Technical Report

Calculated R-values for Five Roof Assemblies with DECRA Roofing Panels

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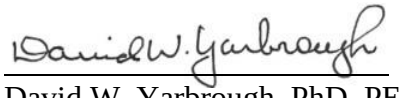

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R-values for five roof assemblies that include DECRA panels[1] that when installed above a low-emittance surface provide an enclosed reflective airspace have been calculated using published correlations for the contribution of the airspace to the overall thermal resistance.[2] The reflective airspace is created by a layer of Low-E Therma-Sheet present below the DECRA panels. The R-values shown in this report are for the regions between the framing. The R-values include all of the resistances between the exterior air and the air below the roof sheathing. Figures 1, 2, and 3 contain pictures of the five DECRA panels that are included in this analysis. The heat flow direction was taken to be downward across a roof built with 6/12 pitch. The boundary temperatures for the calculation were exterior region at 120°F and 90°F attic air temperature. The thermal resistance values for the materials in the roof assemblies are listed in Table 1. All of the assemblies included in this report have the same material R-values except for the enclosed reflective air space. The thermal resistance for the reflective air spaces depends on the shape and dimensions of the DECRA panel used in the assembly. Four roof assembly designs that differ with respect to the size of the air space created by battens and counter-battens were evaluated for each panel.

Design 1. DECRA panel attached directly to Thermal-Sheet

Design 2. DECRA panel separated from Therma-Sheet by a 0.75-inch air-space

Design 3. DECRA panel separated from Therma-Sheet by a 1.50-inch air-space

Design 4. DECRA panel separated from Therma-Sheet by a 2.25-inch air-space

Figure 1. DECRA Roofing Profiles: Shake and Shake XD

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Figure 2. DECRA Roofing Profile: Shingle

Figure 3. DECRA Roofing Profiles: Tile and Villa Tile

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Table 1. Physical Properties Used to Calculate Thermal Resistance

Component	Property	Value
Exterior air film	R-value*	0.25
Interior air film	R-value	0.76
Roof Panel	R-value	0.10
	Emittance	0.90
Therma-Sheet (1/8TH in.)	R-value	0.50
	Emittance	0.03
Roof Sheathing (5/8 in.)	R-value	0.68

*$ft^2 \cdot h \cdot °F/Btu$

The parallel path method was used to evaluate the thermal resistance of the enclosed reflective air space when the thickness of the air space varied. The reflective air space was then taken to be in series with the other thermal resistances in the assembly and air films. Figure 4 shows a composite plot of R-values for the five DECRA Panels evaluated with four air-space values; 0, 0.75 , 1.5 , 2.25 .

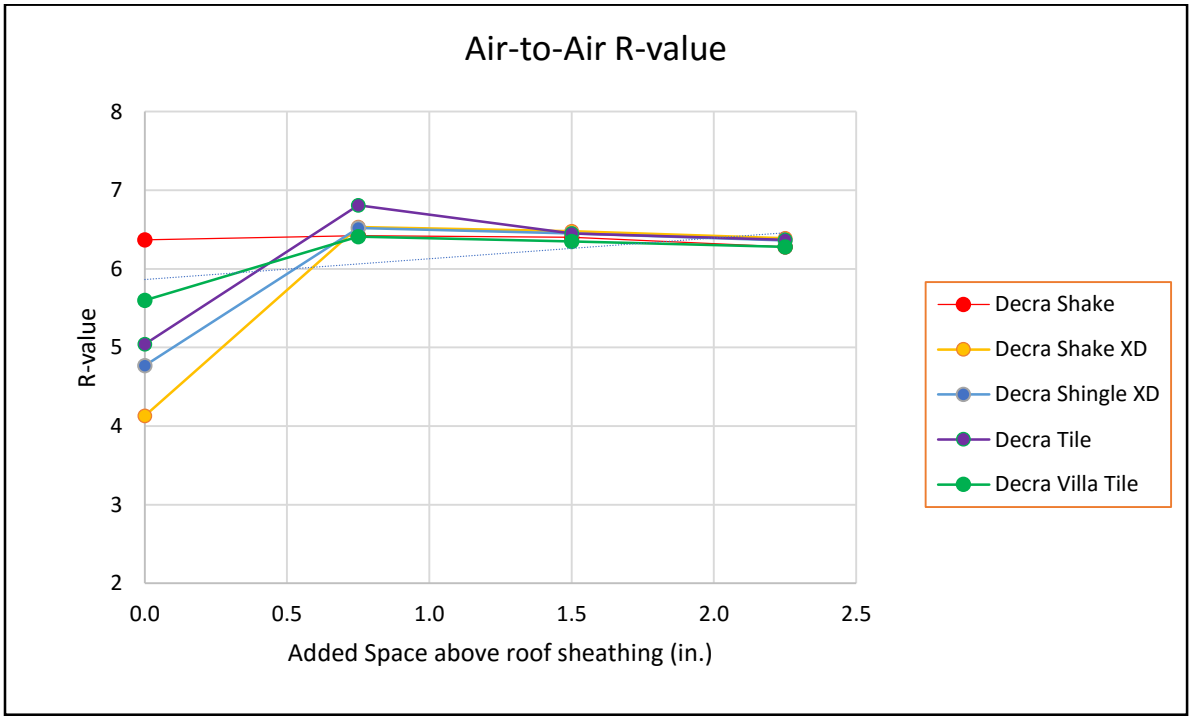

Figure 4. R-values for Five DECRA Panels with Air Spaces from 0 to 2.25 Inches

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Table 2 contains the numerical results shown graphically in Figure 4 for the air-to-air thermal resistance and the contribution of the enclosed reflective air space to the overall air-to-air R-value.

Table 2. Calculated R-values for the DECRA Roof Assemblies

Panel Type	Added Air Space (inches)	R for Reflective Air Space	R air-to-air
Shake	0	4.08	6.37
	0.75	4.21	6.50
	1.50	4.11	6.40
	2.25	4.03	6.32
Shake XD	0	1.84	4.13
	0.75	4.24	6.53
	1.50	4.19	6.48
	2.25	4.10	6.39
Shingle XD	0	2.48	4.77
	0.75	4.23	6.52
	1.50	4.16	6.45
	2.25	4.07	6.36
Tile	0	2.75	5.04
	0.75	4.52	6.81
	1.50	4.16	6.45
	2.25	4.08	6.37
Villa Tile	0	3.21	5.50
	0.75	4.16	6.41
	1.50	4.06	6.35
	2.25	3.99	6.28

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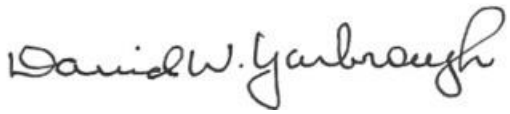
The air-to-air R-values show significant difference when the added air space is zero because of the differences is panel shape. The differences become negligible with added air spaces that reduce the percentage air space differences. At 2.25 inches of added air space, for example, all panels have almost the same total resistance; 6.32, 6.39, 6.36, 6.37, 6.28.



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References

[1] DECRA Roofing Systems, Corona, CA (www.decra.com).

[2] Desjarlais, A.O. and Yarbrough, D.W., "Prediction of the Thermal Performance of Single and Multi-Airspace Reflective Insulation Materials", Insulation Materials: Testing and Applications, 2nd Volume, ASTM STP 1116, R.S. Graves and D.C. Wysocki, Eds., American Society for Testing and Materials (1991) pp 24-43.

[3] Environmentally Safe Products, New Oxford, PA (www. Low-e.com).