How to Do Residential Thermal Performance Calculations Using Table N1104.1(1)

This pamphlet is one in a series that describes residential energy conservation requirements of the Oregon Residential Specialty Code and Structural Specialty Code. Other pamphlets in this series may be downloaded from Oregon Department of Energy web site at http://egov.oregon.gov/ENERGY/CONS/Codes/cdpub.shtml or local building departments or from Oregon Building Codes Division.

Homes may comply with building envelope requirements of the residential energy code through either prescriptive building envelope (Table N1101.1(1)) or thermal performance calculations (Table N1104.1(1)). When following either of Tables N1101.1(1) or N1104.1(4), an additional measure must still be selected from Table N1101.1(2), Additional Measures.

Other combinations of measures may be used if thermal performance calculations show that the combination achieves the performance standard of the Standard Base Case. You must carefully select an additional measure from Table N1101.1(2).

You must carefully select an additional measure from Table N1101.1(2). It is simpler to perform this calculation if you select an additional measure that does not contain a building envelope improvement. If you select an additional measure that requires building envelope improvements, that improvement must be used as the Standard base case value, in lieu of that value. In addition to the modified calculation, any non-envelope measure must be installed.

Untested windows, doors and skylights may be used. In general, prescriptive paths require use of tested products. Builders who want to use certain products that are not yet tested can use thermal performance calculations to demonstrate code compliance. Certain untested

products are assigned conservative default U-factors (rates of heat transfer per square foot). Other parts of the package are adjusted to compensate for conservative performance estimates of untested components.

Thermal performance calculations should be submitted on a copy of Table N1104.1(1), as shown in this pamphlet. Use of a standard format expedites review of the calculations by the code official.

How Table N1104.1(1) works

In a thermal performance calculation, a component U-factor is multiplied by total area (A) of the component in square feet. The result of this calculation is the "UA." The UA indicates rate of heat transfer through total component area. Totaling rates of heat transfer for listed building components gives a "UA total," or a heat transfer rate for all items that affect building envelope code compliance.

In Table N1104.1(2), building heat loss is first calculated as if the building was built using measures in the Standard Base Case from Table N1101.1(1). On Table N1104.1(1) worksheet this is called "Standard base case." The heat loss total is called "Code UA." Next, the UA is calculated for alternate conservation measures under consideration by the builder or designer. On the worksheet this is called the "Proposed alternative." The heat loss rate is called "Proposed UA."

If Proposed UA is equal to or less than Code UA, proposed measures meet energy code performance standards. If the Proposed alternative doesn't initially qualify, the builder or designer improves conservation levels in one or more building components until it complies.

TABLE N1104.1(1)
RESIDENTIAL THERMAL PERFORMANCE CALCULATIONS

BUILDING COMPONENTS [b]	Standard base case [a]			Proposed alternative			
	Areas [c]	U-factor	Areas x U	R-value[d]	Areas[c]	U-factor [e]	Areas x U
Flat ceilings		0.031					
Vaulted ceilings [f]		0.042					
Conventional wood-framed walls		0.060					
Underfloor		0.028					
Slab edge		(perimeter ft. =) F=0.52 [g]					
Windows		0.35					
Skylights <2%[h]		0.75					
Skylights >2%[h]		0.60					
Exterior doors [i]		0.20					
Doors with >2.5 ft² glazing		0.40					
		CODE UA =				**Proposed UA [j] =**	

[a] Base path 1 represents Standard Base Case from Table N1101.1(1).

[b] Performance trade-offs are limited to those listed in column 1. Heat plant efficiency, duct insulation levels, passive and active solar heating, air infiltration and similar measures including those not regulated by code may not be considered in this method of calculation.

[c] Areas from plan take-offs. All areas must be the same for both Standard Base Case and Proposed alternative. The vaulted ceiling surface area for Standard Base Case must be the actual surface area from the plan take-off not to exceed 50 percent of the total heated space floor area. Any areas in excess of 50 percent for Base Case must be entered at U-0.031 (R-38) with "Flat Ceilings" area.

[d] Minimum Component Requirements: Walls R-15; Floors R-21; Flat Ceilings R-38; Vaults R-21; Below-Grade Wood, Concrete or Masonry Walls R-15; Slab Edge R-10; Duct Insulation R-8. R-values used in this table are nominal, for the insulation only and not for the entire assembly. Window and skylight *U*-values shall not exceed 0.65 (CL65). Door *U*-values shall not exceed 0.54 (Nominal R-2). A maximum of 28 square feet (2.6 m²) of exterior door area per dwelling unit can have a U-factor of 0.54 or less and shall not be included in calculations.

[e] *U*-values for wood frame ceilings, walls and floor assemblies shall be as specified in Table N1104.1(2). *U*-values for other assemblies, which include steel framing, brick or other masonry, stucco, etc., shall be calculated using standard ASHRAE procedures.

[f] Vaulted area, unless insulated to R-38, U-0.031, may not exceed 50 percent of the total heated space floor area.

[g] F=The heat loss coefficient, BTU/hr./ft.²/°F. per foot of perimeter.

[h] Whenever skylight area for Proposed alternative exceeds 2 percent of the total heated space floor area, enter 2 percent of area under Standard Base Case at U-0.75 then the remaining area under Standard Base Case at U-0.60. For Proposed alternative skylights, enter the actual skylight area and U-factor of those to be installed in residence.

[i] .A maximum of 28 square feet (2.6 m²) of exterior door area per dwelling unit can have a U-factor of 0.54 or less. Default U-factor for an unglazed wood door is 0.54.

[j] Proposed UA must be less than or equal to Code UA.

The process starts with determining areas (in square feet) of each building component. Then Code UA and Proposed UA are calculated using guidelines in this pamphlet and in footnote c to Table N1104.1(1). The U-factor column for Standard base case on Table N1104.1(1) worksheet lists U-factors for calculating Code UA. Proposed alternative U-values are listed in Table N1104.1(2) Approved Default U-Factors that follows Table N1104.1(1) and is reproduced on pages 7-8 of this pamphlet.

Minimum component requirements

Thermal performance calculations allow trading of lower energy performance of one component for higher energy performance of another. However, the Proposed alternative must at least meet the minimum component requirement listed in footnote c to Table N1104.1(2). U-factors for minimum component R-values are specified in Table N1104.1(2) "Approved Default U-Factors" that follows Table N1104.1(2).

Standard base path area limits apply to Table N1104.1(1) calculations

Standard base case contains component limitations: R-30 vaulted ceilings are limited to 50 percent of heated space floor area and skylights (U-0.61 to U-0.75) are limited to 2 percent of heated floor space. These component limits must be observed when calculating Standard base case in Table N1104.1(1). A maximum of 28 square feet of exterior door area per dwelling unit can have a U-factor of 0.54 or less and shall not be included in calculations; Footnote c in Table N1104.1(1) and this pamphlet explain how component area limits are modeled in Standard base case calculation. Example calculation worksheets are on pages 8-11 of this pamphlet.

Calculating component areas

The first step in using Table N1104.1(1) is to find actual areas of each component:

Flat ceilings

Ceiling area equals length multiplied by width. Use outside dimensions and round to the nearest whole square foot. Deduct skylight area and use "net ceiling area."

Minimum component requirement is R-38, or U-0.031.

Vaulted ceilings

Ceiling area equals length multiplied by width of the ceiling surface. Measure vault length along the slope to the peak. Deduct skylight area and use "net vault area."

Minimum component requirement is R-21, or U-0.047.

U-0.042 (R-38) vault area limit in Standard Base Case calculation: For Standard base case, enter area of the R-38 (U-0.042) vault, not to exceed 50 percent of heated floor space. Enter the actual U-factor for this assembly. U-factor for a standard R-38 scissors truss is U-0.042. U-factor for a rafter vaulted ceiling with R-30 insulation is typically U-0.033.

Include excess vault area (area that is greater than 50 percent of heated space floor area) with "Flat Ceilings." For Proposed alternative, enter actual area of vaulted ceiling under "Vaulted Ceilings." If there are two or more vaulted ceilings with different U-values, enter each vaulted ceiling UA on separate lines for the Proposed alternative calculation.

Opaque (solid) walls

Wall area equals length multiplied by height, using outside dimensions and rounding to the nearest whole square foot. For triangular walls at vaults and gable ends, area equals base multiplied by height divided by two. Subtract area of windows and exterior doors from total opaque wall area. Use this "net wall area" for the performance calculation.

Minimum component requirement is R-15, or U-0.080.

Account for all walls that divide heated and unheated spaces. Remember to include walls between house and garage, vault end walls, skylight wells, pony walls, knee walls, and stairway walls that may divide heated and unheated spaces.

Windows & Sliding Glass Doors (SGD)

For rectangular windows, area equals width multiplied by height. Since window U-factors include heat loss through the frame, use rough opening dimensions to calculate window area. Round to the nearest whole square foot. For whole circles, area equals π (3.14) multiplied by radius (r) squared ($A = \pi r^2$). For half-round windows, figure whole circle area and divide by two. For triangular windows, area equals base multiplied by height divided by two.

Deduct window and SGD area from gross wall area.

Minimum component requirement is U-0.65, or a class 65 window – typically a double-glazed window with a thermally-improved metal frame.

For site-assembled windows, use default U-factors from Table NF1112.4(1).

1 percent unique glazing exemption: Glazing area equal to 1 percent of heated space floor area may be exempt from meeting window U-factor standards if it is a "unique architectural glazing feature." That includes door sidelights, stained glass, glass contained in a door, garden windows and other decorative glass. Skylights and conventional window configurations that include but are not limited to horizontal sliders, double-hung and picture windows are not eligible as unique architectural features. Do not include unique exempted glazing in thermal performance calculations. A note accompanying calculations should indicate which windows were exempted and exempted window area.

Skylights

Skylight area equals rough opening dimension: length multiplied by width. Deduct skylight area from gross flat or vaulted ceiling area.

2 percent skylight area limit in the Standard Base Case calculation: For Standard base case, actual skylight area, up to 2 percent of the heated space floor area is entered as "Skylight" (U-0.75). If actual area exceeds 2 percent of heated space floor area, enter excess area under "Window" (U-0.60).

For the Proposed alternative, enter actual skylight area using the tested U-factor or appropriate default U-factor. If skylights have different U-factors, calculate each skylight UA separately.

Exterior doors – without any glazing

Area equals width multiplied by height of the rough opening. Sidelights are included with windows. Deduct entire door area from gross wall area.

Exempt door - unglazed doors, untested or tested:

For Standard base case door area, up to 28 square feet exterior door area per dwelling unit can have a U-factor of 0.54 or less and shall not be included in calculations. Enter all other door area(s) as "Exterior Doors" (U-0.20).

For the Proposed alternative, enter door area as "Exterior Doors" using the tested door U-factor or the default factor (U-0.54). If an untested 1-3/4- inch foam core door with a thermal break is used, use a U-0.20 default factor for the Proposed alternative.

Exterior doors with ≤2.5 ft^2 glazing

Deduct entire door area from gross wall area.

1 percent unique glazing exemption for doors with less than 2.5 ft^2 glazing: If the 1 percent unique glazing exemption is taken, note excluded glazing area on the Table N1104.1(1) worksheet, but do not include it in Standard base case or Proposed alternative calculations. Use net door area: total door area minus exempted glazing area.

In Standard base case, enter square footage of net door area under "Exterior Doors" (U-0.20). If excess glazing area remains, use the base case window default factor (U-0.35).

For Proposed alternative opaque door area, use U-0.54 or the 1-3/4-inch foam core door with thermal break default value (U-0.20) or NFRC-tested U-factor and enter under "Exterior Doors." The glazing exemption "removes" the glass from the door. Thus, tested U-factors are no longer valid. If excess glazing area remains after the exemption, use default glazing U-factors.

When no glazing exemption is available for doors with less than 2.5 ft^2 glazing: Enter excess opaque area under "Exterior Doors" (U-0.20). Enter excess glazing as "Window" (U-0.35) in the Standard base case. In the Proposed alternative, use default U-factor if not a tested door assembly.

Tested doors: Use actual net door area and tested U-factor for the Proposed alternative.

Untested doors: Use actual net door area and U-0.54 or the 1-3/4-inch foam core door with thermal break default factor (U-0.20) for the Proposed alternative.

Exterior doors with >2.5 ft^2 glazing

Deduct entire door area from gross wall area.

When the glazing in these doors are either double pane glazing with low-*e* coating on one surface, or triple pane, it can be assigned a default of U-0.40 if NFRC certification is not available. A U-factor of 0.40 can be used as the U-factor for the Proposed alternative.

If glazing in the door is not either double pane glazing with low-*e* coating on one surface, or triple pane, use of the following described options: "1 percent unique glazing exemption for doors with more than 2.5 ft^2 glazing" or "No glazing exemption for doors with more than 2.5 ft^2 glazing"

1 percent unique glazing exemption for doors with more than 2.5 ft^2 glazing: If the 1 percent unique glazing exemption is taken, note excluded glazing area on the Table N1104.1(1) worksheet, but do not include it in Standard base case or Proposed alternative calculations. Use net door area: total door area minus exempted glazed area.

Tested doors: Exclude 2.5 ft^2 of exempted area from calculations. Enter excess opaque area under "Exterior Doors" (U-0.20) in the Standard base case. Enter glazed area in excess of 2.5 ft^2 as "Window" (U-0.40).

For Proposed alternative, use U-0.54 or the 1-3/4-inch foam core door with thermal break default value (U-0.20) for net opaque door area.

Untested doors: Exclude 2.5 ft^2 of exempted area from calculations. Enter glazed area in excess of 2.5 ft^2 as "Window"U-0.40) in Standard base case. Enter excess opaque door area under "Exterior Doors" (U-0.20). Excess glazed area must be included as windows.

For Proposed alternative, use U-0.54 or the 1-3/4-inch foam core door with thermal break default value (U-0.20) for net opaque door area. Enter net glazed area under "Window" using default window U-values (0.60 or 0.65).

No glazing exemption for doors with more than 2.5 ft^2 glazing:

Tested doors: For Standard base case, enter net door area under "Exterior Door" (U-0.20). Enter glazed area in excess of 2.5 ft^2 as "Window" (U-0.35).

For Proposed alternative, enter actual door area as "Exterior Door" using NFRC tested U-factor.

Untested doors: For Standard base case, enter net door area under "Exterior Door" (U-0.20) in Standard base case. Enter glazed area in excess of 2.5 ft^2 as "Window" (U-0.35).

For Proposed alternative opaque door area, use U-0.54 or the 1-3/4-inch foam core door with thermal break default value (U-0.20) and enter under "Exterior Doors." Use window default factors for glazed door area in excess of 2.5 ft^2.

Underfloor

Underfloor area is floor area that divides heated from unheated spaces. Examples include floors above unheated crawl spaces or unheated basements, cantilevered floors, and floors above unheated garages.

Underfloor area called for in the calculation may be different from total "heated space floor area" of the home. Heated space floor area in a two-story home includes the area of both the first and second floors because both are heated. But in many homes, only the first floor divides heated from unheated space, so only first floor area is used as underfloor area for the calculation.

The minimum component requirement for underfloor area is R-21, or U-0.035.

Slab edge (in linear feet of perimeter)

To calculate slab heat loss, first determine linear footage of the slab perimeter. Slab edge losses pertain to on-grade slabs only, which are part of the heated space floor area.

Minimum component requirement is R-10, or F-0.54.

Slab interior – for heated slabs

In addition to slab edge perimeter insulation,

Basement walls

Basement walls are not included in Table N1104.1(1) calculations because the minimum component requirement is R-15. The basement wall insulation requirement includes insulation at the rim joist.

Air infiltration

Air infiltration is not included in Table N1104.1(1) thermal performance calculations.

Footnote b

Footnote b indicates that performance trade-offs are limited to building components listed in Table N1104.1(1). Furnace efficiency, duct insulation and passive and active solar heating are not considered in thermal performance calculations.

Footnote e

Footnote e to Table N1104.1(1) states U-factors calculated using standard ASHRAE methodology may be used. Consult the Oregon Department of Energy for information about assumptions used to calculate new component U-factors.

What happens if Proposed UA exceeds Code UA?

If Proposed UA exceeds Code UA, the building does not comply with energy code. Make changes in proposed U-factors until you find a combination of measures equivalent to or less than Code UA.

Example calculations

Following are examples of Table N1104.1(1) thermal performance calculations:

In **Example 1**, the builder is using windows that exceed code standards and trade-offs with floor insulation that does not meet Standard base case requirements.

Example 2 shows how to do calculations for a building that has R-30 vaults in excess of 50 percent of heated floor space.

Example 3 shows how to do calculations for a building that has R-30 vaults in excess of 50 percent of heated floor area and skylights in excess of 2 percent of heated floor space.

Example 4 shows how to do calculations when the exempt door is a 40 square feet solid wood, exceeding the 28 square feet limitation.

Example 5 shows how to treat untested glazing in thermal performance calculations.

How-to incorporate Table N1101.1(2) building envelope measures into calculations

Example 6 shows how to do calculations when Additional Measure 3 from Table N1101.1(2) is selected. Option 3 requires U-0.025 and U-0.033 flat and vaulted ceilings, U-0.047 (R-24) walls, and U-0.32 windows.

Since Option 3 only consists of "building envelope" improvements, no other additional measures are necessary.

Example 7 shows how to do calculations when Additional Measure 5 from Table N1101.1(2) is selected. Option 5 requires U-0.025 and U-0.033 flat and vaulted ceilings, and U-0.32 windows. It **also** requires that 75 percent of permanently installed lighting fixtures as CFL or linear fluorescent or a min efficacy of 40 lumens per watt.

Since Option 5 consists of a measure besides "building envelope" improvements, that measure is also required to be installed in addition to the modified Table N1104.1(1) calculation.

TABLE N1104.1(2)— APPROVED DEFAULT U-FACTORS

FLAT CEILINGS[a]		
Insulation	Type	U-Factor
R-38	Conventional framing	0.031
R-38	=>8/12 roof pitch	0.028
R-38	Advance framing[c]	0.026
R-49	Conventional framing	0.025
R-49	=>8/12 roof pitch	0.024
R-49	Advance framing[c]	0.020

VAULTED CEILINGS[a]		
Insulation	Type	U-Factor
R-21	Rafter framings	0.047
R-30	Rafter framing	0.033
R-38	Rafter framing	0.027
R-21	Scissors truss	0.055
R-30	Scissors truss	0.046
R-38	Scissors truss	0.042
R-49	Scissors truss	0.039
R-30	Advance scissors truss[c]	0.032
R-38	Advance scissors truss[c]	0.026
R-49	Advance scissors truss[c]	0.020

EPS FOAM CORE PANEL VAULTED CEILINGS		
Insulation	Type	U-Factor
R-29	8-1/4" EPS foam core panel	0.037
R-37	10-1/4" EPS foam core panel	0.030
R-44	12-1/4" EPS foam core panel	0.025

FLOORS[a]		
Insulation	Type	U-Factor
R-21	Underfloor	0.035
R-25	Underfloor	0.032
R-30	Underfloor	0.028

SLAB-ON-GRADE		
Insulation	Type	F-Factor[f]
R-10	Slab edge	0.54
R-15	Slab edge	0.52

EPS FOAM CORE PANEL EXTERIOR WALLS		
Insulation	Type	U-Factor
R-14.88	4-1/2" EPS foam core panel	0.065
R-22.58	6-1/4" EPS foam core panel	0.045
R-29.31	8-1/4" EPS foam core panel	0.035

EXTERIOR WALLS[a]			
Insulation	Insulation Sheathing	Framing	U-Factor
R-15	0	Conventional framing	0.080
R-15	0	Intermediate framing[b]	0.075
R-19	0	Conventional framing	0.065
R-19	0	Intermediate framing[b]	0.063
R-19	0	Advance framing[d]	0.061
R-21	0	Conventional framing	0.060
R-21	0	Intermediate framing[b]	0.058
R-21	0	Advance framing[d]	0.055
R-11	3.5[e]	Conventional framing	0.069
R-11	5[e]	Conventional framing	0.063
R-11	7[e]	Conventional framing	0.055
R-11	3.5[e]	Advance framing[d]	0.067
R-11	5[e]	Advance framing[d]	0.061
R-11	7[e]	Advance framing[d]	0.054
R-13	3.5[e]	Conventional framing	0.064
R-13	5[e]	Conventional framing	0.058
R-13	7[e]	Conventional framing	0.052
R-13	3.5[e]	Advance framing[d]	0.062
R-13	5[e]	Advance framing[d]	0.056
R-13	7[e]	Advance framing[d]	0.050
R-15	3.5[e]	Conventional framing	0.060
R-15	5[e]	Conventional framing	0.055
R-15	7[e]	Conventional framing	0.049
R-15	3.5[e]	Advance framing[d]	0.057
R-15	5[e]	Advance framing[d]	0.052
R-15	7[e]	Advance framing[d]	0.047
R-19	3.5[e]	Conventional framing	0.052
R-19	5[e]	Conventional framing	0.047
R-19	7[e]	Conventional framing	0.043
R-19	3.5[e]	Advance framing[d]	0.049
R-19	5[e]	Advance framing[d]	0.045
R-19	7[e]	Advance framing[d]	0.041
R-21	3.5[e]	Conventional framing	0.048
R-21	5[e]	Conventional framing	0.044
R-21	7[e]	Conventional framing	0.040
R-21	3.5[e]	Advance framing[d]	0.044
R-21	5[e]	Advance framing[d]	0.042
R-21	7[e]	Advance framing[d]	0.038

TABLE N1104.1(2) — APPROVED DEFAULT U-FACTORS

[a] *U*-factors are for wood frame construction. *U*-factors for other assemblies, which include steel framing, brick or other masonry, stucco, etc., shall be calculated using standard ASHRAE procedures.

[b] Intermediate framing consists of wall studs placed at a minimum 16 inches on-center with insulated headers. Voids in headers shall be insulated with rigid insulation having a minimum R-value of 4 per one-inch (w/m^3-k) thickness.

[c] Advanced framing construction for ceilings as defined in Section 1104.6

[d] Advanced framing construction for walls as defined in Section 1104.5.1

[e] Insulation sheathing shall be rigid insulation material, installed continuously over entire exterior or interior of wall (excluding partition walls).

[f] *F*-Factor is heat loss coefficient in Btu/hr/ºF per lineal foot of concrete slab perimeter.

Example 1
Builder trades window performance against underfloor insulation

Heated Floor Area | *Skylight Area* | $\frac{16}{2301} = 0.006\%$
Slab 674 | *Floor Area* |
Crawl 1627 |
Total 2301 Ft^2

More efficient windows make it possible to decrease floor insulation.

TABLE N1104.1(1)
RESIDENTIAL THERMAL PERFORMANCE CALCULATIONS

Example 1 BUILDING COMPONENTS [b]	Standard base case [a]			Proposed alternative			
	Areas [c]	U-factor	Areas x U	R-value[d]	Areas[c]	U-factor [e]	Areas x U
Flat ceilings	1965	0.031	60.91	R-38	1965	0.031	60.91
Vaulted ceilings [f]	407	0.042	17.09	R-38	407	0.042	17.09
Conventional wood-framed walls	1754	0.060	105.24	R-21	1754	0.060	105.24
Underfloor	1627	0.028	45.56	R-25	1627	0.032	52.06
Slab edge	117'	(perimeter ft. =) F=0.52 [g]	60.84	R-15	117'	0.52	60.84
Windows	287	0.35	100.45	-	287	0.32	91.84
Skylights <2%[h]	16	0.75	12.0	-	16	0.75	12.0
Skylights >2%[h]		0.60					
Exterior doors [i]	17	0.20	3.4	Insul	17	0.20	3.4
Doors with >2.5 ft^2 glazing	40	0.40	16.0	-	40	0.40	16.0
		CODE UA =	421.49			Proposed UA [j] =	419.38

Example 2
Home exceeds prescriptive R-30 vault area limit

Floor Area = 2301   Flat Ceiling = 857
Vault (Gross) = 1463 Skylights = 16
Allowable Vault 2301 X .5=1151 Ft² (Note max=50% of floor area)
Net Vault = Gross Vault 1463 - Skylights 16 = 1447
Excess Vault as Flat Ceiling: Net Vault 1477 - Allowable Vault 1151 = 296 Vault as Flat Ceiling

When R-38 vault area exceeds 50 percent of the floor area, enter vault in excess of 50 percent as flat ceiling for Standard base case.

TABLE N1104.1(1)
RESIDENTIAL THERMAL PERFORMANCE CALCULATIONS

BUILDING COMPONENTS [b]	Standard base case [a]			Proposed alternative			
	Areas [c]	U-factor	Areas x U	R-value[d]	Areas[c]	U-factor [e]	Areas x U
Flat ceilings	857 + 296	0.031	35.76	R-49 Std	857	0.025	21.43
Vaulted ceilings [f]	1151	0.042	48.32	R-38	1447	0.042	60.77
Conventional wood-framed walls	2447	0.060	146.82	R-21	2497	0.060	146.82
Underfloor	1627	0.028	45.56	R-30	1627	0.028	45.56
Slab edge	117	(perimeter ft. =) F=0.52 [g]	60.84	R-15	117	0.52	60.84
Windows	287	0.35	100.45	-	287	0.35	100.45
Skylights <2%[h]	16	0.75	12.00	-	16	0.75	12.00
Skylights >2%[h]		0.60					
Exterior doors [i]	17	0.20	3.40	Insul	17	0.20	3.40
Doors with >2.5 ft² glazing	40	0.40	16.00	-	40	0.40	16.00
		CODE UA =	469.15			Proposed UA [j] =	465.16

Example 3
Home exceeds R-30 vault and 2 percent skylight limit

Actual Skylight Area: 48 Ft 2 Allowable Skylight Area 2301 X .02 = 46 Ft²
1463 Gross Vault - 48 Skylight 1415 Net Value
1415 - 1151 264 Excess Vault Area to Flat Ceiling
48 Actual Skylight - 46 Allowed 2 Ft to Window

Enter excess R-30 vault as flat ceiling and excess skylight area as window for Standard base case.

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	Areas [c]	U-factor	Areas x U	R-value[d]	Areas[c]	U-factor [e]	Areas x U
Flat ceilings	857 + 264	0.031	34.77	R-49 std.	857	0.025	21.43
Vaulted ceilings [f]	1151	0.042	48.32	R-38	1415	0.042	59.43
Conventional wood-framed walls	2447	0.060	146.82	R-21	2447	0.060	146.82
Underfloor	1627	0.028	45.56	R-30	1627	0.028	45.56
Slab edge	117	(perimeter ft. =) F=0.52 [g]	60.84	R-15	117	0.52	60.84
Windows	287	0.35	100.45	-	287	0.35	100.45
Skylights <2%[h]	46	0.75	34.5	-	48	0.75	36.0
Skylights >2%[h]	2	0.60	1.2	-			
Exterior doors [i]	17	0.20	3.4	-	17	0.20	3.4
Doors with >2.5 ft² glazing	40	0.40	16.0	-	40	0.40	16.0
		CODE UA =	491.85			Proposed UA [j] =	489.93

Example 4
Exterior wood door is 40 ft² and exceeds 28 ft² feet allowance

Actual Wood Door is 40 Ft²
Door Area Qualifying as Exempt 28 Ft²
Excess Area to Exterior Door: 40 − 28 = 12 Ft²

When an exterior door area exceeds 28 square feet and the door is wood, enter excess area as exterior door for Standard base case.

TABLE N1104.1(1)
RESIDENTIAL THERMAL PERFORMANCE CALCULATIONS

BUILDING COMPONENTS [b]	Standard base case [a]			Proposed alternative			
	Areas [c]	U-factor	Areas x U	R-value [d]	Areas [c]	U-factor [e]	Areas x U
Flat ceilings	1965	0.031	60.92	R-38	1965	0.031	60.92
Vaulted ceilings [f]	407	0.042	17.09	R-38	407	0.042	17.09
Conventional wood-framed walls	1734	0.060	104.04	R-21	1734	0.060	104.04
Underfloor	1627	0.028	45.56	R-30	1627	0.028	45.56
Slab edge	117	(perimeter ft. =) F=0.52 [g]	60.84	R-15	117	0.52	60.84
Windows	287	0.35	130.8	-	287	0.32	91.8
Skylights <2% [h]	16	0.75	8.0	-	16	0.75	8.0
Skylights >2% [h]		0.60					
Exterior doors [i]	17+12	0.20	5.80	Insul Wood	17 / 12	0.20 / 0.54	3.4 / 6.48
Doors with >2.5 ft² glazing	40	0.40	16.0	-	40	0.40	16.0
		CODE UA =	422.70			Proposed UA [j] =	418.17

Example 5
House with untested door sidelight

Untested Sidelight 12 Ft²
Default U-Value = 0.54 (Wood Frame, 1/2" Air Space, Clear Glass)

Use the default U-value for an untested door sidelight for the Proposed Alternate.

TABLE N1104.1(1)
RESIDENTIAL THERMAL PERFORMANCE CALCULATIONS

BUILDING COMPONENTS [b]	Standard base case [a]			Proposed alternative			
	Areas [c]	U-factor	Areas x U	R-value [d]	Areas [c]	U-factor [e]	Areas x U
Flat ceilings	1965	0.031	60.92	R-38	1965	0.031	60.92
Vaulted ceilings [f]	407	0.042	17.09	R-38	407	0.042	17.09
Conventional wood-framed walls	1754	0.060	105.24	R-21	1754	0.060	105.24
Underfloor	1627	0.028	45.56	R-30	1627	0.028	45.56
Slab edge	117	(perimeter ft. =) F=0.52 [g]	60.84	R-15	117	0.52	60.84
Windows	275+12	0.35	100.45	- / -	275 / 12	0.34 / 0.54	93.50 / 6.48
Skylights <2% [h]	16	0.75	12.0	-	16	0.75	12.0
Skylights >2% [h]		0.60					
Exterior doors [i]	17	0.20	3.4	-	17	0.20	3.4
Doors with >2.5 ft² glazing	40	0.40	16.0	-	40	0.40	16.0
		CODE UA =	421.50			Proposed UA [j] =	421.03

Example 6
How to incorporate Additional Measure 3 in Standard base case

PROPOSED CONSTRUCTION   *Modified Standard base case when*
Flat Ceiling Construction/R-value   *Raised-Heel Truss, R-38*   *Additional Measure 3 is selected*
Vaulted Ceiling Construction/R-value   *Raised-Heel Scissors Truss, R-38*
Exterior Walls Construction/R-value   *2x6 Advance Framed, R-19 w/R-5 rigid exterior*
Window U-Factor   *U-0.32*

TABLE N1104.1(1)
RESIDENTIAL THERMAL PERFORMANCE CALCULATIONS

BUILDING COMPONENTS [b]	Standard base case [a]			Proposed alternative			
	Areas [c]	U-factor	Areas x U	R-value[d]	Areas[c]	U-factor [e]	Areas x U
Flat ceilings	1965	0.025	49.13	R-38A	1965	0.026	51.09
Vaulted ceilings [f]	407	0.033	13.13	R-38A	407	0.026	10.58
Conventional wood-framed walls	1754	0.047	82.44	R-24A	1754	0.045	78.93
Underfloor	1627	0.028	45.56	R-30	1627	0.028	45.56
Slab edge	117'	(perimeter ft. =) F=0.52 [g]	60.84	R-15	117'	0.52	60.84
Windows	287	0.32	91.84	-	287	0.32	91.84
Skylights <2%[h]	16	0.75	12.0	-	16	0.75	12.0
Skylights >2%[h]		0.60					
Exterior doors [i]	17	0.20	3.4	Insul	17	0.20	3.4
Doors with >2.5 ft² glazing	40	0.40	16.0	-	40	0.40	16.0
		CODE UA =	374.63			Proposed UA [j] =	370.24

Example 7
How to incorporate Additional Measure 5 in Standard base case

PROPOSED CONSTRUCTION   *Modified Standard base case when*
Flat Ceiling Construction/R-value   *Raised-Heel Truss, R-38*   *Additional Measure 5 is selected*
Vaulted Ceiling Construction/R-value   *Raised-Heel Scissors Truss, R-38*
Window U-Factor   *U-0.32*

TABLE N1104.1(1)
RESIDENTIAL THERMAL PERFORMANCE CALCULATIONS

BUILDING COMPONENTS [b]	Standard base case [a]			Proposed alternative			
	Areas [c]	U-factor	Areas x U	R-value[d]	Areas[c]	U-factor [e]	Areas x U
Flat ceilings	1965	0.025	49.13	R-38A	1965	0.026	51.09
Vaulted ceilings [f]	407	0.033	13.43	R-38A	407	0.026	10.58
Conventional wood-framed walls	1754	0.060	105.24	R-21	1754	0.060	105.24
Underfloor	1627	0.028	45.56	R-30	1627	0.028	45.56
Slab edge	117'	(perimeter ft. =) F=0.52 [g]	60.84	R-15	117'	0.52	60.84
Windows	287	0.32	91.84	-	287	0.32	91.84
Skylights <2%[h]	16	0.75	12.0	-	16	0.75	12.0
Skylights >2%[h]		0.60					
Exterior doors [i]	17	0.20	3.4	Insul	17	0.20	3.4
Doors with >2.5 ft² glazing	40	0.40	16.0	-	40	0.40	16.0
		CODE UA =	397.43			Proposed UA [j] =	396.55

Building Codes Division

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