

Linking the IECC and Home Energy Ratings

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Why Changes are Being Made

- Standard has not been updated in 5 years
- Outdated, MEC '93 is used as the basis for current HERS Reference home
- RESNET now “owns” the Standard, simplifying the revision process
- A more experienced HERS industry has highlighted weaknesses in current Standard
 - Small vs. large home bias
 - Issues not adequately addressed

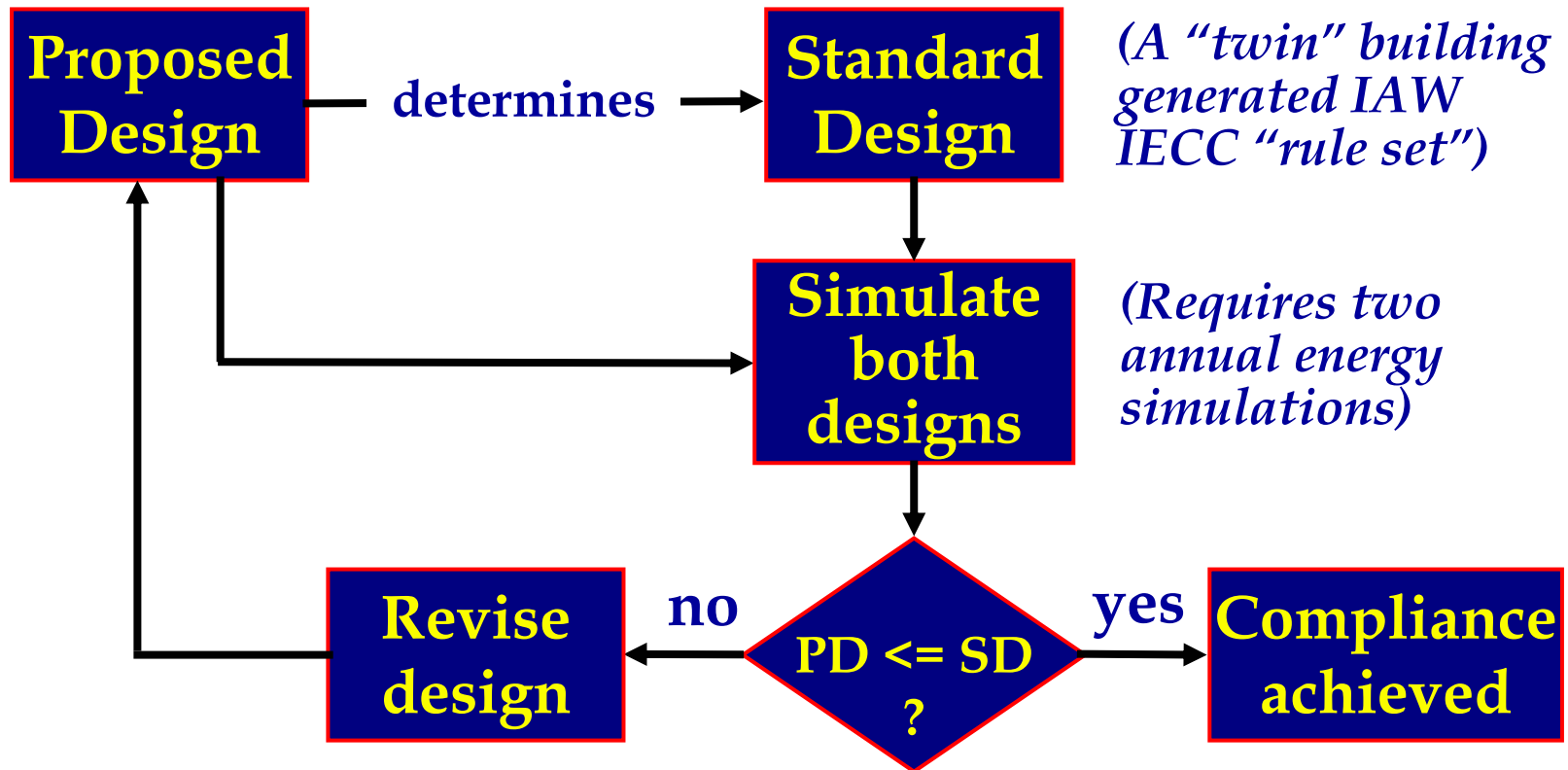
Aligning HERS with IECC

- HERS Reference home
 - Rule set created in 1995 by HERS Council to align with MEC 93
 - Substantive 1998 IECC code change for windows in hot climates ($HDD \leq 3,500$)
- There is wide adoption of IECC
- All proposed tax credit legislation uses IECC 2003, Chapter 4 as the basis of comparison

Performance Code Compliance

- Much like HERS ratings, performance code compliance:
 - Compares “proposed design” with a “standard reference design” using annual building energy simulation techniques.
- Standard reference design provides the minimum acceptable energy budget to achieve compliance.
- Compliance is achieved when the proposed design energy is equal to or less than that of the standard reference design budget.

Performance Method Process



Standard Reference Design

- Same size as the proposed design.
- Same geometry as proposed design (except windows).
- Same orientation as the proposed design (except windows).
- Same operating conditions as the proposed design.
- Component characteristics specified by climate zone as defined by a detailed “rule set.”

Previous IECC Code Versions

- Insufficient “rule set” specificity leading to large opportunities for gaming
- A hodge-podge of changes occurring over many years led to a rule set that was difficult to understand and interpret
- Little to no compliance guidance provided for code officials
- Perceived as impossible to cost-effectively enforce in the field.

The “RICC”

- RICC – DOE’s “Residential IECC Code Change” Proposal
- Modification/simplification of climate zones to 8 zones that follow geo-political boundaries (counties) rather than degree-day criteria
- Significant simplification of prescriptive compliance criteria (Sections 402 & 403)
 - One component R-Value table (402.1), plus
 - One equivalent component U-Factor table (402.1.2)
 - No window area limitation

RICC: Improved Provisions

- Improved compliance guidance provided for code officials
 - Minimum standard compliance report elements are specified
 - Computer generated field inspection checklist is required
 - Software tool documentation is required
 - Improved software tool specification

RICC: Software Tool Specification

- Minimum Capabilities:
 - Computerized auto-generation of Standard Reference Design is required – no user modification allowed
 - Calculation of equipment sizing for Standard Reference Design is required
 - Generation of code official inspection checklist listing each of the Proposed Design component characteristics is required
 - Calculations that account for effects of climate and equipment sizing on system performance is required.

RICC: The “Rule Set”

- Same building component efficiencies as prescriptive compliance method
- Specification is by individual building component
- Significant increase in specificity
- Understandable format – Table 404.5.2(1) presents Standard Reference Design criteria side-by-side with the Proposed Design criteria.

RICC: Example of Table Format

Table 404.5.2(1) Specifications for the Standard Reference and Proposed Designs

Component	Standard Reference Design	Proposed Design
Above grade walls:	Type: wood frame	As proposed
	Gross Area: same as proposed	As proposed
	U-Factor: from Table 402.1.2	As proposed
	Solar absorptance = 0.75	As proposed
	Emittance = 0.90	As proposed

RICC: Specified Components

- Above grade walls
- Basements and crawlspace walls
- Above grade floors
- Ceilings
- Roofs
- Attics
- Foundations
- Doors
- Glazing
- Skylights
- Sunrooms
- Air exchange rates
- Mechanical ventilation
- Internal gains
- Internal mass
- Structural mass
- Heating systems
- Cooling systems
- Service hot water
- Thermal distribution systems

RICC: Significant Performance Method Changes

- Climate and envelope efficiency changed as for the prescriptive method
- Significantly more specification detail throughout the “rules set”
- Air exchange rates – aligned to correspond with the new ASHRAE 62.2 Standards and account for mechanical ventilation systems
- Thermal distribution system efficiency specifications improved.

HERS Reference Windows: Current Standards

- Other things being equal, smaller homes have lower window U-factors than larger homes in current HERS standards
 - **Eq. 3:** $U_F = [(U_O * A_O) - (U_W * A_W) - 8] / A_F$
 - Geometry dependant
- SHGC is larger than is currently required by IECC for warm climates ($\leq 3,500$ HDD)
- Basements and multifamily windows treated differently by IECC than HERS Standards.

RESNET & RICC Proposals

- RESNET proposes to adopt RICC window U-factor requirements, which depend only on climate zone, rather than geometry
- RESNET proposes to adopt RICC's climate-specific window SHGC requirements
- RICC proposes to change IECC's treatment of windows for basement and multifamily homes to align with HERS standards
- RICC proposes to change IECC's treatment of air distribution system to align with HERS standards.

Other Differences

- Hot water storage temperature not specified in current HERS Standards – 120 °F in RICC and RESNET amendment.
- Programmable thermostat specified as Standard Reference Design by current IECC – manual in RICC and HERS.
- Exterior surface characteristics not specified by current IECC – specified in RICC and RESNET amendment.

Other Differences

- Exterior door size not specified by current IECC. Specified in RICC and RESNET amendment
- Distribution system efficiency not sufficiently clear in current IECC – clearly specified in RICC and RESNET amendment
- Basement and multifamily windows not adequately considered by current IECC – specifically considered in RICC and RESNET amendment.

Internal Gains

- **HERS:** 72,000 Btu/day, regardless of house size and number of bedrooms
- **RICC:** $17,900 + 23.8 \cdot \text{CFA} + 4104 \cdot N_{\text{br}}$
Btu/day per dwelling unit
- **Proposal:** RESNET proposes to adopt RICC's internal gains equation so as to more accurately account for house size and number of bedrooms.

REF: 2004-01 Summary

- Proposes to make HERS Reference Home the same as the RICC Standard Reference Design.
- Result in significantly different HERS Reference Home in 3 areas:
 - Reference home air exchange rate
 - Reference home envelope U-factors
 - Reference home window SHGC
- Different impacts in different climates

Air Exchange Rate: Specification

- Specific leakage area (SLA) = 0.00048
- If Rated home tested (ASHRAE 119, Section 5.1), then minimum air exchange = **0.35 ach**
- If Rated home tested **plus** mechanical ventilation, then minimum air exchange = measured air exchange in combination with mechanical vent but not less than:

$$\text{cfm} = 0.01 * \text{CFA} + 7.5 * (\text{N}_{\text{br}} + 1)$$

- If mechanical ventilation, then fan energy assumed in Reference home:

$$\text{kWh/yr} = 0.03942 * \text{CFA} + 29.565 * (\text{N}_{\text{br}} + 1)$$

Air Exchange Rate: Basements

- Envelope air exchange rates for homes with conditioned basements are ill-specified by IECC and RICC:
 - “Strict” interpretation results in excessive air exchange for homes with conditioned basements
 - RESNET proposal is to modify basement air exchange rate based on the ratio of below-grade to total basement wall area.

Air Exchange Rate: Basements

$$SLA_{bsmt} = SLA_{std} * [(above-grade basement wall area) / (total basement wall area)]$$

$$SLA_{a-g} = SLA_{std} \text{ (where 'a-g' indicates above-grade)}$$

$$SLA_{overall} = [(CFA_{bsmt} * SLA_{bsmt}) + (CFA_{a-g} * SLA_{a-g})] / [CFA_{total}]$$

Calculation may be by zone, applying SLA_{bsmt} to the basement zone and SLA_{std} to the above-grade zones of the home and treating the energy balances separately for each zone or by applying $SLA_{overall}$ to the combined spaces in the home as a single zone

Air Exchange Rate: Impacts

- Reference air exchange rate reduced.
Specific leakage area (SLA) reduced from approximately 0.00057 to 0.00048.
- Impacts on HERS scores
 - Slightly more stringent in hot climates (zones 1-3)
 - More stringent in mixed climates (zones 4-5)
 - Most stringent in cold climates (zones 6-8, significantly so in zones 7 and 8)

Envelope U-Factors

- Door and window U-factors are equal (as a function of climate zone location)
- Envelope and window U-factors are changed compared to IECC
- Impact on HERS scores
 - More stringent in hot climates (zones 1-3)
 - Less stringent in mixed climates (zones 4 & 5)
 - More stringent in cold climates (zones 6-8)

Note: “more stringent” means lower HERS score and “less stringent” means higher HERS score for the same home

Window SHGC

- Window SHGC = 0.40 in climate zones 1-3 (equivalent to IECC requirement for climates with HDD $\leq$ 3,500)
- Window SHGC = 0.55 in climate zones 4-8
- Impacts on HERS scores
 - More stringent in hot climates (significantly so in climate zone 1 – e.g. Miami, FL)
 - Little to no change in mixed climates (zones 4-5)
 - Less stringent in cold climates (zones 6-8)

RICC vs. HERS

“An Analysis of the RICC in Comparison to the HERS Reference Home”

Potential impacts of RICC on HERS scores
by energy use characteristic across climates

Characteristic:	Low	High	Average
U-Factors	-0.8	+0.8	+0.1
Windows	-0.6	+2.9	+0.9
Infiltration	+0.3	+1.2	+0.7
All characteristics	+0.4	+4.0	+1.7

See RESNET proposed amendment REF: 2004-01
at www.natresnet.org/amend/ for full report.

All Changes by Climate Zone

- More stringent in all cases
- Approximate impact on HERS Scores:

Zone 1: 3.1 – 4.1 points

Zone 2: 2.0 – 2.9 points

Zone 3: 1.3 – 2.3 points

Zone 4: 0.3 – 2.2 points

Zone 5: 0.7 – 1.4 points

Zone 6: 0.4 – 0.9 points

Zone 7: 0.9 – 1.2 points

Latest Developments

- RICC adopted by IECC committee with floor modifications
 - 18% window/floor area ratio in Standard Reference Design modified to “same as Proposed Design”
 - DOE public comment seeking to reinstate 18% WFA criteria in Section 404
- ICC Final Action Hearing: May 17-20, 2004, in Overland Park, KS