Wood & Other Materials Used to Construct Nonresidential Buildings

UNITED STATES

2011

A Cooperative Study Sponsored by Industry and Government

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Wood and Other Materials Used to Construct Nonresidential Buildings in the United States 2011

Craig Adair, Director of Market Research
APA – The Engineered Wood Association
7011 So. 19th St
Tacoma, WA 98466-5333

David B. McKeever, Research Forester
USDA Forest Service
Forest Products Laboratory
Madison, WI 53726-2398

Chris Gaston, Ph.D
FPInnovations
2665 East Mall
Vancouver, B.C. Canada V6T 1W5

Margaret Stewart
MSC Marketing Solutions Consulting Ltd.
1833 Dublin Street
New Westminster, B.C. Canada V3M 3A2

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Research Conducted by:

Home Innovation Research Labs ™
400 Prince George's Boulevard
Upper Marlboro, Maryland 20774

March 2013

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EXECUTIVE SUMMARY

David B. McKeever, Research Forester
USDA Forest Service
Forest Products Laboratory
Madison, WI 53726-2398

ABSTRACT

The construction of low-rise nonresidential buildings is an important market for lumber, engineered wood products, and structural and nonstructural wood panels in the United States. This report examines low-rise nonresidential buildings of six or fewer stories. Those with more than six stories are normally severely restricted by building codes from being wood framed.

The value of all low-rise nonresidential buildings constructed in 2011 totaled $208 billion. Construction in 2011 was still being severely impacted by the lingering recession of the late 2000s, and when measured in inflation adjusted dollars, was 35 percent below the high reached in 2008. Total floor area constructed was also impacted. The 733 million ft^2 built in 2011 was just under two-thirds of that built in 2008. This value of construction and floor area resulted in the consumption of 627 million board feet (bf) of lumber, 27 million linear feet of wood I-joists, 67 million bf of glulam timber, 6 million cubic feet of structural composite lumber, 1 million square feet, 3/8-in. basis (ft^2) of engineered rim boards, and small amounts of cross- laminated timber, as well as 712 million ft^2 of structural panels, and 19 million ft^2 of nonstructural panels. When converted to board feet equivalents [1](bfe), total wood products consumption was estimated to be 1,214 million bfe. These volumes were used to construct nearly 10,500 new buildings and major additions and for alterations and renovations to numerous existing buildings. Volumes include allowances for onsite waste and loss. Not included are the amounts of wood used for interior finishing, outdoor structures, and facilitation (temporary uses such as concrete forms, shoring, etc.)

Keywords: Nonresidential construction, wood products consumption, value of new construction, lumber, structural panels, nonstructural panels, engineered wood products, wood I-joists, glulam timber, structural composite lumber, engineered rim boards, cross-laminated timber.

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[1] Board foot equivalents (bfe) are the amounts of non-lumber wood products converted to equivalent board foot volume based on the following conversions: 1 lf (I-joist) = 2 bfe; 1 ft^3 = 16 bfe, and, 1 ft^2, 3/8-in. basis = 0.5 bfe.

EXECUTIVE SUMMARY

The construction of low-rise nonresidential buildings (buildings with six or fewer stories above ground level) is an important market for lumber, engineered wood products, and structural and nonstructural wood panels, as well as a promising market for newly developed wood products such as cross-laminated timber. Annual consumption of wood products is dependent on many factors, including the number, types, and geographical locations of new buildings started, building size and height, architectural characteristics, and principal framing type. The extent of alterations, renovations, and remodeling to existing buildings also affects wood products consumption. In a study conducted in conjunction with the USDA Forest Service and others in 2003 and updated with new construction value and wall-framing incidence data in 2008, low-rise nonresidential buildings were defined to be buildings with four or fewer stories. A re-evaluation of the International Building Code suggested that a sizeable number of buildings with five or six stories could readily be constructed of wood with minor design changes. For this reason, this study was based on buildings with six or fewer stories. Also, the 2003 and 2008 studies were based on a limited number of buildings in which the quantities of specified wood products in the blueprints were used to develop factors of wood use. The current study is based on a much larger sample and with a detailed database of buildings currently or soon to be under construction. For these and other reasons, consumption values from the current study are not strictly comparable to earlier studies, although relative measures of activity are still appropriate.

CONSTRUCTION VALUE AND FLOOR AREA

In 2011, all types of construction activity in the United States were still being severely impacted by the continuing economic recession that began in the late 2000's. Total value of all construction in the United States was valued at $778 billion (USDC 2013) (Fig. ES-1). Residential and nonresidential buildings were nearly equal in value at 36 percent and 35 percent of total construction, respectively. Other nonresidential construction accounted for the remaining 29 percent of total value. Other nonresidential includes all construction that is not buildings, such as bridges, highways, dams, etc.

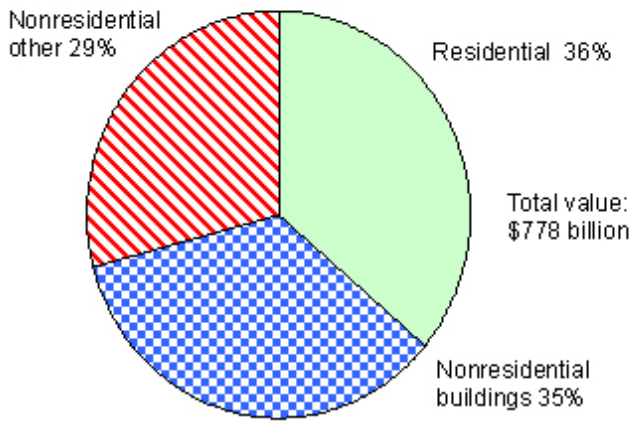

Figure ES-1. Value of construction in the U.S., by type, 2011.

The construction of all nonresidential buildings in 2011 was valued at $289 billion current dollars or $228 (inflation-adjusted constant 2005 dollars), about 54 percent of all nonresidential construction (Fig. ES-2). This level of nonresidential buildings was at its lowest mark since 2002, nearly 35 percent below the high of $355 billion reached in 2008. The gap between buildings and other nonresidential construction was also at its low mark over the 10-year period. The construction of low-rise nonresidential buildings (buildings with six or fewer stories) was estimated to be $164 billion (2005 $) in 2011, about 72 percent of all nonresidential buildings.

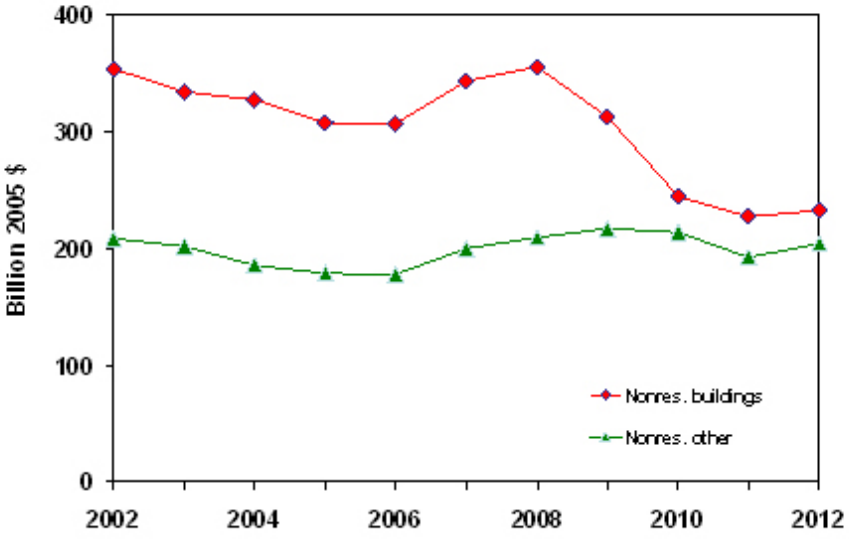

Figure ES-2. Value of nonresidential construction in the U.S., by type, 2002-2012.

Total floor area in new and major additions to low-rise nonresidential buildings totaled 733 million ft^2 in 2011, which was less than two-thirds of the area built in 2008 (Reed Construction Data 2013). The use of wood and other building products is ultimately dependent on new floor area added. Changes in floor area will be reflected in changes in building product consumption.

In 2011, total low-rise nonresidential building construction was $208 billion current dollars (Table ES-1). Figure ES-3 shows the value of construction by building type. Schools and Public buildings had the highest value of construction at approximately $47 billion each, or a combined 45 percent of total construction. This is a dramatic change from 2008 when Schools and

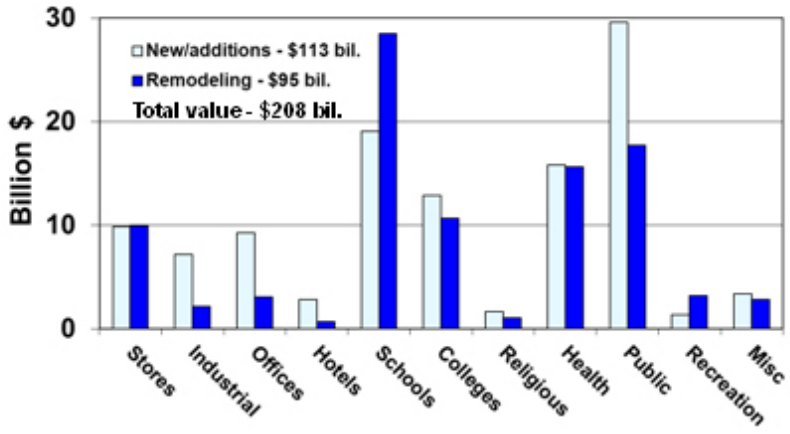

Figure ES-3. Value of new/additions vs. remodeling in low-rise nonresidential buildings in the U.S., 2011.

Public buildings accounted for just 19 percent of all construction. The value of buildings publically financed as a percentage of total value in 2011 stood at 42 percent, 7 percent above the 10-year average. This increase may be partially attributable to the The American Recovery and Reinvestment Act of 2009[2]. Religious and Hotels were the two lowest valued building types at under $4 billion each, for a combined 3 percent of total low-rise nonresidential construction.

The continuing economic recession also affected the mix of new construction (new buildings and major additions) to remodeling (alterations and renovations) in low-rise nonresidential buildings. During times of slow economic growth, new construction tends to fall while remodeling of existing structures tends to increase as a proportion of total construction value. Older buildings are refurbished in favor of new construction. The same is evident in residential construction. In 2003, new construction accounted for 82 percent of all construction (McKeever, Adair, O'Connor 2006) but fell to 54 percent of all construction in 2011. Some building types, such as Public were much less affected by this drop in new construction to remodeling than other buildings type such as Schools (Fig. ES-3).

WOOD PRODUCTS CONSUMPTION

In 2011, the construction of new and major additions to low-rise nonresidential buildings and alterations, renovations, and remodeling of existing buildings required 627 million board feet (million bf) of lumber, 222 million board feet equivalents (million bfe) of engineered wood products, 712 million square feet, 3/8-in. basis (million ft^2), of structural panels, and 19 million ft^2 of nonstructural panels (Table ES-1, Fig. ES-4). Engineered wood includes 27 million linear feet (million lf) of wood I-joists, 67 million bf of glulam timber, 6 million cubic feet (million ft^3) of structural composite lumber (SCL), 1 million ft^2 of rim boards, and small amounts of newly certified cross-laminated timber. When converted to board feet equivalents, a combined 1,214 million bfe of wood was consumed for low-rise nonresidential construction in 2011. Included in this figure are framing, columns, stairs, siding, soffit, fascia, exterior trim, sheathing, and underlayment, as well as

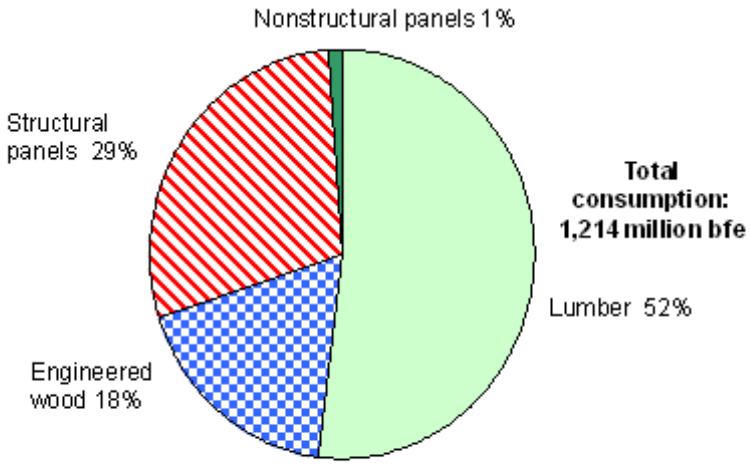

Figure ES-4. Wood products consumption for low-rise nonresidential construction in the U.S., by type, 2011.

[2] http://www.recovery.gov/About/Pages/The_Act.aspx *(Accessed March 24, 2013)*

allowances for onsite waste and loss. Just 1 percent of the 1,214 million bfe was for nonstructural type uses (siding, soffit, fascia, exterior trim). Total volumes represent about 1 percent of total U.S. lumber consumption, 3 percent of total structural panel consumption, and 15 percent of engineered wood products consumption in 2011. Not included are amounts of wood used principally for interior finishing, outdoor structures, and for facilitation (temporary uses such as concrete forms, shoring, etc.).

The South was by far the region with the highest level of wood products consumption in 2011, at 531,120 bfe (Tables ES-1, ES-2). Each other region consumed less than half as much as the South. Regional wood consumption patterns follow closely regional population patterns with the exception of the West. The Northeast and Midwest each consumed wood at about the same proportion as their population, while the South consumed about 7 percent more wood than their population, and the West 7 percent less. Consumption by divisions within regions generally reflect use patterns of their respective region. The South Atlantic and West South Central were the top two consuming divisions with combined lumber, engineered wood, and wood panels, accounting for about 38 percent of total consumption. This percentage is the same as the bottom five divisions, which also consumed 38 percent. The Pacific and East North Central divisions were intermediate in consumption.

Wood products consumption is dependent not only on the overall extent of construction, but also on the types of buildings being constructed. Health, Schools, and Stores ranked first, second, and third in total wood products consumption in 2011. Combined, they accounted for nearly one-half (47 percent) of all wood consumption—569 million bfe (Table ES-2). High levels of construction of Hotels and Offices in 2008, and to a lesser extent in 2003, helped to reduce their overall construction levels in 2011, dropping them from first and second ranking in 2008 to seventh and sixth, respectively. Health buildings were not only ranked first overall in 2011, but were also first in lumber and structural panel use, and third in engineered wood and nonstructural panel use. Conversely, Misc., Recreation, and Industrial were the lowest wood product-using building types, accounting for a combined 72 million bfe, just 6 percent of all wood consumption.

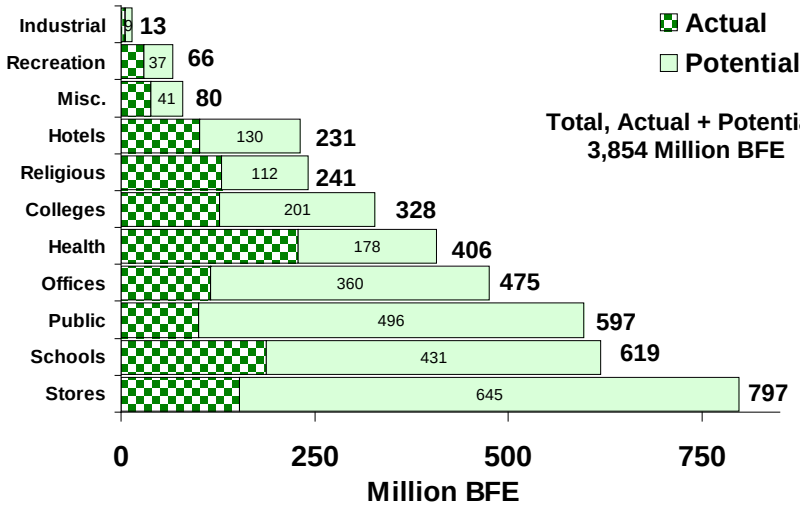

Figure ES-5. Actual and incremental potential wood products use in low-rise nonresidential buildings in the U.S., 2011.

POTENTIAL WOOD PRODUCTS CONSUMPTION

Great potential exists for increasing the amounts of wood products used for low-rise nonresidential building construction. Potential is defined as the incremental amounts of wood that could be used if all major building applications (framing, columns, stairs, siding, soffit, fascia, exterior trim, sheathing and underlayment) in concrete or steel- framed buildings were built entirely with wood, and if all major building applications in wood-framed buildings that were not wood were converted to wood. However, not all buildings and applications can be built from wood. To qualify for wood construction, specific characteristics of the building must meet the International Building Code standards for allowable wood construction. Potential applies only to new construction and major additions. Alterations and renovations are typically too varied and not so dependent on building codes as new construction to reliably estimate incremental potential. Wall-framing type is a key determinant of wood potential. In 2011, an estimated 12 percent of all nonresidential low-rise buildings were categorized as wood framed, based on principal exterior wall framing material (Table ES-3). This is a small increase from 10 percent in 2003 and 11 percent in 2008. Most building types exhibited modest changes of plus or minus 7 percentage points in wood-framed share between 2011 and previous years with the exception of Religious and Misc. buildings, which increased their wood shares by more than 12 percentage points each. Conversely, Stores, Industrial and Public buildings had the lowest at 7 percent each. This would suggest that Religious and Misc buildings should have lower incremental wood potential, while Stores, Industrial, and Public should have higher incremental potential. This is in fact the case for all of these building types with the exception of Industrial buildings which have the lowest incremental potential (Table ES-4). Many Industrial buildings do not meet the building code criteria needed to be a candidate for wood framing.

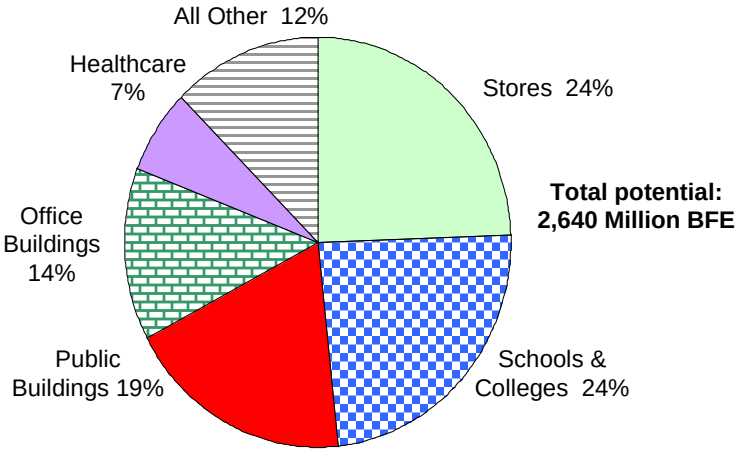

Figure ES-6. Wood potential for new low-rise nonresidential buildings in the U.S., by principal building groups, 2011.

In 2011, an additional 2,640 million bfe of wood products could have been used in low-rise nonresidential buildings if all low-rise concrete and steel-framed buildings had been built entirely from wood, and if nonwood components of wood framed buildings were built with wood (Table

ES-4). This potential consisted of 1,253 million bf of lumber, 700 million bfe of engineered wood, 1,298 million ft^2 of structural panels, and 78 million ft^2 of nonstructural panels. The combined additional volumes represent more than a two-fold increase in wood use. If all of the incremental potential were to be achieved, total consumption would increase from 1,214 million bfe to 3,854 million bfe (Figs. ES-5, ES-6).

The South was not only the region with the highest level of actual wood products consumption in 2011, but was also the region with the highest potential to incrementally increase consumption. Nearly 47 percent of the total 2,640 million bfe of potential wood consumption was in the South (Table ES-4). Each other region accounted for about 18 percent. Regional wood potential patterns follow closely regional patterns of actual consumption. Potential consumption by divisions within regions generally reflect use patterns of their respective region. The South Atlantic division had by far the highest potential with combined lumber, engineered wood, and wood panels accounting for about 27 percent of total potential. The bottom two divisions (Mountain and East South Central) each accounted for less than 7 percent of total potential.

COMPARING 2011 TO A TYPICAL YEAR

The continuing U.S. economic recession that began in the late 2000's started to negatively impact low-rise nonresidential building construction in 2009, continued through 2011 and into 2012 and 2013. Based on information from Reed Construction Data (2013), floor area added for new and major additions to low-rise (six and fewer stories above ground) nonresidential buildings during the 2009 through 2011 period averaged just 735 million square feet (ft^2). Prior to 2009, floor area added during the more typical construction period 2005 through 2008 averaged in excess of 1,300 million ft^2. This 44 percent reduction in floor area from typical, coupled with other recession related changes, was responsible for dramatically reduced levels of building products consumption.

To answer concerns about the effects of the current recession ion nonresidential construction, and the potential for volume growth, we remade 2011 into a more typical "normal" nonresidential construction year. The assumptions used were: (Tables ES-5, ES-6).

1. Assume a total of 1,300 million ft^2 of new floor area added.
2. Assume the same distribution of floor area to building types in 2011 as in a more typical year to avoid recession related effects. Since 2003 was more typical than 2011, and since it's the only non-recession year for which we have building type distributions, the 2003 distribution was used.
3. Assume the same ratio of new and major additions construction to alterations, renovations and remodeling (R&R) as in 2003. This will help negate any shifts to R&R caused by a recession as in 2011.
4. Use 2011 framing type distributions because they reflect recent shifts between wood, concrete and steel framing preferences.
5. Use 2011 wood use factors (use per ft^2 of floor area) because they reflect current building practices.

Based on these assumptions, total wood use for all new and major additions construction increased from 786 million board feet equivalents (bfe) in 2011 to 1,411 million bfe in a more typical year, a 1.8 fold increase. (Table ES-7). Wood use for alterations, renovations and remodeling fell from 429 to 379 million bfe (Table ES-8). This reduction was based largely on lower rates of R&R activity in a typical “good” year as compared to a “bad” recession year.

Overall, total wood use for all low-rise nonresidential construction increased from 1,214 in 2011 to 1,790 million bfe in a typical year. This was a 1.5 fold increase (Table ES-9). It may take three to five years for nonresidential construction to return to a typical year. When it does, wood use will be much higher than in 2011, which was influenced by recession.

The potential incremental volume gained by converting concrete and steel buildings and buildings with less than 100% wood construction was 2,640 million bfe in 2011. In the typical year, with more overall construction, the potential increase was 4,508 million bfe (Table ES-10). This represents a 1.7 fold increase from 2011.

SUMMARY AND CONCLUSIONS

Nonresidential building construction is an important market for wood products, but one that should not be taken for granted. Nonwood building products are continually challenging wood in many nonresidential building applications. But at the same time, new wood products and innovative building practices are working to increase the use of wood. The acceptance by code and consumers of cross-laminated timber building systems, for example, could substantially increase wood use in the future.

In 2011, Health and Schools were the building types with the highest wood use. Combined, they accounted for more than one third of total consumption. Industrial and Recreation buildings were the lowest, using just under 3 percent of all wood. Stores and Public were the building types with greatest potential, while Industrial and Recreation were the lowest. Schools had much of their potential attributable to very high levels of nonstructural panels. Schools accounted for more than 90 percent of nonstructural panel potential.

The South consistently used more wood in total than any other region, and also used more of each product group. Two divisions in the South, South Atlantic, and West South Central, led all divisions in total wood use, and in all product groups except for engineered wood. The South and its divisions consistently led all other regions and divisions in potential wood consumption.

A large unfulfilled potential exists to greatly increase wood products consumption in nonresidential construction. While the strategies needed to fill this potential were not a part of this study, the data here may provide clues and approaches for the wood products industry as it plans for the future. One such approach would be the development of new wood-based products that are competitive in performance and value to concrete and steel, thereby creating an advantage for wood. Wood is, must remain, and must become even more competitive in order to maintain and increase its share of the low-rise nonresidential building market.

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TABLE ES-1: CONSTRUCTION VALUE, AND LUMBER, ENGINEERED WOOD, & WOOD PANELS USED IN LOW-RISE NONRESIDENTIAL BUILDING CONSTRUCTION IN THE U.S., BY BUILDING TYPE AND GEOGRAPHIC AREA, 2011.

		Lumber, Engineered Wood, and Wood Panels														
		Lumber & Engineered Wood								Wood Panels						
			Engineered wood							Structural Panels			Non-Structural			
Characteristic	Construction value Mil. $	Lumber[1] Th. bf	I-Joist Th. lf	Glulam Th. bf	SCL[2] Th. ft^3	Rim Board[3] Th. ft^2 3/8"	CLT[4] Th. ft^3	Total[5] Th. bfe	TOTAL Th. bfe	Softwood Plywood Th. ft^2 3/8"	OSB Th. ft^2 3/8"	Total Th. ft^2 3/8"	Panels[6] Th. ft^2 3/8"	TOTAL Th. ft^2 3/8"	TOTAL Th. bfe[7]	TOTAL Th. bfe
Building type																
Stores	19,796	71,281	0	3,398	250	51	0	7,432	78,712	147,847	351	148,198	0	148,198	74,099	152,811
Industrial	9,377	3,084	12	2	20	0	0	353	3,437	2,500	0	2,500	0	2,500	1,250	4,687
Offices	12,294	63,606	96	396	389	53	0	6,835	70,442	63,652	25,517	89,169	0	89,169	44,584	115,026
Hotels	3,542	40,262	7,646	2	1,567	199	0	40,468	80,730	41,254	0	41,254	0	41,254	20,627	101,357
Schools	47,511	105,232	6,528	19,999	1,502	342	5	57,339	162,571	28,446	3,612	32,058	17,719	49,776	24,888	187,459
Colleges	23,547	68,510	529	325	779	104	0	13,901	82,412	88,095	0	88,095	173	88,268	44,134	126,546
Religious	2,709	88,674	4,388	2,257	297	123	0	15,845	104,519	50,777	53	50,830	0	50,830	25,415	129,934
Health	31,465	112,537	3,634	6,797	1,143	167	0	32,433	144,970	135,995	30,249	166,244	767	167,011	83,506	228,475
Public	47,302	47,237	1,734	18,252	132	206	0	23,936	71,173	56,494	977	57,470	810	58,280	29,140	100,313
Recreation	4,584	11,559	0	8,284	25	8	0	8,686	20,245	18,124	0	18,124	0	18,124	9,062	29,308
Misc.	6,251	14,772	2,367	7,370	144	111	0	14,460	29,232	17,932	0	17,932	0	17,932	8,966	38,198
All buildings	208,380	626,755	26,935	67,082	6,249	1,364	5	221,689	848,443	651,115	60,759	711,874	19,468	731,343	365,671	1,214,114
Region																
Northeast	39,480	108,719	3,483	12,572	1,345	250	0	41,175	149,894	113,095	13,693	126,788	2,976	129,764	64,882	214,776
New England	13,051	41,059	1,050	5,366	646	99	0	17,860	58,918	38,762	3,144	41,906	1,243	43,149	21,575	80,493
Mid Atlantic	26,429	67,660	2,432	7,206	698	151	0	23,315	90,976	74,333	10,549	84,881	1,733	86,614	43,307	134,283
Midwest	36,135	126,683	5,727	16,663	1,747	316	0	56,221	182,904	132,212	12,157	144,369	4,718	149,087	74,543	257,447
E N Central	22,222	73,317	2,900	11,204	1,160	206	0	35,670	108,986	75,335	7,982	83,317	3,247	86,564	43,282	152,268
W N Central	13,914	53,367	2,827	5,459	586	110	0	20,551	73,918	56,877	4,175	61,052	1,470	62,522	31,261	105,179
South	79,268	284,991	12,556	25,627	2,226	543	0	86,628	371,619	285,024	25,532	310,557	8,446	319,002	159,501	531,120
South Atlantic	40,284	149,584	5,980	15,071	1,256	302	0	47,272	196,856	156,188	14,797	170,984	3,542	174,526	87,263	284,119
E S Central	10,861	40,034	1,928	3,734	328	71	0	12,875	52,910	40,742	3,599	44,341	1,351	45,691	22,846	75,755
W S Central	28,123	95,373	4,648	6,822	642	170	0	26,481	121,854	88,095	7,137	95,231	3,554	98,785	49,393	171,246
West	53,497	106,361	5,169	12,220	931	255	5	37,665	144,026	120,784	9,377	130,161	3,329	133,490	66,745	210,771
Mountain	15,393	37,195	1,836	2,350	295	75	5	10,852	48,047	40,293	2,997	43,290	1,176	44,466	22,233	70,280
Pacific	38,104	69,166	3,334	9,870	637	180	0	26,814	95,980	80,491	6,380	86,871	2,153	89,024	44,512	140,492
U.S.	208,380	626,755	26,935	67,082	6,249	1,364	5	221,689	848,443	651,115	60,759	711,874	19,468	731,343	365,671	1,214,114

[1]Includes framing lumber, boards, wood trusses, and shakes, shingles and siding.

[2]Structural composite lumber (SCL) includes includes laminated veneer lumber, parallel strand lumber, laminated strand lumber, and oriented strand lumber.

[3]Includes OSB and strand lumber rim boards.

[4]Cross-laminated timber (CLT). Small volumes due to product infancy.

[5]Includes glulam, and the board foot equivalent of engineered wood (1 lf I-joist = 2 BF equivalents; 1 ft^3 SCL and CLT = 16 BF equivalents, 1 ft^2, 3/8" basis = 0.5 BF equivalent).

[6]Includes hardboard, insulation board, particleboard, medium density fiberboard, and hardwood plywood.

[7]1 ft^2, 3/8" basis = 0.5 BF equivalents.

TABLE ES-2: LUMBER, ENGINEERED WOOD, & WOOD PANELS USED IN LOW-RISE NONRESIDENTIAL BUILDING CONSTRUCTION[1] IN THE U.S., BY BUILDING TYPE AND GEOGRAPHIC AREA, RANKED HIGH TO LOW, 2011.

	Lumber[2]		Engineered Wood[3]		Structural Panels[4]		Non-Structural Panels[5]		All Wood Products[6]	
Rank	Building Type	Th. bf	Building Type	Th. bfe	Building Type	Th. ft^2 3/8"	Building Type	Th. ft^2 3/8"	Building Type	Th. bfe
1	Health	112,537	Schools	57,339	Health	166,244	Schools	17,719	Health	228,475
2	Schools	105,232	Hotels	40,468	Stores	148,198	Public	810	Schools	187,459
3	Religious	88,674	Health	32,433	Offices	89,169	Health	767	Stores	152,811
4	Stores	71,281	Public	23,936	Colleges	88,095	Colleges	173	Religious	129,934
5	Colleges	68,510	Religious	15,845	Public	57,470	Stores	0	Colleges	126,546
6	Offices	63,606	Misc.	14,460	Religious	50,830	Industrial	0	Offices	115,026
7	Public	47,237	Colleges	13,901	Hotels	41,254	Offices	0	Hotels	101,357
8	Hotels	40,262	Recreation	8,686	Schools	32,058	Hotels	0	Public	100,313
9	Misc.	14,772	Stores	7,432	Recreation	18,124	Religious	0	Misc.	38,198
10	Recreation	11,559	Offices	6,835	Misc.	17,932	Recreation	0	Recreation	29,308
11	Industrial	3,084	Industrial	353	Industrial	2,500	Misc.	0	Industrial	4,687
	All buildings	626,755	All buildings	221,689	All buildings	711,874	All buildings	19,468	All buildings	1,214,114
Rank	Region	Th. bf	Region	Th. bfe	Region	Th. ft^2 3/8"	Region	Th. ft^2 3/8"	Region	Th. bfe
1	South	284,991	South	86,628	South	310,557	South	8,446	South	531,120
2	Midwest	126,683	Midwest	56,221	Midwest	144,369	Midwest	4,718	Midwest	257,447
3	Northeast	108,719	Northeast	41,175	West	130,161	West	3,329	Northeast	214,776
4	West	106,361	West	37,665	Northeast	126,788	Northeast	2,976	West	210,771
	All regions	626,755	All regions	221,689	All regions	711,874	All regions	19,468	All regions	1,214,114
Rank	Division	Th. bf	Division	Th. bfe	Division	Th. ft^2 3/8"	Division	Th. ft^2 3/8"	Building Type	Th. bfe
1	South Atlantic	149,584	South Atlantic	47,272	South Atlantic	170,984	W S Central	3,554	South Atlantic	284,119
2	W S Central	95,373	E N Central	35,670	W S Central	95,231	South Atlantic	3,542	W S Central	171,246
3	E N Central	73,317	Pacific	26,814	Pacific	86,871	E N Central	3,247	E N Central	152,268
4	Pacific	69,166	W S Central	26,481	Mid Atlantic	84,881	Pacific	2,153	Pacific	140,492
5	Mid Atlantic	67,660	Mid Atlantic	23,315	E N Central	83,317	Mid Atlantic	1,733	Mid Atlantic	134,283
6	W N Central	53,367	W N Central	20,551	W N Central	61,052	W N Central	1,470	W N Central	105,179
7	New England	41,059	New England	17,860	E S Central	44,341	E S Central	1,351	New England	80,493
8	E S Central	40,034	E S Central	12,875	Mountain	43,290	New England	1,243	E S Central	75,755
9	Mountain	37,195	Mountain	10,852	New England	41,906	Mountain	1,176	Mountain	70,280
	All divisions	626,755	All divisions	221,689	All divisions	711,874	All divisions	19,468	All divisions	1,214,114

[1]Includes new construction, major additions, and alterations, renovations, & remodeling.

[2]Includes framing lumber, boards, wood trusses, and shakes, shingles and siding.

[3]Includes I-joists, glulam, structural composite lumber, engineered rim boards, and cross-laminated timber.

[4]Includes softwood plywood and OSB.

[5]Includes hardboard, insulation board, particleboard, medium density fiberboard, and hardwood plywood.

[6]Includes lumber, and board foot equivalent of engineered wood and wood panels. See Table ES-1 for conversion factors.

TABLE ES-3: WALL FRAMING TYPE INCIDENCE IN LOW-RISE NONRESIDENTIAL BUILDING CONSTRUCTION[1] IN THE U.S., BY BUILDING TYPE, 2003, 2008 & 2011.

Building and framing type	Percentage of buildings			Building and framing type	Percentage of buildings		
	2003[2]	2008[2]	2011[3]		2003[2]	2008[2]	2011[3]
STORES				RELIGIOUS			
Wood	7%	13%	7%	Wood	22%	27%	34%
Concrete	29%	26%	20%	Concrete	21%	21%	19%
Steel	63%	62%	73%	Steel	58%	52%	47%
INDUSTRIAL				HEALTH			
Wood	2%	1%	7%	Wood	25%	30%	18%
Concrete	38%	39%	47%	Concrete	16%	14%	17%
Steel	61%	60%	46%	Steel	59%	56%	65%
OFFICES				PUBLIC			
Wood	12%	12%	12%	Wood	7%	2%	7%
Concrete	33%	32%	23%	Concrete	39%	11%	23%
Steel	55%	57%	65%	Steel	55%	88%	69%
HOTELS				RECREATION			
Wood	59%	58%	54%	Wood	12%	10%	13%
Concrete	11%	19%	17%	Concrete	29%	23%	26%
Steel	30%	23%	28%	Steel	60%	67%	62%
SCHOOLS				MISC.			
Wood	11%	6%	9%	Wood	6%	7%	29%
Concrete	26%	24%	23%	Concrete	22%	20%	35%
Steel	63%	71%	68%	Steel	72%	72%	36%
COLLEGES				ALL BUILDINGS			
Wood	15%	17%	18%	Wood	10%	11%	12%
Concrete	21%	16%	23%	Concrete	29%	26%	25%
Steel	64%	67%	59%	Steel	61%	63%	63%

[1]New construction and additions only.

[2]Based on low-rise buildings with four or fewer stories.

[3]Based on low-rise buildings with six or fewer stories.

Sources: 2003 and 2008: McKeever 2010.

TABLE ES-4: NET POTENTIAL CHANGE IN LUMBER, ENGINEERED WOOD, & WOOD PANEL VOLUME IN LOW-RISE NONRESIDENTIAL BUILDING CONSTRUCTION[1] IN THE U.S., BY BUILDING TYPE AND GEOGRAPHIC AREA, RANKED HIGH TO LOW, 2011.

	Lumber[2]		Engineered Wood[3]		Structural Panels[4]		Non-Structural Panels[5]		All Wood Products[6]	
Rank	Building type	Th. bf	Building type	Th. bfe	Building type	Th. ft^2 3/8"	Building type	Th. ft^2 3/8"	Building type	Th. bfe
1	Stores	392,261	Public	284,837	Stores	463,124	Schools	49,960	Stores	644,636
2	Schools	218,009	Schools	156,706	Offices	198,991	Public	26,872	Public	496,487
3	Offices	178,775	Offices	81,706	Public	152,441	Health	822	Schools	431,457
4	Public	121,994	Hotels	46,311	Colleges	131,256	Colleges	463	Offices	359,976
5	Colleges	106,576	Health	36,676	Health	104,752	Stores	0	Colleges	201,038
6	Health	88,512	Colleges	28,603	Hotels	90,107	Industrial	0	Health	177,975
7	Religious	68,804	Stores	20,813	Schools	63,525	Offices	0	Hotels	130,030
8	Hotels	38,665	Religious	20,387	Religious	44,744	Hotels	0	Religious	111,563
9	Misc	21,030	Recreation	12,737	Recreation	21,548	Religious	0	Misc	41,483
10	Recreation	13,354	Misc	11,002	Misc	18,904	Recreation	0	Recreation	36,865
11	Industrial	4,532	Industrial	53	Industrial	8,437	Misc	0	Industrial	8,803
	All buildings	1,252,512	All buildings	699,829	All buildings	1,297,828	All buildings	78,115	All buildings	2,640,314
Rank	Region	Th. bf	Region	Th. bfe	Region	Th. ft^2 3/8"	Region	Th. ft^2 3/8"	Region	Th. bfe
1	South	631,296	South	286,052	South	596,069	South	32,876	South	1,231,820
2	Midwest	251,445	Midwest	167,982	Midwest	295,713	Northeast	17,789	Midwest	574,227
3	Northeast	196,145	Northeast	125,102	Northeast	212,869	Midwest	13,888	Northeast	436,576
4	West	173,626	West	120,694	West	193,177	West	13,563	West	397,690
	All buildings	1,252,512	All buildings	699,829	All buildings	1,297,828	All buildings	78,115	All buildings	2,640,314
Rank	Division	Th. bf	Division	Th. bfe	Division	Th. ft^2 3/8"	Division	Th. ft^2 3/8"	Division	Th. bfe
1	S Atlantic	377,618	S Atlantic	160,531	S Atlantic	350,429	S Atlantic	17,432	S Atlantic	722,080
2	W S Central	159,314	E N Central	113,304	E N Central	180,213	New England	14,467	E N Central	362,611
3	E N Central	154,138	W S Central	98,561	W S Central	155,162	W S Central	10,533	W S Central	340,723
4	Mid Atlantic	111,914	New England	71,982	Mid Atlantic	141,892	E N Central	10,126	Mid Atlantic	237,641
5	W N Central	97,307	Pacific	70,422	W N Central	115,501	Pacific	9,575	Pacific	219,674
6	E S Central	94,364	W N Central	54,678	Pacific	103,812	E S Central	4,910	W N Central	211,617
7	Pacific	92,558	Mid Atlantic	53,120	E S Central	90,478	Mountain	3,988	New England	198,935
8	New England	84,231	Mountain	50,273	Mountain	89,364	W N Central	3,762	Mountain	178,017
9	Mountain	81,068	E S Central	26,960	New England	70,977	Mid Atlantic	3,322	E S Central	169,018
	All divisions	1,252,512	All divisions	699,829	All divisions	1,297,828	All divisions	78,115	All divisions	2,640,314

[1]New construction and major additions only.

[2]Includes framing lumber, boards, wood trusses, and shakes, shingles and siding.

[3]Includes I-joists, glulam, structural composite lumber, engineered rim boards, and cross-laminated timber.

[4]Includes softwood plywood and OSB.

[5]Includes hardboard, insulation board, particleboard, medium density fiberboard, and hardwood plywood.

[6]Includes lumber, and board foot equivalent of engineered wood and wood panels. See Table ES-1 for conversion factors.

TABLE ES-5: 2003 BUILDING TYPE DISTRIBUTION, 2011 FRAMING TYPE DISTRIBUTION, AND 2011 WOOD USE FACTORS USED TO ESTIMATE TYPICAL YEAR WOOD USE FOR NEW AND MAJOR ADDITIONS.

Building type	Building type distri-bution, 2003 %	Framing type distribution, 2011			Use per ft^2 of floor area, 2011			
		Wood %	Conc %	Steel %	Lumber Bf/ft^2	Eng wood Bf/ ft^2	Str panels Ft^2/ft^2	Nonstr panels Ft^2/ft^2
Stores	37%	7%	20%	73%	0.324	0.037	0.680	0.000
Industrial	15%	7%	47%	46%	0.033	0.004	0.027	0.000
Offices	12%	12%	23%	65%	0.607	0.065	0.852	0.000
Hotels	3%	54%	17%	28%	1.611	1.621	1.715	0.000
Schools	12%	9%	23%	68%	0.358	0.184	0.109	0.060
Colleges	5%	18%	23%	59%	0.739	0.145	0.963	0.002
Religious	3%	34%	19%	47%	4.600	0.814	2.643	0.000
Health	6%	18%	17%	65%	0.953	0.264	1.411	0.007
Public	1%	7%	23%	69%	0.426	0.219	0.524	0.008
Recreatioı	4%	13%	26%	62%	0.417	0.291	0.663	0.000
Misc	1%	29%	35%	36%	0.683	0.780	0.979	0.000
All bldgs	100%	12%	25%	63%	0.551	0.189	0.649	0.014

TABLE ES-6: ESTIMATED FLOOR AREA BY FRAMING TYPE FOR NEW AND MAJOR ADDITIONS, TYPICAL YEAR AND 2011.

Building type	Floor area, typical year				Reported floor area, 2011			
	Wood Mil. ft^2	Conc Mil. ft^2	Steel Mil. ft^2	Total Mil. ft^2	Wood Mil. ft^2	Conc Mil. ft^2	Steel Mil. ft^2	Total Mil. ft^2
Stores	34.2	98.8	353.5	486.4	10.7	31.0	110.8	152.5
Industrial	14.7	91.4	90.3	196.4	6.4	40.0	39.5	85.8
Offices	18.8	34.8	98.3	151.9	10.7	19.9	56.0	86.6
Hotels	20.3	6.5	10.5	37.3	11.5	3.7	6.0	21.2
Schools	13.1	34.7	103.6	151.3	13.1	34.9	104.1	152.0
Colleges	12.5	16.0	41.7	70.2	9.2	11.9	30.9	52.1
Religious	15.3	8.7	21.3	45.2	4.4	2.5	6.2	13.2
Health	13.1	12.9	48.2	74.1	12.4	12.3	45.8	70.4
Public	1.2	4.0	11.7	16.9	5.2	16.8	49.7	71.7
Recreatioı	6.8	13.9	33.1	53.8	2.4	4.8	11.6	18.8
Misc	4.7	5.8	6.0	16.5	2.5	3.1	3.2	8.8
All bldgs	154.5	327.4	818.1	1,300.0	88.7	180.8	463.7	733.1

TABLE ES-7: ESTIMATED WOOD USE FOR NEW AND MAJOR ADDITIONS, TYPICAL YEAR AND 2011.

	Estimated actual wood use, typical year					Reported wood use, new & additions, 2011				
Building type	Lumber Mil bf	Eng wood Mil bf	Str panels Mil ft^2	Nonstr panels Mil ft^2	Total Mil bf	Lumber Mil bf	Eng wood Mil bf	Str panels Mil ft^2	Nonstr panels Mil ft^2	Total Mil bf
Stores	157.6	17.9	330.7	0.0	340.9	49.4	5.6	103.7	0.0	106.9
Industrial	6.4	0.7	5.3	0.0	9.8	2.8	0.3	2.3	0.0	4.3
Offices	92.2	9.9	129.5	0.0	166.8	52.5	5.6	73.8	0.0	95.1
Hotels	60.1	60.5	64.0	0.0	152.5	34.1	34.3	36.3	0.0	86.6
Schools	54.1	27.9	16.5	9.1	94.8	54.4	28.0	16.5	9.2	95.2
Colleges	51.8	10.2	67.6	0.1	95.9	38.5	7.6	50.1	0.1	71.1
Religious	207.9	36.8	119.5	0.0	304.5	60.5	10.7	34.8	0.0	88.7
Health	70.6	19.6	104.6	0.5	142.7	67.1	18.6	99.4	0.5	135.6
Public	7.2	3.7	8.8	0.1	15.4	30.5	15.7	37.6	0.5	65.3
Recreatio	22.4	15.7	35.7	0.0	56.0	7.8	5.5	12.5	0.0	19.5
Misc	11.3	12.9	16.1	0.0	32.2	6.0	6.9	8.6	0.0	17.2
All bldgs	741.7	215.6	898.3	9.9	1,411.4	403.7	138.8	475.6	10.3	785.5

TABLE ES-8: ESTIMATED WOOD USE FOR ALTERATIONS, RENOVATIONS AND REMODELING (R&R), TYPICAL YEAR AND 2011.

	Estimated R&R wood use, typical year					Reported R&R wood use, 2011				
Building type	Lumber Mil bf	Eng wood Mil bf	Str panels Mil ft^2	Nonstr panels Mil ft^2	Total Mil bf	Lumber Mil bf	Eng wood Mil bf	Str panels Mil ft^2	Nonstr panels Mil ft^2	Total Mil bf
Stores	12.7	0.2	43.1	0.0	34.5	21.9	1.8	44.5	0.0	46.0
Industrial	0.4	0.0	0.1	0.0	0.5	0.3	0.0	0.2	0.0	0.4
Offices	44.0	8.3	88.2	0.0	96.4	11.1	1.2	15.3	0.0	19.9
Hotels	1.1	0.6	1.0	0.0	2.2	6.2	6.2	5.0	0.0	14.8
Schools	6.7	3.8	5.7	12.4	19.5	50.9	29.3	15.5	8.5	92.2
Colleges	9.3	1.3	14.7	0.8	18.4	30.1	6.3	38.0	0.1	55.4
Religious	30.6	9.4	18.7	0.0	49.4	28.1	5.1	16.0	0.0	41.3
Health	12.9	2.8	29.1	4.6	32.6	45.4	13.8	66.8	0.3	92.8
Public	2.8	1.1	5.4	11.6	12.3	16.7	8.2	19.9	0.3	35.0
Recreatio	6.8	1.1	6.9	0.0	11.4	3.7	3.2	5.7	0.0	9.8
Misc	4.6	83.4	26.7	0.0	101.3	8.7	7.6	9.3	0.0	21.0
All bldgs	131.9	112.0	239.7	29.5	378.5	223.0	82.9	236.2	9.2	428.6

TABLE ES-9: ESTIMATED WOOD USE FOR ALL NONRESIDENTIAL CONSTRUCTION, TYPICAL YEAR AND 2011.

	Estimated actual wood use, typical year					Reported actual wood use, 2011				
Building type	Lumber Mil bf	Eng wood Mil bf	Str panels Mil ft^2	Nonstr panels Mil ft^2	Total Mil bf	Lumber Mil bf	Eng wood Mil bf	Str panels Mil ft^2	Nonstr panels Mil ft^2	Total Mil bf
Stores	170.4	18.1	373.8	0.0	375.4	71.3	7.4	148.2	0.0	152.8
Industrial	6.8	0.7	5.4	0.0	10.2	3.1	0.4	2.5	0.0	4.7
Offices	136.2	18.2	217.7	0.0	263.2	63.6	6.8	89.2	0.0	115.0
Hotels	61.1	61.1	65.0	0.0	154.8	40.3	40.5	41.3	0.0	101.4
Schools	60.8	31.7	22.2	21.5	114.3	105.2	57.3	32.1	17.7	187.5
Colleges	61.2	11.5	82.3	1.0	114.3	68.5	13.9	88.1	0.2	126.5
Religious	238.5	46.2	138.2	0.0	353.8	88.7	15.8	50.8	0.0	129.9
Health	83.6	22.4	133.7	5.1	175.4	112.5	32.4	166.2	0.8	228.5
Public	9.9	4.8	14.2	11.7	27.7	47.2	23.9	57.5	0.8	100.3
Recreatio	29.3	16.8	42.6	0.0	67.3	11.6	8.7	18.1	0.0	29.3
Misc	15.9	96.2	42.8	0.0	133.5	14.8	14.5	17.9	0.0	38.2
All bldgs	873.6	327.6	1,137.9	39.3	1,789.9	626.8	221.7	711.9	19.5	1,214.1

TABLE ES-10: ESTIMATED POTENTIAL WOOD USE FOR NEW AND MAJOR ADDITIONS, TYPICAL YEAR AND 2011.

	Estimated potential wood use, typical year					Reported potential wood use, 2011				
Building type	Lumber Mil bf	Eng wood Mil bf	Str panels Mil ft^2	Nonstr panels Mil ft^2	Total Mil bf	Lumber Mil bf	Eng wood Mil bf	Str panels Mil ft^2	Nonstr panels Mil ft^2	Total Mil bf
Stores	1,251.5	66.4	1,477.6	0.0	2,056.7	392.3	20.8	463.1	0.0	644.6
Industrial	10.4	0.1	19.3	0.0	20.1	4.5	0.1	8.4	0.0	8.8
Offices	313.5	143.3	349.0	0.0	631.3	178.8	81.7	199.0	0.0	360.0
Hotels	68.1	81.6	158.8	0.0	229.1	38.7	46.3	90.1	0.0	130.0
Schools	217.0	156.0	63.2	49.7	429.5	218.0	156.7	63.5	50.0	431.5
Colleges	143.7	38.6	177.0	0.6	271.0	106.6	28.6	131.3	0.5	201.0
Religious	236.3	70.0	153.7	0.0	383.1	68.8	20.4	44.7	0.0	111.6
Health	93.2	38.6	110.2	0.9	187.3	88.5	36.7	104.8	0.8	178.0
Public	28.7	67.1	35.9	6.3	116.9	122.0	284.8	152.4	26.9	496.5
Recreatio	38.2	36.5	61.7	0.0	105.5	13.4	12.7	21.5	0.0	36.9
Misc	39.2	20.5	35.3	0.0	77.4	21.0	11.0	18.9	0.0	41.5
All bldgs	2,439.8	718.6	2,641.6	57.5	4,508.0	1,252.5	699.8	1,297.8	78.1	2,640.3