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ADVISORY COMMITTEE COMMENT FORM

FOR PROPOSED CODE CHANGES

(This form must be submitted electronically)

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IECC RE- 9

Proposed Code Change - Language

Please provide your proposed code change in strikeout/underline format. Provide the *specific* language you would like to see changed, with new words underlined and words to be deleted should be striken. Also, state whether the language contained in your proposal is from a code book or from an amendment currently found in Minnesota Rule. (You may provide the language (electronically) on a separate, attached sheet).

See next page

R402.1.1 Insulation and fenestration criteria.
The *building thermal envelope* shall meet the requirements of Table R402.1.1 based on the climate zone specified in Chapter 3.

TABLE R402.1.1 INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR[b]	SKYLIGHT[b] *U*-FACTOR	GLAZED FENESTRATION SHGC[b, e]	CEILING *R*-VALUE	WOOD FRAME WALL *R*-VALUE	MASS WALL *R*-VALUE[i]	FLOOR *R*-VALUE	BASEMENT[c] WALL *R*-VALUE	SLAB[d] *R*-VALUE & DEPTH	CRAWL SPACE[c] WALL *R*-VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.35	0.55	0.25	38	20 or 13+5[h]	8/13	19	5/13[f]	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13+5[h]	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5[h]	13/17	30[g]	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	20+5 or 13+10[h]	15/20	30[g]	~~15/19~~ 10	10, 4 ft	~~15/19~~ 10
7 and 8	0.32	0.55	NR	49	20+5 or 13+10[h]	19/21	38[g]	~~15/19~~ 10	10, 4 ft	~~15/19~~ 10

c. "15/19" means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. "15/19" shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home. "10/13" means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation at the interior of the basement wall.

For SI: 1 foot = 304.8 mm.

a. *R*-values are minimums. *U*-factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R*-value of the insulation shall not be less than the *R*-value specified in the table.

b. The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration. Exception: Skylights may be excluded from glazed fenestration SHGC requirements in Climate Zones 1 through 3 where the SHGC for such skylights does not exceed

0.30.

c. "~~15/19~~10" means R-~~15~~ 5 continuous insulation on the interior or exterior of the foundation wall. ~~home or R-19 cavity insulation at the interior of the basement wall.~~ An additional minimum R-5 continuous insulation must be installed on the exterior or interior of the foundation wall or an R-13 cavity insulation on the interior of the foundation wall. "~~15/19" shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the "10/13" means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation at the interior of the basement wall~~.

d. R-5 shall be added to the required slab edge R-values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Climate Zones 1 through 3 for heated slabs.

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

f. Basement wall insulation is not required in warm-humid locations as defined by Figure R301.1 and Table R301.1.

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

h. First value is cavity insulation, second is continuous insulation or insulated siding, so "13+5" means R-13 cavity insulation plus R-5 continuous insulation or insulated siding. If structural sheathing covers 40 percent or less of the exterior, continuous insulation *R*-value shall be permitted to be reduced by no more than R-3 in the locations where structural sheathing is used – to maintain a consistent total sheathing thickness.

i. The second *R*-value applies when more than half the insulation is on the interior of the mass wall.

R402.1.3 *U*-factor alternative.
An assembly with a *U*-factor equal to or less than that specified in Table R402.1.3 shall be permitted as an alternative to the *R*-value in Table R402.1.1.

TABLE R402.1.3 EQUIVALENT U-FACTORS[a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR	SKYLIGHT *U*-FACTOR	CEILING *U*-FACTOR	FRAME WALL *U*-FACTOR	MASS WALL *U*-FACTOR[b]	FLOOR *U*-FACTOR	BASEMENT WALL *U*-FACTOR	CRAWL SPACE WALL *U*-FACTOR
1	0.50	0.75	0.035	0.082	0.197	0.064	0.360	0.477
2	0.40	0.65	0.030	0.082	0.165	0.064	0.360	0.477
3	0.35	0.55	0.030	0.057	0.098	0.047	0.091[c]	0.136
4 except Marine	0.35	0.55	0.026	0.057	0.098	0.047	0.059	0.065

5 and Marine 4	0.32	0.55	0.026	0.057	0.082	0.033	0.050	0.055
6	0.32	0.55	0.026	0.048	0.060	0.033	~~0.050~~ 0.059	~~0.055~~ 0.065
7 and 8	0.32	0.55	0.026	0.048	0.057	0.028	~~0.050~~ 0.059	~~0.055~~ 0.065

a. Nonfenestration U-factors shall be obtained from measurement, calculation or an approved source.

b. When more than half the insulation is on the interior, the mass wall U-factors shall be a maximum of 0.17 in Climate Zone 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.

c. Basement wall U-factor of 0.360 in warm-humid locations as defined by Figure R301.1 and Table R301.1.

Proposed Code Change – Need and Reasonableness

Please provide a thorough explanation of the need for this change and why this proposed code change is a reasonable change. During the rulemaking process, the Agency must defend the need and reasonableness of all its proposed changes. The Agency must submit evidence that is has considered all aspects of the proposal. (You may provide the need and reason (electronically) on a separate attached sheet).

Overview of Existing Minnesota Residential Energy Code Requirements for Foundation Walls

The current Minnesota Residential Energy Code (Chapter 1322) requires a minimum R-10 for foundation insulation (basement walls and crawlspace walls) for climate zones 6 & 7. The minimum R-values can be installed on the interior or exterior of the home. There are VERY prescriptive requirements for installing different types of insulation to avoid moisture problems, especially for interior foundation wall insulation applications. See Attachment A for the numerous pages of the current 1322 rule that outlines when and how builders can insulation foundations in Minnesota. To translate these code requirements into visual guides the Builders Association of Minnesota used a grant from the US Dept of Energy and the MN Dept of Commerce to create a “Field Guide to the Residential Energy Code”. See Attachment B for this guide’s Illustrations 6-19 or download from http://www.bamn.org/fieldguide-foundations.pdf

Why is Minnesota’s current energy code so complicated when it comes to basements and crawl spaces? Because incorrectly insulated basement and crawl space walls in Minnesota have very dramatic failures. Minnesota winters require interior insulation with a very effective air barrier or condensation will occur. Interior insulation is also prone to summer condensation from warm humid (July/August) air that moves through the above grade portion of basement walls and condenses on the interior insulation layer and studs. Insulating on the exterior of the foundation wall is a best practice that building scientists, The Minnesota Department of Commerce and the Builders Association of Minnesota has been promoting for well over a decade but not all builders use this method due to additional cost and the complexities of covering the insulation on the above grade part of the wall.

Overview of 2012 IECC's Residential Energy Code Requirements for Foundation Walls

Compared to the current Minnesota Residential Energy Code requirements for basements, the proposed 2012 IECC has:

- Higher R-values: minimum R-15 for exterior foundation insulation and R-19 for interior foundation insulation
- No requirements to prevent moisture issues,
- An approved method of interior basement wall insulation (cavity insulation) that Minnesota builders, building scientists, and energy experts have tried to prevent ever since failures began to emerge after using it in the housing stock.

<u>The stricter R-value requirements and the non-existent moisture prevention requirements of the 2012 IECC are not reasonable for Minnesota's climate. These increased R-values are not needed due to minimal energy gains and are not reasonable due to moisture problems which will occur by following the 2012 IECC's lack of attention to basic building science principals.</u>

Higher R-Values will not benefit Minnesota homeowners

Higher R-values are not always "better" when it comes to promoting durable, cost-effective, energy saving foundation walls in Minnesota. During the last energy code adoption cycle the Minnesota Department of Labor and Industry hired the University of Minnesota to create recommendations for the Minnesota Residential Energy Code based on research specific to Minnesota's two climate zones. The entire report called the MINNESOTA ENERGY CODE BUILDING FOUNDATION RULE: AMENDMENT PROPOSAL DEVELOPMENT PROJECT FINAL REPORT is located at http://www.buildingfoundation.umn.edu/FinalReportWWW/default.htm

Chapter 5 of Dr. Louise Goldberg's report is titled Optimum Foundation Insulation Thermal Resistance Determination. This part of the final report contains very relevant information for this code proposal (See Attachment 3). Dr. Goldberg used very rigorous modeling to determine at what specific R-value additional insulation on foundation walls would no longer give a cost-effective energy benefit to a homeowner. Four cities were used in this modeling: Minneapolis in climate zone 6 (Figure 5.1), St. Cloud in climate zone 6 (Figure 5.2) Duluth in climate zone 7 (Figure 5.3) and International Falls in climate zone 7 (Figure 5.4). The graphs in Chapter 5 of Dr. Goldberg's report visualize the law of diminishing returns. Meaning that at some point simply adding more and more insulation does not produce more and more energy savings for homeowners. Or in technical terms from the report:

> As figures 5.1 through 5.4 are quite similar, discussion of the Minneapolis case details is sufficient. The energy savings increase steeply (declining normalized envelope heat flow) until about R-5 where the gradient starts to flatten significantly. Beyond R-5, the increase in energy savings with increasing wall insulation R-value decreases until it asymptotes to approximately a straight line at R-10. A least squares regression fit to the heat flow curve from R-10 onwards is within the experimental limits for all climates. The absolute magnitude of the simulated heat flow at R-10 is greater than those measured by about 5% for the Minneapolis climate. This is partly accounted for by the measured 4% increase in energy consumption produced by a masonry block wall (in comparison with poured concrete) offset by approximately a 9% decrease in energy consumption because the experimental configurations were constrained to have an adiabatic boundary condition on the wall top surface (the simulations have a diabatic boundary condition at that location).

Note: Merriam-Webster defines *adiabatic* as occurring without loss or gain of heat.

The line for envelope heat flow “asymptotes”. Merriam-Webster defines *asympotote* as a straight line associated with a curve such that as a point moves along an infinite branch of the curve the distance from the point to the line approaches zero and the slope of the curve at the point approaches the slope of the line. In English, in this case the “normalized envelope heat flow” approaches a limit (R-10) when there is very little or no benefit to adding more insulation. The line above R-10 flattens out and looks more like a flat line than a curve.

During Minnesota’s Here is the summary of the research results for all four Minnesota climate locations:

> The optimization results for all four climates are summarized in table 5.1.

Table 5.1 Full basement optimum insulation summary

Climate	Insulation Layer R-value (ft^2.h.F/Btu)		
	Minimum	Maximum	Average
Minneapolis	9.00	10.46	9.73
St. Cloud	9.46	10.89	10.18
Duluth	10.05	11.41	10.73
International Falls	10.28	11.62	10.95

> The overall optimum R-values range from a minimum of R-9.00 in Minneapolis to a maximum of R-11.62 in International Falls, with the average ranging from R-9.73 through R-10.95. The nearest standard thickness of any standard continuous insulation product is 2 in. of extruded polystyrene with an R-value of 10 and thus this is selected as the optimum. The data do not reveal a basis for requiring the significantly higher levels of insulation in the northern half of the state stipulated in the 2003 IECC as equivalent continuous uniform R-values (including finish R-value and surface convection coefficients) ranging from R-12.5 in the south to R-16.7 in the north.

Critics could argue that requiring only an R-10 in International Falls does not optimize the insulation benefit for homeowners in this part of the state. However, as the report indicates requiring an R-10 in the Twin Cities area (Minneapolis) provides too much insulation for homeowners in this part of the state. There are many more homes built in the Twin Cities than in the most extreme climate conditions in Minnesota. R-10 is an acceptable level of insulation for the entire state based on the University of Minnesota’s extensive research and the existing building materials and methods used by the industry.

The Builders Association of Minnesota, the National Association of Home Builders and many other groups representing homeowner’s interests have tried in vain to find the basis for the U.S. Department of Energy (DOE) code proposals to require higher than R-10 foundation wall values in climate zones 6 & 7. The research and modeling assumptions have not been made public. <u>Until DOE or the International Code Council can refute the Minnesota data provided by the University of Minnesota to the Minnesota Department of Labor and Industry it is NOT reasonable to require foundation walls to be built with a minimum R-15 exterior and R-19 interior insulation layer.</u>

The Proposed 2012 IECC Will Cause Mold Problems in Minnesota Homes

As written, the 2012 IECC allows a home builder to install R-19 fiberglass batts in a stud wall placed directly against the interior foundation wall. Unfortunately many homeowners now know that this is not a durable construction method. There are many ways for an insulated foundation wall to create condensation under typical winter or summer weather conditions in Minnesota. When insulated on the interior there is very little to zero ability for the stud cavity to dry out. The result? Mold and rot. These pictures of a home with a significant moisture problem in the basement wall are worth a 1,000 words.

This home was built with a block foundation wall. The basement walls were finished with a frame wall covered by sheetrock on the interior. Homeowners did not know about the problem until they had remodeling work done which found the problem.

The basement wall was insulated on the interior. The polyethylene sheet served as the air barrier. Note the dry, undamaged wood directly above the foundation wall indicating the moisture did not come from rainwater

The moisture migrated through the block wall on hot, humid days and condensed on the cold poly sheet. The wall could only dry to the outside on the above grade portion of the block wall. This drying ability was not enough to save the sill plate and framing.

Minnesota has long history of moisture problems in insulated basements. The current Minnesota Residential Energy Code (Chapter 1322) has very specific requirements that prevent moisture problems. We don't want to go backwards with the unamended 2012 IECC and ignore basic building science principals. To avoid rotting frame walls in basements the wood framing must be warm and dry. The best way to accomplish this is to install an industry standard grade adjacent to the exterior of a foundation wall, an exterior vapor barrier, drain tile and a minimum R-5 continuous insulation installed on the interior or exterior of the foundation wall (hereinafter "Minimum Foundation Insulation"). Provided Minimum Foundation Insulation is

installed, a wood frame wall with cavity insulation can be installed in the basement without the risk of the studs deteriorating due to moisture from condensation caused by improperly insulating the foundation wall.

It is impossible to build a foundation wall with an R-15 insulation layer on the exterior with existing construction materials and methods unless builders add additional layers to the interior. Interior insulation is effective but loses thermal mass energy benefit of exterior foundation insulation. More importantly, adding a continuous layer of insulation on both sides of the foundation wall allows zero drying capability to either side of the wall.

The R-15 and R-19 requirements in the 2012 IECC prevent the most proven method of foundation wall construction in Minnesota. Why would we promulgate a state energy code that PREVENTS a long-proven insulation method that is durable and energy efficient? This code proposal is reasonable because it allows for an easy solution that will prevent moisture problems and meet the optimized R-10 insulation level for Minnesota's climate. This proposal allows cavity insulation on the interior only when there is an R-5 layer of continuous insulation installed against the foundation wall as a first step. There are many well proven methods and insulation materials that are already used in Minnesota to accomplish this task. The additional R-5 layer required by code can be accomplished by this proposal also allows for the continued use of an exterior applied R-10 layer which would not be acceptable under the 2012 IECC requirements for climate zones 6 and 7.

Proposed Code Change – Cost/Benefit Analysis

Please consider whether this proposed code change will increase/decrease costs or indicate that it will not have any cost implications and explain how it will not. If there is an increased cost, will this cost be offset somehow by a life safety or other benefit? If so, please explain. Are there any cost increases/decreases to enforce or comply with this proposed code change? If so, please explain. (You may provide the cost/benefit analysis (electronically) on a separate, attached sheet).

This method would not increase the cost of construction except for builders in climate zone 6 that are using the existing trade-off which allows R-5 exterior insulation for increased attic insulation and a more efficient furnace or boiler. The R-5 option will no longer be allowed in the new Minnesota Residential Energy Code when this proposal is incorporated. For all other builders this method will not increase the cost of current construction.

Other Factors to Consider Related to Proposed Code Change

1. Is this proposed code change meant to:

   X change language contained in a published code book? If so, list section(s).
   2012 IECC R402.1.1 and R402.1.3

   ☐ change language contained in an existing amendment in Minnesota Rule? If so, list Rule part(s).
   ☐ delete language contained in a published code book? If so, list section(s).
   ☐ delete language contained in an existing amendment in Minnesota Rule? If so, list Rule part(s).
   ☐ neither; this language will be new language, not found in the code book or in Minnesota Rule.

2. Is this proposed code change required by a Minnesota Statute or new legislation? If so, please provide the citation to the Statute or legislation. NO

3. Will this proposed code change impact other sections of a published code book or of an amendment in Minnesota Rule? If so, please list the affected sections or rule parts. NO

4. Will this proposed code change impact other parts of the Minnesota State Building Code? If so, please list the affected parts of the Minnesota State Building Code. NO

5. Who are the parties affected or segments of industry affected by this proposed code change?
   Homeowners, home builders, building code officials, insulators, insulation suppliers

6. Can you think of other means or methods to achieve the purpose of the proposed code change? NO
   If so, please explain what they are and why your proposed change is the preferred method or means to achieve the desired result.

7. Are you aware of any federal requirement or regulation related to this proposed code change? If so, please list the regulation or requirement. NO