

Sector: Residential

Category/Practice: Energy Efficiency / Electric-Heat Envelope Specifications

Proposed GB Practice

Description

Electrically heated buildings must meet the following building envelope thermal specifications, which are more energy-efficient than the recently adopted 2009 *International Residential Code* (IRC) and 2009 *International Energy Conservation Code* (IECC):

- Air sealing: 3.0 ACH50 (maximum)
- Windows: 0.30 U-factor (maximum)
- Ceilings: R-49 (minimum)
- Exterior frame walls: R-20 cavity + R-5 continuous (minimum)
- Mass walls: R-15/R-19 (minimum)
- Basement walls: R-15 continuous / R-19 cavity (minimum)
- Crawl space walls: R-15 continuous / R-19 cavity (minimum)
- Slab-on-grade perimeter: R-10 to 4 feet below grade (minimum)

Assemblies with equivalent U-Factors will also comply.

Applicability

Heating System Type: Applies to buildings with electric heat as primary heat source.

Exception: Primary heat source is a ground-source electric heat pump designed by a licensed design professional to operate without the use of supplemental electric resistance heat.

New Construction: Applies

Existing Buildings/Additions: Applies to addition portion when addition uses electric heat (whether existing portion of building uses gas or electric heat)

Existing Buildings/Alterations: Does not apply

Intent

Energy savings and peak electrical demand reduction

Benefits and Costs

Triple Bottom Line Benefits

People: Increased thermal comfort

Economic:

- Electric bill savings for prototype home approximately \$300 to \$400 per year (energy modeling)

- Peak demand reduction and associated deferral of electrical system capacity expansion

Environment: Benefits associated with decreased energy use

Costs Passed to Owner

Estimated cost increases for prototype home (including builder margin):

- Windows. Assuming no change in frame material, the cost increase for a lower U-factor, dropping from 0.35 to 0.30, is low. Assuming 16 windows, total increase is approximately \$450.
- Ceiling insulation. Increase from R-38 to R-49 is approximately \$475, for either blown fiberglass or cellulose insulation.
- Exterior frame walls. Increase for lowest cost approach is approximately \$750. This assumes the base case is a 2x6 wall with R-20 cavity insulation and OSB sheathing. The lowest cost upgrade to meet the proposed requirement is to sheath the exterior with rigid, one-inch, R-5 extruded polystyrene foam board. Meet sheer bracing requirements with half-inch OSB, overlaid with half-inch foam, at corners and as needed elsewhere. Door jambs are extended.
- Basement walls. Increase for lowest cost approach is approximately \$550. This assumes the base case is an unfinished basement insulated with vinyl-faced, R-11 interior fiberglass drape, upgraded to a similar product rated R-19.
- Air leakage reduction. Approximately \$100 increase. Minimal cost for this based on 2007 new home performance study observations (see “Context” below).
- Total cost increase for the prototype building, with a basement, is estimated in the range of \$2200 to \$2500 (“Very high” cost).

Cost increases for the other two foundation types:

- Crawl space walls. Increase from R-11 continuous blanket to R-19 continuous blanket is approximately \$270. (Note: few new Fort Collins homes have crawl spaces; when they do, the crawl space is frequently a small portion of the total foundation.)
- Slab-on-grade perimeter. Increase from R-10 rigid insulation board, extending 2’ below grade to the same product, extending 4’ below grade, is approximately \$475.

Lost Opportunity

The components addressed in this proposed amendment include some that will likely never be altered once the building has been built (air sealing, frame walls, slab-on-grade perimeter), others that will be very infrequently addressed (windows, typical service life 20+ years, high replacement cost) and others that could be modified, at higher cost, at any time (attics, crawl space walls). The situation varies for basement walls depending on whether the basement is finished or unfinished.

Implementation

Availability of Products and/or Services

The only potential obstacle appears to be that few, if any, wood-framed windows meet the 0.30 U-factor specification. This requirement can be met with vinyl-framed and some composite-framed windows. It is anticipated that more choices will be available soon, as ENERGY STAR has adopted this window specification.

Practicality

The most challenging proposed change is liable to be the frame walls requirement; it will require exterior foam sheathing (currently used by a small number of builders) with alternative methods

used to meet shear requirements, framed walls of 2x8 construction or alternative building systems (e.g. structural insulated panels, double-frame-wall).

Certification Issues

None

Enforcement Procedures

Permit application/plan review: Plan reviewer will check thermal specifications for these building components. (No change from current procedures)

Field inspection: Building inspectors will check that specified materials have been installed. (No change from current procedures)

Certificate of Occupancy: Nothing additional.

Support Materials Needs

None

Training Needs - Industry

No training specific to this proposed amendment is needed. These changes will be addressed in mandatory training on building code updates and comprehensive building envelope training.

Training Needs – Staff

None

Background

Current Practice

In previous versions of the Fort Collins building code, new Fort Collins electrically heated buildings were required to meet more rigorous thermal specifications than gas-heated buildings (see table in “Context” below).

No field surveys of electrically heated buildings have been performed to confirm that these specifications were followed. In recent years, most builders chose to comply with energy code using the Simulated Performance Alternative path, which provided many tradeoff opportunities.

According to Building Department records, no new electrically heated single-family homes have been built in Fort Collins for at least six years (with the exception of a very small number of ground-source heat pumps, exempted from this proposed requirement). Electric heat is used on occasion in remodels and additions.

Context

Since at least the 1996 energy code, Fort Collins has locally amended the model codes to require electrically heated buildings to meet more stringent building envelope thermal specifications than for gas-heated buildings. This reflected the substantially higher cost of delivered energy for electric heat compared with gas heat. Currently, delivered energy from electric heat at 100% efficiency is approximately 2.5 times more expensive than delivered energy from gas heat at 80% efficiency.

The 2009 IRC, adopted by City Council in September 2010, makes no distinction between requirements for buildings with electric versus gas heating systems. The recently adopted code reduces envelope thermal specifications for electric heat. The proposed amendment will restore the approach used in the past. The following table compares requirements in the 2005 Fort Collins code versus the 2009 IECC and this proposed amendment.

Component	Building Envelope Thermal Specifications		
	2005 FC Code (electric heat)	2009 FC Code (any heating system)	Proposed green amendment (electric heat)
Air sealing	ACH 5.0 (blower-door compliance path)	ACH 7.0 (1)	ACH 3.0
Windows	0.35 U-factor	0.35 U-factor	0.30 U-factor (5)
Ceilings	R-49	R-38	R-49 (2,3,4)
Wood frame walls	R-21	R-20 or R-13+R-5	R-20+R-5
Mass walls	R-15	R-13 / R-17 (R-17 applies if more than half the insulation is on interior of mass wall)	R-15 / R-19 (R-19 applies if more than half the insulation is on interior of mass wall) (2,3)
Basement walls	R-10 continuous or R-13 cavity in frame construction	R-10 continuous or R-13 cavity in frame construction	R-15 continuous or R-19 cavity in frame construction (3)
Crawl space walls	R-19	R-10 continuous or R-13 cavity in frame construction	R-15 continuous or R-19 cavity in frame construction
Slab-on-grade perimeter	R-10 to 4' below grade	R-10 to 2' below grade	R-10 to 4' below grade (2,3)

(1) Another proposed green amendment would lower this to ACH 4.0 (see Air Sealing amendment)

(2) Matches 2005 Fort Collins code electric heat requirement

(3) Matches specification in 2009 International Energy Conservation Code, Climate Zone 6.

(4) Matches specification in draft 2012 International Energy Conservation Code, Climate Zone 5 (which is not tied to type of heating fuel)

(5) Matches ENERGY STAR window requirement for this climate zone. Draft 2012 International Energy Conservation Code (which is not tied to type of heating fuel) specifies 0.32 U-factor.

If any of the proposed component requirements is an obstacle for a particular project, alternative code compliance options (UA tradeoff, Simulated Performance Alternative) provide flexibility.

Related Green Building Practices

Installation details for building envelope components are critical in achieving installed performance that matches rated performance. These details are addressed with other proposed amendments (Air Sealing, Insulation Installation, Fenestration Installation).

Known Objections

- Higher first cost for electrically heated buildings