The City of Moraine Building Department
Trade-off Energy Analysis
Based upon the 2003 IECC, HDD 5708

Job Name _____ Date _____

Job Address _____ City_____

Your House				
	Insulation R-value	Area A	System U R Values	Overall U-value - UA
Roof / Ceiling				
1.Roof/Ceiling	_____	A _____	x U$_r$ _____	= _____
2. Skylights	_____	A _____	x U$_r$ _____	= _____
3. Floor Cantilevers	_____	A _____	x U$_r$ _____	= _____
Subtotals		A _____	4.	_____

Code House

Roof / Ceiling

Maximum U$_O$ ___.0275____
A (total area)   x _____
Max UA Allowed = _____ C.

Exterior Walls				
5. Opaque Wall	_____	A _____	x U$_w$ _____	= _____
6. Opaque Wall	_____	A _____	x U$_w$ _____	= _____
7. Opaque Wall	_____	A _____	x U$_w$ _____	= _____
8. Floor Bands	_____	A _____	x U$_w$ _____	= _____
9. Doors w/o glass		A _____	x U$_O$ _____	= _____
10. Doors with glass		A _____	x U$_O$ _____	= _____
11. Door		A _____	x U$_O$ _____	= _____
12. Window		A _____	x U$_O$ _____	= _____
13. Window		A _____	x U$_O$ _____	= _____
14. Bsm't. Window		A _____	x U$_O$ _____	= _____
15. Others	_____	A _____	x U$_O$ _____	= _____
Subtotals(gross wall)		A _____	16.	_____

Exterior Walls

To obtain UA for door and window area on your house, use the u-value provided by the manufacturer for the entire window or door assembly or select typical u-values from the attached tables. If you only have an r-value for the window or door divide the R-value into 1 to obtain a u-value.
Example 1/1.5 =.66

Maximum U$_O$ .130 or .215*
A (total area)   x_____
Max UA Allowed = _____ F.
* use .215 multiplication factor for use groups R-2, R-4 and townhouses, only.

Foundation / Floor				
17. Slab Insulation	_____	A _____	÷ R_____	= 18._____
	Area = 2' height x perimeter length.			
19. Floor over unheated space	_____	A _____	xU$_O$ _____	= 20._____
21. Crawlspace Wall	_____	A _____	xU$_O$ _____	= 22._____
23. Basement Wall	_____	A _____	xU$_O$ _____	= 24._____
25. Basement Wall	_____	A _____	xU$_O$ _____	= 26._____

Foundation / Floor

A _____ ÷ R_____ = UA_____ G.
R= 6.92 for slabs with ducts, 4.8 for slabs without ducts.

A _____ xU$_O$ _.05_ = UA_____ H.

A _____ xU$_O$ _.06__ = UA_____ J.
A _____ xU__.097_ = UA_____ K.
A _____ xU _.097_= UA_____ L.

Total UA

UA from insulation to be installed
Total lines 4+16+18+20+22+24 +26 = 27._____

Total UA
Maximum UA: Lines
   C+F+G+H+J+K+L =_____M.

Line 27 (Your House Total) must be less than or equal to line M (Code House Total)

Prepared by_____ Phone _____

Note: Opaque wall area means the gross wall area minus the window and door rough openings.

Table A (R502.2.3.2)
Roof Ceiling Assemblies

R-value of Insulation	System U-value (U_r)
19	0.050
22	0.040
30	0.030
38	0.025

Table B (502.2.3.1(1))
Wall Assemblies

Type and Spacing of Framing	R-value Cavity insulation	R-value Of Sheathing	U_W
2X4 Studs 16" oc.	11	noninsulating	0.085
	13	noninsulating	0.076
	13	3	0.064
	13	5	0.056
	13	7	0.051
	15	noninsulating	0.070
	15	3	0.059
	15	5	0.053
	15	7	0.048
2X6 Studs 16" oc	19	noninsulating	0.058
	19	3	0.050
	19	5	0.046
	19	7	0.041
	21	noninsulating	0.052
	21	3	0.046
	21	5	0.042
	21	7	0.038
2X6 Studs 24" oc	21	noninsulating	0.050
4" steel studs 16" oc	11	noninsulating	0.14
	13	noninsulating	0.13
6" steel studs 16" oc	19	noninsulating	0.11
4" steel studs 24" oc	11	noninsulating	0.12
	13	noninsulating	0.11
6" steel studs 24" oc	19	noninsulating	0.10

Table C (102.5.2(2))
U-factor default table for non-glazed doors

Door Type	With Foam Core	Without Foam Core
1 ¾" Steel Doors	0.35	0.60
	With Storm Doors	Without Storm Doors
1 ¾" Wood Doors Hollow core Flush	0.32	0.46
Panel with .438 inch panel	0.36	0.54
Panel with 1 1/8" panel	0.28	0.39
Solid core flush	0.26	0.40

Table D (102.5.2(1))
U-factor default table for windows, glazed doors and skylights

Frame Material and product type[a]	Single Glazing	Double Glazing
Metal without thermal break:		
Curtain wall	1.22	.079
Fixed	1.13	.069
Garden Window	2.60	1.81
Operable (including sliding and swinging glass doors)	1.27	0.87
Site-assembled sloped/overhead glazing	1.36	0.82
Skylights	1.98	1.31
Metal with thermal break:		
Curtain wall	1.11	0.68
Fixed	1.07	0.63
Operable (including sliding and swinging glass doors)	1.08	0.65
Site-assembled sloped/overhead glazing	1.25	0.70
Skylights	1.89	1.11
Reinforced vinyl/metal clad wood:		
Fixed	0.98	0.56
Operable (including sliding and swinging glass doors)	1.90	0.57
Skylights	1.75	1.05
Wood/vinyl fiberglass:		
Fixed	0.98	0.56
Garden Window	2.31	1.61
Operable (including sliding and swinging glass doors)	0.89	0.55
Skylights	1.47	0.84

a. Glass block assemblies with mortar but without reinforcing or framing shall have a U-factor of 0.60

Table E (502.2.3.5)
Floor Assemblies

R-value of insulation	U_r
No Insulation	.32
7	0.11
11	0.08
19	0.05

Table F (502.2.3.5 & 502.2.3.6)
Foundation Wall Assemblies

Wall Detail	Crawlspace Wall		Basement Wall	
Wood Foundation	R-value of Insulation	U-Factor	R-value of Insulation	U-Factor
	11	0.10	11	0.08
	13	0.09	13	0.08
	19	0.06	19	0.06
Concrete/Masonry foundation interior insulation	5	0.15	5	0.15
	10	0.08	6.5	0.12
	11	0.08	10	0.08
	13	0.07	11	0.08
	19	0.05	19	0.06
Concrete/Masonry foundation exterior insulation	3	0.20	3	0.20
	5	0.15	5	0.15
	10	0.08	10	0.09
	15	0.06	15	0.06
Insulating concrete form system (ICF)[a,b,c]	12	0.08	12	0.07
	15	0.06	15	0.06
	16	0.06	16	0.06
	17	0.06	17	0.05
	20	0.05	20	0.05
	22	0.04	22	0.05

a. The R-value listed is the sum of the values for the exterior and interior insulation layers
b. The manufacturer shall be consulted for the u-factor if the insulated concrete form system (ICF) uses metal ties to connect the interior and exterior insulation layers.
c. These values shall be permitted to be used for concrete masonry wall assemblies with exterior and interior insulation layers.

INSTRUCTIONS FOR USING THE TRADE-OFF WORKSHEET

The trade-off worksheet compares "Your House" with a virtual identical "Code House" that complies with the Energy Code through the component performance evaluation process. If "Your House" uses equal or less than "Code House", it complies with the Energy Code. The following line by line instructions will assist the user in completing the trade-off worksheet.

LINE 1. Ceiling (attic): Enter the R-value of the attic insulation you will install under "insulation R-value". Consult your building plans and calculate the areas of the ceiling and enter under "A Area". From table A obtain the system U_r-value for the R-value of insulation proposed. Multiply the area of ceiling times the system U_r-value to obtain the UA and enter it under the UA column.

LINE 2. Skylights: Obtain the U_o-value (average of the entire unit) from Table D or from the skylight manufacturer. Enter the total area (from your building plans) under "A Area and enter the U_o-value under the System U-value. Multiply the area of skylights times the system U_o-value to obtain the UA and enter it under the UA column.

LINE 3. Floor Cantilevers: Enter the R-value of the attic insulation you will install under "insulation R-value". Consult your building plans and calculate the areas of the floor cantilever and enter under "A Area". From table A obtain the system U_r-value for the R-

value of insulation proposed. Multiply the area of floor cantilever times the system U_r-value to obtain the UA and enter it under the UA column.

LINE 4. ROOF/CEILING Subtotals. Add the areas to obtain an area subtotal. Then add lines 1-3 UA to obtain the total UA for the Roof /Ceiling assembly. Enter the total UA on line 4.

LINE 5-7. Opaque Wall: This section includes above grade walls excluding window and door rough openings plus floor to ceiling area of any basement wall less than 50% below grade. Enter the R-value of the wall insulation you will install under "insulation R-value". Consult your building plans and calculate the areas of the walls and enter under "A Area". From Table B obtain the system U_w-value for the R-value of insulation proposed. Multiply the area of wall times the system U_w-value to obtain the UA and enter it under the UA column. Use lines 6 and 7 for different wall construction that must be calculated separately.

LINE 8. Floor bands: Enter the R-value of the floor band insulation you will install under "insulation R-value". Consult your building plans and calculate the areas of the floor band and enter under "A Area". From table B obtain the system U_w-value for the R-value of insulation proposed. Multiply the area of floor band times the system U_w-value to obtain the UA and enter it under the UA column.

LINE 9. Solid doors: (doors without glazing) Consult your building plans and calculate the areas of the solid door rough openings and enter under "A Area". From table C obtain the system U_o-value for the type of door used or obtain the U_o-value from the door manufacturer. Multiply the area of the door times the system U_o-value to obtain the UA and enter it under the UA column.

LINE 10 & 11. Doors with glazing: Consult your building plans and calculate the areas of the doors with glazing, rough openings, and enter under "A Area". From Table D obtain the system U_o-value for the type of door used or obtain the U_o-value from the door manufacturer. Multiply the area of the door times the system U_o-value to obtain the UA and enter it under the UA column. Use line 11 for different door construction that must be calculated separately.

LINE 12 & 13. Windows. Consult your building plans and calculate the areas of the window rough openings, and enter under "A Area". From Table D obtain the system U_o-value for the type of window used or obtain the U_o-value from the window manufacturer. If you obtain the U-value from the window manufacturer, make sure you are using the system U-value and not the "center of glass" U-value. Multiply the area of the window times the system U_o-value to obtain the UA and enter it under the UA column. Use line 13 for different window U-values that must be calculated separately.

Line 14. Basement windows. Use this line for windows in conditioned basements with different U-values from line 12 and 13. Conditioned basement include all basements where the exterior basement wall is the insulated envelope and not the floor between the basement and the first floor. See line 12 for instructions to fill out this line.

Line 15. Other: Include here any other assembly having a unique U_o value.

Line 16. Gross Wall Subtotals. Add the areas to obtain an area subtotal. Then add lines 5-15 UA to obtain the total UA for the exterior wall assembly. Enter the total UA on line 16.

Line 17. Slab: Enter the R-value of the slab insulation you will install under "insulation R-value" and the system R-value. Consult your building plans and calculate the lineal feet of the perimeter of the slab. Multiply the lineal feet times two feet high, the minimum height allowed in this zone. Enter this area under "A Area". Divide the system R-value into the "A Area" to obtain the UA for the slab and enter this number on line 18.

Line 19. Floor over unheated space. Unconditioned crawlspaces or basements. Enter the R-value of the floor insulation you will install under "insulation R-value". Consult your building plans and calculate the areas of the floor and enter under "A Area". From Table E, obtain the system U_r-value for the R-value of insulation proposed. Multiply the area of floor times the system U_r-value to obtain the UA and enter it at line 22.

Line 21. Crawlspace Wall: Enter the R-value of the floor insulation you will install under "insulation R-value". Consult your building plans and calculate the areas of the crawlspace wall, length times height. The height is measured from the top of the foundation to the inside ground surface, or to footing when inside ground surface is less than 12" from the top of the foundation. Enter this area under "A Area". From Table F, obtain the system U_r-value for the R-value of insulation proposed. Multiply the area of floor times the system U_r-value to obtain the UA and enter it at line 22.

Line 23 and 25. Basement Walls: Only the opaque portion of the basement walls that are 50% of more below grade are considered here. All basement windows and doors as well as opaque portions of basement walls that are less than 50% below grade are included in "exterior wall" area. Enter the R-value of the basement wall insulation you will install under "Insulation R-Value". Consult your building plans and calculate the area of the basement wall and enter under "A Area". From Table F, obtain the system U-factor for the R-value of insulation proposed. Multiply the area of the basement wall times the system U-factor to obtain the UA and enter it at line 24. Use line 25 for different wall construction or insulation values that must be calculated separately.

Line 27. Total UA (UA from insulation to be installed): Add the subtotals on lines 4+16+18+20+22 and 26, and enter the grand total on line 27.

Code House: Enter the total areas from Your House side of the worksheet on the Code House side in the appropriate locations. Multiply the U_o–values times the areas (or divide the slab area by the insulation R-value) to get the maximum allowable UA for each category. (Roof/Ceiling, Exterior walls and Foundation/Floor types.) Add the Subtotals on line C+F+G+H+K+L and M, and enter the grand total on Line M.

The Comparison: If the value in line 27 is less than the value in line M, you meet the code. If the value on line 27 exceeds that on line M, you fail. In this case you must increase some of the R-values or reduce some of the areas of components having low R-values until you meet of exceed the value in line M, and recalculate your totals.