#3945

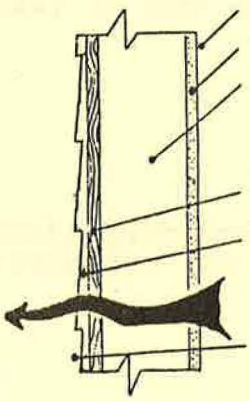
WASHINGTON ENERGY EXTENSION SERVICE

TECHNOTE

AVERAGING R VALUES **TN1511**

We have noticed an error in various manufacturer's literature (as well as an earlier version of our own Heat Loss Calculation factsheet) that has to do with how the heat transfer through a component is figured. While this may seem obvious, it has escaped some firms offering insulation systems that have various components. Specifically, the problem is this: when the heat transfer through a component (like a wall) is figured, one must calculate the R values for all the separate materials comprising the wall and sum them. This will give a total R for the wall which may then be converted to a U value by inverting it. This process leads to error when calculating a weighted R-value for the wall which includes framing.

As the illustration below shows, the heat flow through the framing meets less resistance than heat flowing through an insulated cavity. The difference in the R value is the difference between the insulation and the stud. The two R values are 13.73 and 7.08 respectively.



COMPONENTS	CAVITY R-VALUES	FRAMING R-VALUES
Inside Air Film	0.68	0.68
Gypsum Wallboard (½")	0.45	0.45
Insulation: 2x4 studs or Framing	11.0	4.35
Plywood (½")	0.62	0.06
Bevel Siding (½"x8")	0.81	0.81
Outside Air Film	0.17	0.17
Framing	13.73	7.08

Assuming that the framing comprises 20% of the wall area.

Incorrect

Average = (.2 x 7.08) + (.8 x 13.73) = 12.4 or u = .0806

Correct

Average = (.2 x 1/7.08) + (.8 x 1/13.73)
= (.2 x .14) + (.8 x .073)
= (.028) + (.058) = .086 or R = 11.56

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What often happens is that these R values are weighted according to their proportionate areas to get an average R of 12.4 or a U of 1/12.4 or 0.0806.

This is incorrect. The U value is higher (i.e. the R value is lower). Heat flows that are side by side (rather than straight through) can only be averaged using U values. So, the area R values must be changed to U values first. Then the actual U value of the wall is 0.0865. This is an average R of 1/0.0865 or 11.56.

A good way to keep the distinction in mind is to think of heat flow straight through a composite material as if it were in series--then the R values are additive. When the heat flows are side by side, they are in parallel--then the U values must be used.

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