

Texas Building Energy Performance Standards

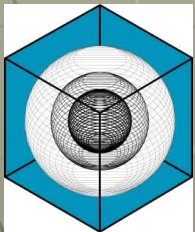
Stakeholder's Meeting

June 2006

Energy Systems Laboratory

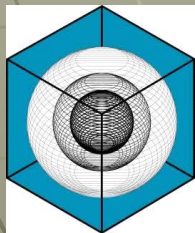
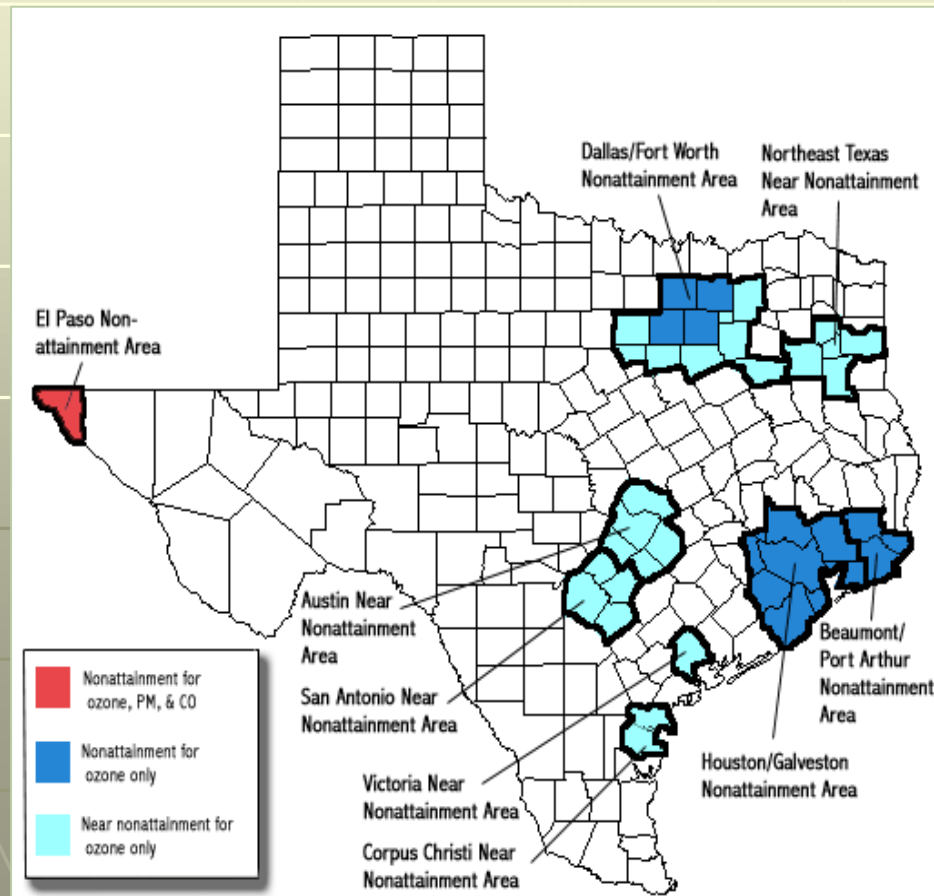
Texas Engineering Experiment Station

Texas A&M University System



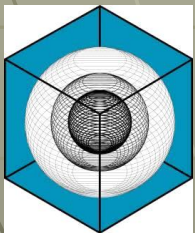
Legislative Issues

- Senate Bill 5, 77th Legislature
 - Texas Building Performance Standards



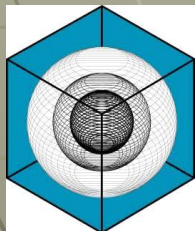
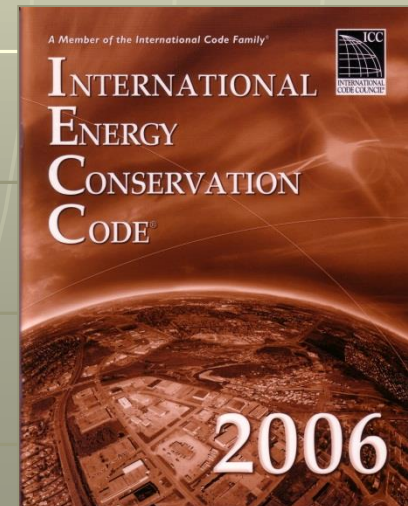
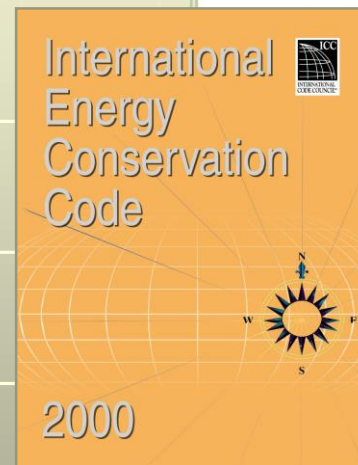
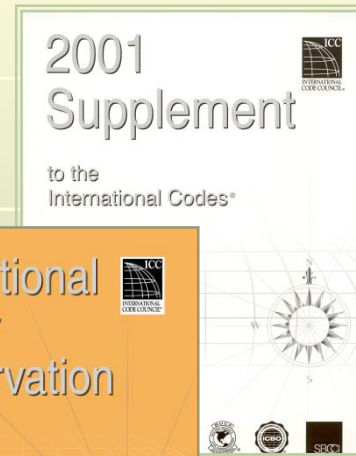
Texas Building Energy Performance Standards

- Chapter 388 – Health and Safety Code
 - Section 388.003 - Adoption Of Building Energy Efficiency Performance Standards
 - Section 388.004 - Enforcement Of Energy Standards Outside Of Municipality
 - Section 388.007 - Distribution Of Information And Technical Assistance
 - Section 388.008 - Development Of Home Energy Ratings



Comparison – International Energy Conservation Code (IECC)

- Major Differences
 - Climate Zones
 - Window-to-wall (W/WR) area ratio
 - Envelope requirements
- Analysis
- Results
- Discussion



Major Differences – Climate

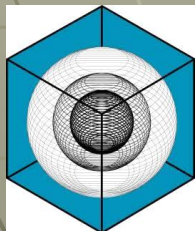
- Climate zones

IECC 2000/2001

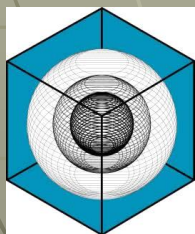
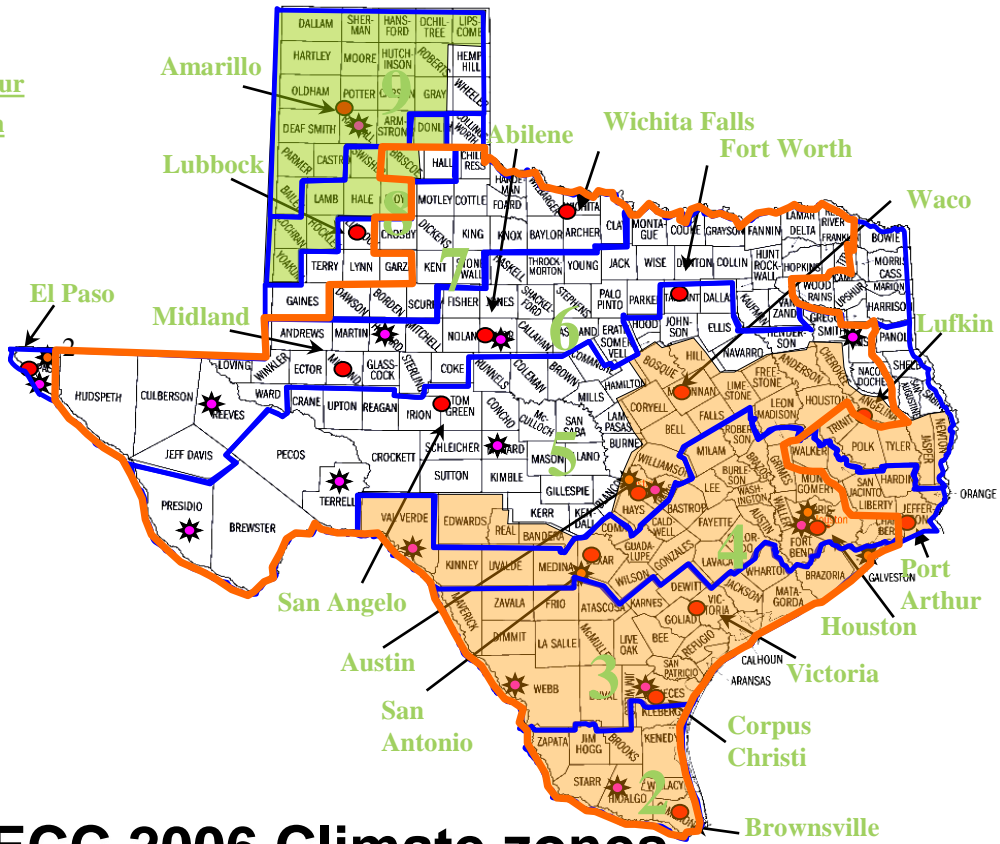
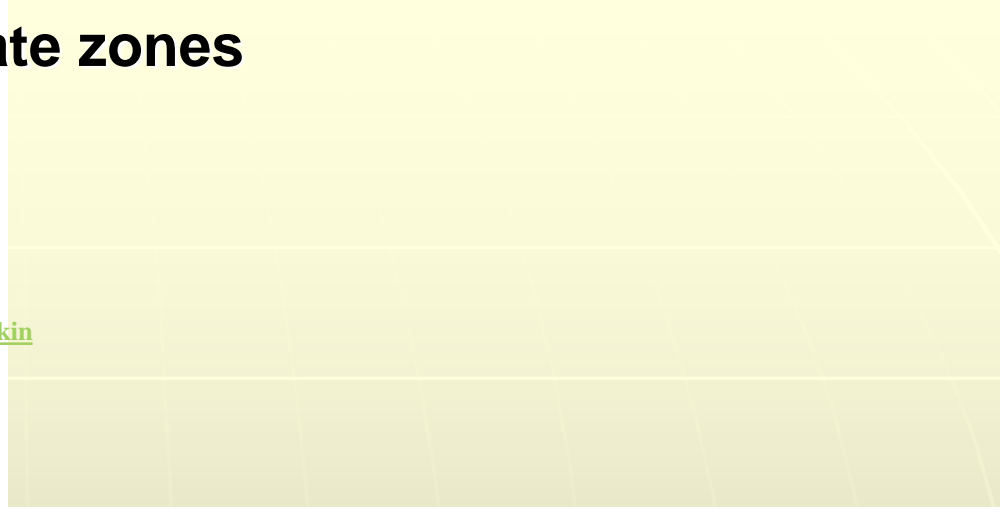
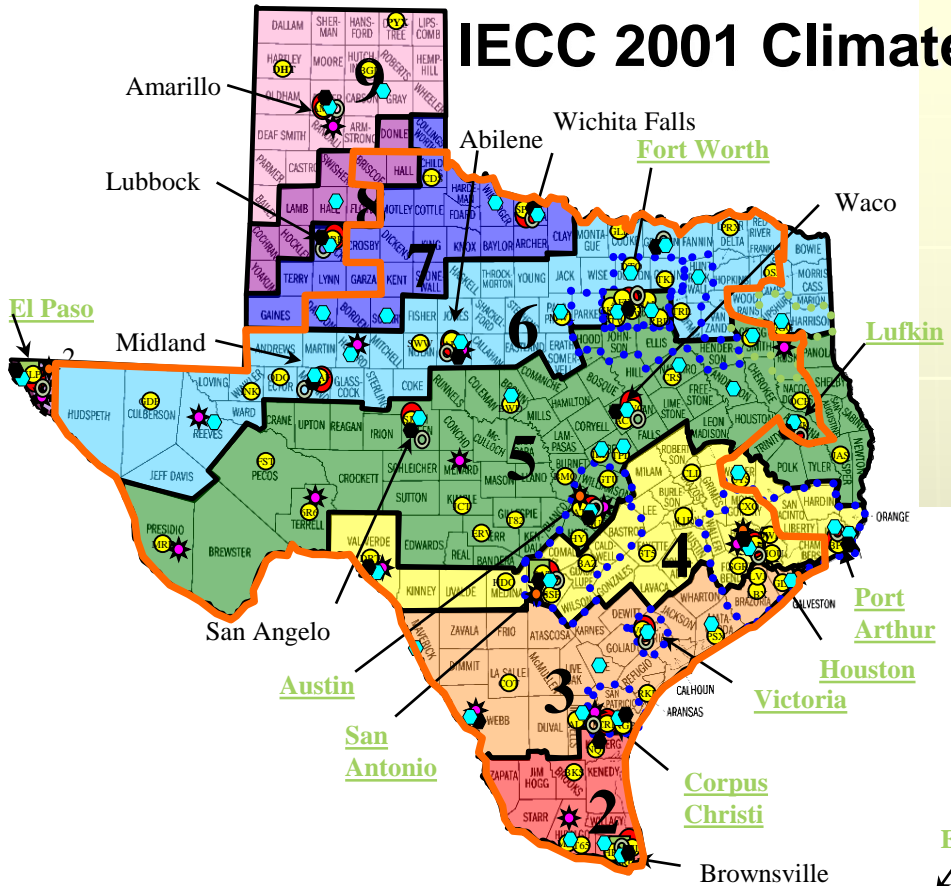
2001 Climate zones	Heating Degree Day range
2	500-999
3	1,000-1,499
4	1,500-1,999
5	2,000-2,499
6	2,500-2,999
7	3,000-3,499
8	3,500-3,999
9	4,000-4,499

IECC 2006

2006 Climate zones	Heating Degree Day range
2	500-2,499
3	2,000-3,999
4	3,500-4,499



IECC 2001 Climate zones



IECC 2006 Climate zones

Envelope Requirements (current)

■ IECC 2000/2001 (ESL Texas Builder's Guide)

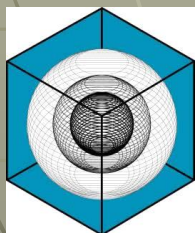
2001 Climate zones	Window-to-wall area ratio (%)	Glazing Properties		Envelope Requirements					
		U-factor	SHGC	Ceiling R-value	Wall R-value	Floor R-value	Basement wall R-value	Slab perimeter R-value	Crawlspace Wall R-value
2	15	0.90	0.40	R-19	R-11	R-11	R-0	R-0	R-4
	20	0.75	0.40	R-30	R-13	R-11	R-0	R-0	R-4
	25	0.65	0.40	R-30	R-13	R-11	R-0	R-0	R-4
3	15	0.75	0.40	R-19	R-11	R-11	R-0	R-0	R-5
	20	0.70	0.40	R-30	R-13	R-11	R-0	R-0	R-5
	25	0.55	0.40	R-30	R-13	R-11	R-0	R-0	R-5
4	15	0.75	0.40	R-26	R-13	R-11	R-5	R-0	R-5
	20	0.60	0.40	R-30	R-13	R-11	R-5	R-0	R-5
	25	0.52	0.40	R-30	R-13	R-13	R-6	R-0	R-6
5	15	0.65	0.40	R-30	R-13	R-11	R-5	R-0	R-6
	20	0.62	0.40	R-38	R-13	R-11	R-5	R-0	R-6
	25	0.50	0.40	R-38	R-13	R-19	R-8	R-0	R-10
6	15	0.60	0.40	R-30	R-13	R-19	R-6	R-0	R-7
	20	0.50	0.40	R-38	R-13	R-19	R-6	R-0	R-7
	25	0.46	0.40	R-38	R-16	R-19	R-6	R-0	R-7
7	15	0.55	0.40	R-30	R-13	R-19	R-7	R-0	R-8
	20	0.46	0.40	R-38	R-13	R-19	R-7	R-0	R-8
	25	0.45	0.40	R-38	R-19	R-19	R-7	R-0	R-8
8	15	0.50	N.R	R-30	R-13	R-19	R-8	R-5, 2ft	R-10
	20	0.42	N.R	R-38	R-13	R-19	R-8	R-6, 2ft	R-10
	25	0.41	N.R	R-38	R-19	R-19	R-8	R-6, 2ft	R-10
9	15	0.45	N.R	R-38	R-13	R-19	R-9	R-5, 2ft	R-11
	20	0.37	N.R	R-38	R-13	R-19	R-9	R-6, 2ft	R-13
	25	0.37	N.R	R-38	R-19	R-19	R-9	R-6, 2ft	R-13

Envelope Requirements

■ IECC 2006 Table 402.1.1

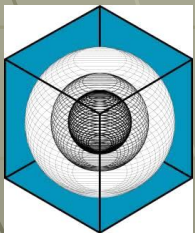
2006 Climate zones	Glazing Properties		Envelope Requirements					
	U-factor	SHGC	Ceiling R-value	Wall R-value	Floor R-value	Basement wall R-value	Slab perimeter R-value	Crawlspace Wall R-value
2	0.75	0.40	R-30	R-13	R-13	R-0	R-0	R-0
3	0.65	0.40	R-30	R-13	R-19	R-0	R-0	R-5
4	0.40	N.R.	R-38	R-13	R-19	R-10	R-10, 2ft	R-10

- The 2000/2001 glazing U -factor for the area in 2006 climate zone 2 varies from 0.90 to 0.50 depending on the W/WR and the 2000/2001 climate zone. Brownsville (635 HDD) has a maximum U -factor of 0.9 while Waco (2,179 HDD) has a maximum of 0.5
- In 2006, the entire area within 500-2,499 HDD has the same window U -factor requirement of 0.75
- The ceiling R-value requirement for 2001 varies from R-19 to R-38 according to W/WR and the 2000/2001 climate zones
- In 2006, whether its Brownsville or Waco the ceiling insulation is fixed at R-30



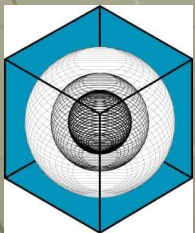
Analysis

- Compared IECC 2000/2001 with IECC 2006
 - DOE-2 simulation
 - Chapter 4 Whole Building Analysis

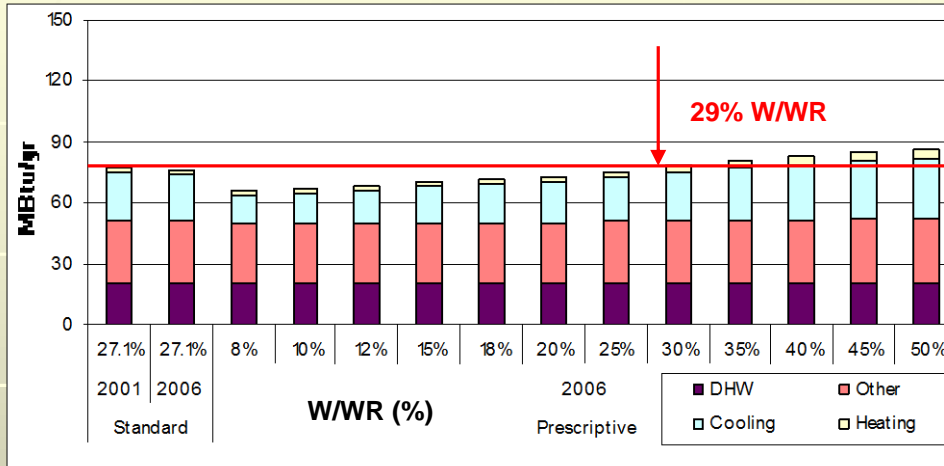


Parameters

- Model Characteristics
 - House size
 - Duct location & loss, sealed air handler
 - Fixed internal loads
 - Electric cooling, gas heating
- Analysis
 - 19 simulations - 17 weather stations
 - 2006 W/WR range 5% - 50%
 - Maximum allowable W/WR
 - Such that 2006 consumption \leq 2000/2001

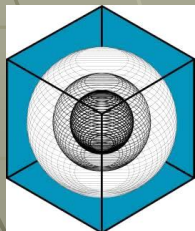
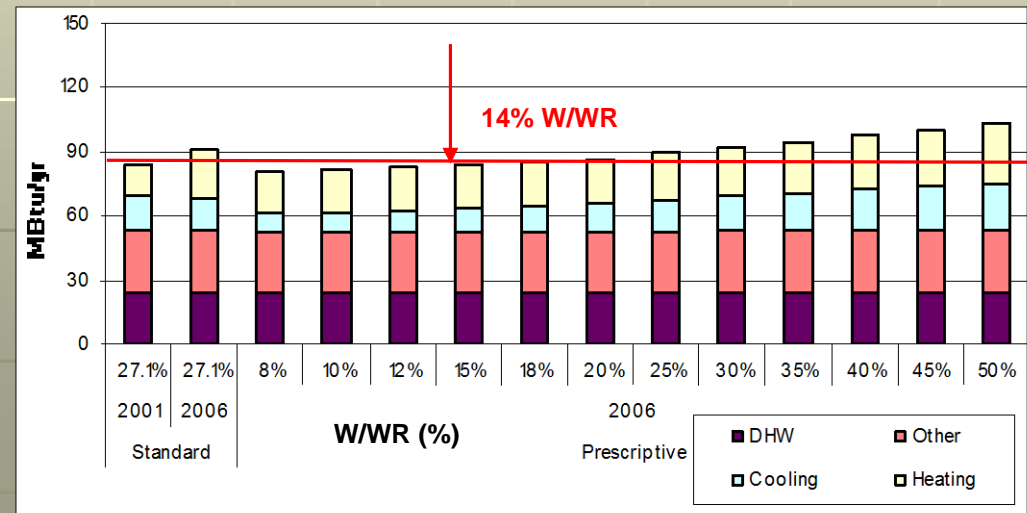


Climate Zone 2 - 2006

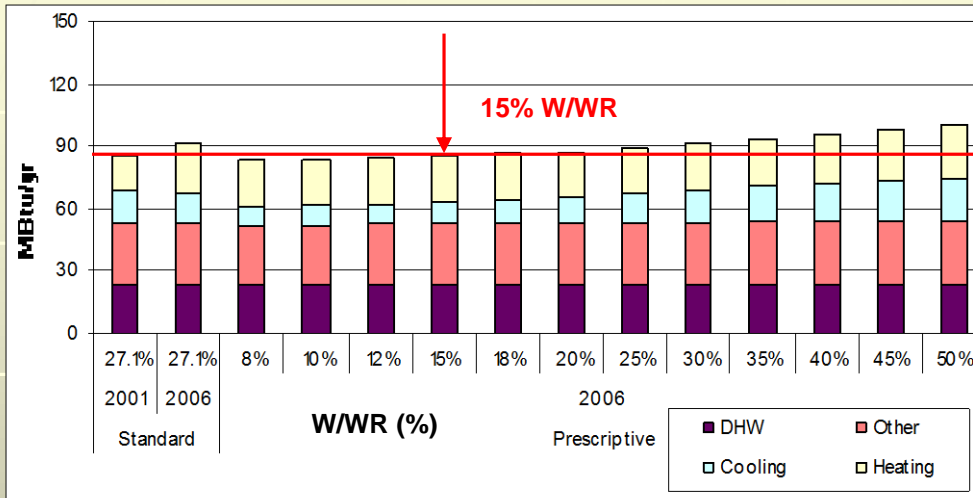


Waco – HDD 2179 (Climate Zone 5 - IECC 2000/2001)

Annual Consumption (MBtu)
 IECC 2001 Performance = 83.66
 IECC 2006 Performance = 90.98
 IECC 2006 Prescriptive = 81.03 (8% W/WR) to 102.92 (50% W/WR)



Climate Zone 3 - 2006



Fort Worth – HDD 2,304
(Climate Zone 5 - IECC 2000/2001)

Annual Consumption (MBtu)

IECC 2001 Performance = 85.44

IECC 2006 Performance = 90.91

IECC 2006 Prescriptive = 83.06 (8% W/W/R) to
100.94 (50% W/W/R)

Lubbock – HDD 3,431

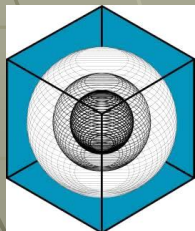
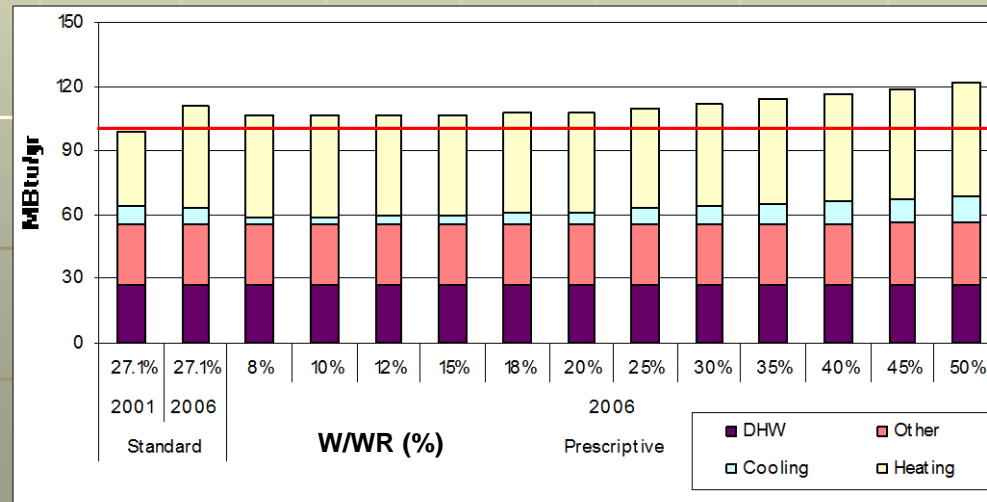
(Climate Zone 7 - IECC 2000/2001)

Annual Consumption (MBtu)

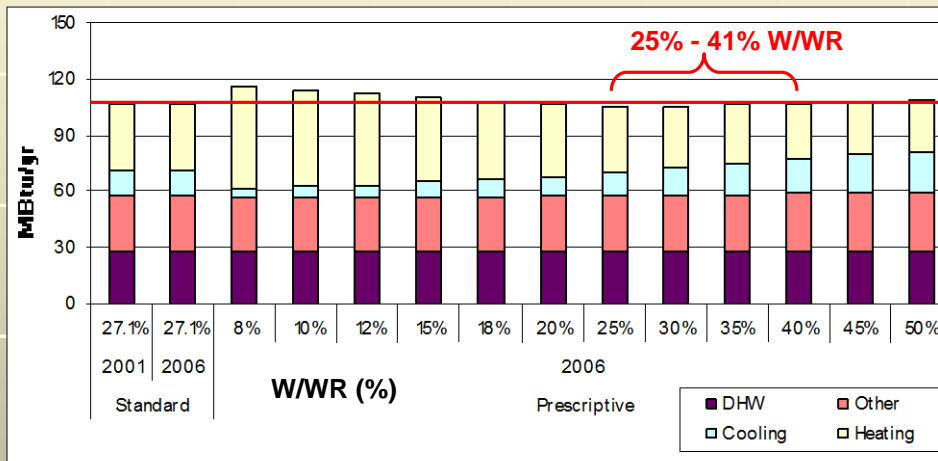
IECC 2001 Performance = 99.25

IECC 2006 Performance = 111.28

IECC 2006 Prescriptive = 105.8 (8% W/W/R) to
121.08 (50% W/W/R)



Climate Zone 4 - 2006



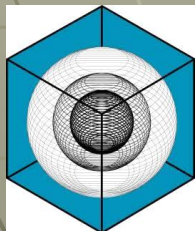
Amarillo – HDD 4,258
(Climate Zone 7 & 8 - IECC 2000/2001)

Annual Consumption (MBtu)

IECC 2001 Performance = 106.07

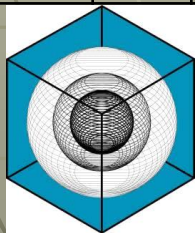
IECC 2006 Performance = 106.81

IECC 2006 Prescriptive = 116.08(8% WWR) to
109.22(50% WWR)



Results

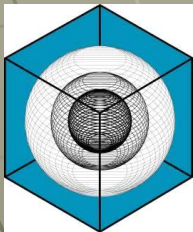
Climate zones		Weather Station	Heating Degree Days	Infiltration rate (air changes/hr)	2006 Maximum W/WR for 2000/2001 stringency	Glazing Properties				Envelope Requirements			
2000/2001	2006					U-Factor		SHGC		Ceiling R-value		Wall R-value	
						2000/2001	2006	2000/2001	2006	2000/2001	2006	2000/2001	2006
2	2	Brownsville	635	0.51	29%	0.74	0.75	0.4	0.4	30	30	12	13
3	2	Corpus Christi	1,016	0.49	26%	0.47	0.75	0.4	0.4	30	30	12	13
3	2	Victoria	1,296	0.49	24%	0.47	0.75	0.4	0.4	30	30	12	13
4	2	Houston	1,371	0.51	21%	0.47	0.75	0.4	0.4	30	30	12	13
4	2	Port Arthur	1,499	0.45	21%	0.47	0.75	0.4	0.4	30	30	12	13
4	2	San Antonio	1,644	0.56	20%	0.47	0.75	0.4	0.4	30	30	12	13
5	2	Austin	1,688	0.46	21%	0.47	0.75	0.4	0.4	38	30	12	13
5	2	Lufkin	1,951	0.36	17%	0.47	0.75	0.4	0.4	38	30	12	13
5	2	Waco	2,179	0.52	14%	0.47	0.75	0.4	0.4	38	30	12	13
5	3	Fort Worth	2,304	0.51	15%	0.47	0.65	0.4	0.4	38	30	12	13
5	3	San Angelo	2,414	0.52	12%	0.47	0.65	0.4	0.4	38	30	12	13
6	3	Abilene	2,584	0.6	12%	0.47	0.65	0.4	0.4	38	30	12	13
6	3	Midland	2,751	0.55		0.47	0.65	0.4	0.4	38	30	12	13
6	3	El Paso	2,708	0.43	5%	0.44	0.65	0.4	0.4	38	30	13	13
7	3	Wichita Falls	3,042	0.56	4%	0.44	0.65	0.4	0.4	38	30	13	13
7	3	Lubbock	3,431	0.57		0.44	0.65	0.4	0.4	38	30	13	13
8	3	Lubbock	3,431	0.57		0.41	0.65	N/A	0.4	38	30	16	13
8	4	Amarillo	4,258	0.65	41%	0.41	0.4	N/A	N/A	38	38	16	13
9	4	Amarillo	4,258	0.65	41%	0.41	0.4	N/A	N/A	38	38	16	13



1. Maximum allowable W/WR - IECC 2006
2. Glazing U-factors relaxed
3. SHGC not required

Summary of Results

- The IECC 2006 does not meet Texas Building Energy Performance Standards (IECC 2000/2001)
- Key issues are
 - U-factors
 - W/WR
 - Climate zones
- Some options are



How can stringency be preserved?

A. Stay with IECC 2000/2001

■ Pros: ■ Cons:

- Currently in use
- Easily understood
- Climate zones would be different for residential and commercial
- W/WR calculation required
- Will not maintain consistency with the updated ICC family of codes

Glazing and Insulation			Foundation Type		
Climate Zone	Path	Glazing (Area%, U-Factor, SHGC)	Ceiling	Wall	Foundation
9 4,000-4,899 HDD	1	15 46 N/S R-38 R-13	R-19	R-9	R-10 R-5, 24 R-11
	2	20 37 N/S R-38 R-13	R-19	R-9	R-10 R-5, 24 R-13
	3	25 37 N/S R-38 R-19	R-19	R-9	R-10 R-5, 24 R-13
8 3,900-4,899 HDD	1	15 50 N/S R-30 R-13	R-19	R-9	R-10 R-5, 24 R-10
	2	20 42 N/S R-38 R-13	R-19	R-9	R-10 R-5, 24 R-10
	3	25 41 N/S R-38 R-19	R-19	R-9	R-10 R-5, 24 R-10
7 3,000-3,899 HDD	1	15 55 40 R-30 R-13	R-19	R-7	R-10 R-5, 24 R-8
	2	20 40 40 R-38 R-13	R-19	R-7	R-10 R-5, 24 R-8
	3	25 46 40 R-38 R-19	R-19	R-7	R-10 R-5, 24 R-8
6 2,000-2,999 HDD	1	15 60 40 R-30 R-13	R-19	R-6	R-10 R-5, 24 R-8
	2	20 50 40 R-38 R-13	R-19	R-6	R-10 R-5, 24 R-8
	3	25 49 40 R-38 R-19	R-19	R-6	R-10 R-5, 24 R-8
5 1,000-1,999 HDD	1	15 65 40 R-30 R-13	R-19	R-6	R-10 R-5, 24 R-8
	2	20 62 40 R-38 R-13	R-19	R-6	R-10 R-5, 24 R-8
	3	25 50 40 R-38 R-19	R-19	R-6	R-10 R-5, 24 R-8
4 1,000-1,999 HDD	1	15 75 40 R-20 R-13	R-11	R-6	R-10 R-5, 24 R-8
	2	20 60 40 R-30 R-13	R-11	R-6	R-10 R-5, 24 R-8
	3	25 52 40 R-30 R-13	R-11	R-6	R-10 R-5, 24 R-8
3 1,000-1,999 HDD	1	15 75 40 R-20 R-13	R-11	R-6	R-10 R-5, 24 R-8
	2	20 70 40 R-30 R-13	R-11	R-6	R-10 R-5, 24 R-8
	3	25 55 40 R-30 R-13	R-11	R-6	R-10 R-5, 24 R-8
2 1,000-1,999 HDD	1	15 90 40 R-19 R-11	R-11	R-6	R-10 R-5, 24 R-4
	2	20 75 40 R-30 R-13	R-11	R-6	R-10 R-5, 24 R-4
	3	25 65 40 R-30 R-13	R-11	R-6	R-10 R-5, 24 R-4

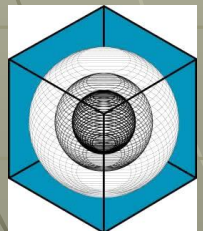
Notes:

- The table of building envelope requirements is based upon the International Energy Conservation Code (IECC) published by the International Code Council.
- 2001 International Residential Code (IRC) published with glazing areas of 15% and below. For homes designed with glazing areas greater than 15% the IRC prescribes performance-based code requirements.
- Source of requirements: 2000 IRC, 15% (to 15% only) and 2000 IECC, Ch. 4, prescriptive. Pathways for Climate Zones 2-9.
- Minimum U-Factor and SHGC maximum acceptable levels.
- Applies to single family, wood frame conventional construction. City, for mass wall construction, see IRC Section N1102.1.1.1 for steel framed walls. See IRC Section N1102.1.1.2.
- SHGC 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 doors.
- For 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 Federal Energy Efficiency Data (IECC Chapter 4).
- Minimum U-Factor and SHGC for the entire glazing area may be exempt from the U-factor requirement if the glazing area is less than 10% of the total window area and must have a maximum U-factor of 0.35. One exempt fenestration product.
- Minimum requirements: minimum of 0.08 cm per inch of window area, doors 0.10 cm per inch of door area (excluding doors less than 550mm) determined in accordance with ASHRAE/ACCA 90.1's "U-factor based and SHGC based" requirements.
- U-Factor shall be added to the requirements for each insulation which is unpermitted under either of the provisions of 12 or 13. Floor over outside air must meet insulation requirements.
- R-values for walls represent the sum of cavity insulation plus exterior cladding. For walls with cavity insulation exceeding minimum equipment efficiency for HVAC and mechanical systems, see IECC Table 402.2.14, IECC Section 402.2.14, and IECC Chapter 4, and the path.

Guiding Guide to Energy Code Compliance
2000 and International Energy Conservation Code (IECC 2000)
© Code of May 11, 2001 Texas Edition 2001, Revision 01

Texas Counties by Climate Zones
A coded map of Texas to locate a county. The reverse side of this form shows three cities for the selected Climate Zone.

Climate Zone	County	City
1,000-1,999 HDD	Alameda	Golden
	Blanco	Blanco
	Comal	San Antonio
2,000-2,999 HDD	Brewster	Big Bend
	Duval	Big Bend
	El Paso	El Paso
3,000-3,899 HDD	Brewster	Big Bend
	Duval	Big Bend
	El Paso	El Paso
4,000-4,899 HDD	Brewster	Big Bend
	Duval	Big Bend
	El Paso	El Paso



How can stringency be preserved?

B. Change the 2006 Table 402.1.1 to match 2000/2001 stringency

■ Pros:

- Will maintain consistency with the updated ICC family of codes

■ Cons:

- Increased stringency in some climate zones

TABLE 402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT^a

CLIMATE ZONE	FENESTRATION U-FACTOR	SKYLIGHT ^b U-FACTOR	GLAZED FENESTRATION SHGC	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE	FLOOR R-VALUE	BASEMENT ^c WALL R-VALUE	SLAB ^d R-VALUE & DEPTH	CRAWL SPACE ^e WALL R-VALUE
1	1.20	0.75	0.40	30	13	3	13	0	0	0
2	0.75	0.75	0.40	30	13	4	13	0	0	0
3	0.65	0.65	0.40 ^f	30	13	5	19	0	0	5 / 13
4 except Marine	0.40	0.60	NR	38	13	5	19	10 / 13	10, 2 ft	10 / 13
5 and Marine 4	0.35	0.60	NR	38	19 or 13+5 ^g	13	30 ^f	10 / 13	10, 2 ft	10 / 13
6	0.35	0.60	NR	49	19 or 13+5 ^g	15	30 ^f	10 / 13	10, 4 ft	10 / 13
7 and 8	0.35	0.60	NR	49	21	19	30 ^f	10 / 13	10, 4 ft	10 / 13

For SI: 1 foot = 304.8 mm.

a. R-values are minimums. U-factors and SHGC are maximums. R-19 shall be permitted to be compressed into a 2 × 6 cavity.

b. The fenestration U-factor column excludes skylights. The SHGC column applies to all glazed fenestration.

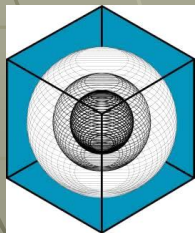
c. The first R-value applies to continuous insulation, the second to framing cavity insulation; either insulation meets the requirement.

d. R-5 shall be added to the required slab edge R-values for heated slabs.

e. There are no SHGC requirements in the Marine zone.

f. Or insulation sufficient to fill the framing cavity, R-19 minimum.

g. "13+5" means R-13 cavity insulation plus R-5 insulated sheathing. If structural sheathing covers 25 percent or less of the exterior, insulating sheathing is not required where structural sheathing is used. If structural sheathing covers more than 25 percent of exterior, structural sheathing shall be supplemented with insulated sheathing of at least R-2.

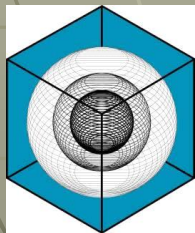


How can stringency be preserved?

C. Add W/WR requirement to an amended 2006 Table 402.1.1

Pros:

- Easily understood
- Will maintain consistency with the updated ICC family of codes
- Climate zones will be the same for residential and commercial



Cons:

- Increased stringency in most climate zones
- W/WR calculation required

TABLE 402.1.1 INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT*

CLIMATE ZONE	FENESTRATION U-FACTOR	SKYLIGHT U-FACTOR	GLAZED FENESTRATION SHGC	CEILING			WALL			FLOOR			SLAB U-FACTOR	SLAB R-VALUE & DEPTH	CRAWL SPACE WALL U-FACTOR
				CEILING	FRAME	MASS	WALL	MASS	WALL	MASS	WALL	MASS			
1	1.20	0.75	0.40	30	13	3	13	0	0	0	0	0	0	0	0
	2	0.75	0.75	0.40	30	13	4	13	0	0	0	0	0	0	0
	3	0.65	0.65	0.40	30	13	5	19	0	0	0	5/13			
2	0.40	0.60	NR	38	13	5	19	10/13	10, 2 ft	10/13	10/13				
	1	0.75	NR	38	19 or 13 ^{5F}	13	30 ⁶	10/13	10, 2 ft	10/13					
	2	0.35	0.60	NR	49	19 or 13 ^{5F}	15	30 ⁶	10/13	10, 4 ft	10/13				
3	0.35	0.60	NR	49	21	19	30 ⁶	10/13	10, 4 ft	10/13					
	1	0.25	NR	49	21	19	30 ⁶	10/13	10, 4 ft	10/13					
	2	0.20	NR	49	21	19	30 ⁶	10/13	10, 4 ft	10/13					

For SI: 1 foot = 304.8 mm.
 a. R-values are minimums. U-factors and SHGC are maximums. R-19 shall be permitted to be compressed into a 2 x 6 cavity.
 b. The fenestration U-factor column excludes skylights. The SHGC column applies to all glazed fenestration.
 c. The first R-value applies to continuous insulation, the second to framing cavity insulation; other insulation meets the requirement.
 d. R-2 shall be added to the reserved side edge R-value for heated slabs.
 e. There are no SHGC requirements in the Marine zone.
 f. Or, minimum coefficient to fill the framing cavity, R-19 minimum.
 g. "13"4" means R-13 cavity insulation plus R-4 insulated sheathing. If structural sheathing covers 25 percent or less of the exterior, insulating sheathing is not required where structural sheathing is used. If structural sheathing covers more than 25 percent of exterior, structural sheathing shall be supplemented with insulating sheathing of at least R-2.

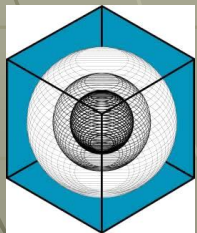
Texas Residential Building Envelope Requirements
Simplified Prescriptive Paths for Envelope Compliance with the International Residential Code (IRC 2003)

Climate Zone	Path	Glazing and Insulation			Foundation Type			Notes		
		Glazing U-factor SHGC ¹	Ceiling	Wall	Basement Floor	Slab	Crawl Space			
9	1	0.45	NR	R-38	R-13	R-10	R-8	R-5, 2 ft	R-11	1. The table of building envelope requirements is based upon the 2003 International Residential Code (IRC), published by the International Code Council. 2. The IRC prescriptive requirements are applicable to homes with glazing areas and other fenestration components designed with a minimum U-factor of 0.35. The prescriptive International Energy Conservation Code (IECC) requirements apply to homes with additional fenestration and glazing areas. See the International Energy Conservation Code (IECC) for additional requirements. 3. For Zone 9, the minimum R-value for the ceiling is 19 only. 4. For Zone 9, the minimum R-value for the foundation is 10. 5. For Zone 9, the minimum R-value for the crawl space is 10. 6. Insulation R-values are minimum acceptable levels. 7. Applies to single-family, second-story residential construction. 8. For Zone 9, the minimum R-value for the foundation is 10. 9. For Zone 9, the minimum R-value for the crawl space is 10. 10. For Zone 9, the minimum R-value for the crawl space is 10. 11. For Zone 9, the minimum R-value for the crawl space is 10. 12. For Zone 9, the minimum R-value for the crawl space is 10. 13. For Zone 9, the minimum R-value for the crawl space is 10. 14. For Zone 9, the minimum R-value for the crawl space is 10. 15. For Zone 9, the minimum R-value for the crawl space is 10. 16. For Zone 9, the minimum R-value for the crawl space is 10. 17. For Zone 9, the minimum R-value for the crawl space is 10. 18. For Zone 9, the minimum R-value for the crawl space is 10. 19. For Zone 9, the minimum R-value for the crawl space is 10. 20. For Zone 9, the minimum R-value for the crawl space is 10. 21. For Zone 9, the minimum R-value for the crawl space is 10. 22. For Zone 9, the minimum R-value for the crawl space is 10. 23. For Zone 9, the minimum R-value for the crawl space is 10. 24. For Zone 9, the minimum R-value for the crawl space is 10. 25. For Zone 9, the minimum R-value for the crawl space is 10. 26. For Zone 9, the minimum R-value for the crawl space is 10. 27. For Zone 9, the minimum R-value for the crawl space is 10. 28. For Zone 9, the minimum R-value for the crawl space is 10. 29. For Zone 9, the minimum R-value for the crawl space is 10. 30. For Zone 9, the minimum R-value for the crawl space is 10. 31. For Zone 9, the minimum R-value for the crawl space is 10. 32. For Zone 9, the minimum R-value for the crawl space is 10. 33. For Zone 9, the minimum R-value for the crawl space is 10. 34. For Zone 9, the minimum R-value for the crawl space is 10. 35. For Zone 9, the minimum R-value for the crawl space is 10. 36. For Zone 9, the minimum R-value for the crawl space is 10. 37. For Zone 9, the minimum R-value for the crawl space is 10. 38. For Zone 9, the minimum R-value for the crawl space is 10. 39. 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For Zone 9, the minimum R-value for the crawl space is 10. 85. For Zone 9, the minimum R-value for the crawl space is 10. 86. For Zone 9, the minimum R-value for the crawl space is 10. 87. For Zone 9, the minimum R-value for the crawl space is 10. 88. For Zone 9, the minimum R-value for the crawl space is 10. 89. For Zone 9, the minimum R-value for the crawl space is 10. 90. For Zone 9, the minimum R-value for the crawl space is 10. 91. For Zone 9, the minimum R-value for the crawl space is 10. 92. For Zone 9, the minimum R-value for the crawl space is 10. 93. For Zone 9, the minimum R-value for the crawl space is 10. 94. For Zone 9, the minimum R-value for the crawl space is 10. 95. For Zone 9, the minimum R-value for the crawl space is 10. 96. For Zone 9, the minimum R-value for the crawl space is 10. 97. For Zone 9, the minimum R-value for the crawl space is 10. 98. For Zone 9, the minimum R-value for the crawl space is 10. 99. For Zone 9, the minimum R-value for the crawl space is 10. 100. For Zone 9, the minimum R-value for the crawl space is 10.

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How can stringency be preserved?

Discussion



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