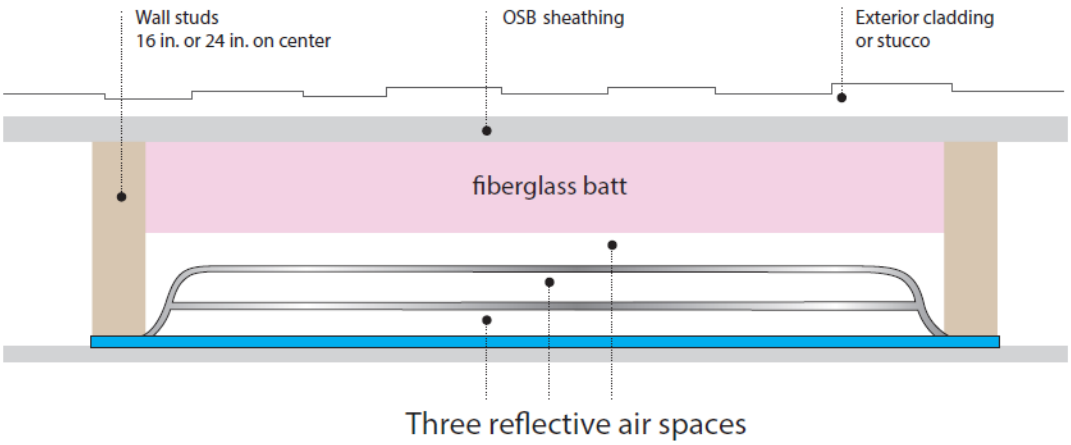
R-values for a Hybrid Insulation System for Frame Walls that Combines Full-Thickness Fiberglass Batts and HY-Fi Reflective Insulation

Description of Assembly

A hybrid assembly consisting of a full-thickness fiberglass batt insulation that partly fills a wall cavity with HY-Fi reflective insulation in the remaining space has been evaluated. R-values for the hybrid assemblies installed in nominal 2 by 6 in. 16 in. or 24 in. OC frame-wall cavities have been calculated. In each case, the 3.5 inch thick fiberglass batt insulation is installed on the exterior side of the cavity with HY-Fi reflective insulation installed in the remaining space on the interior side of the cavity to form three enclosed reflective air spaces as shown in the following figure. The total R-value of the insulated cavity is the sum of the thermal resistance of the fiberglass batt and the thermal resistances of the enclosed reflective air spaces. HY-Fi reflective insulation is manufactured by the Fi-Foil Company located in Auburndale, Florida.



Conditions and Properties

The R-value calculations were done with an average cavity temperature of 75 °F and a temperature difference across the cavity of 30 °F in order to be consistent with ASTM C1224[1] and a Federal Trade Commission requirement that thermal resistances used for labeling be determined at 75°F.[2] . The thermal emittance of the reflective surfaces that are part of HY-Fi were determined to be 0.034 while the thermal emittance of the non-reflective surfaces was taken to be 0.9. This results in an effective emittance of 0.0339 for the enclosed reflective air spaces.

Calculated R-values

R-values for the hybrid insulation assemblies in wall cavity were calculated using the procedure described in ASTM STP 1116 [3] with a two-dimensional adjustments for radiative transport

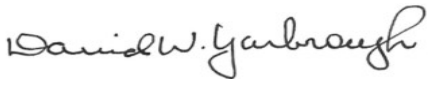
according to Glicksman.[4] The calculation is iterative because the thermal resistance of enclosed reflective air spaces depends on average air gap temperature and temperature difference. These temperatures depend on the thermal resistances of all of the materials in the cavity being evaluated. Table 1 contains the temperatures at the interface between the foam and HY-Fi for each of the seven assemblies that were evaluated The R-value for the reflective air space is obtained when the iterative process converges to a constant value. The results for the R-values of the fiberglass component and the reflective component are shown in Table 2. Table 2 also contains a "Rounded R-value" in accordance with Paragraph 460.11 of the Federal Trade Commission Rule for Residential Insulation Labeling.[4]

Table 1. Temperatures at Interface Between Fiberglass Batt and HY-Fi Reflective Insulation

Fiberglass Batt R	Interface Temperature (°F)
13	72.54
15	71.55

Table 2. Calculated R-values ($ft^2 \cdot h \cdot °F/Btu$) for Hybrid Insulations

Fiberglass Batt R-value	R-value of HY-Fi		Total R		**Rounded R**	
	16 in. OC	24 in. OC	16 in. OC	24 in. OC	16 in. OC	24 in. OC
13	8.72	8.93	21.72	21.93	**22**	**22**
15	8.76	8.97	23.76	23.97	**24**	**24**



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References

[1] ASTM C1224, "Standard Specification for Reflective Insulation for Building Applications" Annual Book of ASTM Standards Vol. 04.06 (2013) pp 698-702.

[2] Federal Trade Commission, 16 CFR 460, "Labeling and Advertising of Home Insulation".

[3] Andre O. Desjarlais and David W. Yarbrough, "Prediction of the Thermal Performance of Single and Multi-Airspace Reflective Insulation Materials", ASTM STP 1116 (1991) pp 24-43.

[4] Leon R. Glicksman, "Two-Dimensional Heat Transfer Effects on Vacuum and Reflective Insulations', *J. of Thermal Insulation* 14 281-294 (1991).