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November 30, 2007

Subject: Framing factor and effective R value of Deltec wall assemblies.

This report summarizes our analysis of Deltec's wall systems to determine the framing factor and effective R-value of Deltec's wall assemblies. This analysis is based on photographs of two types of wall assemblies (a standard Deltec wall and a Deltec "energy" wall) provided to us by Deltec. Framing factors were computed algebraically based on the framing makeup of these walls. Wall sections with windows were computed based on a single 3' by 5' window in the wall section, using the same framing techniques around the window as are shown in the photographs.

Framing factor:

Calculated framing factors are shown in Table 1 below for various types of wall panel. All calculations are based on a standard 8' wide panel. Blocking is provided for nailing on 9' and 10' high panels, and is not provided on 8' high panels. Framing factors are provided for wall sections with and without windows. An "average" framing factor is calculated based on a combination of wall sections with one 3'x5' window and wall sections without windows that results in 15% window to wall area ratio (shown in bold). In general, this is the value that should be used to calculate effective wall R-value. For walls with a significantly larger or smaller window to wall ratio, the appropriate weighted average of the "no window" and "with 3x5 window" could be used instead to obtain a more accurate effective R-value.

Framing factors for the standard Deltec wall apply to either 2x4 or 2x6 construction with studs 16" on center. The "energy wall" is a 2x6 wall with studs 24" on center. Blocking for the 9' and 10' high energy wall is a 2x4 member that allows for partial insulation behind the blocking.

Table 1 also includes framing factors for stick-built walls and Structural Insulated Panel (SIP) walls for reference. The stick-built walls include standard 16" on center walls, and 24" on center walls with advanced framing. "Advanced framing" includes two-stud insulated corners, and ladder-style T-walls to reduce thermal bypasses due to framing. These values were obtained from the latest HERS (home energy rating system) guidelines. The amount of wood framing in SIP panels varies significantly between manufacturers. We include two examples – a polyurethane SIP that has no wood framing in the wall (ie, connections are made with a CAM lock or other device that can be embedded in the insulation), and a 8 ft by 9 ft polystyrene SIP that has one 2x4 or 2x6 at the edges of each panel and around each window.

Type of wall section	Wall height	Framing factor
Standard Deltec wall, no windows	8'	0.19
Standard Deltec wall, no windows	9'	0.21
Standard Deltec wall, no windows	10'	0.20
Standard Deltec wall, with 3'x5' window	8'	0.28
Standard Deltec wall, with 3'x5' window	9'	0.29
Standard Deltec wall, with 3'x5' window	10'	0.28
Average framing factor for standard Deltec wall	**8'**	**0.25**
Average framing factor for standard Deltec wall	**9'**	**0.27**
Average framing factor for standard Deltec wall	**10'**	**0.26**
Deltec energy wall, no windows	8'	0.11

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Deltec energy wall, no windows	9’	0.11
Deltec energy wall, no windows	10’	0.11
Deltec energy wall, with 3’x5’window	8’	0.16
Deltec energy wall, with 3’x5’window	9’	0.16
Deltec energy wall, with 3’x5’window	10’	0.16
Average framing factor for Deltec energy wall	**8’**	**0.14**
Average framing factor for Deltec energy wall	**9’**	**0.15**
Average framing factor for Deltec energy wall	**10’**	**0.15**
Reference value – Standard stick-built (16” oc)	8’	0.23
Reference value – Standard stick-built (16” oc)	10’	0.22
Reference value – Advanced framing (24” oc)	8’	0.16
Reference value – Advanced framing (24” oc)	10’	0.15
Reference value – polyurethane SIP with no framing	any	0.00
Reference value – polystyrene SIP with framing	9’	0.08

Table 1. Framing factors.

Effective R-value:

Based on the calculated framing factors (above), we have calculated an effective R-value for various Deltec wall assemblies. Effective R-values of several other types of wall system are also presented for reference. All effective R-values were calculated using the REMrate software package. It is important to note that manufacturers of various insulation materials report “effective” R-values that are based on widely varying assumptions. For instance, “effective” R-values for foam insulation often try to include air sealing effects. Although foam insulation products generally are more effective due to air sealing, it is difficult to combine this accurately into an “effective R value”. We prefer to report R-values that relate to thermal conduction only, with the understanding that foam insulation products also offer further energy-saving benefits related to air sealing. Thus, the values provided below apply only to the thermal conduction performance of the wall, including insulation and framing members. All of the values below include gypsum board on the inside of the wall, OSB and exterior finish on the exterior, and interior and exterior air films.

Effective R-values for all wall sections with Fiberglass batt insulation below are assumed to be installed according RESnet’s guidelines for a “grade 2” installation. This allows for no more than 2% of the insulation surface area to be missing, and no more than 10% of the surface area compressed or filled incompletely. Compression and incomplete fill is no less than 70% of the intended thickness. Effective R-values for other insulation types shown below are based on a RESnet “grade 1” installation, which allows only occasional very small gaps and compression or incomplete fill of 2% or less. Areas of incomplete fill are no less than 70% of the intended thickness.

All Deltec “Energy walls” shown below include R5 Foam continuously applied to the exterior of the wall.

Values for standard stick-built, advanced framed walls, and SIP walls are included for reference. The SIP walls shown with polyurethane core assume no wood framing in the SIP. Polystyrene-core SIP walls are more commonly used, and these usually contain some wood framing. The framing factor used for the Polystyrene SIPS shown here is 8%, per our calculation above.

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Type of wall	Cavity insulation	Wall height	Framing factor	Effective R-value
Standard 2x4 Deltec wall	R13 Fiberglass batt	8’	0.25	10.9
Standard 2x4 Deltec wall	R13 Fiberglass batt	9’	0.27	10.6
Standard 2x4 Deltec wall	R13 Fiberglass batt	10’	0.26	10.7
Standard 2x4 Deltec wall	Cellulose (R 3.8/inch)	8’	0.25	11.6
Standard 2x4 Deltec wall	Cellulose (R 3.8/inch)	9’	0.27	11.4
Standard 2x4 Deltec wall	Cellulose (R 3.8/inch)	10’	0.26	11.5
Standard 2x4 Deltec wall	Foam (R 4.2/inch)	8’	0.25	12.2
Standard 2x4 Deltec wall	Foam (R 4.2/inch)	9’	0.27	11.9
Standard 2x4 Deltec wall	Foam (R 4.2/inch)	10’	0.26	12.0
Standard 2x6 Deltec wall	R19 Fiberglass batt	8’	0.25	14.7
Standard 2x6 Deltec wall	R19 Fiberglass batt	9’	0.27	14.5
Standard 2x6 Deltec wall	R19 Fiberglass batt	10’	0.26	14.5
Standard 2x6 Deltec wall	Cellulose (R 3.8/inch)	8’	0.25	16.7
Standard 2x6 Deltec wall	Cellulose (R 3.8/inch)	9’	0.27	16.4
Standard 2x6 Deltec wall	Cellulose (R 3.8/inch)	10’	0.26	16.4
Standard 2x6 Deltec wall	3.5” Foam (R 4.2/inch)	8’	0.25	14.5
Standard 2x6 Deltec wall	3.5” Foam (R 4.2/inch)	9’	0.27	14.3
Standard 2x6 Deltec wall	3.5” Foam (R 4.2/inch)	10’	0.26	14.3
Standard 2x6 Deltec wall	5.5” Foam (R 4.2/inch)	8’	0.25	17.5
Standard 2x6 Deltec wall	5.5” Foam (R 4.2/inch)	9’	0.27	17.2
Standard 2x6 Deltec wall	5.5” Foam (R 4.2/inch)	10’	0.26	17.2
Deltec Energy wall	R19 Fiberglass batt	8’	0.14	22.7
Deltec Energy wall	R19 Fiberglass batt	9’	0.15	22.2
Deltec Energy wall	R19 Fiberglass batt	10’	0.15	22.2
Deltec Energy wall	Cellulose (R 3.8/inch)	8’	0.14	25.0
Deltec Energy wall	Cellulose (R 3.8/inch)	9’	0.15	24.4
Deltec Energy wall	Cellulose (R 3.8/inch)	10’	0.15	24.4
Deltec Energy wall	3.5” Foam (R 4.2/inch)	8’	0.14	21.3
Deltec Energy wall	3.5” Foam (R 4.2/inch)	9’	0.15	20.8
Deltec Energy wall	3.5” Foam (R 4.2/inch)	10’	0.15	20.8
Deltec Energy wall	5.5” Foam (R 4.2/inch)	8’	0.14	26.3
Deltec Energy wall	5.5” Foam (R 4.2/inch)	9’	0.15	25.6
Deltec Energy wall	5.5” Foam (R 4.2/inch)	10’	0.15	25.6
Standard 2x4 stick-built (16” oc)	R13 Fiberglass batt	8’	0.23	11.1
Standard 2x4 stick-built (16” oc)	R13 Fiberglass batt	10’	0.22	11.2
Standard 2x4 stick-built (16” oc)	3.5” Foam (R 3.6/inch)	8’	0.23	11.5
Standard 2x4 stick-built (16” oc)	3.5” Foam (R 3.6/inch)	10’	0.22	11.6
2x6 Advanced Framing (24” oc)	R19 Fiberglass batt	8’	0.16	16.1
2x6 Advanced Framing (24” oc)	R19 Fiberglass batt	10’	0.15	16.1
2x6 Advanced Framing (24” oc)	5.5” Foam (R 3.6/inch)	8’	0.16	17.9

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2x6 Advanced Framing (24" oc)	5.5" Foam (R 3.6/inch)	10'	0.15	18.2
SIP with no wood framing	R-25 polyurethane core	any	0	27.7
SIP with no wood framing	R-39 polyurethane core	any	0	41.7
SIP with wood framing	R-17 polystyrene core	9'	0.08	16.9
SIP with wood framing	R-17 polystyrene core	9'	0.08	23.3

Table 2. Wall assembly R-values.

Photo 1. Deltec standard wall.

Photo 2. Deltec energy wall.