CARBNews
Consortium for Advanced Residential Buildings
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Double Wall: Staggered or In-Line Studs?

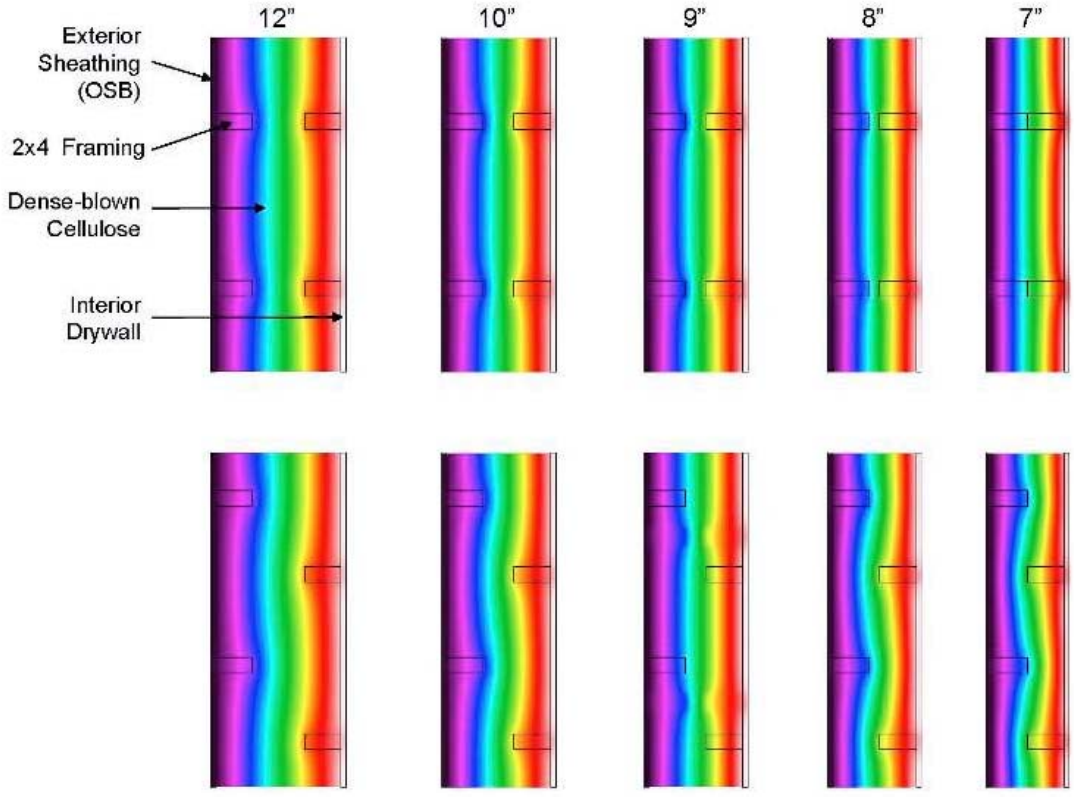
Double walls at an RDI home – before insulation with dense cellulose.

Double walls at an RDI home – after insulation with dense cellulose.

One of the key features of Rural Development, Inc's (RDI's) super-insulated homes is the double wall system. RDI first builds an exterior, load-bearing, 2x4 frame wall (with studs 16" on center). After the home is enclosed, RDI carpenters erect a second 2x4 wall five inches inside the exterior wall. This entire 12" cavity (3.5"+5"+3.5") is netted and filled with dense cellulose for an R-value of approximately 42 ft^2-hr-°F/Btu.

While working with RDI and other builders and insulators using double wall construction, the question came up frequently if it was worth staggering – or offsetting – the inner and outer studs to mitigate thermal bridging. Using Lawrence-Berkeley National Laboratory's THERM software (a finite-element heat transfer simulator), CARB investigated the thermal effect of staggering the studs.

The THERM models consisted of simplified 32" sections with two framed walls (both 2x4 at 16" on center, one with staggered studs and one with aligned studs). The thickness of the wall cavity ranged from 12" (a 5" gap between the interior and exterior framing) to 7" (with no gap between interior and exterior framing). The temperature gradient results are shown below. Boundary conditions are 0°F outside and 70°F inside.



CARB suspected that the difference in the 12" wall would be negligible – that even when studs are directly in-line, a full five inches of cellulose insulation (approximately R-18) would mitigate any serious bridging. The results – in the following table – bear this out. What was more surprising is that the thermal bridging effects remain small even when the studs get closer together. Even when the interior and exterior studs are touching – and there's no thermal break – offsetting the studs only improves performance by approximately R-1.

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Effective R-values for walls from THERM analysis.

	Wall Cavity Thickness	12 in	10 in	9 in	8 in	7 in
	Gap Between Framing	5 in	3 in	2 in	1 in	-
R-Value [ft²hr°F/Btu]	In-line	42.6	35.2	31.5	27.8	23.8
	Offset	42.6	35.5	31.8	28.2	24.7

Of course, there are caveats as with any simplified model like this. This model looked at a perfect 2-dimensional section of clear wall – there were no top or bottom plates, no jack studs, no doors, no headers. Most real-world walls will have at least twice the framing factor, which certainly lowers effective R-value. In such double wall systems, however, door framing, window framing, and wall plates will always be aligned – even when studs in sections of clear wall are staggered.

These modeled walls also have perfect insulation – no gaps, no air spaces, and no air movement. Even the best real-world walls will have some inconsistencies that can compromise performance. Still, this study demonstrates that staggering studs in double walls need not be a major concern. Attention to insulation quality and air sealing is much more important.

Details:
CARB used THERM version 5 for this analysis. Information on THERM is available here: http://windows.lbl.gov/software/therm/therm.html

For reference, thermal properties of the materials used in the model are shown below.

	k Btu/h-ft-°F	R per inch ft²hr°F/Btu
Cellullose Insulation	0.0231	3.6
Softwood Framing	0.0809	1.0
Exterior Plywood	0.1387	0.6
Gyp board	0.0925	0.9

For more information, contact CARB's Robb Aldrich at raldrich@swinter.com.

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