BSC Information Sheet 500

Building Materials Property Table

for All Climates

This table presents some of the key technical properties of many of the most common building materials.

The information presented has been compiled from:

- ASHRAE Fundamentals - 2001
- Moisture Control in Buildings
- CMHC
- NRC/IRC
- IEA Annex 24
- Manufacturer data

When using this information, it MUST be done in the following context:

1. Some of these properties are difficult to measure and very sensitive to small changes in the material. That is why ranges are often given and any single value should be considered "representative."
2. The importance of the numbers is almost always in the context of the numbers for substitute or alternative materials.
3. In order to compare numbers, they must be in the same units and obtained under the same standard test conditions - a very tall order. This is the main reason that a table like this has never really been compiled before. The table and its contents will continue to be refined and gaps filled in.
4. The importance of the numbers is almost always in the context of a given building assembly, for a given climate.
5. There are very few if any bad building materials, from a building science perspective; bad applications, however, abound.
6. The most important column in this table is likely to be the "Comments" column because it includes the experience/expertise/unique perspective of many of the leading building scientists in North America. The title of this column could be "OK - now what do these numbers REALLY mean?"

Use this table to augment the information provided in the Building Profiles and Best Practices of the Houses That Work resource. And remember, this resource attempts to supply you with the best knowledge currently available - your professional and field use of it turns it into wisdom.

This table is a work in progress - please direct questions or comments to: info@buildingscience.com.

Building Materials Property Table

HPR= Hydrostatic Pressure Resistance (AATCC127)

AP = Air permeability (ASTM E2178-01)

FS = Flame Spread (ASTM E84)

MGI/IC - Mold Growth Index for Interior Coatings (ASTM D3273)
MGI/I&F - Mold Growth Index for Insulation & Facings (ASTM C1338)

SD = Smoke Development (ASTM E84)

WA = Water Adsorption (ASTM C209)

Material	Typical Relevant Dimension	Water Vapor Permeability (perm-inch)[1]		Water Absorption[2]	R-Value	Other Relevant Properties	Comments	Web Link for More Information
		Dry Cup	Wet Cup					
Exterior Sheathings								
Plywood (CDX)	3/8"	0.75	3.5	na	0.5	FS =76-200 SD =130	At saturation, factor of 10 increase in permeability -- 14 - 20.5 perms	More Information
OSB	3/8"	0.75	2	na	0.5	FS = 148 SD= 137	At saturation, marginal increase in permeability - 2.8 - 3.4 perms	More Information
Fiberboard - asphalt impregnated	7/16"	14.5	15	2.3 - 7%	1.2	FS > 75 AP=0.82	Among the most vapor permeable of exterior sheathings	More Information More Information
Thin profile structural sheathing	.078" - .137"	0.5 - 0.6	0.5 - 0.6	na	0.2 - 3.4		R-value dependent on air space; this sheathing is essentially an exterior vapor barrier	More Information
Foil-faced PIR insulation	1"	0.01	0.03	0%	7	FS = 5 SD = 165	Combined thermal, vapor transmission & combustion properties must be used appropriately	More Information
XPS rigid insulation	1"	1	1	0.10%	5	FS = 5 SD = 165	Compare/contrast moisture properties to	More Information

						AP=0	EPS, CAREFULLY	
XPS (skinned)	3/8"	0?	0?		1.5		Polypro skin enables the fan-fold but can be removed and greatly affects vapor permeability	
EPS rigid insulation (Type II - 1.5 pcf density)	1"	3.5		3%	3.7	FS = 20 CD = 150 - 300	There are lots of different grades and densities--and hence toughness--of EPS. Make sure you specify by Type (they range from Type I—1 pcf to Type IX—2 pcf)	More Information
Glass mat faced gypsum board (DensGlass®)	1/2"	23		5%	0.56	FS = 0 SD = 0	Among the most vapor permeable of exterior sheathings	More Information
Wall Claddings								
Brick	31/2"		1.7 - 13.7		0.1		Properties as variable as the material but water storage capacity is always very high	More Information
Traditional stucco	7/8"	3.8	5.8		0.1		Properties as variable as the material but almost always has relatively high vapor permeability	
Polymer-modified stucco							Vapor permeability is dependent on paint - with latex paint generally in the 2-3 perm range; with elastomeric paint highly variable.	
Wood lap siding (unfinished)	3/8"	"35 perms"			0.5	FS = 69 SD = 98	35 perms is an equivalent vapor permeance value. Based on both empirical	

							tests (laboratory and test hut conditions), the value is obtained under the following conditions: a 1 Pa air pressure difference between the cladding and environment; crack width between courses of 3/1000 of an inch; and crack length of 18 inches. Note that this value is independent of finishes or coatings on the wood, unless the treatment closes the width or reduces the length of the space between courses.	
Fibercement lap siding (primed all surfaces)	5/16"	1.5				FS = 0 CD = 5	Siding comes in different finishes, including texture and coatings (factory priming). Product must be installed over top of a weather barrier--BSC also recommends over furring strips.	More Information
Vinyl lap siding	n/a	"70 perms"					70 perms is an equivalent vapor permeance value. Based on both empirical tests (laboratory and test hut conditions), the value is obtained under the following conditions: a 1 Pa air pressure difference between the cladding and	More Information

							environment; crack width between courses of 2 sheets of paper; and crack length of 18 inches.	
Interior Wallboards								
Standard paper-faced	1/2"	40				FS = 15 SD = 0	Both faces and core highly water vapor permeable; paper faces highly susceptible to mold and mildew growth.	
DensArmor Plus™	1/2"	12	23	5%		FS = 10 SD = 0	Paper facings are replaced with fiberglass mat facings for increased resistance to moisture, mold and mildew.	More Information
Fiberock®	1/2"							
Hardie Tilebacker Hardie Backerboard 500	13/32"	2.8				FS = 0 SD - 5		More Information
DensShield®	1/2"						A tilebacker board with the top face acrylic coating acting as water and moisture barrier.	More Information
Durock®	1/2"							
Non-paper faced gypsum board: Fiberock Aqua-TOUGH™	1/2"		35		.5	FS = 5 SD = 0	Drainage pattern is embossed on back surface of sheathing	More Information
Cavity Fill Insulations								
Fiberglass/Rockwool (unfaced batt)	31/2"	120	168		11	FS = 10 SD = 10	The thermal performance of all batt insulation depends on independent air sealing components and details.	More Information

Cellulose	31/2"		75	<15%	13	FS < 25 SD < 50	While the air tightness of cellulose insulation is significantly better than some other common cavity fill insulation, it's thermal performance still depends on independent air sealing components and details.	More Information
Icynene - modified spray urethane	31/2"	16		0%	12.6-14	FS < 20 SD < 400 AP = 0.008	While all spray foams are excellent for air sealing, they vary, often widely, in their density, R-value, blowing agent, water resistance, vapor permeability. These last two can have the greatest affect on just how you use spray foam in various building assemblies.	More Information
Flooring								
Hardwood	3/4"							
Softwood	3/4"							
Glazed tile	3/8"							
Synthetic carpet								
Organic fiber carpet								
Linoleum								
Vinyl tile							essentially vapor impermeable--not recommended with concrete floors, particularly with	

							high w/c ratios	
Vinyl sheet	1/32" - 1/16"						essentially vapor impermeable--not recommended with concrete floors, particularly with high w/c ratios	
		Vapor Dry Cup	**Permeance** (Perms)[1] Wet Cup	**Air Permeance** (L/s*m2@75 Pa)				
Sheet Good Building Products								
No. 15 asphalt-saturated felt		6	31	0.4			vapor permeable at any moisture content should be compliant with ASTM D226	
No. 30 asphalt-saturated felt				0.19			should be compliant with ASTM D226	
Tyvek®			58	0.0045 (@ wind pressure 30 mph)		HPR=210 cm FS = 5 SD = 20		More Information
Typar®	0.013"	14		0.0023		HPR=165 cm FS = 0 SD = 15		
60-minute roofing paper: Fortifiber Two-Ply Super Jumbo Tex	two ply	11						More Information
Polyethylene	.004-.006 (4-6 mils)	0.06	0.06	0?		FS = 5-35 SD = 15-80	a vapor barrier appropriate only for very cold climates	
MemBrain™	2-mil	1	12+			FS = 75 SD = 450	well-suited as a vapor pressure boundary for cold and mixed climates	More Information
Coatings								
Vapor retarder	0.25 mm	0.5						

primer								
Latex paint (primer + sealer)		3.5-6.1	~17				although published laboratory data (Kumaran 2002) typically gives gypsum board painted with latex paint a value of ~3 perms (dry cup), BSC has measured samples with dry cup measurements of roughly 8-10 perms (see Ueno et al. 2007)	More information
Exterior acrylic paint		5.5						
Semi-gloss vinyl acrylic enamel		6.6	6.6					
Exterior oil-based paint (3 coats)		0.3-1.0						
Oil paint (1 coat + primer)		1.6 - 3					various primers plus 1 coat flat oil paint on plaster	
Elastomeric paint							substantial variability in water vapor permeability	

[1] The water vapor permeability of a material is roughly inversely proportional to its thickness - doubling the thickness halves the permeability. It's more complicated for films and coatings, however, and this rule should not be applied to these materials.

[2] Although manufacturers often report this property per ASTM C209 and as a per cent by weight, this only gives information about the material's POROSITY (overall quantity of water absorbed over an indefinite--long, often 24 hours-- time period) and what is much more useful is the material's water absorption coefficient, a measure of WICKING (initial rate of capillary transport). There is unfortunately NO relationship between the two, no ASTM standard for the water absorption coefficient, and few manufacturers in North America have measured or reported water absorption coefficients. When researching a building product, strongly encourage manufacturers to PROVIDE the water absorption coefficient.