNFA			
	$\frac{RV}{3} = \underline{\qquad} + \underline{\qquad}$	=	=	ft
	د			
If CAS Volume (from Step 2) is greater that	n TRV then no outdoor opening	gs are needed.		
If CAS Volume (from Step 2) is less than Th	RV then go to STEP 5.			
Step 5: Calculate the ratio of available interi	ior volume to the total required	l volume.		
Ratio = CAS Volume (from Step 2) <i>divided</i> <i>by</i> TRV (from Step 4a or Step 4b)	Ratio = /		_=	
Step 6: Calculate Reduction Factor (RF).				
RF=1 minus Ratio	RF=1	=		
Step 7: Calculate single outdoor opening as	if all combustion air is from ou	utside.		
Total Btu/hr input of all Combustion Applian	ices in the same CAS	Input:		_
(EXCEPT DIRECT VENT)		Btu/hr		_
Combustion Air Opening Area (CAOA): Total Btu/hr <i>divided by</i> 3000 Btu/hr				
per in <sup>2</sup>				
CAOA = 2	/3000 Btu/hr per	in <sup>2</sup> =		in
Step 8: Calculate Minimum CAOA.				
Minimum CAOA = CAOA <i>multiplied by</i> RF	,			
$\underset{2}{\text{Minimum CAOA}} = \_$	X	=		in

Total Btu/hr input of all fan-assiste NOT COUNT DIRECT VENT APP	ed and power vent appliances (DO PLIANCES)	Input: Btu/hr		-
Use Fan-Assisted Appliances colu	RVFA:	2625		
Volume Fan Assisted (RVFA) Total Btu/hr input of all non-fan-as	-		N/A	_
Use Non-Fan-Assisted Appliances Required Volume Non-Fan-Assist		Btu/hr RVNFA: _ 3	N/A	
Total Required Volume (TRV) = F	$\frac{RVFA + RVNFA}{RV} = \frac{2625}{3} + \frac{1}{2}$	N/A =	2625	
If CAS Volume (from Step 2) is g	reater than TRV then no outdoor ope	enings are needed.		
If CAS Volume (from Step 2) is le	ess than TRV then go to STEP 5.			
Step 5: Calculate the ratio of avail	lable interior volume to the total requ	ired volume.		
Ratio = CAS Volume (from Step 2 by TRV (from Step 4a or Step 4b)	2) <i>divided</i> Ratio =	/	_=	
Step 6: Calculate Reduction Facto	or (RF).			
RF=1 minus Ratio	RF=1	=		
Step 7: Calculate single outdoor of	opening as if all combustion air is from	m outside.		
Total Btu/hr input of all Combusti (EXCEPT DIRECT VENT)	on Appliances in the same CAS	Input: Btu/hr		-
Combustion Air Opening Area (CA Total Btu/hr <i>divided by</i> 3000 Btu/				
per in <sup>2</sup> $CAOA =$	/3000 Btu/hr	$rer in^2 =$		
2 2	75000 Dtu/III			
Stor 0. Colorite Minimum CAO	•			
Step 8: Calculate Minimum CAO	A.			

Minimum CAOA = \_\_\_\_\_ x \_\_\_\_

2

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=

	put of all fan-assisted and pow		liances (DO		Input:	33,000	
	DIRECT VENT APPLIANCES	-	10		Btu/hr	2625	
	ted Appliances column in Tabl ssisted (RVFA)	e E-1 to fir	id Required		RVFA:	2025	ft
	put of all non-fan-assisted app	liances			-	N/A	
	r				Btu/hr		
	Assisted Appliances column in		to find		RVNFA:	N/A	_ft
Required Volu	me Non-Fan-Assisted (RVNFA	A)			3		
Total Required	Volume (TRV) = RVFA + RV	/NFA					
-			2625		N/A =	2625	ft
		3		_	•		
If CAS Volum	e (from Step 2) <i>is greater tha</i>	n TRV then	no outdoor	openings	are needed.		
	e (from Step 2) is less than TF			-18-			
		-					
Step 5: Calcul	ate the ratio of available interi	or volume t	to the total r	equiredv	olume.		
Ratio = CAS V	olume (from Step 2) divided	Ratio = _		/		=	
by TRV (from	Step 4a or Step 4b)						
Sten 6: Calcul	ate Reduction Factor (RF).						
-							
RF=1 minus	Ratio	RF = 1			=		
Step 7: Calcul	ate single outdoor opening as	if all comb	ustion air is	from outs	side.		
Total Btu/hr in	put of all Combustion Applian	ces in the s	ame CAS		Input:		
(EXCEPT DIR	ECT VENT)				Btu/hr		_
Combustion A	ir Opening Area (CAOA):						
	wided by 3000 Btu/hr						
per in <sup>2</sup>							
	CAOA=		/3000 Bti	ı∕hr per in	$n^2 = $		in
	2						
Step 8: Calcul	ate Minimum CAOA.						
Minimum CA	DA = CAOA <i>multiplied by</i> RF						
	Minimum CAOA =						
	Millinum CAOA –		х		=		in

	input of all fan-assisted and por		liances (DO	)	Input:		33,000	
	ΓDIRECT VENT APPLIANCE isted Appliances column in Tab		d Decrined		Btu/hr		2625	ft
	Assisted (RVFA)		ia Requirea		КУГА 3		2023	n
	input of all non-fan-assisted ap	pliances			Dtu/hr		N/A _	
	-Assisted Appliances column i lume Non-Fan-Assisted (RVNI		to find		RVNFA 3	:	N/A	_ ft
Total Require	ed Volume (TRV) = RVFA + R	VNFA						
		RV=	2625	—	N/A	=	2625	ft
If CAS Volur	ne (from Step 2) is greater the	<i>in</i> TRV then	1 no outdoor	openings	are neede	d.		
If CAS Volur	ne (from Step 2) <i>is less than</i> T	RV then go	to STEP 5.				_	
Step 5: Calco	ulate the ratio of available inter	ior volume	to the total 1	required v	olume.			
Ratio = CAS by TRV (from	Volume (from Step 2) <i>divided</i> n Step 4a or Step 4b)	Ratio =	12,896	/	1750	=		
Step 6: Calco	ulate Reduction Factor (RF).							
RF=1 minu	s Ratio	RF = 1 -			=			
Step 7: Calco	ulate single outdoor opening as	if all comb	ustion air is	from outs	side.			
	input of all Combustion Applia RECT VENT)	nces in the s	same CAS		Input: Btu/hr			-
Combustion	Air Opening Area (CAOA): <i>divided by</i> 3000 Btu/hr							
per 112	CAOA=		/3000 Bt	u/hrperin	$n^2 =$			in
	2			F 11				
Step 8: Calco	ulate Minimum CAOA.							
Minimum CA	AOA = CAOA <i>multiplied by</i> RI	7						
	$\underset{2}{\text{Minimum CAOA}} = \_$		X		=			in

Total Btu/hr input of all t	fan-assisted and po	wer vent app	liances (DC	)	Input:	33,000	
NOTCOUNTDIRECTV	ENT APPLIANCE	S)			Btu/hr		
Use Fan-Assisted Appliances column in Table E-1 to find Required					RVFA:	2625	
Volume Fan Assisted (R					3		
Total Btu/hr input of all i	non-fan-assisted ap	pliances				_ N/A	_
The New Your Assisted A			4 . E . 1		Btu/hr		
Use Non-Fan-Assisted A Required Volume Non-F			to find		KVNFA 3	:N/A	-
Required volume ivon-r					2		
Total Required Volume (	(TRV) = RVFA + R						
		RV=	2625	_	N/A	=2625	
		3					
It CAS Volume (from St	an / is orantar th	an IPV then		000001000	are needed		
II CAS Volume (from St					sale needer	u.	
If CAS Volume (from St	ep 2) <i>is less than</i> I	RV then go	to STEP 5.				
Step 5: Calculate the rat	io of available inter	rior volume	to the total	required	volume.		
Ratio = CAS Volume (fr	om Sten 2) divided	Ratio =	12 896	/	1750	_	
by TRV (from Step 4a or	Step 4b)	-7.37	12,050	/			
by mer (nemotop huer	Step (0)	_/.5/					
Step 6: Calculate Reduc	tion Factor (RF).						
RF=1 minus Ratio		DE = 1	7 77		_	-6.37	
RF = 1 minus Ratio		$\mathbf{K}\mathbf{F} = \mathbf{I} - \mathbf{I}$	/.3/		=	0.07	
Step 7: Calculate single	outdoor opening as	s if all comb	ustion air is	from out	side.		
Total Discharge investor Call	G				Taunata		
Total Btu/hr input of all ( (EXCEPT DIRECT VEN		nces in the s	ame CAS		Btu/hr		
(EACEPT DIRECT VEN	1)				Dtu/III		
Combustion Air Opening	g Area (CAOA):						
Total Btu/hr divided by 3	000 Btu/hr						
per in <sup>2</sup>							
	AOA=		_/3000 Bt	tu/hr per i	$n^2 = $		
2							
Step 8: Calculate Minim	um CAOA.						
		_					
Minimum CAOA = CAO	A <i>multiplied by</i> R	H.					

\_ X \_\_\_\_\_

=\_\_\_\_

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 $\underset{2}{\text{Minimum CAOA}} = \_$ 

	f all fan-assisted and pov CTVENTAPPLIANCE		liances (DO		Input: Btu/hr	·	
Use Fan-Assisted A Volume Fan Assiste	ppliances column in Tab ed (RVFA)	le E-1 to fir	nd Required		RVFA:	2625	ft
	f all non-fan-assisted ap	pliances			Input: Btu/hr	N/A _	
	ted Appliances column i Ion-Fan-Assisted (RVNI		to find		RVNFA:	N/A	_ft
Total Required Volu	ıme (TRV) = RVFA + R		2625	_	N/A	=2625	ft
	om Step 2) is greater the			openings	are needed.		
	om Step 2) <i>is less than</i> T ne ratio of available inter	-		equired v	olume.		
Ratio = CAS Volum by TRV (from Step	ne (from Step 2) <i>divided</i> 4a or Step 4b)		12,896	_/	1750	_=	
Step 6: Calculate R	eduction Factor (RF).						
RF=1 <i>minus</i> Ratio	•	RF = 1 -	7.37		=	-6.37	
Step 7: Calculate si	ngle outdoor opening as	s if all comb	ustion air is f	from outs	side.		
Total Btu/hr input o (EXCEPT DIRECT	f all Combustion Applia VENT)	nces in the s	same CAS		Input: Btu/hr	33,000	
Total Btu/hr divided	ening Area (CAOA): <b>1 by</b> 3000 Btu/hr						
per in <sup>2</sup>	CAOA =2		/3000 Btu	ı/hr per ir	1 <sup>2</sup> =		in
Step 8: Calculate M	finimum CAOA.						
Minimum CAOA =	CAOA multiplied by R1	F					

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	f all fan-assisted and pov CT VENT APPLIANCE		liances (DO		Input: Btu/hr		
Use Fan-Assisted A Volume Fan Assiste	ppliances column in Tab ed (RVFA)	le E-1 to fin	d Required		RVFA:	2625	ft
	f all non-fan-assisted ap	pliances			Input: Btu/hr	N/A	-
	ted Appliances column i Ion-Fan-Assisted (RVNI		to find		RVNFA: 3	: N/A	_ ft
Total Required Volu	ıme (TRV) = RVFA + R		2625	_	N/A	=262	<mark>5</mark> _ft
	om Step 2) is greater the om Step 2) is less than T			penings a	are needed	1.	
	ne ratio of available inter	č		quired vo	olume.		
Ratio = CAS Volun by TRV (from Step	ne (from Step 2) <i>divided</i> 4a or Step 4b)	Ratio =		_/	1750	=	
Step 6: Calculate R	eduction Factor (RF).						
RF=1 minus Ratio	,	RF=1	7.37		=	-6.37	
Step 7: Calculate si	ngle outdoor opening as	if all comb	ustion air is fi	rom outsi	ide.		
Total Btu/hr input o (EXCEPT DIRECT	f all Combustion Applia VENT)	nces in the s	ame CAS		Input: Btu/hr	33,000	
Total Btu/hr divided	ening Area (CAOA): <b>1 by</b> 3000 Btu/hr						
per in <sup>2</sup>	CAOA=	33,000	/3000 Btu	/hr per in	<sup>2</sup> =	11	in
Step 8: Calculate N	finimum CAOA.						
Minimum CAOA=	CAOA multiplied by RI	7					
	$\underset{2}{\text{Minimum CAOA}} = \2$		X		=		in

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NOTCOUNTE	ut of all fan-assisted and pov DIRECT VENT APPLIANCEs ed Appliances column in Tab	S)		Input: Btu/hr RVFA:	_ 33,000 2625	ft
Volume Fan As Total Btu/hr inp	sisted (RVFA) ut of all non-fan-assisted app	pliances		3 Input: Btu/hr	N/A	
	ssisted Appliances column in ne Non-Fan-Assisted (RVNF		o find		N/A	ft
Total Required	Volume (TRV) = RVFA + RV	VNFA				
Ĩ			2625	N/A	2625	t
	(from Step 2) is greater that		-	enings are needed.		
If CAS Volume	(from Step 2) is less than T	RV then go t	o STEP 5.			
Step 5: Calcula	te the ratio of available inter	ior volume to	o the total requ	uired volume.		
Ratio = CAS Vo by TRV (from S	olume (from Step 2) <i>divided</i> Step 4a or Step 4b)	Ratio =	12,896	/ 1750	=	
Step 6: Calcula	te Reduction Factor (RF).					
RF = 1 <i>minus</i> F	latio	RF = 1	7.37	=	-6.37	
Step 7: Calcula	te single outdoor opening as	if all combu	stion air is fro	om outside.		
Total Btu/hr inp (EXCEPT DIRE	ut of all Combustion Appliar CCT VENT)	ices in the sa	me CAS	Input: Btu/hr	33,000	
	r Opening Area (CAOA): <i>ided by</i> 3000 Btu/hr					
per in <sup>2</sup>	CAOA=2	33,000	_/3000 Btu/h	$r per in^2 = $	11	in
Step 8: Calcula	te Minimum CAOA.					

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## Balanced Ventilation

NSF-PW ASTMD-1785 AST

• IECC Section R 403.5 (as Amended)

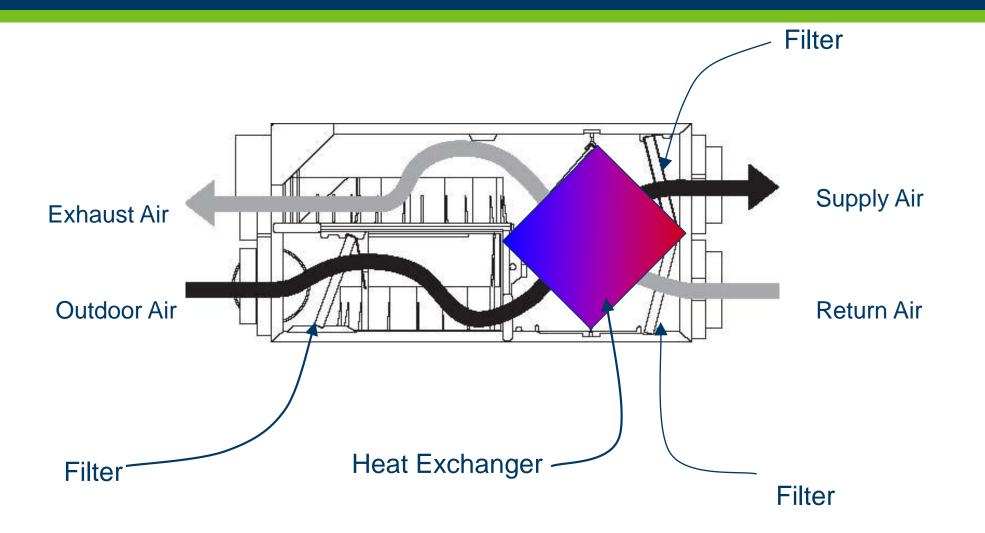
BROAN

## **Ventilation System Requirements**

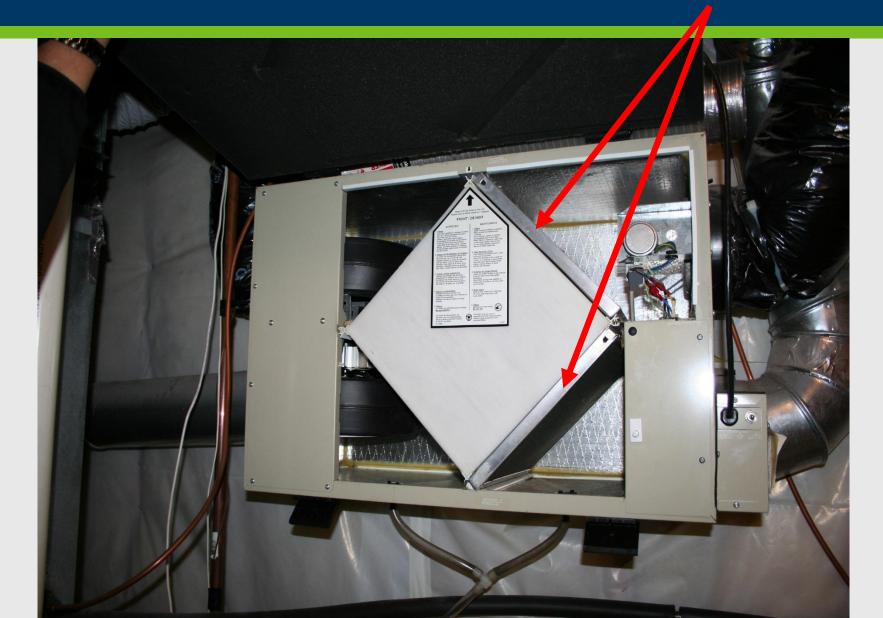
• Exhaust Only Systems (no longer Allowed)

- "Balanced Systems"
  - HRV/ERV
  - An intake and exhaust fan linked together to operate equally

# Heat Recovery Ventilator



## Filters Require maintenance

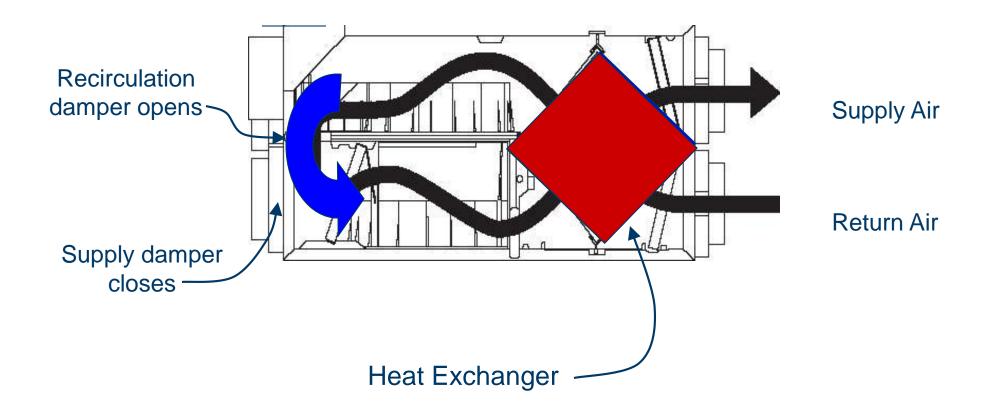


2/27/2019

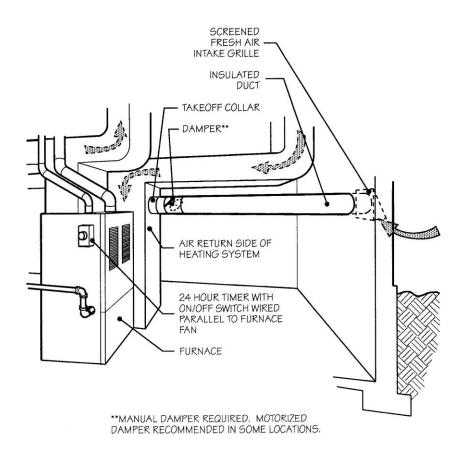
## **Filters Require maintenance**

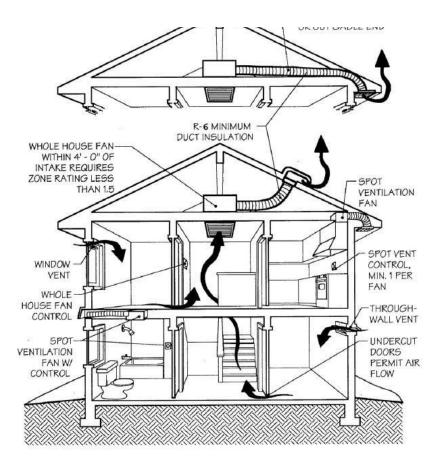


## HRV Defrost Operation (10%)



## **Balanced Ventilation System**





## Total Ventilation Air (Method 1)

- Equation R403.5.2
- Total ventilation rate (CFM) = (0.02 x square feet of conditioned space) + (15 x (number of bedrooms +1)).

## Table R 403.5.2 (Method 2)

7	<b>Fotal and co</b>	ntinuous ve	ntilation rat	es (in CFM)	)	
	-	1	Number o	f Bedrooms		
	1	2	3	4	5	6 <sup>2</sup>
Conditioned	Total/	Total/	Total/	Total/	Total/	Total/
space <sup>1</sup>	Continuo	Continuo	Continuo	Continuo	Continuo	Continuou
(in sq. ft.)	us	us	us	us	us	S
1000 - 1500	60/40	75/40	90/45	105/53	120/60	135/68
1501 - 2000	70/40	85/43	100/50	115/58	130/65	145/73
2001 - 2500	80/40	95/48	110/55	125/63	140/70	155/78
2501 - 3000	90/45	105/53	120/60	135/68	150/75	165/83
3001 - 3500	100/50	115/58	130/65	145/73	160/80	175/88
3501 - 4000	110/55	125/63	140/70	155/78	170/85	185/93
4001 - 4500	120/60	135/68	150/75	165/83	180/90	195/98
4501 - 5000	130/65	145/73	160/80	175/88	190/95	205/103
5001 - 5500	140/70	155/78	170/85	185/93	200/100	215/108
$5501 - 6000^2$	150/75	165/83	180/90	195/98	210/105	225/113

- Equation R403.5.2
- Total ventilation rate (CFM) = (0.02 x square feet of conditioned space) + (15 x (number of bedrooms +1)).

- Equation R403.5.2
- Total ventilation rate (CFM) = (0.02 x square feet of conditioned space) + (15 x (number of bedrooms +1)).
  - Includes the basement but excludes conditioned crawl spaces.

- Equation R403.5.2
- <u>Total</u> ventilation rate (CFM) = (0.02 x square feet of conditioned space) + (15 x (number of bedrooms +1)).
  - Includes the basement but excludes conditioned crawl spaces.
  - Subsript 2 in the table states "If conditioned space exceeds 6000 Sq. Ft or there are more than 6 bedrooms, use the equations"

#### • Our Home:

- 3224 square feet of conditioned space house
  - Conditioned space = "An area, room or space being heated or cooled by any equipment or appliance."
- 3 bedrooms

#### • Our Home

- 3224square feet of conditioned space house
  - Conditioned space = "An area, room or space being heated or cooled by any equipment or appliance."
- 3 bedrooms

- .02 x square feet of conditioned space = .02 x 3224 = 65 CFM
- Number of bedrooms (3) + 1 = 4
- 15 x 4 = 60 CFM
- Total ventilation rate (CFM) = 65 CFM + 60 CFM = **125 CFM**

		9	Number o	f Bedrooms		
57 1	1	2	3	4	5	6 <sup>2</sup>
Conditioned	Total/	Total/	Total/	Total/	Total/	Total/
space <sup>1</sup>	Continuo	Continuo	Continuo	Continuo	Continuo	Continuou
(in sq. ft.)	us	us	us	us	us	S
1000 - 1500	60/40	75/40	90/45	105/53	120/60	135/68
1501 - 2000	70/40	85/43	100/50	115/58	130/65	145/73
2001 - 2500	80/40	95/48	110/55	125/63	140/70	155/78
2501 - 3000	90/45	105/53	120/60	135/68	150/75	165/83
3001 - 3500	100/50	115/58	130/65	145/73	160/80	175/88
3501 - 4000	110/55	125/63	140/70	155/78	170/85	185/93
4001 - 4500	120/60	135/68	150/75	165/83	180/90	195/98
4501 - 5000	130/65	145/73	160/80	175/88	190/95	205/103
5001 - 5500	140/70	155/78	170/85	185/93	200/100	215/108
$5501 - 6000^2$	150/75	165/83	180/90	195/98	210/105	225/113

	e.	9	Number o	f Bedrooms		
	1	2	3	4	5	6 <sup>2</sup>
Conditioned	Total/	Total/	Total/	Total/	Total/	Total/
space <sup>1</sup>	Continuo	Continuo	Continuo	Continuo	Continuo	Continuou
(in sq. ft.)	us	us	us	us	us	S
1000 - 1500	60/40	75/40	90/45	105/53	120/60	135/68
1501 - 2000	70/40	85/43	100/50	115/58	130/65	145/73
2001 - 2500	80/40	95/48	110/55	125/63	140/70	155/78
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3001 - 3500	100/50	115/58	130/65	145/73	160/80	175/88
3501 - 4000	110/55	125/63	140/70	155/78	170/85	185/93
4001 - 4500	120/60	135/68	150/75	165/83	180/90	195/98
4501 - 5000	130/65	145/73	160/80	175/88	190/95	205/103
5001 - 5500	140/70	155/78	170/85	185/93	200/100	215/108
$5501 - 6000^2$	150/75	165/83	180/90	195/98	210/105	225/113

	2	6	Number o	f Bedrooms		
	1	2	3	4	5	6 <sup>2</sup>
Conditioned	Total/	Total/	Total/	Total/	Total/	Total/
space <sup>1</sup>	Continuo	Continuo	Continuo	Continuo	Continuo	Continuou
(in sq. ft.)	us	us	us	us	us	S
1000 - 1500	60/40	75/40	90/45	105/53	120/60	135/68
1501 - 2000	70/40	85/43	100/50	115/58	130/65	145/73
2001 - 2500	80/40	95/48	110/55	125/63	140/70	155/78
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5001 - 5500	140/70	155/78	170/85	185/93	200/100	215/108
$5501 - 6000^2$	150/75	165/83	180/90	195/98	210/105	225/113

	2	i) 20	Number o	f Bedrooms		
	1	2	3	4	5	6 <sup>2</sup>
Conditioned	Total/	Total/	Total/	Total/	Total/	Total/
space <sup>1</sup>	Continuo	Continuo	Continuo	Continuo	Continuo	Continuou
(in sq. ft.)	us	us	us	us	us	S
1000 - 1500	60/40	75/40	90/45	105/53	120/60	135/68
1501 - 2000	70/40	85/43	100/50	115/58	130/65	145/73
2001 - 2500	80/40	95/48	110/55	125/63	140/70	155/78
2501 - 3000	90/45	105/53	120/60	135/68	150/75	165/83
3001 - 3500	100/50	115/58	130/65	145/73	160/80	175/88
3501 - 4000	110/55	125/63	140/70	155/78	170/85	185/93
4001 - 4500	120/60	135/68	150/75	165/83	180/90	195/98
4501 - 5000	130/65	145/73	160/80	175/88	190/95	205/103
5001 - 5500	140/70	155/78	170/85	185/93	200/100	215/108
$5501 - 6000^2$	150/75	165/83	180/90	195/98	210/105	225/113

## **Continuous Ventilation Air**

• Continuous Ventilation:

## **Continuous Ventilation Air**

#### • Continuous Ventilation:

• R403.5.3: "... a minimum of 50% of the total ventilation rate, but not less than 40 CFM, on a continuous rate average for each one hour period in accordance with Table R403.5.2 or Equation 403.5.2

## **Continuous Ventilation Air**

- Continuous Ventilation:
  - **R403.5.3: "… a minimum of 50% of the total** ventilation rate, **but not less than 40 CFM,** on a continuous rate average for each one hour period in accordance with Table R403.5.2 or Equation 403.5.2

• Equation R403.5.3: Continuous ventilation (CFM)= total ventilation rate /2.

Our Home = 125 CFM (Total ventilation Rate) divided by 2 =

125 / 2 = 62.5 or 63 CFM of Continuous Ventilation

	e.	9	Number o	f Bedrooms		
	1	2	3	4	5	6 <sup>2</sup>
Conditioned	Total/	Total/	Total/	Total/	Total/	Total/
space <sup>1</sup>	Continuo	Continuo	Continuo	Continuo	Continuo	Continuou
(in sq. ft.)	us	us	us	us	us	S
1000 - 1500	60/40	75/40	90/45	105/53	120/60	135/68
1501 - 2000	70/40	85/43	100/50	115/58	130/65	145/73
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4501 - 5000	130/65	145/73	160/80	175/88	190/95	205/103
5001 - 5500	140/70	155/78	170/85	185/93	200/100	215/108
$5501 - 6000^2$	150/75	165/83	180/90	195/98	210/105	225/113

		6	Number o	f Bedrooms		
	1	2	3	4	5	6 <sup>2</sup>
Conditioned	Total/	Total/	Total/	Total/	Total/	Total/
space <sup>1</sup>	Continuo	Continuo	Continuo	Continuo	Continuo	Continuou
(in sq. ft.)	us	us	us	us	us	S
1000 - 1500	60/40	75/40	90/45	105/53	120/60	135/68
1501 - 2000	70/40	85/43	100/50	115/58	130/65	145/73
2001 - 2500	80/40	95/48	110/55	125/63	140/70	155/78
2501 - 3000	90/45	105/53	120/60	135/68	150/75	165/83
3001 - 3500	100/50	115/58	130/65	145/73	160/80	175/88
3501 - 4000	110/55	125/63	140/70	155/78	170/85	185/93
4001 - 4500	120/60	135/68	150/75	165/83	180/90	195/98
4501 - 5000	130/65	145/73	160/80	175/88	190/95	205/103
5001 - 5500	140/70	155/78	170/85	185/93	200/100	215/108
$5501 - 6000^2$	150/75	165/83	180/90	195/98	210/105	225/113

	2	6	Number o	f Bedrooms		
	1	2	3	4	5	6 <sup>2</sup>
Conditioned	Total/	Total/	Total/	Total/	Total/	Total/
space1	Continuo	Continuo	Continuo	Continuo	Continuo	Continuou
(in sq. ft.)	us	us	us	us	us	S
1000 - 1500	60/40	75/40	90/45	105/53	120/60	135/68
1501 - 2000	70/40	85/43	100/50	115/58	130/65	145/73
2001 - 2500	80/40	95/48	110/55	125/63	140/70	155/78
2501 - 3000	90/45	105/53	120/60	135/68	150/75	165/83
3001 - 3500	100/50	115/58	130/65	145/73	160/80	175/88
3501 - 4000	110/55	125/63	140/70	155/78	170/85	185/93
4001 - 4500	120/60	135/68	150/75	165/83	180/90	195/98
4501 - 5000	130/65	145/73	160/80	175/88	190/95	205/103
5001 - 5500	140/70	155/78	170/85	185/93	200/100	215/108
$5501 - 6000^2$	150/75	165/83	180/90	195/98	210/105	225/113

## **Service Hot Water Systems**



### **New SHW pipe insulation and run-length requirements (R-3)**

## R 403.4.4 Hot Water Pipe Insulation

#### Hot water piping will be insulated to at least R-3 as follows:

- Piping is larger than 3/4" in nominal diameter,
- Piping serves more than one dwelling unit,
- Piping runs from water heater to kitchen outlets,
- Piping is located outside of conditioned space,
- Piping runs from water heater to a distribution manifold,
- Piping is located under a floor slab,
- Piping is buried,
- Supply and return piping is in recirculation systems other than demand recirculation systems,
- Piping run exceeds the following maximum run lengths:

Nominal diameter of largest pipe diameter in run	3/8"	1/2"	3/4"	> 3/4"
Max run length	30 ft	20 ft	10 ft	5 ft



# R403.4.2 – Hot water pipe insulation

• All hot water pipe, minimum R-3. Thermal resistance for all piping

TABLE R40 MAXIMUM RUN LE		feet)°		
Nominal Pipe Diameter of Largest Diameter Pipe in the Run (inch)	<sup>3</sup> / <sub>8</sub>	<sup>1</sup> / <sub>2</sub>	3/4	> 3/4
Maximum Run Length	30	20	10	5
For SI: 1 inch = 25.4 mm, 1 foot 304.8 m	m.			
<ul> <li>a. <u>Total length</u> of all piping from t recirculation loop to a point of use.</li> </ul>	he distri	ibution	manifold	l or the



2012 IECC Fundamentals

## **Prescriptive Lighting Equipment**

A minimum of 75 percent of the lamps in permanently installed lighting fixtures shall be high-efficacy lamps or 75% of permanently installed lighting fixtures to contain only high efficacy lamps

#### **Exception:**

✓ Low-voltage lighting



## Recessed Lighting Fixtures Section R402.4.5

- ✓ Type IC rated and labeled as meeting ASTM E 283 when tested at 1.57 psf (75 Pa) pressure differential with no more than 2.0 cfm of air movement
- ✓ Sealed with a gasket or caulk between the housing and interior wall or ceiling covering



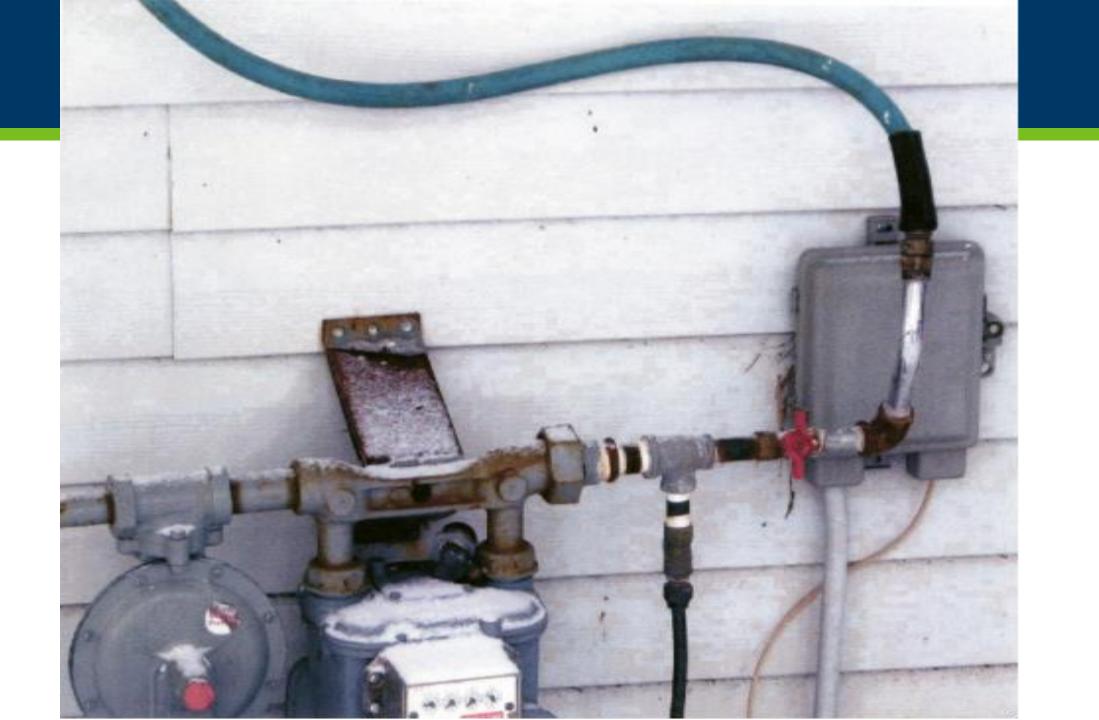
# **Review of our Course Objectives**

- Calculate Heat loss for Building
- Size the Furnace for the Building
- Calculate the Make up air requirements
- Calculate the Combustion air requirements
- Calculate and design the ventilation system
  - Continuous ventilation
  - Total Ventilation (continuous + intermittent)
- Discussion on the Service water heating System and the Energy code Requirements
- Discussion on Electrical requirements and the Energy Code Requirements R R404 2/27/2019

## **Gas Meter locations**











# Please Drive Carefully on your way home!

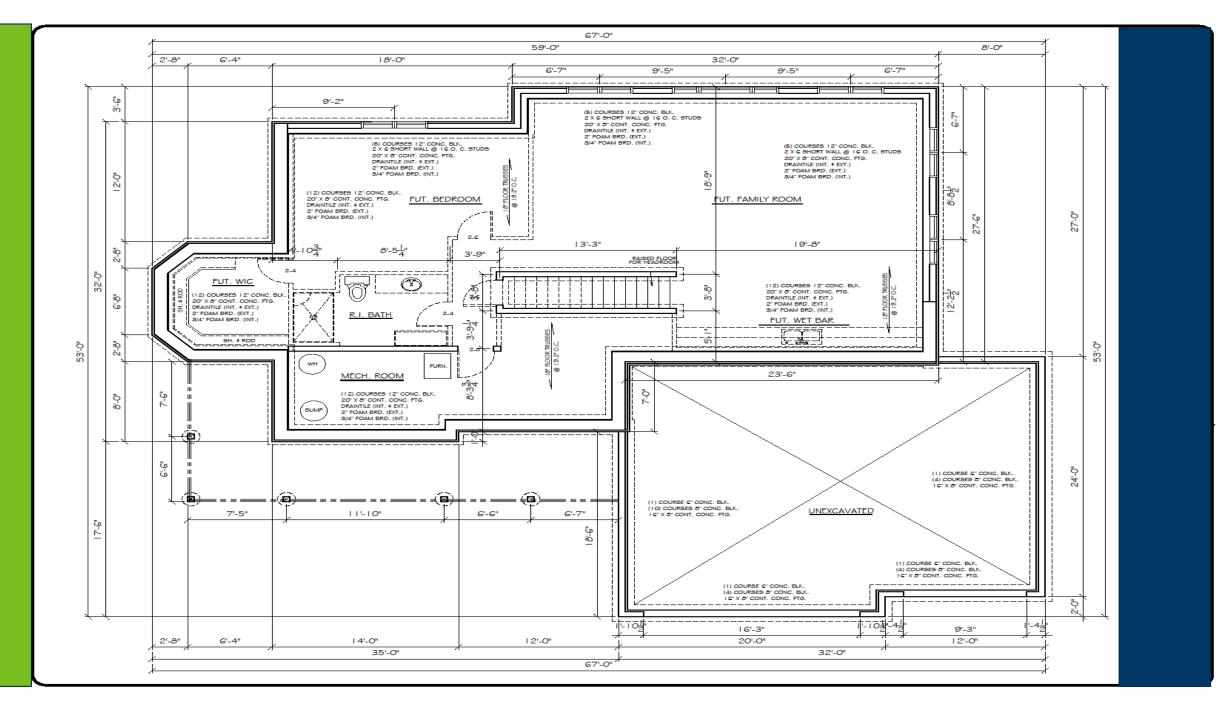


### SO, ... HOW'S YOUR DAY GOING?



# Thank You!

Don Sivigny don.sivigny@state.mn.us 651-284-5874

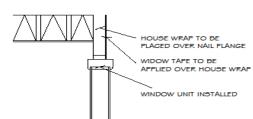


#### ENERGY CODE NOTE:

CONTRACTOR AND SUB-CONTRACTOR ARE RESPOSIBLE FOR COMPLIANCE OF THE CURRENT NOTE: CODE AS REQUIRED. ALL OVERHEAD DOORS TO HAVE I. INTERIOR VAPOR RETARDER ON INSULATED CEILINGS, WALLS AND FLOORS. A 90 MPH WIND RATING PER CODE. 2. CONTINIOUS AIR BARRIER AT ALL PLUMBING AND HEATING PENETRATIONS. 3. FIRE STOPS MUST BE INSTALLED TO BLOCK AIR MOVEMENT INTO ATTIC. 4. PENETRATIONS IN THE BUILDING ENEVELOPE FOR ELECTRICAL AND TELECOMMICATIONS (EXCEPT FOR ELECTRICAL BOXES AND FAN HOUSINGS) MUST BE SEALED TO PREVENT AIR LEAKAGE. TYPICAL PORTAL PRAME CONSTRUCTION MIN. 3" X 11.25" NET HEADER. 5. WIND WASH BARRIER REQUIRED AT THE EXTERIOR EDGE OF ATTIC INSULATION. PASTEN TOP PLATE TO HEADER WITH TWO ROWS OF I GE SINKERS NAILS AT 3" O.O. TYP. 1000 LB STRAB FOR A FANEL SPLICE 6. WIND WASH BARRIER REQUIRED AT OVERHANG SUCH AS For A fanel splue (if rector), fance Eddes Shall Be Blocked, and count within 24' of Mid-Heart, one flow of typ. Sheathing-to-trading adjusted required. If 2 x 4 Blocking is used, the 2 x 4 Midt Be Naled Together with 3 16 a Sekers CANTILEVERED FLOORS AND BAY WINDOWS. 1000 LB. STRAB OFFOSITE SHEATHINGING 노 7. WINDOW AND DOOR FRAMES MUST BE SEALED. PASTEN SHEATHINGHING TO HEADER WITH BA COMMON OR GAUVANIZZED BOX NALS IN 3" GRID PATTERN AS SHOWN AND 3" O.O. IN ALL PRAMING (STUDS, BLOCKING, AND SULSHTF. MAX. 5 8. ALL EXTERIOR JOINTS THAT MAY BE A SOURCE OF AIR. ö INTRUSION MUST BE SEALED. MIN. WIDTH = I & FOR ONE STORY STRUCTURES MIN. WIDTH = 24° FOR USE IN THE FIRST OF TW TWO STORY STRUCTURES 9. RIM JOISTS MUST BE SEALED TO PREVENT AIR LEAKAGE. ō I O. TOPS OF INTERIOR PARTITION WALLS MUST BE SEALED TO PREVENT ò DOUBLE 2 X 4 POST MIN. 2 X 4 PRAMING AIR LEAKAGE. SVA THICKNESS WOOD STRUCTURAL PANEL SHEATHING I I. ELECTRICAL BOXES AND FANS MUST BE SEALED TO PREVENT AIR LEAKAGE. MIN. 4200 LB TIE-DOWN DEVICE (EMBEDDED INTO ODNORETE AND NAILED INTO FRAMING) MIN. 1000 LB. TIE DOWN DEVICE 12. BETWEEN WALL ASSEMBLIES, RIM JOISTS, AND FOUNDATIONS MUST BE SEALED TO PREVENT AIR LEAKAGE. 13. A MECHANICAL VENTILATION SYSTEM WHICH REPLACES, BY DIRECT OR INDIRECT MEANS, AIR FROM HABITABLE ROOMS WITH OUTDOOR AIR (THIS WOULD ALLOW EXHAUST ONLY. AIR EXCHANGER OR HEAT RECOVERY VENTILATOR-HRV) 14. DIRECT VENT, POWER VENT, OR SEALED COMBUSTION FURNACE, WATER HEATER, OR GAS FIREPLACE. 15. IF ANY SINGLE EXHAUST DEVICE (E.G. KITCHEN FAN OR DRYER) WINDOW UNIT . OVER 300 CFM IS INSTALLED. A SEALED COMBUSTION FURNACE MUST BE USED OR AN ALTERNATIVE MAKE UP AIR SOURCE NAILING FLANGE MUST BE USED. BEYOND WINDOW TAPE PAN FLASHING AT SILL

OUTLET TO BE SUPPLIED OUTLET TO BE SUPPLIED WITHIN GLOSE PERDIMITY TO THE RADON EXHAUST FIFE ON THE GARAGE WALL TO ALLOW FOR FUTURE ACTIVE SYSTEM ഹ S" FVO RADON EXHAUST FIFE TO TERMINATE THROUG THE ROOF MIN. 12" ABOVE HIGHEST POINT OF ROOF @ FENETRATION 2" EVO SUME UNE TO TERMINATE TO THE EXTERIOR 4" CONORETE SLA G MIL FOLY BARRIER BENEATH 4" OONO. SLA . . LAYER OF OLEAS ...... INTERIOR DRAINTLE SUMP BASKET

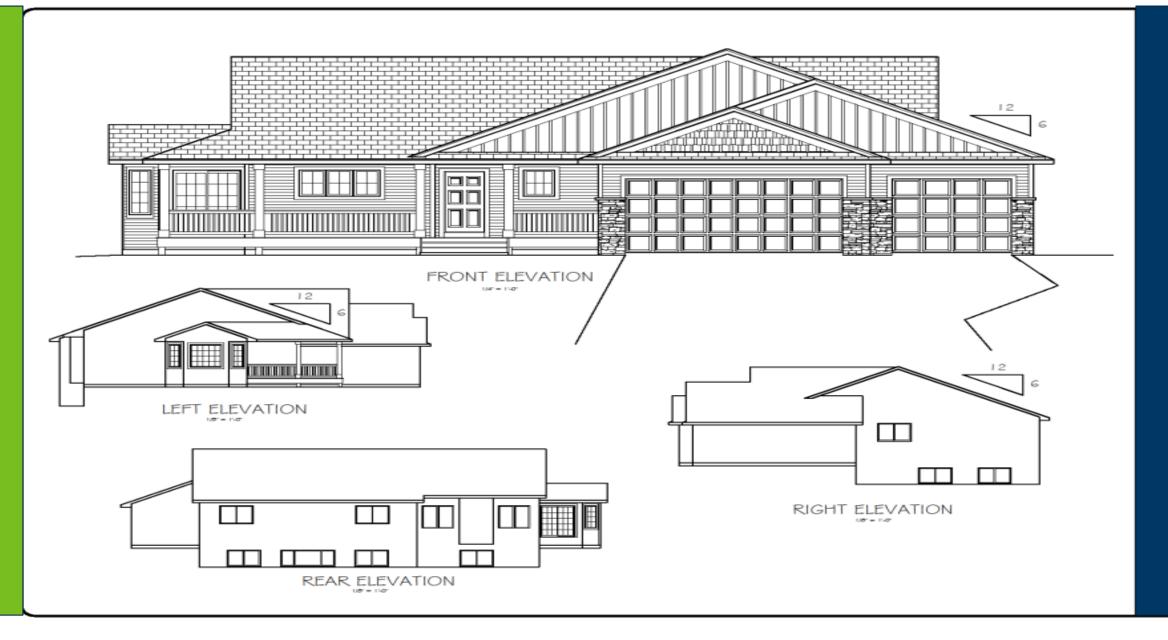
RADON DETAIL

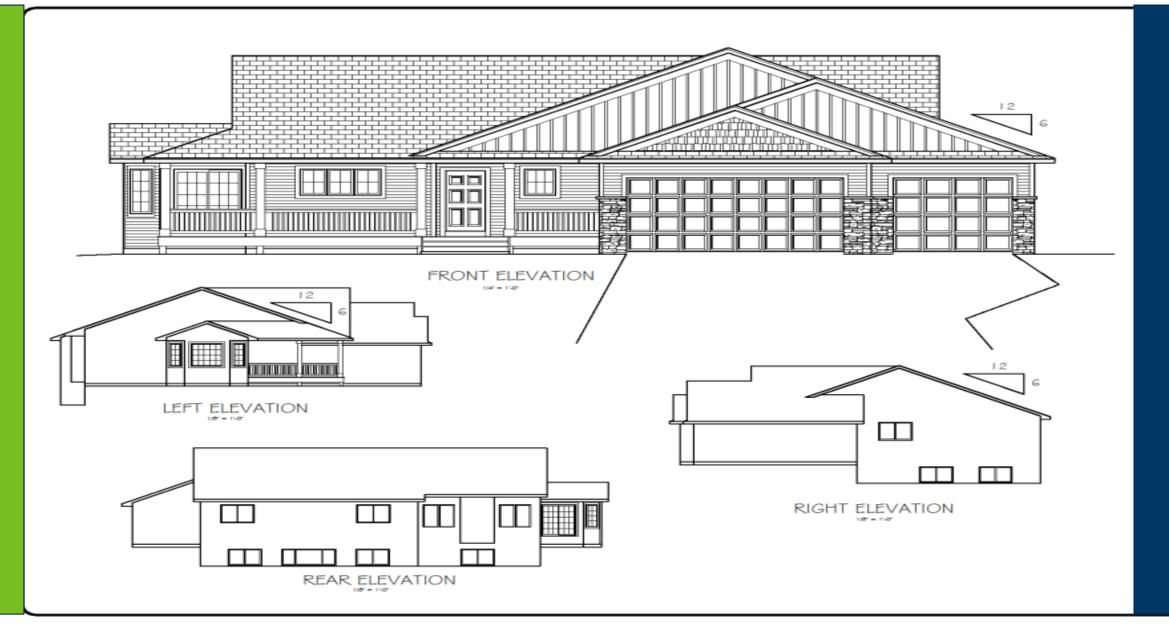


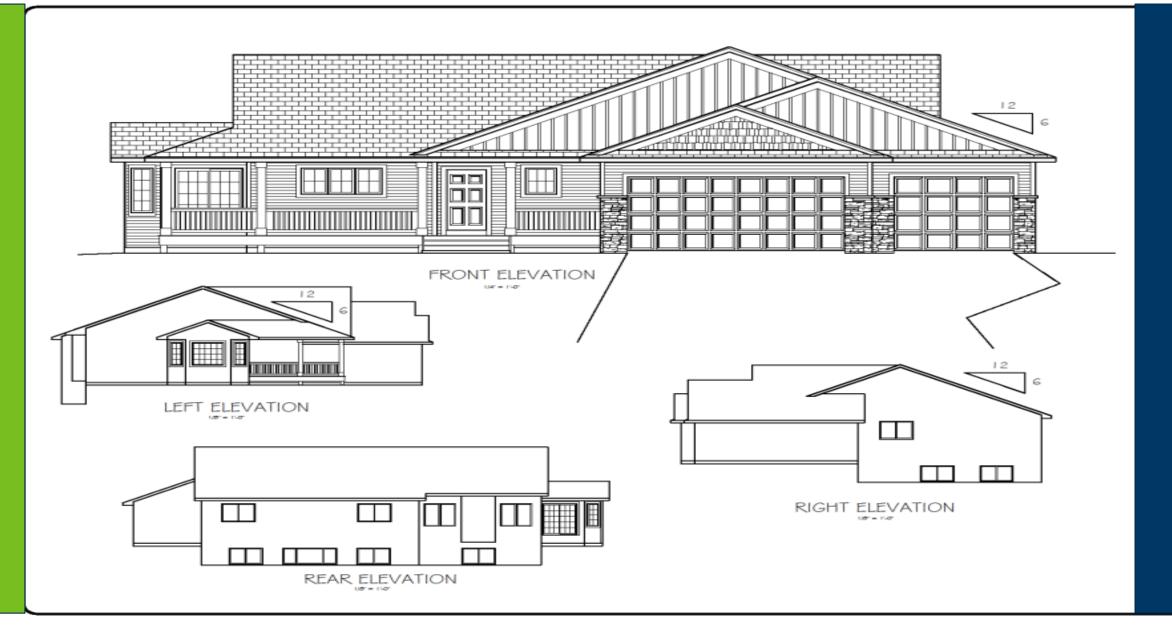
WINDOW TAPE DETAIL

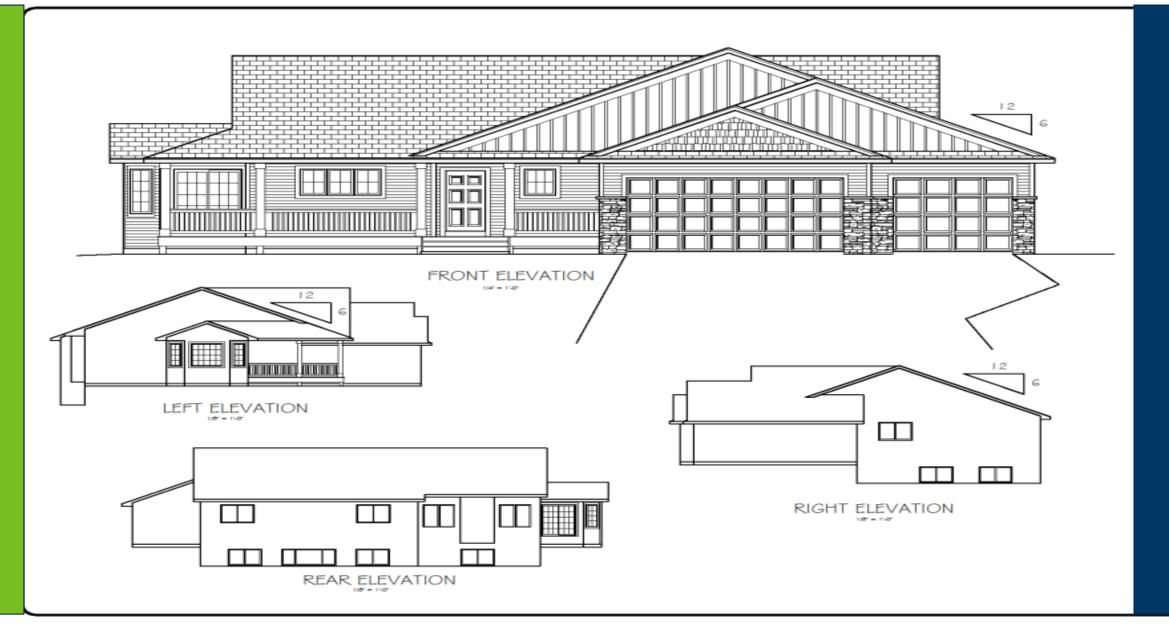
MIN. 3" PAST WINDOW

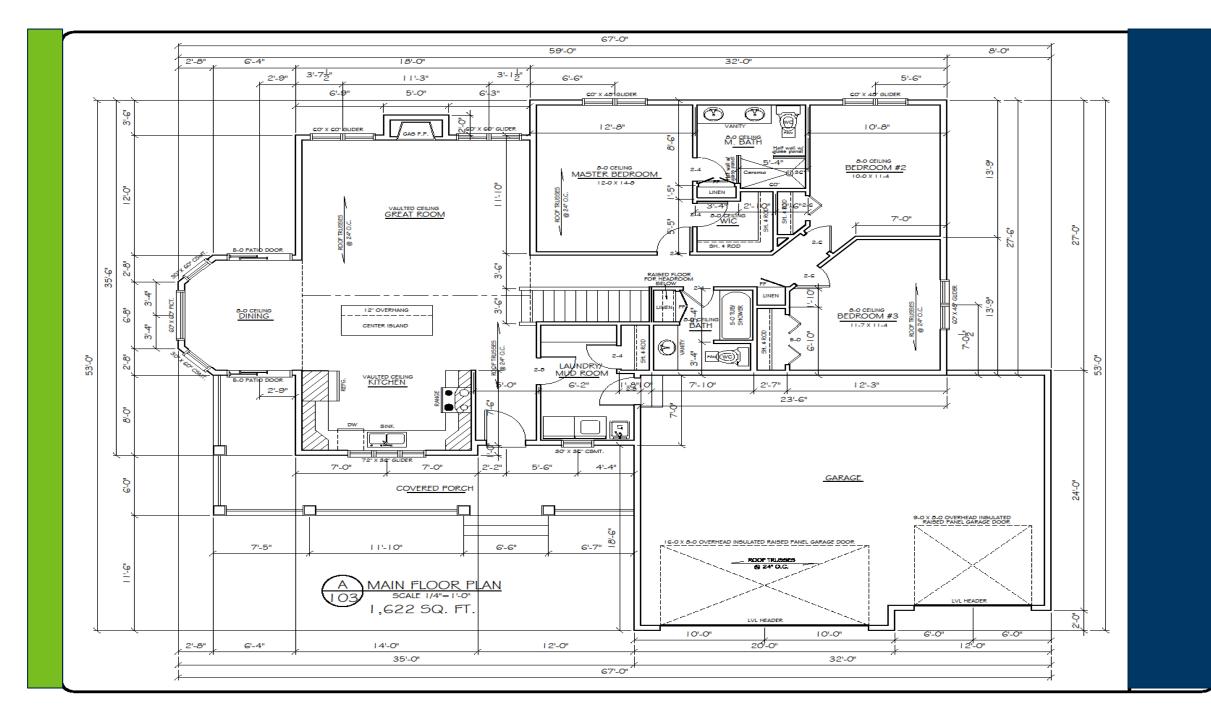
NOTE: THESE FLANS ARE FREFARED AS A DRAFTING SERVICE ONLY. GENERAL CONTRACTOR ASSUMES FULL RESPONSIBILITY FOR ALL DAMESIGNES, ARADES, LEVARIDUE, NOTES, AND CONTROLMENT TO LEVERY THESE FLANS FOR ANY FOSSIBLE OHANGES OR CORRECTIONS FRECE TO CONSTRUCTION. NOTE: ALL BEAMS AND STRUCTURAL MEMBER SEES TO BE DETERMINED AND VERIFIED BY SUFFLIES AND CONTRACTOR. ROOM DIMENSIONS TO BE AFFROXIMATE AND TO BE DETERMINED ON JOB STE.

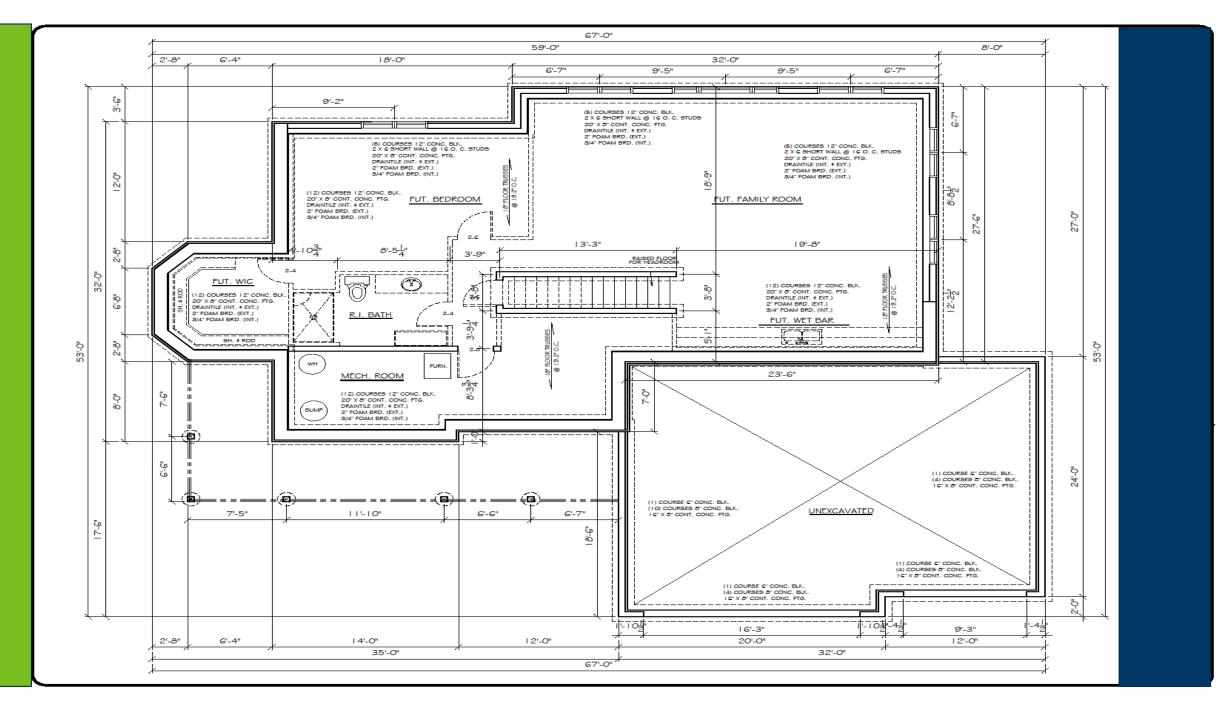












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 KIM JOISTS MUST BE SEALED TO PREVENT AIR LEARAGE.
 TOPS OF INTERIOR PARTITION WALLS MUST BE SEALED TO PREVENT AIR LEARAGE.

11. ELECTRICAL BOXES AND FANS MUST BE SEALED TO PREVENT AIR LEAKAGE.

I 2. BETWEEN WALL ASSEMBLIES, RIM JOISTS, AND FOUNDATIONS MUST BE SEALED TO PREVENT AIR LEAKAGE.

1.3. A MECHANICAL VENTILATION SYSTEM WHICH REFLACES, BY DIRECT OR INDIRECT MEANS, AIR FROM HABITABLE ROOMS WITH OUTDOOR AIR (THIS WOULD ALLOW EXHAUST ONLY. AIR EXCHANGER

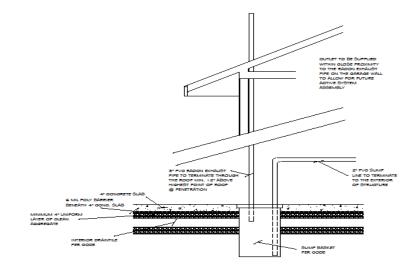
OR HEAT RECOVERY VENTILATOR-HRV)

14. DIRECT VENT, POWER VENT, OR SEALED COMBUSTION FURNACE, WATER HEATER, OR GAS FIREPLACE.

FURNACE, WATER HEATER, OR GAS HIREPLACE.

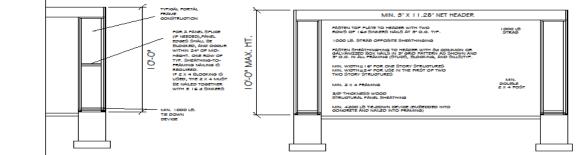
 I.5. IF ANY SINGLE EXHAUST DEVICE (E.G. KITCHEN FAN OR DRYER)
 OVER 300 CFM IS INSTALLED. A SEALED COMPUSITION FURNACE

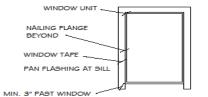
MUST BE USED OR AN ALTERNATIVE MAKE UP AIR SOURCE MUST BE USED.



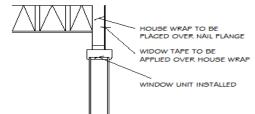
RADON DETAIL







WINDOW TAPE DETAIL



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#### New Construction Energy Code Compliance Checklist/Certificate

Mailing Address of the D		ualling Unit					0.1							Place your
Mailing Address of the D	welling or D	welling Unit					Cit	-		м.	•			logo here
1234 Any Street Name of Residential Cor	tractor							ny te N Lice					_	-
John Doe Construc								001			1001			
THERMAL ENVELOPE							00	001	-0-					CONTROL SYSTEM
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			otal R-Va nsulation	°Z	lass	lass	ဗိ	do	Ē	Extr	soc			
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Foundation Wall				NI/A			Х				R-10	Using	Exte	erior Closed cell Foam
Perimeter of Slab on Grade				N/A R-21			х					Heine	P. 2	1 Foam Insulation. Closed cell
Rim Joist (1st Floor) Rim Joist (2nd Floor+)				N/A			^					Using	<u>-</u> 2	i i oani insulation. Cioseu cell
Wall				R-21		х						Usina	Fric	tion Fit Fiberglass Batt Insulation
Ceiling, flat				R-49	Х							Joing		
Ceiling, vaulted				R-49	х									
Bay Windows or cantilevered	d areas			R-49		Х								
Floors over unconditioned a	rea			R-30		х		1						
Describe other inculated are						^								
Describe other insulated are	as		N/A							ļ				
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