Simplified Prescriptive Options in the Texas Residential Building Energy Code Make Compliance Easy

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Texas recently adopted the 2000 International Residential Code ("IRC") energy chapter and the 2000 International Energy Conservation Code ("IECC") as its residential building energy code for new construction and existing homes.

The range of code compliance options in the new Texas code spans from simplified prescriptive methods on one end to more complex performance (whole building) methods on the other.

This paper addresses how energy code compliance is much simpler through the use of simplified, easy-to-follow prescriptive compliance options, particularly in a state like Texas, which historically has had no uniform building codes. This paper also provides samples of simplified prescriptive energy code compliance aids that could make it easier for energy code compliance in Texas.

I. INTRODUCTION AND BACKGROUND

Historically, because Texas is a home-rule state, building codes and their enforcement have been exclusively in the hands of local municipal officials. However, in 2001, the Texas Legislature, with the encouragement of Texas builders, manufacturers and energy efficiency advocates, took a bold step by crafting legislation to implement a uniform building code and building energy code statewide. The two key pieces of building codes legislation passed by the legislature and signed by Governor Perry were Senate Bills 5 and 365.[1]

SB 5 adopted the energy efficiency chapter of the IRC and the IECC, respectively, as the residential and commercial building energy codes for the entire state of Texas. Senate Bill 365 adopted the IRC as a comprehensive residential building code (including energy) for all municipalities in Texas. This paper focuses on the residential energy provisions of the IECC and IRC, only. These codes are now in effect in Texas, however, implementation and enforcement of them has only just begun.

With the adoption of any new comprehensive statute, the mind-set of those who must meet it can be the most important aspect of any successful change in law or policy. One of the keys to a smooth transition when such a huge statutory leap is made is the ease at which implementation can be achieved through simple, yet flexible compliance options. The simplified prescriptive residential compliance options in the Texas building energy code are the most straightforward and easiest-to-follow compliance options. Additional compliance tools building upon the simplified prescriptive tables in the codes have also been developed, namely the "Texas Residential Building Guide to Energy Code Compliance" recently published by the Texas A&M Energy Systems Lab ("ESL"), which make code compliance even simpler. The simplified prescriptive tables and the Texas A&M Guide are very user-friendly because most building envelope components (windows and insulation) are clearly labeled with their energy performance ratings (scores of windows are labeled with ratings according to the National Fenestration Rating Council ("NFRC") procedures and most insulation products are branded with their R-values).[2] These readily available product ratings can be easily matched up against the line-by-line prescriptive criteria in the codes and the ESL Guide. While there are many different compliance options in the IRC and

[1] The new legislation retains local enforcement and makes allowances for limited local amendments to the Codes. *See* Health and Safety Code, Sec. 388.003(d) and (e).

[2] "U-factor and "R-value" are measures of the resistance of a glazing, insulating material, or fenestration assembly to heat flow. U-factor is the inverse of R-value (R=1/U) and is expressed in units of Btu/hr-sq ft-°F; R-value is expressed in units of hr-sq.ft.-°F/Btu. As an example, a low U-factor window has a greater resistance to heat flow and a higher insulating value than one with a high U-factor. *See* CARMODY, ET AL., RESIDENTIAL WINDOWS: A GUIDE TO NEW TECHNOLOGIES AND ENERGY PERFORMANCE (2nd Ed. 2000).

IECC, simplified tools like the ESL Guide will be the keys to successful energy code implementation in Texas.

I. Texas Building Energy Efficiency Code. The 2000 IRC & 2000 IECC

The IRC and the IECC are consistent with one another and together contain several different methods (or paths) to comply with the new Texas building energy code for all new and existing structures, including the construction of, addition to, replacement, alteration, or repair performed on the structure. While many of the IECC's compliance options are mentioned below, this paper focuses on the importance of a simplified prescriptive package to successful code implementation.

A. Building Energy Efficiency Requirements for New Homes.

The amount of glazing in a home is one of the primary drivers to the code's energy performance requirements. A simple glazing area calculation is necessary to determine which set of prescriptive code requirements to follow. The IRC energy chapter is a simplified energy code that provides a single set of prescriptive criteria for homes built with a glazing area at or below 15% of the home's wall area (25% for townhomes), whereas, the IECC provides greater flexibility, with prescriptive tables up to 25% (30% for townhomes).

To perform the required "glazing area" calculation under the IRC and IECC (also known as "window-to-wall area"), the area of all the rough openings in the walls of the home where glazing will be installed (glazing area) is added up, then divided by the total area of the exterior walls in the home (gross wall area):

$$\frac{\text{Glazing Area (sq.ft.)}}{\text{Gross Wall Area (sq.ft.)}} = \text{Glazing Area \%}$$

Under the IRC, builders always have the option of following the various additional prescriptive and performance compliance paths under the IECC, regardless of the amount of window area in the home. However, if the home has greater than 15% glazing area, builders **must** use the IECC:

IRC § N1101.2.1 Residential buildings, Type A-1. Compliance shall be demonstrated by either:

1. Meeting the requirements of this chapter for buildings with a glazing area that does not exceed 15 percent of the gross area of exterior walls; or

2. Meeting the requirements of the *International Energy Conservation Code* for residential buildings, Type A-1.

IRC § N1102.1 Thermal performance criteria.

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Residential buildings, Type A-1, with greater than 15-percent glazing area; residential buildings, Type A-2, with greater than 25-percent glazing area; and any residential building in climates with HDD equal to or greater than 13,000 shall determine compliance using the building envelope requirements of the *International Energy Conservation Code*.

For those instances where a builder either chooses to use the IECC, or has no choice but to use the IECC because of a higher glazing area, the IECC contains additional prescriptive tables for window area up to 25%. In addition, Chapter 5 of the IECC has other envelope component compliance options, or a builder may use the whole building performance compliance approach in Chapter 4. While the Chapter 5 prescriptive compliance paths are the most widely used, the next sections briefly describe the other code compliance options.

1. Residential Building Design by Systems Analysis: IECC Chapter 4.

The most complex compliance option under the IRC and IECC is the systems analysis approach in IECC Chapter Four. This approach requires that the proposed building design be analyzed for annual energy usage compared against a "standard design" home that meets minimum code requirements.[3] A complex set of calculations must be made to the satisfaction of a code official that compares the overall performance of materials and designs of a Proposed Design to the criteria established for a

[3] Sec. 402.1.1, 2000 IECC, Chapter 4.

similar Standard Design building. A side-by-side comparison of the bottom lines of the two buildings will determine whether a Proposed Design is acceptable when compared to the Standard Design.

As a practical matter, this approach requires the use of computer modeling and simulation in order to achieve the energy efficiency goals mandated by the IECC. The systems analysis approach has been included in the national model code for many years, dating back to the early Model Energy Codes, but, in part due to its complexity, it is rarely used.

2. The Component Performance Compliance Approaches in IECC Chapter 5.

Chapter Five of the IECC contains a series of "component performance" approaches, which range in difficulty from a series of complex equations and charts of overall thermal transmittance to a series of simplified tables with requirements that can be met by following straightforward windows and insulation product performance labels.

Under the "compliance by performance on an individual component basis" approach (IECC Section 502.2.1), the builder or designer must, for example, determine the compliance of a particular wall divorced from the remainder of the building and do so for each remaining wall. After compliance is reached for each exterior wall, the remainder of the building envelope requires the same piece-by-piece examination. The "compliance by total building envelope performance" (Section 502.2.2) and "compliance by acceptable practice on an individual component basis" (Section 502.2.3) options in the IECC are similarly complex. Like the systems analysis approach, these compliance options are rarely used in practice.

3. The IRC and IECC Prescriptive Performance Requirements.

Despite not being widely used, the systems analysis and the component performance approaches mentioned previously are essential to the code because they offer flexibility in design and building practices, which make the IRC and IECC a truly comprehensive set of codes. However, for the vast majority of builders and code enforcement officials, the easy-to-follow prescriptive performance criteria in the IRC and IECC are the most useful compliance options.

Over the years, the IECC has become much more user-friendly as a result of repeated requests by the building industry and code enforcement officials for simplicity. This persistence resulted in the development of the simplified prescriptive compliance options in the IRC Energy Efficiency Chapter and in the IECC.

Chapters five and six of the IECC and chapter eleven of the IRC contain a series of tables providing builders and designers with options that cover each climate zone in the US. (Texas is made up of nine different climate zones ranging from 500 through 4,500 heating degree-days.) These tables list, line-by-line, maximum window and insulation requirements depending upon: (1) where the house is located, *i.e.*, which "climate zone"; and (2) the quantity of windows installed in the house, *i.e.*, the "glazing area." Insulation product R-values for most products are stamped directly on the facing or packaging materials of the insulation (sheathing, batts, vapor barrier, etc.). For windows, glass doors and skylights, labels certified through the NFRC process provide the appropriate energy performance values.

A sample NFRC label looks like this:[4]

As you can see, the window U-factor,[5] SHGC,[6] and air leakage performance values are clearly marked on

[4] An improved, even more simplified NFRC label is expected to be introduced in 2003.

[5] See note 2 above for a definition of "U-factor".

[6] "SHGC," or "Solar Heat Gain Coefficient" is the fraction of solar radiation admitted through a

the label and can be easily matched up against the code's prescriptive requirements.

Table 1 is an excerpt from the IRC and IECC simplified energy chapters and is limited to 15% maximum glazing area (for glazing area greater than 15%, the IECC contains additional tables in this same format, but the performance requirements are more stringent to offset the higher glazing area). To comply with this table, builders simply need to match the window U-factors and SHGCs from the NFRC label and the labeled R-values on the insulation with the values from the appropriate line of the table for the city or county where the construction is taking place. Beyond these prescriptive values, other basic requirements must also be met, including requirements for HVAC systems, air leakage rates for windows, duct insulation and sealing, caulking and sealing all penetrations in the envelope, and vapor barriers, to name a few. These are found in various sections of the code. Some code compliance tools spell-out these basic requirements making it easier for the user to follow them (see below for a discussion of the Texas A&M ESL Residential Building Guide).

As an example, if a slab home is being built in Dallas (roughly 2,400 HDD), under the IRC/IECC, in addition to meeting the basic requirements, the builder will comply with the code if they install windows labeled with U-factors less than 0.65; SHGCs less than 0.40; R-30 or greater insulation in the ceilings; and R-13 or greater insulation in the walls.

B. Building Energy Efficiency Requirements for Additions to Existing Homes and Replacement Windows.

Even easier than the IRC and IECC simplified prescriptive requirements for new homes is the short table for additions and replacement windows in Chapter 5 of the IECC. (The IECC is the first, national model building energy code to adopt energy efficiency standards for replacement windows.) The IRC also specifies the same energy efficiency requirements for existing homes, which includes additions, alterations, and replacement windows.

1. IRC/IECC Requirements for Additions.

Home additions may either (i) meet the same criteria under the IRC or IECC that is in place for new homes; or (ii) if the addition is less than 500 sq.ft. and less than 40% glazing, a builder has the option of complying with the code by following a simplified, easy-to-follow prescriptive table of envelope requirements found in the IECC (Table 502.2.5).

2. IRC/IECC Requirements for Replacement Windows.

All windows installed as replacements in Texas must meet the prescriptive U-factor criteria in IECC Table 502.2.5, they must meet the IRC's air leakage requirement for glazing (0.30 cfm/sq.ft.), and, if the climate zone is less than 3,500 HDD, replacement windows must also have SHGCs less than 0.40. The Additions/Replacements table is incorporated by reference in the IRC:

> **IRC § N1102.4 Replacement Fenestration.** Where an entire fenestration product, including frame sash and glazed portion, is being replaced in an existing building, the replacement fenestration product shall have a U-factor that does not exceed the "Maximum Fenestration U-factor" in Table 502.2.5 of the 2000 International Energy Conservation Code applicable to the climate zone (HDD) where the building is located. Replacement skylights and roof windows shall be permitted to have a maximum U-factor of 0.50 when installed in any location above 1,999 HDD. The replacement fenestration products must also satisfy the SHGC and air leakage requirements of Sections N1102.2 and N1101.3.2.2, respectively.

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window or skylight, both directly transmitted, and absorbed and subsequently released inward. The SHGC has replaced the shading coefficient as the standard of a window's shading ability. It is expressed as a number between 0 and 1. The lower a window's SHGC, the less solar heat it transmits, and the greater its shading ability. SHGC ratings refer to the entire window assembly. (For more information on product SHGC, refer to the CARMODY book referenced in note 2 above.)

TABLE 1

2000 INTERNATIONAL RESIDENTIAL CODE & INTERNATIONAL ENERGY CONSERVATION CODE IN TEXAS

SIMPLIFIED PRESCRIPTIVE BUILDING ENVELOPE CRITERIA

(Table N1102.1 (IRC) & Table 602.1 (IECC))

Texas Heating Degree Days	MAXIMUM		MINIMUM INSULATION R-VALUE					
	Glazing U-factor	Glazing SHGC	Ceilings	Walls	Floors	Basement Walls	Slab Perimeter	Crawl Space Walls
500 – 999	0.90	0.40	R-19	R-11	R-11	R-0	R-0	R-4
1,000 – 1,499	0.75	0.40	R-19	R-11	R-11	R-0	R-0	R-5
1,500 – 1,999	0.75	0.40	R-26	R-13	R-11	R-5	R-0	R-5
2,000 – 2,499	0.65	0.40	R-30	R-13	R-11	R-5	R-0	R-6
2,500 – 2,999	0.60	0.40	R-30	R-13	R-19	R-6	R-4, 2 ft.	R-7
3,000 – 3,499	0.55	0.40	R-30	R-13	R-19	R-7	R-4, 2 ft.	R-8
3,500 – 3,999	0.50	Any	R-30	R-13	R-19	R-8	R-5, 2 ft.	R-10
4,000 – 4,499	0.45	Any	R-38	R-13	R-19	R-8	R-5, 2ft.	R-11

Table 2 is an excerpt containing the relevant portions of the prescriptive requirements that apply to additions, alterations and replacement windows for existing homes in Texas:

TABLE 2

PRESCRIPTIVE ENVELOPE COMPONENT CRITERIA FOR TEXAS APPLICABLE IN ADDITIONS TO AND REPLACEMENT WINDOWS FOR EXISTING RESIDENTIAL BUILDINGS

(From Table 502.2.5)

Texas Heating Degree Days	MAXIMUM		MINIMUM INSULATION R-VALUE					
	Glazing U-factor	Glazing SHGC	Ceiling	Wall	Floor	Basement Wall	Slab perimeter	Crawl space wall
0 – 1,999	0.75	0.40	R-26	R-13	R-11	R-5	R-0	R-5
2,000 – 3,500	0.5	0.40	R-30	R-13	R-19	R-8	R-5, 2ft.	R-10
3,501 – 3,999	0.5	Any	R-30	R-13	R-19	R-8	R-5, 2ft.	R-10
4,000 – 5,999	0.4	Any	R-38	R-18	R-21	R-10	R-9, 2ft.	R-19

II. CODE COMPLIANCE TOOLS

A. Texas A&M University Residential Building Guide to Energy Code Compliance.

Despite the vast improvement and simplification of the IECC and IRC through the addition of the simplified prescriptive tables, the IECC codebook is still 200 pages long, and at first glance, might appear overwhelming to a builder, designer, or code official. That is why code compliance tools that reduce the entire code down to just a few short pages are critical to successful code implementation. The simplified IRC energy chapter and Chapter 6 of the IECC are a good start because they boil down the code to four or five pages. However, an even more useful and practical compliance tool is one that can be compiled on just one sheet of paper and will withstand the rigors of the job site – or the dashboard of a builder's truck.

In SB 5, the Texas Legislature directed the Energy Systems Lab at Texas A&M to provide educational materials to the building and construction community.[7] In that regard, as mentioned in the Introduction to this paper, the ESL has recently published a very useful homebuilding guide called the "Texas Residential Building Guide to Energy Code Compliance." While the simplified prescriptive

[7] Health and Safety Code, Sec. 388.007.

tables in the IRC and IECC are fairly straightforward already, they have been further simplified in the ESL Guide and the various basic requirements, which are scattered throughout the codes, are compiled in one straightforward section of the Guide. What is most intriguing about the Guide is that the entire IRC/IECC is assembled on one laminated sheet, which we think will be very useful to builders.

To cover the wide range of home designs built in Texas, the ESL has selected the 15%, 20% and 25% glazing area prescriptive packages and coordinated them with a map of Texas illustrating the counties by color according to HDD zones. A copy of this Guide is included as **Appendix A**.

The Guide's many notations and footnotes provide exceptions and explanations where necessary to answer many of the questions that may arise as designers and builders become more familiar with the 2000 IECC and IRC. When considering the volume of information and technical language of the 2000 IECC and IRC, the Guide removes the intimidation factor that these documents could present to builders, designers, legislators and the general public. Additionally, it provides information to introduce the Codes and to assist on site for compliance purposes.

B. MEC*check*™.

MEC*check*™ is another example of a simplified compliance tool for meeting the IRC and IECC in Texas. MEC*check* was developed for the US Department of Energy by the Pacific Northwest National Laboratory (PNNL). The MEC*check* program is also available free to homebuilders and contractors to assist with compliance with the energy code. MEC*check* allows homebuilders to choose from a set of pre-printed Prescriptive Packages (similar to the IRC and IECC's prescriptive tables), a "pencil and paper" Trade-off Method, or a Software Compliance Approach to comply with the code.

In the computer software method, the user inputs various envelope and equipment performance values and MEC*check* displays on the screen whether the proposed home will "Pass" or "Fail" the code requirements. We should caution the user, however, that MEC*check* does not properly address the code requirements for window solar heat gain coefficient (SHGC). MEC*check* accurately states in its compliance checklist that for most of Texas, windows must meet the IECC's 0.40 maximum SHGC requirement. However, the only way this requirement is conveyed to the user is by printing the compliance report generated by MEC*check*. The MEC*check* computer input screens do not require the user to input SHGC values for windows. This is a problem for many reasons. For one, the code allows users to calculate an "area-weighted average" fenestration SHGC, which means that builders could install windows with higher than 0.40 SHGCs in some areas (possibly for decorative glazing), so long as the overall fenestration SHGC on a weighted average basis is less than 0.40. Without a way to input SHGC, builders using the computer software will have to do the SHGC area-weighted average calculation by hand.

Also, by not requiring the user to input fenestration SHGC, the MEC*check* "pass/fail" grade is not contingent on the window SHGC values to determine code compliance, but it certainly should be. MEC*check* simply relies on the line in the compliance checklist that informs users when the 0.40 SHGC requirement must be met. Thus, a builder or contractor who relies simply on the MEC*check* pass/fail screen will be misled, and worse, may not install the fenestration required by the code, causing problems during inspection and code enforcement. These problems have been reported to the Department of Energy and hopefully will be resolved soon.

III. CONCLUSION

As stated above, often one of the greatest difficulties associated with the implementation of any statutory revision is the mind-set of those faced with the challenge of complying with and enforcing the code. Useful compliance options are also another barrier to effective code implementation.

Familiarization with the prescriptive paths contained in the Texas residential building energy code and especially the Texas A&M-ESL Residential Building Guide are the first steps towards getting those in the Texas building industry accustomed to the new energy codes. These simplified tools are presented in a way for builders to quickly and easily determine what is necessary to meet the codes. Hopefully, as these simplified tools are introduced and put into practice, the Texas building energy efficiency code will be widely followed and accepted throughout the state.

Texas Residential Building Guide to Energy Code Compliance

International Residential Code (IRC 2000) and International Energy Conservation Code (IECC 2000) as of May 1, 2001

Texas Edition 2001, Revision 1.04

Using This Guide

This guide contains eight color-coded climate zones (numbers 2 through 9) designed to simplify determination of the envelope requirements of the International Residential Code (IRC 2000, Chapter 11) or the International Energy Conservation Code (IECC 2000) for Texas. Refer to the IRC 2000 or IECC 2000, as amended by the 2001 Supplement, for a complete description of all the requirements and compliance alternatives. Local requirements may also vary. Each county is assigned to one of the eight zones, which vary according to the different climate zones in Texas.

Step-by-Step Instructions

A. Use the color-coded map to locate the county in which the construction or remodeling is taking place and find the climate zone (2 through 9) associated with that county.

B. Use the "Table of Building Envelope Requirements" (on the back of this sheet) to find the set of construction options or "paths" associated with the climate zone selected above. Each path describes an acceptable combination of envelope components based on percent glazed area.

C. Review the paths and select the one most suited to your project.

D. Construct or remodel the building according to the selected path and comply with basic code requirements, which include:

- Installing components to Mfr specifications
- Documenting load calculations to insure properly sized HVAC equipment
- Meeting minimum equipment efficiency requirements for HVAC, water heating and other fixtures (Tables 503.2 and 504.2 of IECC)
- Providing preventative maintenance manuals
- Installing temperature controls
- Limiting window and door leakage
- Caulking or sealing joints, gaps and penetrations
- Installing vapor retarders where required
- Sealing and insulating ducts (No duct tape allowed)
- Insulating pipes properly

Texas Counties by Climate Zones

Use the color-coded map of Texas to locate a county. The reverse side of this form shows three prescriptive paths for the selected Climate Zone.

9 — 4,000 - 4,499 HDD

Armstrong	Hansford	Oldham
Bailey	Hartley	Parmer
Carson	Hemphill	Potter
Castro	Hutchinson	Randall
Dallam	Lipscomb	Roberts
Deaf Smith	Moore	Sherman
Gray	Ochiltree	Wheeler

8 — 3,500 - 3,999 HDD

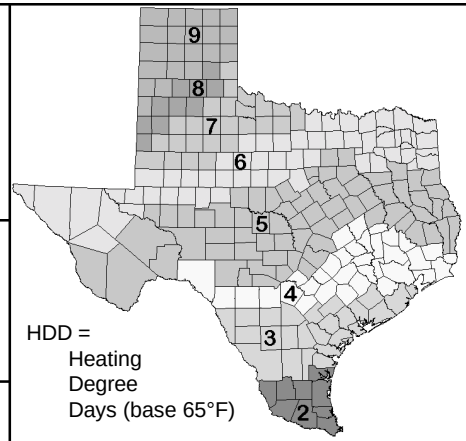
Briscoe	Hall
Cochran	Hockley
Donley	Lamb
Floyd	Swisher
Hale	Yoakum

7 — 3,000 - 3,499 HDD

Archer	Dickens	Lynn
Baylor	Foard	Motley
Borden	Gaines	Scurry
Childress	Garza	Stonewall
Clay	Hardeman	Terry
Collingsworth	Kent	Wichita
Cottle	King	Wibarger
Crosby	Knox	
Dawson	Lubbock	

6 — 2,500 - 2,999 HDD

Andrews	Gregg	Palo Pinto
Bowie	Harrison	Parker
Callahan	Haskell	Rains
Camp	Hopkins	Red River
Cass	Howard	Reeves
Coke	Hudspeth	Rockwall
Collin	Hunt	Shackelford
Cooke	Jack	Stephens
Culberson	Jeff Davis	Sterling
Delta	Jones	Taylor
Denton	Kaufman	Throckmorton
Eastland	Lamar	Titus
Ector	Loving	Upshur
El Paso	Marion	Van Zandt
Erath	Martin	Ward
Fannin	Midland	Winkler
Fisher	Mitchell	Wise
Franklin	Montague	Wood
Glasscock	Morris	Young
Grayson	Nolan	



5 — 2,000 - 2,499 HDD

Anderson	Henderson	Pecos
Angelina	Hill	Polk
Bandera	Hood	Presidio
Bell	Houston	Reagan
Blanco	Irion	Real
Bosque	Jasper	Runnels
Brewster	Johnson	Rusk
Brown	Kendall	Sabine
Burnet	Kerr	San Augustine
Cherokee	Kimble	San Saba
Coleman	Lampasas	Schleicher
Comanche	Leon	Shelby
Concho	Limestone	Smith
Coryell	Llano	Somervell
Crane	Mason	Sutton
Crockett	McCulloch	Tarrant
Dallas	McLennan	Terrell
Edwards	Menard	Tom Green
Ellis	Mills	Travis
Falls	Nacogdoches	Trinity
Freestone	Navarro	Tyler
Gillespie	Newton	Upton
Hamilton	Panola	Williamson
Hays		

4 — 1,500 - 1,999 HDD

Austin	Grimes	Milam
Bastrop	Guadalupe	Montgomery
Bexar	Hardin	Orange
Brazos	Harris	Robertson
Burleson	Jefferson	San Jacinto
Caldwell	Kinney	Uvalde
Chambers	Lavaca	Val Verde
Colorado	Lee	Walker
Comal	Liberty	Waller
Fayette	Madison	Washington
Fort Bend	Medina	Wilson
Gonzales		

3 — 1,000 - 1,499 HDD

Aransas	Galveston	McMullen
Atascosa	Goliad	Nueces
Bee	Jackson	Refugio
Brazoria	Jim Wells	San Patricio
Calhoun	Karnes	Victoria
DeWitt	La Salle	Webb
Dimmit	Live Oak	Wharton
Duval	Matagorda	Zavala
Frio	Maverick	

2 — 500 - 999 HDD

Brooks	Jim Hogg	Starr
Cameron	Kenedy	Willacy
Hidalgo	Kleberg	Zapata

Limitations

Texas recently enacted a statewide energy code. This guide provides a simplified prescriptive specification for individual envelope components to aid with code compliance. This guide does not provide a guarantee for meeting the IRC. For additional details on the IRC or IECC, refer to the code documents, consult local code officials or contact the International Code Council.

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Energy Systems Laboratory - Texas A&M University
http://eslsb5.tamu.edu Toll Free: 1-877-AnM-CODE (1-877-266-2633)

Texas Residential Building Envelope Requirements

Simplified Prescriptive Paths for Envelope Compliance with the International Residential Code (IRC 2000)

Table of Building Envelope Requirements

Climate Zone	Path	Glazing and Insulation: Glazing Area%	Glazing U-Factor	Glazing SHGC	Ceiling	Wall	Foundation Type: Basement Wall Floor	Basement Wall	Slab Perimeter	Crawl Space Wall
9	1	15	.45	[1]NR	R-38	R-13	R-19	R-8	R-5, 2ft	R-11
	2	20	.37	[1]NR	R-38	R-13	R-19	R-9	R-6, 2ft	R-13
	3	25	.37	[1]NR	R-38	R-19	R-19	R-9	R-6, 2ft	R-13
8	1	15	.50	[1]NR	R-30	R-13	R-19	R-8	R-5, 2ft	R-10
	2	20	.42	[1]NR	R-38	R-13	R-19	R-8	R-6, 2ft	R-10
	3	25	.41	[1]NR	R-38	R-19	R-19	R-8	R-6, 2ft	R-10
7	1	15	.55	.40	R-30	R-13	R-19	R-7	[2]R-4, 2ft	R-8
	2	20	.46	.40	R-38	R-13	R-19	R-7	R-0	R-8
	3	25	.45	.40	R-38	R-19	R-19	R-7	R-0	R-8
6	1	15	.60	.40	R-30	R-13	R-19	R-6	[2]R-4, 2ft	R-7
	2	20	.50	.40	R-38	R-13	R-19	R-6	R-0	R-7
	3	25	.46	.40	R-38	R-16	R-19	R-6	R-0	R-7
5	1	15	.65	.40	R-30	R-13	R-11	R-5	R-0	R-6
	2	20	.52	.40	R-38	R-13	R-11	R-5	R-0	R-6
	3	25	.50	.40	R-38	R-13	R-19	R-8	R-0	R-10
4	1	15	.75	.40	R-26	R-13	R-11	R-5	R-0	R-5
	2	20	.60	.40	R-30	R-13	R-11	R-5	R-0	R-5
	3	25	.52	.40	R-30	R-13	R-13	R-6	R-0	R-6
3	1	15	.75	.40	R-19	R-11	R-11	R-0	R-0	R-5
	2	20	.70	.40	R-30	R-13	R-11	R-0	R-0	R-5
	3	25	.55	.40	R-30	R-13	R-11	R-0	R-0	R-5
2	1	15	.90	.40	R-19	R-11	R-11	R-0	R-0	R-4
	2	20	.75	.40	R-30	R-13	R-11	R-0	R-0	R-4
	3	25	.65	.40	R-30	R-13	R-11	R-0	R-0	R-4

[1]NR means “No Requirement” specified in IECC Chapter 5 for SHGC in Zone 8 and 9.

[2]The map in IRC Figure R301.2(6) or IECC Figure 502.2(7) indicates that parts of Texas qualify as areas of "very heavy" termite infestation probability. Under an exception in the IRC, the slab perimeter insulation requirement in this path may be avoided. To make use of this exception and still comply with the Code, a builder must use IECC Section 502.2.1.4, IECC Section 502.2.4, or IECC Chapter 4, instead of this path.

Notes:

1. The Table of Building Envelope Requirements is based upon the 2000 International Residential Code (IRC), published by the International Code Council, as amended by the 2001 Supplement.
2. The IRC prescriptive requirements are applicable to single family homes with glazing areas of 15% and below. For homes designed with glazing areas greater than 15%, the IRC incorporates the International Energy Conservation Code (IECC) by reference, which contains additional prescriptive and performance-related compliance alternatives. The glazing areas for each path are maximum levels. For example, a glazing area of 22% must use Path 3, which is the path level for 25% glazing area.
3. Source of requirements: 2000 IRC, Ch. 11 (up to 15% only) and 2000 IECC, Ch. 5, Prescriptive Packages for Climate Zones 2-9, and the 2001 Supplement to IECC. IECC Chapter 4 must be used for glazing areas greater than 25%.
4. U-factor, and SHGC are **maximum** acceptable values.
5. Insulation R-values are **minimum** acceptable levels.
6. Applies to single-family, wood-frame residential construction, only. For mass wall construction, see IRC Section N1102.1.1.1; for steel-framed walls, see IRC Section N1102.1.1.2.
7. ”Glazing" refers to any translucent or transparent material in exterior openings of buildings, including windows, skylights, sliding glass doors, the glass areas of opaque doors, and glass block.
8. Fenestration product (window, door, glazing) U-factor and SHGC must be determined from a National Fenestration Rating Council (NFRC) label on the product, or obtained from default tables (IECC Table 102.5.2(3) in Chapter 1).
9. Glazing area % is the ratio of the area of the rough opening of windows to the gross wall area, expressed as a percentage. Up to one percent of the total window area may be exempt from the U-factor requirement.
10. Opaque doors are not considered glazing (or "windows") and must have a U-factor less than 0.35. One exempt door allowed.
11. Infiltration requirements: Windows ≤ 0.30 cfm per sq.ft. of window area; sliding doors ≤ 0.30 cfm per sq.ft. of door area (swinging doors below 0.50 cfm); determined in accordance with AAMA/WDMA 101/I.S.2 (must be tested in accordance with ASTM E 283).
12. R-2 shall be added to the requirements for slab insulation where uninsulated hot water pipes, air distribution ducts or electric heating cables are installed in or under the slab.
13. Floors over outside air must meet ceiling insulation requirements (Table 502.2 in the IECC).
14. R-values for walls represent the sum of cavity insulation plus insulated sheathing, if any.
15. Prescriptive packages are based upon meeting or exceeding minimum equipment efficiencies for HVAC and water heating (IECC Tables 503.2 and 504.2).

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