

# Double Stud Wall Assemblies

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## Program Description

With the increasing push for more energy-efficient homes, one method for increasing the R-value is advanced framing of exterior wall assemblies. Double-stud framed walls are a low tech and relatively easy assembly to complete, but they can create a marked increase in the overall performance of an exterior wall assembly. Some potential benefits of a double-stud wall assembly are improved thermal performance, reduced sound transfer, and an increased R-value over using traditional insulation methods and products. However, while double stud wall assemblies offer numerous benefits, they also require a few additional considerations during the construction process to ensure proper moisture management and overall structural integrity.

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## Learning Objectives

1. Understand the components of a double-stud wall assembly.
2. Determine how a double-stud framed wall can allow for increasing R-values, decreasing air permeability, and lowering of exterior noise pollution.
3. Identify and compare the benefits and drawbacks of double-stud walls versus other common wall framing systems.
4. Examine the potential risks within a double-stud wall assembly if improperly designed.

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## Agenda

- What are the Wall R-values in Pennsylvania?
- Take a look at how these R-values will change for the 2021 codes
- Explain double stud wall assemblies and their advantages and disadvantages.
- Compare double stud assemblies to other advanced framing techniques



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## UCC Energy Code Summary



Chapter 11 + Residential Provisions + On our website: [phrc.psu.edu](http://phrc.psu.edu)



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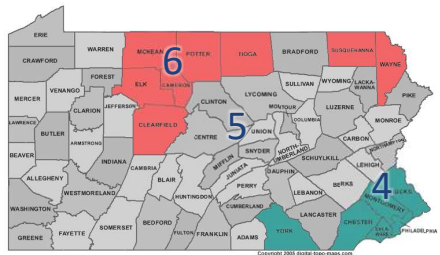
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## Climate Zones in PA



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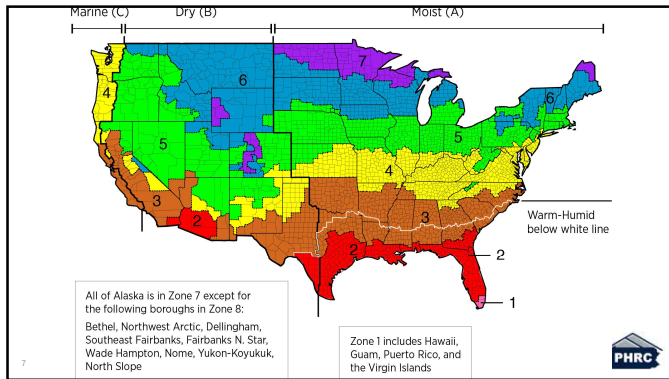
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### 2018 IRC Table N1102.1.2

Table N1102.1.2 (R402.1.2)  
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT \*

Climate Zone	Fenestration U-FACTOR	SKYLIGHT† U-FACTOR	GLAZED FENESTRATION SHGC‡	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE	FLOOR R-VALUE	BASEMENT† WALL R-VALUE	SLAB† R-VALUE & DEPTH	CRAWL SPACE† WALL R-VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.35	0.55	0.25	38	20 or 13 + 5"	8/13	19	5/12"	0	5/13
4 except Marine	0.32	0.55	0.40	49	20 or 13 + 5"	8/13	19	10/13	10, 2 ft	10/13
5 and Marine	0.30	0.55	NR	49	20 or 13 + 5"	13/17	30"	15/19	10, 2 ft	15/19
6	0.30	0.55	NR	49	20 + 5" or 13 + 10"	15/20	30"	15/19	10, 4 ft	15/19
7 and 8	0.30	0.55	NR	49	20 + 5" or 13 + 10"	19/21	38"	15/19	10, 4 ft	15/19

Source: International Code Council (ICC), (2017), 2018 International Residential Code, Country Club Hill, IL

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### Potential for Changing Prescriptive Wall R-Values

- N1102.1.3 Insulation & Fenestration Table for zones 4, 5 and 6
  - R30
  - R20 changing to R20&5ci
  - R13&5ci changing to R13&10ci
  - R0&20ci

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### 2021 IRC Table N1102.1.3

Table N1102.1.2 (R402.1.2)  
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT \*

Climate Zone	Fenestration U-Factor	SKYLIGHT† U-FACTOR	GLAZED FENESTRATION SHGC**	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE	FLOOR R-VALUE	BASEMENT WALL R-VALUE	SLAB† R-VALUE & DEPTH	CRAWL SPACE WALL R-VALUE
4 except Marine	0.30	0.55	0.40	60	30 or 20R5ci or 13R10ci or 0R20ci	8/13	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.30	0.55	NR	60	30 or 20R5ci or 13R10ci or 0R20ci	13/17	30†	15/19	10, 2 ft	15/19
6	0.30	0.55	NR	60	30 or 20R5ci or 13R10ci or 0R20ci	15/20	30†	15/19	10, 4 ft	15/19

10 Source: International Code Council (ICC), (2021) International Residential Code, Country Club Hill, IL. PHRC

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## The Perfect Wall Assembly

“The perfect wall is an environmental separator—it has to keep the outside out and the inside in.”  
Joe Lstiburek

- Walls are designed to with 4 layers of control in mind
  - Rain
  - Air
  - Vapor
  - Thermal
- When talking about rain and air control we want to keep it out of our wall assembly.
- Vapor control is how to best deal safely with moisture passing through our assemblies.
- Thermal is stopping the transfer of heat.

11 Source: International Code Council (ICC), (2017) 2018 International Residential Code, Country Club Hill, IL. PHRC

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## What is Advanced/OVE Framing (optimal value engineering)

Advanced framing is able to give builders a cost effective method do reduce the overall cost of materials while simultaneously increasing the amount of insulation that can be installed.



<https://www.apawood.org/advanced-framing>

12 Source: International Code Council (ICC), (2017) 2018 International Residential Code, Country Club Hill, IL. PHRC

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### Why Double Stud Wall

- Uncomplicated
- High R-Value
- Removes all or almost all thermal bridging
- Expense?
- Reduce noise pollution



Source: [https://insulationinstitute.org/wp-content/uploads/2016/08/Compressed\\_R\\_values.pdf](https://insulationinstitute.org/wp-content/uploads/2016/08/Compressed_R_values.pdf)



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### Level Complexity

- There are many different variations of a double stud wall but it can be as simple as traditional 2x4 16" O/C. or as complicated as hanging Larson trusses on the exterior of your assembly.
- In areas where heavier wind loads are possible 2x6 framing may be required.
- 24" O/C may be an option but may require an engineer's sign off.
- As with all decisions when developing a wall assembly detail, climate zone is key.
- Like everything you can make this a simple or complicated system.



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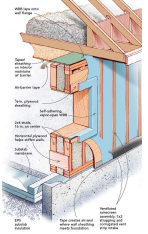
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### A Simple 2x4 Assembly

- Framed 16" O/C with plywood sheathing
- Second wall 24" O/C
- R/O of windows and door, take into account the thickness of plywood gussets
- Vapor permeable WRB
- 1x3 Rain screen



<https://www.finehomebuilding.com/project-guides/insulation/a-case-for-double-stud-wall>



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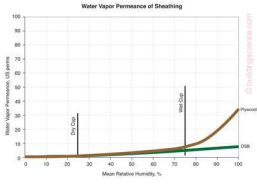
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### Sheathing Choices

- Plywood and OSB have about the same permeance when the mean relative humidity (RH) is low.
- But as the RH mean grows, so, too, does the difference between plywood and OSB in terms of their ability to move water vapor through from one side to the other.



The graph shows Mean Vapor Permeance (OS perms) on the y-axis (0 to 100) and Mean Relative Humidity (%) on the x-axis (0 to 100). Two curves are shown: Plywood (green) and OSB (orange). Both start at approximately 10 perms at 0% RH. As RH increases, the OSB curve rises more steeply than the Plywood curve, reaching about 40 perms at 100% RH, while Plywood reaches about 25 perms.

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### Sheathing Choice

- Plywood
  - Very permeable - Can be over 30perms
  - Dries quickly
  - Air barrier
  - Will need WRB
- OSB
  - Semi-Permeable
  - Air Barrier
  - Option of integrated WRB

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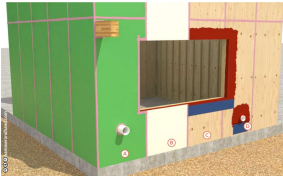
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### Air Sealing

- Once you have determined your exterior sheathing air sealing is the same as any wall assembly.



The diagram shows a cross-section of a wall assembly with green sheathing on the left and wood framing on the right. A window is shown with a red air sealant around its frame. Numbered callouts 1 through 5 point to various air sealing details: 1. Sealant at the bottom of the window frame; 2. Sealant at the top of the window frame; 3. Sealant at the side of the window frame; 4. Sealant at the bottom of the wall framing; 5. Sealant at the top of the wall framing.

<https://hammerandhand.com/best-practices/manual/5-envelope/5-2-air-sealing/>

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### Air Sealing

The slide features three images illustrating air sealing. On the left, a cross-section diagram shows a window frame with a purple sealant applied to the gap between the frame and the wall. In the center, a close-up shows a purple sealant being applied to a joint in a wooden wall assembly. On the right, a photograph shows a house exterior with white spray foam insulation applied to the joints between siding and the roofline. A small 'PHRC' logo is in the bottom right corner.

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### Water Barrier

- If you are not using an OSB integrated with a WRB you will need to plan just like any other wall assembly in this situation.
- Depending on the type of siding, a rain screen is often recommended to help with keeping the wall assembly dry.

A photograph shows a construction worker in a grey shirt and dark pants installing a white, flexible water barrier membrane onto a wall. The wall has vertical studs. A yellow crane is visible in the background. A small 'PHRC' logo is in the bottom right corner.

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### The Right Insulation Matters

- Cellulose
- Fiberglass
- Batt
- Spray foam

- The two most common for double-stud walls are cellulose and spray foam.

A small 'PHRC' logo is located in the bottom right corner of the slide.

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## Cellulose Insulation

- There is a lot to like about cellulose in this application for the climate zones in PA.
- R-value is 3.7 per inch
- Excellent air barrier
- Cellulose is hygroscopic
- Carbon negative
- Reduces noise pollution



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## Reducing Carbon

**Comparison of Insulation Materials: R-30**

Material	R-value	Carbon Footprint (kg CO <sub>2</sub> eq)
Cork board insulation (Demonte) (Insulation) / 10.4 per inch	10.4	-0.35
Wood fiber board / G/TEE / Multi-them / 10.8 per inch	10.8	-2.13
Hempcrete / Can. Insul / USA / R 2.1 per inch, avg. min.	2.1	-1.47
Wood fiber board (SEAM eng.)	10.8	-1.29
Cellulose / dens pack / R 3.7 per inch / CIMA (Industry avg.)	3.7	-1.04
Hemp fiber batt / NaturFlow / (Hemp wool) / R 3.7 per inch	3.7	-0.27
Fiberglass batt / 15.8 per inch (SEAM eng.)	15.8	0.33
Fiberglass loose fill / 18.2 per inch (SEAM eng.)	18.2	0.49
Mineral wool batt (SEAM eng.)	15.8	0.93
Mineral wool board - light density (NABM) / R 3.7 per inch (N. America)	3.7	1.03
Polyisocyanurate / Wall boards / R 4.2 per inch / PIMA (Industry avg.)	4.2	1.05
EPS foam board / R 4.4 per inch (SEAM eng.)	4.4	1.35
Spray polyurethane foam - high density (RFG gas) / R 6.3 per inch	6.3	2.43
Mineral wool board - heavy density (NABM) / R 4.2 per inch (N. America)	4.2	4.03
Spray polyurethane foam - closed cell (RFG gas) / R 4.4 per inch	4.4	6.46
Spray polyurethane foam - high density (RFG gas) / R 4.3 per inch	4.3	6.35
Aerogel blanket / Aspen Aerogel / 19.6 per inch	19.6	9.96
XPS foam board / DuPont / Styrofoam / Reduced GWP / R 4.5 per inch	4.5	17.92
XPS foam board / DuPont / Styrofoam / HFC-blend / R 5.4 per inch	5.4	25.04

Table 4 demonstrates a broad range of available insulation materials and corresponding GWP as a guide for comparison. As indicated in the product description, data represents either industry averages or product-specific GWP but is not exhaustive for all products available. Individual EPDs for actual specified products should be used in project-specific analysis.



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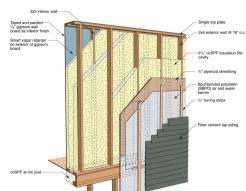
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## Spray Foam Insulation

- Spray foam is an excellent insulator:
  - Closed-cell spray foam has an R-value of R-7 per inch.
  - In comparison, open cell spray foam has an R-value of R-3.8 per inch.



<https://basic.pmi.gov/resource-guides/double-stud-wall-frame@hfi-group-description>



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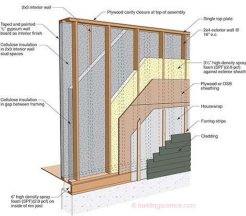
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## Flash and Batt

- This type of system is more popular the colder the climates you are building in.
- The batt portion is generally a dense pack cellulose to prevent any chance of air pockets being left in the wall.



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## Cold Sheathing Warnings

- Some modeling shows 12" walls insulated on the interior side of the sheathing will have elevated moisture levels well above 20% and for prolonged periods of time.
- Looking at the modeling number begs the question of how realistic are these warnings.
  - In the beginning a lot of the models were using an indoor RH of up to 90% even during cooling periods. They have recently capped this number at 70%.
- It is important to understand that these numbers are for a design standard.
  - They are using extreme conditions due to the fact that average homes generally do not fail.

<https://www.greenbuildingadvisor.com/article/monitoring-moisture-levels-in-double-stud-walls>



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## Concerning Levels of Moisture

- Mold and fungi need a moisture level at least 20% to grow, this is especially concerning when it is in the warmer months of summer.
- Wood needs a moisture content of 28% for decay to set in and temp above 28 deg. F.
- Decay is slow when the temp is below 50 deg. F



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### Monitored Field Study

- Location MA-Zone 5
- R-40 double-stud wall with cellulose insulation and OSB sheathing.
- Gypsum wallboard primed with 0.5 perm vapor retarder.
- Cladding is vinyl siding and well ventilated
- Monitored on the North and South sides.
- Oct 10%
- February 20%
- April 10%



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### Controlling Moisture

- Drying
  - The easiest way is to use materials that promote drying
  - Plywood – OSB
  - Cellulose-spray foam
- Prevention through materials
  - Spray foam
  - Smart membrane
  - Vapor retarder paint/primer



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### Summary

- Double wall assemblies are an attractive option for higher R-value wall assemblies.
- They are relatively simple to implement.
- The caution is that this type of wall assembly has the potential of being on the edge between risky and safe, so it is important to choose the right materials with a high permeability rating, such as plywood over OSB.



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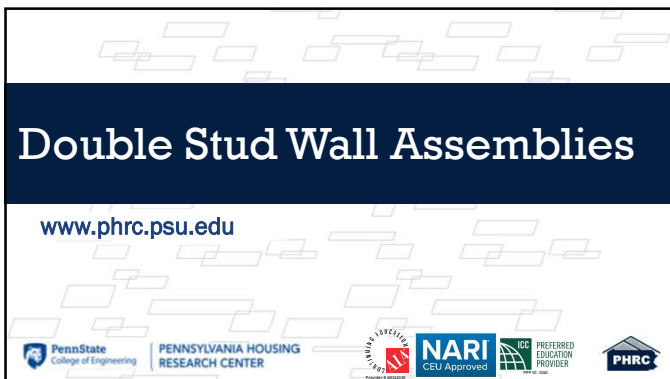
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The banner features a dark blue header with the title "Double Stud Wall Assemblies" in white. Below the header, the website "www.phrc.psu.edu" is displayed. The bottom section contains logos for PennState College of Engineering, PENNSYLVANIA HOUSING RESEARCH CENTER, NARI CEU Approved, IBC PREFERRED EDUCATION PROVIDER, and PHRC.

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