WOOD PRODUCTS USED IN THE CONSTRUCTION OF LOW-RISE NONRESIDENTIAL BUILDINGS IN THE UNITED STATES, 2008

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Wood Products Used in the Construction of Low-Rise Nonresidential Buildings in the United States, 2008

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Abstract

Low-rise nonresidential building construction is an important market for lumber, structural wood panels, nonstructural wood panels, and engineered wood products in the United States. This report examines low-rise nonresidential buildings of four or fewer stories only. Buildings with five or more stories are normally severely restricted by building code from being wood framed.

In 2008, 1,758 million board feet of lumber, 56 million board feet of glulam timber, 2,677 million square feet, 3/8-in. basis, of structural panels, 79 million square feet, 3/8-in. basis of nonstructural panels, 68 million linear feet of wood I-joists, and 4 million cubic feet of structural composite lumber were used to construct nearly 84,400 new buildings or additions, and in the alterations and renovations of numerous existing buildings. Volumes include allowances for onsite waste and loss. Not included are the amounts of wood used for facilitation (concrete forms, shoring, etc.) and millwork. Farm construction and nonbuilding construction, such as bridges, dams, and highways, were not included in this study. Overall consumption of all wood products increased substantially over amounts reported in 2003.

Keywords: Nonresidential construction, wood products consumption, value of new construction, lumber, structural panels, nonstructural panels, engineered wood products.

Executive Summary

The construction of low-rise nonresidential buildings (buildings with 4 or fewer stories above ground) is an important market for lumber, structural and nonstructural wood panels, and engineered wood products. This analysis is limited to low-rise nonresidential buildings because buildings with five or more stories are normally restricted by building code from wood framed construction. In 2008, the estimated $412 billion of low-rise nonresidential construction resulted in the use of 1,758 million board feet (million bf) of lumber, 56 million bf of glulam timber, 2,677 million square feet, 3/8-in. basis (million ft^2), of structural panels, 79 million ft^2 of nonstructural panels, 68 million linear feet (million lf) of wood I-joists, and nearly 4 million cubic feet (million ft^3) of structural composite lumber (SCL) (Table ES-1). When converted to board foot equivalents, 3.4 billion bf of wood was consumed for low-rise nonresidential construction in 2008. These volumes represent nearly 4 percent of total U.S. lumber consumption, 11 percent of total structural panel consumption, and 11 percent of engineered wood products consumption in 2008. Included are the construction of entirely new buildings, major additions to or in conjunction with existing buildings, and alterations and renovations to existing buildings. Volumes include allowances for onsite waste and loss. Not included are the amounts of wood used for facilitation and millwork, for nonbuilding construction, and for farm structures.

Wood products consumption is dependent not only on the overall extent of construction, but on the types of buildings being constructed. In general, hotels, offices and stores are typically large markets for wood products. In 2008 they ranked as the top three markets for lumber, structural panels and engineered wood (Table ES-2). Schools topped the nonstructural panel list. Conversely, industrial, misc. and public buildings were typically the lowest wood product users.

Wood product consumption for low-rise nonresidential building construction in 2008

Table ES-1. Wood used in low-rise nonresidential building construction, by building type, 2008.

Building type	Lumber[1] (Mil. bf)	Structural panels: Softwood plywood (Mil. ft^2, 3/8")	Structural panels: OSB (Mil. ft^2, 3/8")	Structural panels: Total (Mil. ft^2, 3/8")	Non-structural panels[2] (Mil. ft^2, 3/8")	Engineered wood: I-joist (Lf)	Engineered wood: Glulam (Bf)	Engineered wood: SCL[3] (Ft^3)	Total, all wood products[4] (Mil. bf)
Stores	259.6	190.1	288.8	478.9	6.1	21.3	18.3	0.2	566.9
Industrial	42.5	26.1	25.2	51.2	0.0	0.6	1.2	0.7	81.4
Offices	334.6	146.1	308.2	454.3	5.9	9.2	13.2	0.2	599.5
Hotels	541.6	309.7	328.0	637.8	1.0	24.8	4.6	1.4	937.4
Schools	133.7	112.6	155.5	268.0	54.2	4.8	4.7	0.3	313.3
Colleges	155.2	63.7	93.7	157.4	3.6	1.5	3.5	0.1	244.1
Religious	83.9	31.3	70.8	102.1	0.4	2.0	4.9	0.4	150.5
Health	121.1	135.6	177.0	312.7	2.0	1.4	1.3	0.2	285.1
Public	17.0	15.6	20.8	36.4	4.4	1.0	0.2	0.0	40.0
Recreation	44.7	39.9	59.5	99.4	0.8	1.6	3.1	0.1	102.1
Misc.	23.9	27.8	50.8	78.6	0.0	0.0	0.6	0.4	69.8
Total	1,757.8	1,098.5	1,578.3	2,676.8	78.5	68.4	55.7	3.9	3,390.0

[1]Includes framing lumber, boards, wood trusses, and shakes, shingles and siding.
[2]Includes hardboard, insulation board, particleboard, MDF, and hardwood plywood.
[3]Structural composite lumber (SCL) includes laminated veneer lumber, parallam, and timberstrand.
[4]Includes lumber and glulam, the board foot equivalent of panel products (1 ft^2 (3/8" basis) = 0.5 bf) and engineered wood (1 lf I-joist = 2 bf; 1 ft^3 SCL = 16 bf).

Table ES-2. Wood used in low-rise nonresidential building construction, by building type ranked high to low, 2008.

Rank	Lumber[1]: Building type	Lumber[1]: (Mil. bf)	Structural panels[2]: Building type	Structural panels[2]: (Mil. ft^2, 3/8")	Nonstructural panels[3]: Building type	Nonstructural panels[3]: (Mil. ft^2, 3/8")	Engineered wood[4]: Building type	Engineered wood[4]: (Mil. bf) equiv.)	All wood products[5]: Building type	All wood products[5]: (Mil. bf) equiv.)
1	Hotels	541.6	Hotels	637.8	Schools	54.2	Hotels	76.4	Hotels	937.4
2	Offices	334.6	Stores	478.9	Stores	6.1	Stores	64.8	Offices	599.5
3	Stores	259.6	Offices	454.3	Offices	5.9	Offices	34.8	Stores	566.9
4	Colleges	155.2	Health	312.7	Public	4.4	Schools	18.5	Schools	313.3
5	Schools	133.7	Schools	268.0	Colleges	3.6	Religious	15.4	Health	285.1
6	Health	121.1	Colleges	157.4	Health	2.0	Industrial	13.2	Colleges	244.1
7	Religious	83.9	Religious	102.1	Hotels	1.0	Colleges	8.4	Religious	150.5
8	Recreation	44.7	Recreation	99.4	Recreation	0.8	Recreation	7.2	Recreation	102.1
9	Industrial	42.5	Misc.	78.6	Religious	0.4	Misc.	6.6	Industrial	81.4
10	Misc.	23.9	Industrial	51.2	Misc.	0.0	Health	6.6	Misc.	69.8
11	Public	17.0	Public	36.4	Industrial	0.0	Public	2.6	Public	40.0
Total		1,757.8		2,676.8		78.5		254.6		3,390.0

[1]Includes framing lumber, boards, wood trusses, and shakes, shingles and siding.
[2]Includes softwood plywood and OSB.
[3]Includes hardboard, insulation board, particleboard, MDF, and hardwood plywood.
[4]Includes I-joists, glulam, laminated veneer lumber, parallam, and timberstrand.
[5]Includes lumber and glulam, the board foot equivalent of panel products (1 ft^2 (3/8" basis) = 0.5 bf) and engineered wood (1 lf I-joist = 2 bf; 1 ft^3 SCL = 16 bf).

Table ES-3. Wood used in low-rise nonresidential building construction, by building type ranked high to low, 2003 and 2008.

Rank		Building type	Lumber[1]	Structural panels			Non-structural panels[2]	Engineered wood			Total, all wood products[4]
				Softwood plywood	OSB	Total		I-joist	Glulam	SCL[3]	
2003	2008	and year	(Mil. bf)	(Ft^2, 3/8")	(Ft^2, 3/8")	(Ft^2, 3/8")	(Ft^2, 3/8")	(Lf)	(Bf)	(Ft^3)	(Mil. bf)
		2003[5]									
1	--	Offices	305.6	142.4	299.1	441.5	4.2	9.3	14.8	0.2	564.7
2	--	Stores	228.8	188.9	277.7	466.6	4.3	13.8	10.5	0.2	505.5
3	--	Schools	163.6	129.5	174.6	304.1	53.8	8.4	7.3	0.4	372.8
4	--	Hotels	140.0	93.1	101.9	194.9	0.3	7.4	0.9	0.5	260.6
5	--	Health	97.5	127.9	161.8	289.7	2.2	0.8	1.3	0.1	248.1
6	--	Colleges	120.2	56.9	86.4	143.4	3.8	1.1	4.9	0.1	202.4
7	--	Religious	100.9	37.7	84.8	122.6	0.6	2.4	7.0	0.5	182.1
8	--	Recreation	57.1	48.8	73.3	122.1	1.1	2.3	3.9	0.1	128.4
9	--	Industrial	46.8	25.6	21.4	47.0	0.0	0.5	3.4	0.5	82.1
10	--	Misc.	13.9	14.3	26.2	40.5	0.0	0.0	0.4	0.2	37.8
11	--	Public	15.4	13.8	17.7	31.5	3.6	0.9	0.2	0.0	35.2
		All buildings	1,289.8	879.0	1,324.9	2,203.8	73.9	46.9	54.6	2.7	2,619.8
		2008									
4	1	Hotels	541.6	309.7	328.0	637.8	1.0	24.8	4.6	1.4	937.4
1	2	Offices	334.6	146.1	308.2	454.3	5.9	9.2	13.2	0.2	599.5
2	3	Stores	259.6	190.1	288.8	478.9	6.1	21.3	18.3	0.2	566.9
3	4	Schools	133.7	112.6	155.5	268.0	54.2	4.8	4.7	0.3	313.3
5	5	Health	121.1	135.6	177.0	312.7	2.0	1.4	1.3	0.2	285.1
6	6	Colleges	155.2	63.7	93.7	157.4	3.6	1.5	3.5	0.1	244.1
7	7	Religious	83.9	31.3	70.8	102.1	0.4	2.0	4.9	0.4	150.5
8	8	Recreation	44.7	39.9	59.5	99.4	0.8	1.6	3.1	0.1	102.1
9	9	Industrial	42.5	26.1	25.2	51.2	0.0	0.6	1.2	0.7	81.4
10	10	Misc.	23.9	27.8	50.8	78.6	0.0	0.0	0.6	0.4	69.8
11	11	Public	17.0	15.6	20.8	36.4	4.4	1.0	0.2	0.0	40.0
		All buildings	1,757.8	1,098.5	1,578.3	2,676.8	78.5	68.4	55.7	3.9	3,390.0

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

[2]Includes hardboard, insulation board, particleboard, MDF, and hardwood plywood.

[3]Structural composite lumber (SCL) includes laminated veneer lumber, parallam, and timberstrand.

[4]Includes lumber and glulam, the board foot equivalent of panel products (1 ft^2 (3/8" basis) = 0.5 bf) and engineered wood (1 lf I-joist = 2 bf; 1 ft^3 SCL = 16 bf).

[5]Revised.

Source: McKeever, Adair, O'Connor 2006.

was substantially higher than that reported five years prior in 2003 (Table ES-3). Much of the increase in overall wood products consumption was directly due to a large increase in low-rise hotel construction. In 2008, hotels accounted for two-thirds more wood than did offices in 2003 when it used more wood than any other building type. In both years offices, stores, schools and hotels ranked as the top four wood products using building types although their relative rankings changed.

Exterior wall framing type defines the building framing type. In 2003, 10.2 percent of all new and additions to low-rise buildings were deemed to be wood framed (Table ES-4). This compares to 11.0 percent in

2008. Such an increase would, in general, help to increase wood use, but not necessarily by the difference between the two percentages. Different building types use wood at different rates. A small change in a more wood intensive building type, such as stores, would result in a greater change in wood use than a similar change in a less wood intensive building type such as public buildings.

Table ES-4. Wall framing type incidence in low-rise nonresidential construction[1] in the United States, selected years 2000-2008.

	Percentage of buildings:						Percentage of buildings:				
	2000	2003	2006	2007	2008		2000	2003	2006	2007	2008
Stores						**Religious**					
Wood	7.0	7.4	13.5	13.2	12.6	Wood	21.3	21.9	20.9	25.2	26.9
Concrete	30.6	29.1	24.3	27.0	25.8	Concrete	22.9	20.6	23.5	21.1	21.1
Metal	62.4	63.4	62.2	59.8	61.6	Metal	55.9	57.5	55.6	53.7	52.0
Industrial						**Health**					
Wood	1.6	1.7	1.2	0.7	0.7	Wood	32.0	25.0	26.4	27.1	29.8
Concrete	39.8	37.7	55.0	49.5	38.8	Concrete	20.1	16.2	17.4	15.4	14.4
Metal	58.6	60.6	43.9	49.7	60.5	Metal	47.8	58.8	56.2	57.6	55.8
Office						**Public**					
Wood	7.5	11.9	13.2	12.3	11.7	Wood	9.1	6.6	4.7	3.3	1.6
Concrete	42.1	33.3	38.2	37.6	31.7	Concrete	33.4	38.6	36.7	26.7	10.6
Metal	50.4	54.8	48.6	50.1	56.5	Metal	57.5	54.8	58.6	70.0	87.8
Hotels						**Recreation**					
Wood	64.3	58.9	49.3	55.8	57.8	Wood	14.1	11.5	12.8	8.1	9.5
Concrete	12.7	10.8	20.3	18.5	19.5	Concrete	26.8	28.6	21.0	15.4	23.2
Metal	22.9	30.3	30.4	25.7	22.7	Metal	59.0	59.9	66.3	76.5	67.2
Schools						**Misc.**					
Wood	7.6	11.2	7.0	6.4	5.6	Wood	13.7	5.9	3.9	6.6	7.5
Concrete	31.9	25.8	29.6	27.9	23.7	Concrete	17.3	21.8	47.7	10.4	20.1
Metal	60.4	63.1	63.4	65.7	70.7	Metal	68.9	72.3	48.4	83.0	72.4
Colleges						**All buildings**					
Wood	12.1	15.3	12.3	16.4	16.5	Wood	9.6	10.2	10.8	11.5	11.0
Concrete	31.1	20.9	21.5	21.6	16.2	Concrete	33.5	29.1	34.2	31.7	26.0
Metal	56.9	63.8	66.3	62.0	67.3	Metal	56.9	60.7	55.0	56.8	62.9

[1]Includes new and additions only.

Source: McGraw Hill Corp. 2009.

Great potential exists for increasing the amounts of wood products used for low-rise nonresidential building construction. An additional 4,630 million bf of lumber, 3,686 million ft^2 of structural panels, 31 million ft^2 of nonstructural panels, and 572 million bf of engineered wood could have been used in low-rise nonresidential buildings in 2008 if all low-rise concrete and metal framed buildings had been built using the same construction methods as wood framed buildings (Table ES-5). When combined, these additional volumes represent nearly a 3-fold increase in wood use. Potential gains would be reduced somewhat if estimates excluded buildings that exceed the building code size limits for wood framing. Roofs and exterior walls represent the two greatest applications for incremental volume potential for all wood products.

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. Acceptance by code and consumer of cross-laminated timber building systems could substantially increase wood use. A large unfulfilled potential exists to greatly increase wood products consumption in nonresidential construction. Wood must remain and become even more competitive in order to maintain and increase its share of the nonresidential building market

Table ES-5. Potential incremental wood product volumes[1] in low-rise nonresidential building construction, ranked high to low, 2008.

	Lumber[2]		Structural panels[3]		Nonstructural panels[4]		Engineered wood[5]		All wood products[6]	
Rank	Building type	(Mil. bf)	Building type	(Mil. ft^2, 3/8")	Building type	(Mil. ft^2, 3/8")	Building type	(Mil. bf) equiv.)	Building type	(Mil. bf) equiv.)
1	Stores	1,584.2	Stores	1,082.7	Stores	22.0	Stores	229.9	Stores	2,366.5
2	Offices	1,177.5	Offices	792.4	Colleges	3.1	Schools	97.3	Offices	1,649.7
3	Industrial	529.4	Hotels	228.0	Schools	1.6	Hotels	67.7	Industrial	794.5
4	Colleges	375.7	Industrial	404.6	Hotels	1.0	Offices	75.8	Colleges	523.2
5	Hotels	191.1	Schools	285.3	Recreation	0.8	Industrial	62.7	Hotels	373.3
6	Recreation	188.1	Colleges	283.1	Public	0.6	Health	11.7	Schools	391.0
7	Health	150.8	Health	184.3	Misc	0.6	Religious	9.8	Recreation	285.1
8	Schools	150.2	Recreation	181.3	Health	0.5	Recreation	5.9	Health	254.8
9	Religious	142.5	Religious	153.3	Offices	0.4	Colleges	4.4	Religious	229.2
10	Public	112.3	Public	87.1	Religious	0.3	Public	4.2	Public	160.3
11	Misc	27.6	Misc	3.9	Industrial	0.0	Misc	1.8	Misc	31.6
Total		4,629.5		3,685.9		31.0		571.3		7,057.8

[1]Volumes of wood products likely to be used if concrete and metal framed applications were built with wood at the same usage rates as wood framed applications.

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

[3]Includes softwood plywood and OSB.

[4]Includes hardboard, insulation board, particleboard, MDF, and hardwood plywood.

[5]Includes I-joists, glulam, laminated veneer lumber, parallam, and timberstrand.

[6]Includes lumber and glulam, the board foot equivalent of panel products (1 ft^2 (3/8" basis) = 0.5 bf) and engineered wood (1 lf I-joist = 2 bf; 1 ft^3 SCL = 16 bf).

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Wood Products Used in the Construction of Low-Rise Nonresidential Buildings in the United States, 2008

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Introduction

Nonresidential construction is an important part of U.S. construction markets, and a major market for wood products. This was especially true in 2008. As U.S. housing markets slipped to record low levels of activity, nonresidential construction climbed to unprecedented levels. In 2008 the total value of all nonresidential construction was $715 billion, 67 percent of all construction (Table 1). The buildings component of nonresidential construction was valued at $456 billion, 64 percent of all nonresidential construction, and 43 percent of all construction. Low-rise buildings of four or fewer stories had construction valued at $412 billion in 2008.

Nonresidential buildings are a diverse mixture of structures with uses ranging from small churches and shops, to large shopping malls and high-rise office buildings. In this study, 11 building types were identified which correspond to those used by the U.S. Bureau of the Census (2010). Building types identified here are: Stores, Industrial, Offices, Hotels, Schools, Colleges, Religious, Health, Public, Recreation, and Miscellaneous (Misc.). A complete description of each building type, and definitions of other terms used in this report are in the Appendix. This analysis is limited to low-rise nonresidential buildings because high-rise buildings with five or more stories are severely restricted from wood framed construction by building codes. All high-rise buildings were excluded because little if any wood is used for structural purposes in their construction, and because their inclusion would tend to bias results of the analysis. All results cited throughout this report are for low-rise buildings of four or fewer stories.

Three types of construction activity were identified for each building type: 1) new construction, 2) additions to existing buildings which may be either free standing or attached, and 3) alterations and renovations to existing structures. Alterations and renovations typically do not add floor area to the building, and may or may not include the use of structural building materials. There is no framing type or floor area associated with alterations and renovations. In this study new construction and additions are treated as a single construction type.

The construction of nearly 84,400 new nonresidential buildings and additions in 2008 translated into 2.5 billion square feet (ft^2) of floor area, 0.5 billion ft^2 of exterior wall area, and 1.9 billion ft^2 of roof area (Table 1). The estimated number of buildings is based on average values per building type from the McGraw Hill database (McGraw Hill Corp. 2009), and then applied to total construction value from the U.S. Department of Commerce (2010a). Wood

products were an important part of the mix of building products used in nonresidential buildings in 2008. An estimated 1,758 million board feet (million bf) of lumber, 2,677 million ft^2, 3/8-in. basis (million ft^2), of structural panels (1,099 million ft^2 of softwood plywood, 1,578 million ft^2 of oriented strand board [OSB]), 79 million ft^2, 3/8-in. basis of nonstructural panels, 68 million linear feet (million lf) of wood I-joists, 56 million bf of glulam timber, and 4 million cubic feet (million ft^3) of structural composite lumber (SCL) were used. (See the Appendix for wood product definitions.) All reported volumes include allowances for onsite waste and loss: lumber, and shakes and shingles – 10 percent, wood trusses and engineered wood products (I-joist, glulam, SCL) – 5 percent, and structural and nonstructural panels – 10 percent. Not included are the amounts of wood used for facilitation (formwork, scaffolding, etc.), millwork, and other non-construction uses. All wood-based panel volumes are on a 3/8-in. basis unless otherwise noted.

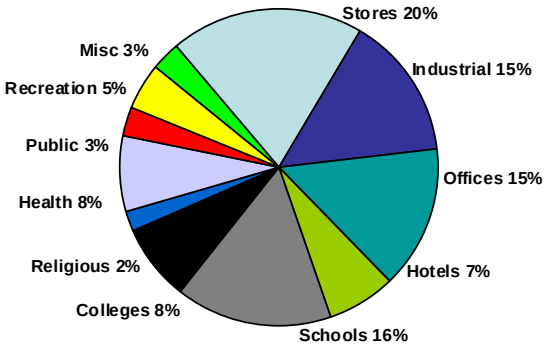
Nonresidential buildings use a diverse mixture of wood and nonwood building materials and building methods. The choice of materials and methods used are dependent on many factors including building type, location, and size, cost differentials between competing building materials, state and local building codes, architectural styles, and others. Also, wood may be used in specific applications even though the buildings may not be primarily built with wood, or specific applications may use wood more frequently than other applications. A building's framing type (wood, concrete, or metal) is defined by the predominant building material in the exterior wall. In order to capture these differences, data for this study were stratified and evaluated by building type, region, construction type, framing type, building application, and wood product.

This study updates a similar study conducted in 2003 (McKeever, Adair and O'Connor 2006), and uses the same basic procedures as those used in 2003. See Appendix B of the 2003 report for details on the procedures used. The 2003 study was undertaken cooperatively by the USDA Forest Service, Forest Products Laboratory, the then Forintek Canada Corporation, and the Wood Products Council (WPC). These studies do not include wood products used for nonbuilding construction (streets and highways, water and sewer systems, conservation and development, utilities, and other nonbuilding construction), nor does it include information on farm structures.

Measures of Construction Activity

Construction activity for new nonresidential buildings is measured in both the value of the new construction put in place, and total floor area built. Value of new construction put in place, by building type, is available for the nation as a whole from the U.S. Department of Commerce, Bureau of the Census (USDC 2010). Floor area built was estimated using floor area per $1,000 of construction value from data purchased from McGraw Hill Corp. (2009). Construction values and floor areas were estimated by U.S. Department of

Figure 1. Low-rise nonresidential construction value, 2008.



Total construction value: $329 billion constant (2005).

Commerce, Bureau of the Census regions, and sections of the U.S. In order to make meaningful comparisons of construction values over time, actual (current) dollars spent were converted to constant 2005 dollars. Constant dollar values measure the level of construction activity with inflationary effects removed. Closely related to floor area is exterior wall area and roof area. Each affects the consumption of wood products.

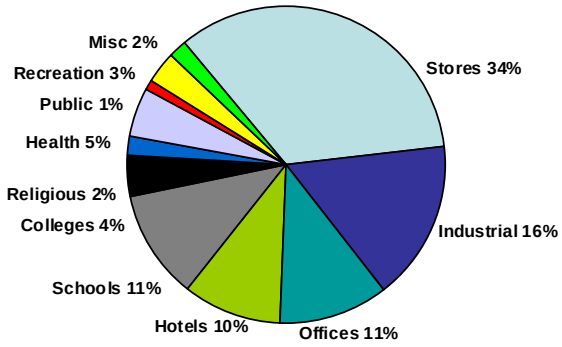
Value of Construction

In 2008 the construction of low-rise nonresidential buildings in the United States was valued at nearly $329 billion (2005 dollars) (Table 2). This is an increase of about 3 percent from 2003. Overall, 76 percent of all construction value was for new construction, the remaining 24 percent for alterations and renovations. Stores were the highest valued building type in 2008 at $65 billion, accounting for 20 percent of all nonresidential building construction (Table 2, Fig. 1). Schools were ranked second followed by office and industrial buildings. These four building types accounted for accounted for nearly two-thirds (65 percent) of all construction value.

Floor Area

An estimated 2,547 million ft^2 of floor area was built in 2008 in nonresidential buildings, up from 2,460 in 2003 (Table 2). Stores were the building type with most floor area built in both 2003 and 2008 at 920 and 899 million ft^2 respectively, and accounted for more than one-third of all new floor area added in 2008 (Fig.2). Industrial buildings ranked a distant second at 412 million ft^2, 16 percent of total floor area and less than half of that for stores. Schools and office buildings accounted for 12 and 11 percent of the floor area respectively. Each of the remaining building types accounted for no more than 7 percent of all new floor area added.

Figure 2. Low-rise nonresidential floor area added, by building type, 2008.



The value of new construction per square foot of floor area averaged $98 in 2008, down from $114 in 2003 (Table 2). Average value by building type in 2008 ranged from a high of $173 per square foot for colleges to just $56 for stores.

Between 2003 and 2008, total nonresidential floor area built increased slightly, from 2,460 to 2,547 million ft^2 (Table 3). There were many differences evident in floor area built in 2008 compared to 2003. The largest floor area gain occurred in hotels with floor area increasing by nearly 110 million ft^2 more than a 155 percent increase over 2003. Seven of the eleven building types added less area in 2008 than in 2003. Overall there was a 4 percent gain in floor area in 2008 compared to 2003.

Exterior Wall and Roof Area

Just over 546 million ft^2 of exterior wall area was built in 2008, 15 percent less than the 642 million ft^2 built in 2003 (Table 3). Total floor area is a good indicator of total exterior wall area by building type. Stores, the building type with the most floor area built in 2008, was also the building type with the largest exterior wall area. In general, each

building type ranked about the same in relative amounts of both floor area and exterior wall area built. Factors which affect exterior wall area include size of building (smaller buildings require proportionally more wall area to enclose the floor area), floor to ceiling height, number of stories (multistory buildings require proportionally more wall area to enclose a given floor area), shape of the building, and other architectural characteristics. Overall, 0.21 ft^2 of exterior wall area was required per ft^2 of floor area built in 2008.

Total roof area built in 2008 was estimated to be 1,853 million ft^2 (Table 3). The correspondence between floor area and roof area is similar to that for exterior walls. Stores and industrial buildings, the two largest building types for floor area were also the two largest types for roof area. Factors which affect roof area are number of stories, roof style (flat, pitched, mansard, etc.), extent of overhang, and other architectural characteristics. Overall, 0.73 ft^2 of roof area was required per ft^2 of floor area built in 2008.

Principal Framing Type

Four principal framing types were identified in this study, and accounted for all nonresidential building construction: 1) wood, 2) concrete, 3) metal, and 4) other/none. Framing type was determined for each individual project by McGraw Hill Corp. (2009), and is defined to be the predominant type of structural material in the exterior wall. Framing type incidences from the original 2003 report were revised based on the new information from McGraw Hill Corp. Wood construction includes lumber or other wood product framing, regardless of sheathing type; concrete construction includes concrete, masonry, stone, brick and block; metal construction includes primarily steel framing or support members; and other/none refers primarily to alterations and renovations which do not add floor space and thus do not have a framing type. Although some buildings are built entirely from the same structural material as the exterior walls, many combine two or more types of structural materials within or among specific applications in the building. For example, many concrete framed schools have wood framed roofs, or roofs with both wood and steel framing members. This is why structural wood products are present in many buildings regardless of framing type.

In 2008 wood framed construction accounted for 11 percent of all buildings, concrete framing 26 percent, and metal framing 63 percent (Table 4). Wood framing increased by 1 percentage point and metal framing by 2 percentage points between 2003 and 2008. Concrete framing fell 3 percentage points.

Metal framing was the dominant framing type in all building types except for hotels in 2008 (Table 4). More than one-half of all low-rise hotels in 2008 were wood framed. Public buildings were the most heavily metal framed at 88 percent, and excluding hotels, religious buildings were the lowest at 52 percent.

Wood Products Use, 2008

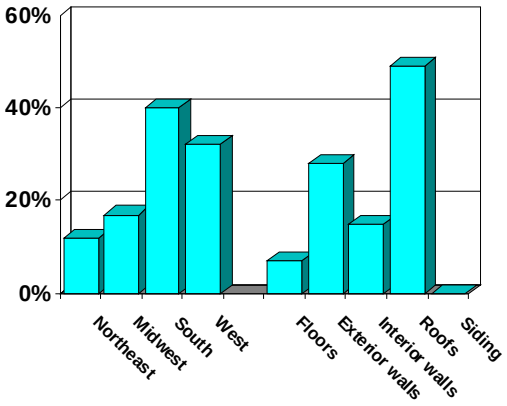
Wood products are important to the construction of nonresidential buildings of all types and sizes. Specific products include lumber (framing and board lumber, shakes, shingles and siding, and wood trusses), structural panels (softwood plywood and OSB), nonstructural panels, and engineered wood products (wood I-joists, glulam timbers, and structural composite lumber). Amounts of each used were estimated by type of nonresidential building, region, and building application. Nonstructural panels, consisting of particleboard, MDF, hardboard, insulation board and hardwood plywood, were reported as a single product type because of their relatively low level of overall use,

and declining importance in the new nonresidential building market. All reported volumes in this report include allowances for onsite waste and loss: 10 percent for lumber (excluding trusses), 10 percent for structural and nonstructural panels, and 5 percent for engineered wood products. Not included in the reported amounts is wood used for facilitation (form work, scaffolding, etc.), millwork, and other nonbuilding-related uses. All wood-based panel volumes are on a 3/8-in. basis unless otherwise noted

Lumber

Nearly 1,758 million bf of lumber was used in 2008 (Table 5, Fig. 3). The South was the region with the greatest use of lumber, followed by the West. Use for these two regions was 701 and 554 million bf respectively. The Northeast used the least amount of lumber in 2008.

Figure 3. Percentage of lumber use by region and application, 2008.



Roofs were by far the building application with the greatest share of lumber use in 2008 at 863 million bf, nearly one-half of all lumber used (Table 5, Fig. 3). Exterior walls were second at 28 percent of all lumber used. Interior walls, floors, and siding followed in decreasing order, and accounted for the remaining 17 percent of total lumber used. Floors accounted for just 7 percent of total lumber use. The relatively small amount of lumber in floors is due, in part, to the very large number of one-story buildings that have concrete slab on grade floor systems. Very little lumber siding was used, less than 1 percent of total lumber consumption.

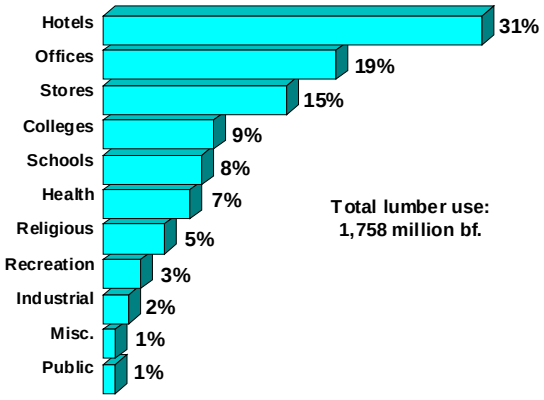
Many factors affect the use of wood products in the construction of nonresidential buildings, with building type perhaps being the single largest determining factor. Within each building type, variations in wood use are affected by geographical location of buildings, size of buildings, and by specific applications within the buildings. Tables 6 and 7 report lumber, structural panel, nonstructural panel and engineered wood use by building type and region, division, and Wood Products Council (WPC) target markets; and building type and application. Information on lumber use by building type and size class was not available in 2008.

The construction of new hotels and their additions and alterations and renovations used 542 of the 1,758 million bf of lumber used in 2008 for nonresidential building construction (Table 6), This volume was nearly 31 percent of all lumber used (Fig. 4). Offices and stores were next highest at 335 and 260 million bf respectively. These three building types combined used more than 1,136 million bf of lumber and accounted for nearly two-thirds of all lumber used.

Regional lumber use for all building types combined was greatest in the South at 701 million bf, closely followed by the West at 554 million bf (Table 6). These two regions combined accounted for 71 percent of all lumber used. About 60 percent of the remaining lumber was used in the Midwest, the remainder in the Northeast region. Regional patterns of use and regional variations were evident within specific building types. Stores, schools, colleges, and religious buildings in the West used more lumber than was used in other regions

within these building types. Hotels, offices, recreational and public buildings in the

Figure 4. Percentage of lumber use by building type, 2008.



South, and industrial, health and miscellaneous buildings in the Midwest used more lumber than was used in other regions within these building types. The Northeast region never used more lumber than any other single region in any building type. More lumber was used for hotels in the South than for any other building type or region, and public buildings in the Midwest used less lumber than any other building type or region. Regional variation in lumber use by individual building types between the lowest and highest lumber using region ranged from a low of 3.5 million bf for public buildings in the Midwest to a high of 305.5 million bf for hotels in the South. Regional variations in lumber use are attributable in part to size differences between regions, differences in traditionally accepted architectural styles and building practices, differences in environmental factors such as snow load requirements, earthquake resistance and insect resistance between regions, and differing levels of success of ongoing wood products promotional activities.

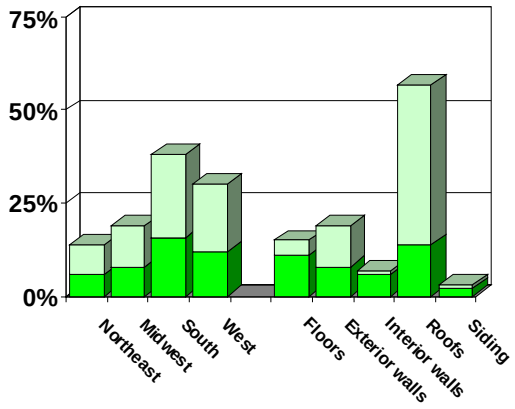
More lumber was used in roof systems than in any other building application in 2008, accounting for nearly 863 million of the 1,758 million bf of lumber used for nonresidential construction (Table 7). This level of consumption is nearly one-half of all lumber used. Exterior walls were a distant second at 492 million bf, just over one-half of the use for roofs. Interior walls and floors were third and fourth in lumber use intensity. Little lumber siding was used. One reason for the high percentage of lumber in roofs is that not only do wood framed buildings typically have wood roof systems, but many concrete framed buildings also use either all wood framed roofs, or hybrid wood-metal roof systems. Roofs in office buildings accounted for the largest percentage of lumber used in an individual building type at 79 percent of all lumber used. Lumber use by application varied somewhat among building types. Roofs were the largest lumber using application in all building types except for schools where exterior walls were the major lumber application. In 10 of the 11 building types, exterior walls were the second largest lumber using application. Interior walls were the second highest lumber using application in hotels at 28 percent of all lumber used, slightly below roofs by 4 percentage points. Variations in relative lumber use by application among building types is directly attributable to characteristics specific to the building type. Many hotels for example tend to be wood framed structures with 2 stories and numerous interior walls and partitions. The first (ground) floor is typically poured concrete, and upper floors wood framed. For these reasons hotels have the greatest percentage of lumber in interior walls and floors than any other building type.

Structural Panels

Total structural panel use in low-rise nonresidential building construction was estimated to be 2,677 million ft^2 in 2008 (Table 5, Fig. 5). The South and West regions were the two regions with the highest structural panel use. Thirty eight percent of total consumption was in the

South, more than the Northeast and Midwest regions combined. The West accounted for 29 percent of total consumption. OSB is the structural panel of choice for nonresidential construction. OSB consumption in 2008 was nearly 50 percent greater than that of softwood plywood.

Figure 5. Percentage of structural panel use by region and application, 2008.



Roofs were the building application with the greatest share of structural panel use in 2008 at 1,535 million ft^2, 57 percent of total structural panel use (Table 5). Exterior wall sheathing was a distant second at 18 percent, followed by floors, interior walls and siding. The high share of structural panel use in roofs compared to other applications is due in part to the use of wood roof systems on predominately nonwood buildings, and the use of nonwood sheathing panels on wood framed exterior walls. Softwood plywood had a larger share of the sheathing market for floors, interior walls and siding than did OSB, but in roof applications, more OSB was used than plywood in total.

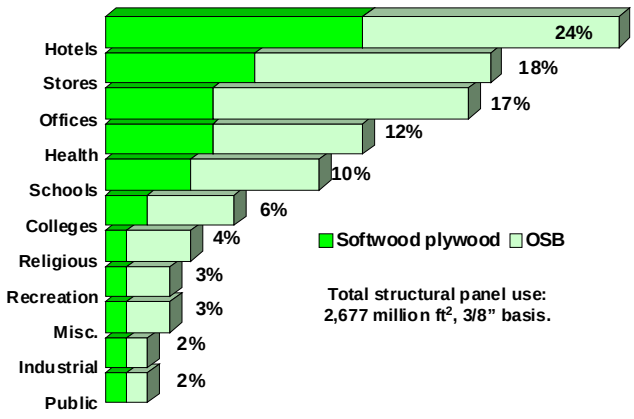
Nearly one-fourth, 638 million ft^2, of all structural panels in nonresidential building construction in 2008 were used for hotels (Table 6, Fig. 6). Stores and offices were the next largest at 479 and 454 million ft^2 respectively. These three building types accounted for nearly 60 percent of all structural panel use.

The share of softwood plywood vs. OSB varied somewhat by building type. Overall about 59 percent of all structural panels used were OSB. Industrial buildings and hotels used nearly equal amounts of softwood plywood and OSB at 49 and 51 percent OSB respectively. All other building types used more OSB than softwood plywood with percentages averaging in the upper 50s to upper 60s

Structural panel use by region for all building types combined varied considerably, from a low of 370 million ft^2 in the Northeast to a high of 1,029 million ft^2 in the South, more than two and three-fourths times that of the Northeast (Table 6). Different regional patterns of use and greater regional variations were evident within specific building types. Hotels in the South used more structural panels, 371.0

million ft^2, than any other building type in any other region The West region had the highest structural panel use in 5 of the 11

Figure 6. Percentage of structural panel use by building type, 2008.



building types, the South 4, and the Northeast and Midwest 1 each. Regional variation in structural panel use by individual

building types was greatest for hotels. Hotels built in the South used 58 percent of all structural panels used for hotels in 2008, compared to just 8 percent respectively for hotels built in the Northeast. Structural panels consumption in public buildings varied by 15 percent between regions.

Structural panel use by building application in 2008 was predominately for roofs, accounting for 57 percent of all structural panels used (Table 7, Fig. 5). Exterior walls and floors were a distant second and third at 18 and 15 percent of all structural panels respectively. Just 7 percent of all structural panels were used for interior walls and 3 percent for siding.

Office building roofs were the single largest use for structural panels in 2008 at nearly 358 million ft^2, followed by store roofs at 273 million ft^2 (Table 7). Although roofs consistently ranked as the top structural panel using application in every building type, the percentage of use within a building type varied. Hotel roofs used the least amount of all structural panels within the hotel building type at 42 percent, while office building roofs used the greatest at 79 percent..

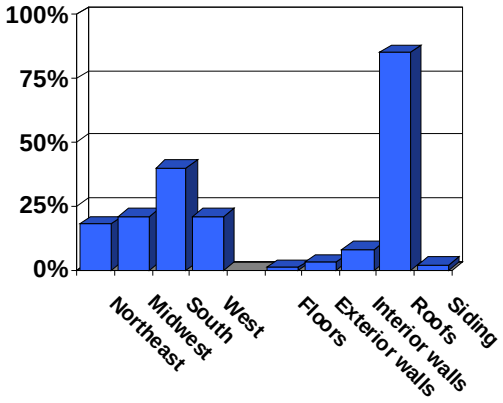
Softwood plywood as a percent of all structural panels averaged about 40 percent for all building types combined. This percentage varied from about 20 percent softwood plywood for roofs in religious buildings to about 90 percent softwood plywood for interior walls in hotels. About 80 percent of structural panel siding was softwood plywood.

Nonstructural Panels

The use of nonstructural wood panels in nonresidential building construction was small in 2008, totaling just 79 million ft^2 (Table 5, Fig. 7). Regional use was fairly evenly distributed across all the Northeast, Midwest and West regions. Use in the South using nearly twice that of each other region.

Nonstructural panels are typically not used in applications requiring a structural building component, which tends to greatly restrict their use. In 2008, 86 percent of all nonstructural panels were used in roofs, primarily as underlayment and insulation for flat, nonwood roofs. Small amounts were also used for floor decking, wall sheathing, and siding (Fig. 7).

Figure 7. Percentage of nonstructural panel use by region and application, 2008.



Nearly 70 percent of all nonstructural panels were used in schools in 2008. Each of the remaining building types accounted for 8 percent or less of total nonstructural panel use.

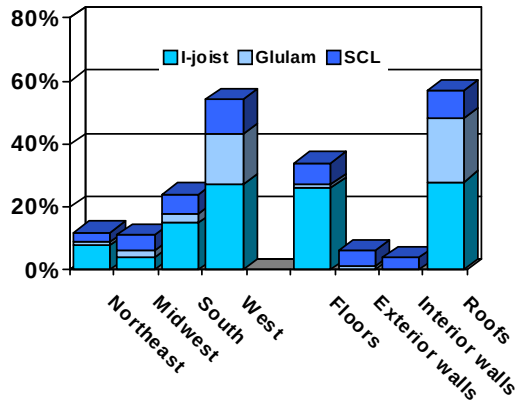
Engineered Wood

Engineered wood includes a growing family of wood-based building products made from adhesively bonded wood veneers, strands, or flakes. Included here are prefabricated wood I-joists (I-joists), glued laminated timbers (glulam), and structural composite lumber (SCL). SCL includes laminated veneer lumber, parallel strand lumber and oriented strand lumber. These structural

products substitute for lumber and nonwood building products in a variety of floor, wall and roof framing applications. Softwood plywood and OSB are also considered by many to be engineered wood products, but because their primary use is sheathing and decking rather than framing, they were reported separately above.

In 2008 an estimated 68 million linear feet (lf) of I-joists, 56 million bf of glulam, and nearly 4 million cubic feet (ft^3) of SCL were used in nonresidential building construction (Table 5). These volumes are equivalent to approximately 255 million bf. As such, I-joists accounted for about 54 percent of all engineered wood use, glulam 22 percent, and SCL 24 percent (Fig. 8). LVL was the dominant SCL type used. Engineered wood use in the West exceeded use in all other regions, at 53 percent of total use.

Figure 8. Percentage of engineered wood use by region and application, 2008.



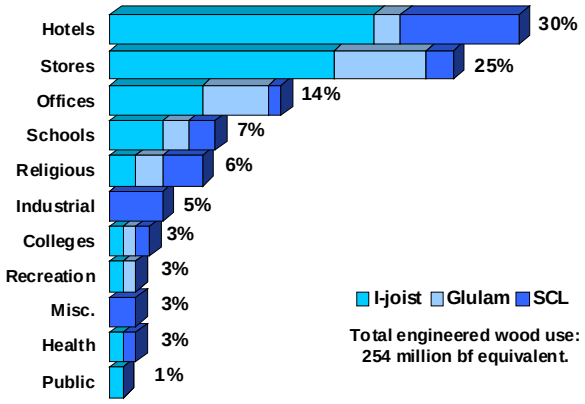
Roofs were the dominant use for each engineered wood product. The use of glulam timbers in roofs accounted for more than 90 percent of total glulam use in 2008. Wood I-joist use was second at 52, and SCL lowest at 35 percent. Overall, roofs accounted for 57 percent of all engineered wood use in 2008. Much of the variation by application for individual engineered wood products is due to the uses for which they are designed, and for which they can substitute for framing lumber. I-joists are used primarily for floor and roof framing, and occasionally for door and window headers in walls. Since floors have a much lower incidence of wood as the principal construction type than roofs, and since wood roofs are more common on otherwise nonwood buildings, I-joist use in roofs was greater than that for floors. Also, door and window headers are a small component of wall framing, causing I-joist use in walls to be quite small. The principal use for glulam timbers is as large, often decorative, roof beams and girders where large, clear spans are required. Principal uses for SCL include support beams and girders, primarily in roofs, rim joists in wood framed floor systems, door and window headers, and as chord material in I-joists. SCL estimates here do not include use as I-joist chords.

Engineered wood use varied considerably by building type, region and product. However, some overall trends were evident. Hotels used more engineered wood in 2008 than any other building type and accounted for 30 percent of total use (Table 6, Fig. 9). This was equivalent to 36 percent of all I-joists, 8 percent of all glulam, and 36 percent of all SCL. Stores and office building followed at 25 and 14 percent respectively. The remaining 8 building types each accounted for7 percent or less of total consumption. Much of the variation in use by building type was due to the ability of a specific engineered wood product to satisfy framing needs of the particular building type.

Nonresidential buildings in the West used, on average, more engineered wood than any other region in 2003. I-joist and glulam use was highest in the West in 8 of the 11 building types (Table 7), which accounted

for 46 and 60 percent of total use respectively. SCL use was also high in the West in six building types which captured 40 percent of the SCL market.

Figure 9. Percentage of engineered wood use by building type, 2008.



Different regional patterns of use and greater regional variations were evident within specific building types. Stores in the West used more engineered wood, 52.5 million bf, than any other building type in any other region. Hotels in the South were second at 42.0 million bf. The West region had the highest engineered wood use in 6 of the 11 building types, the South 2, and the Northeast and Midwest 2 and 1 respectively. Regional variation in engineered wood use by building types was very pronounced. The miscellaneous building ranged fro less than 1 percent of use in the Northeast region to 84 percent of use in the Midwest. The least variation was exhibited by health buildings with 12 percent of use in the Northeast and 38 percent in the South.

Wood-Use Factors

Wood-use factors measure the amount of a specific wood product used per unit of construction activity, i.e., the rate of wood use. This study used the wood-use factors developed in the more comprehensive 2003 study (McKeever, Adair and O'Connor, 2006). Wood-use factor details can be found in the 2003 study.

For the 2003 study, wood product take-offs were made for 1,069 buildings to determine wood use factors. For example, the volume of lumber used in roofs in a randomly selected number of schools was used to determine the board feet of lumber used per square foot of floor area and per $1,000 of construction value. Since 2003, wood use factors may have changed with the changing mix of products specified by architects and engineers. A new study of nonresidential construction is needed to determine current use factors for each product. Until such a study can be conducted, data and analyses in this report provide a reasonable estimate of wood products use in nonresidential construction.

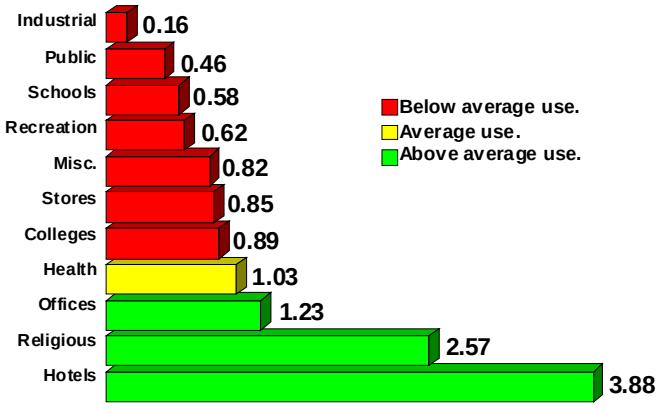
Use per $1,000 of Construction Value

On average, more structural panels were used per $1,000 of constant (2005) construction value than any other wood product at 8.14 ft^2 (3.34 ft^2 of softwood plywood, and 4.80 ft^2 of OSB) (Table 8). Lumber was second highest at 5.35 bf. Use of nonstructural panels and engineered wood products were all less than 1.00 ft^2.

Hotels were the most wood intensive building type in 2008. With the exception of nonstructural panels and some engineered wood products, more wood of each product type was used per $1,000 of construction value than for any other building type (Table 8). In order to compare total wood use (all wood products combined) per $1,000 of construction value by building types, an index of wood use was constructed. For each building type, use per $1,000 of each wood product was first converted to board

foot equivalents[1], and then summed over all wood products. This total use per $1,000 for

Figure 10. Index of wood use per $1,000 of construction value, 2008.



each building type was then divided by the total use per $1,000 for all buildings combined. The resulting index measures the relative magnitude of wood use per $1,000 compared to the all-building average. The index values for hotels and religious buildings were 3.88 and 2.57 respectively. This means that hotels used nearly four times more wood per $1,000 of construction value than the average building, and religious buildings used more than twice as much wood than average (Fig. 10). Industrial buildings were the least intensive wood using building type, with an index value of 0.16. Health care buildings, with a wood use index value of 1.03, used wood at about the same rate as the average nonresidential building in 2008.

[1] Factors used to convert panels and engineered wood products to board foot equivalents. Note, panel conversion based on actual, not nominal dimensions:

Structural and nonstructural panels:
1 ft² (3/8-inch basis) = 0.5 bf
Wood I-joists
1 lf = 2 bf:
Structural composite lumber:
1 ft³ = 16 bf

Wood use was considerably and consistently higher in the West than in other regions. About 60 percent more wood products were used per $1,000 of construction value in the West than in all regions combined. Nonstructural panels were the only wood products which was not used in greater amounts in the West than other regions.

Roofs were consistently the most intensive wood using building application in 2008. All wood products were used at higher rates in roofs than other applications without exception. Exterior walls were second highest with overall wood use per $1,000 of construction value at just under one-half that of roofs. Floors and interior walls were third and fourth in wood use per $1,000 of construction value, followed by siding.

Use per Square Foot of Floor Area

Wood products use per square foot of finished floor area is another measure of the intensity of wood products use in new nonresidential buildings. Since total construction value and area of finished floor area built are closely related, it is not surprising that relative intensity of wood products use per ft^2 of floor area by building type, region, size class and application are very similar to use per $1,000 of construction value. Overall, hotels and religious buildings remained the two most intensive wood-using building types in 2008 as measured by the wood use per ft^2 of floor area index value (Table 9). Industrial buildings were the least intensive. Buildings of intermediate use shifted slightly in order of importance when compared to use per $1,000.

Buildings in the West used more wood per ft^2 of floor area than buildings in other regions. Roofs were the most intensive wood-using building application, siding the least.

Wood-Use Comparisons, 2003 and 2008

Nonresidential construction is a very dynamic, changing market for both wood and nonwood building products. Some of the trends in wood products consumption which occurred between 1985 and 2003 continue, others do not. See McKeever, Adair and O'Connor (2006) for details of changes which occurred through 2003. Between 2003 and 2008 total wood consumption, measured in board foot equivalents, increased from 2.6 billion bf to 3.4 billion bf (Table 10). Use of each individual wood product also increased. Although below the 3.8 billion bf of wood used in 1985, it is still a substantial increase from previous years. This is not to say that all wood products increased in all building types or all applications. Wood use in industrial, schools, religious, and recreational buildings was lower in 2008 than 2003. Overall wood products consumption, and consumption of specific building products is directly affected by levels of construction activity, substitution of wood and nonwood products for other wood products, changes in architectural designs, consumer preferences and other factors. Between 2003 and 2008, changes in construction activity within building types were the principal factors affecting wood products consumption. Wood I-joists posted the largest percentage increase between 2003 and 2008 at 46 percent, while structural panels posted the largest absolute volume gain, increasing by 473 million ft^2 to 2,677 million ft^2.
Changes in wood use between 2003 and 2008 varied considerably by building type. Hotels had the largest increase in combined wood use in terms of both amount (677 million bf equivalents), and percentage (260%). Conversely, schools had the greatest overall decrease in the amount of total wood used (-60 million bf) (Table 10). Of the eleven building types, four (industrial, schools, religious, and recreation) had declining, and the remaining eight increasing combined wood use. With few exceptions, declines in specific wood products use were in the building types where overall total wood products use declined. Many factors contributed to the ongoing changing use of wood in new nonresidential building construction. Some are anecdotal, others more quantifiable. Included are:

- An increase in total value of nonresidential construction measured in constant (2005) dollars between 2003 and 2008 tended to increase overall wood use.

- An increase in total floor area between 2003 and 2008 tended to increase overall wood use.

- A lower constant dollar construction value per square foot of floor area in 2008 may have tended to increase overall wood use.

- An increase in the mix of building types constructed which are more wood intensive tended to increase overall wood use.

- An overall increase in the proportions of wood framed buildings to other framing types in 2008 tended to increase wood use.

- Adoption of the International Building Code for nonresidential construction continued to favor increased overall wood use. (See McKeever, Adair and O'Connor (2006) for a discussion of the impact of the International Building Code on wood use.)

The changing use of wood in nonresidential building construction between 2003 and 2008 affected average wood use per $1,000 of constant (2005) construction value, and average wood use per square foot of finished floor area. Overall, combined wood products use increased from 8.2 to 10.3 bf

per $1,000 of construction value in 2008 (Table 11). Each wood product group also increased use per $1,000 between 2003 and 2005.

The use of all wood products combined per square foot of floor area also increased between 2003 and 2008 (Table 11). Use per square foot of floor area estimates do not include wood products use for alterations and renovations because there is no floor area associated with alterations and renovations.

U.S. Wood Products Consumption

Overall, the construction of nonresidential buildings in 2008 accounted for 5 percent of total U.S. consumption of lumber, structural and nonstructural panels, and engineered wood products (Table 12). Structural panels and engineered wood products consumption each accounted for about 11 percent of U.S. consumption. Glulam captured the largest share of the U.S. market at more than 21 percent of consumption, and wood I-joists second at 13 percent. The market share for SCL was greater than indicated because large amounts are used for I-joist flanges. Differences in the percentage of total consumption between the various wood products were not unexpected. Products with a more diverse market base such as lumber and nonstructural panels tend to have lower percentage use in nonresidential construction than those with a more limited base.

Potential Wood Products Market Growth

The construction of new nonresidential buildings holds potential for expanding the use of wood building products. In 2008 concrete and metal construction continued to dominate the nonresidential building construction market, accounting for nearly 89 percent of total construction (Table 4). Since 2003 wood framed construction made modest gains against concrete and steel, but additional gains are possible. Currently, only about 11 percent of all new buildings are wood framed. Numerous approaches to examine the potential amounts of wood which could be used in nonresidential building construction exist. Here we will examine one - the maximum potential wood use approach. It should be noted that alteration and renovation projects are not included in this discussion.

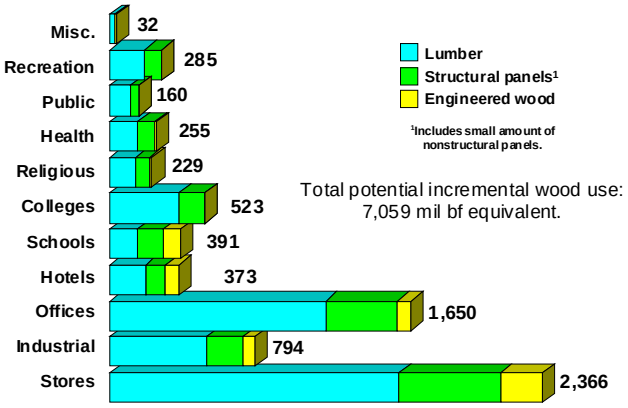
Substantial additional amounts of lumber and structural panels, and lesser amounts of engineered wood and nonstructural panels could be used if concrete and metal framed buildings were wood framed. Realistically, very little, if any, wood will ever penetrate the foundation and ground level floor market. Also, if wood were to replace concrete and metal in other applications, the usage rate (volume of wood used per ft^2 of floor area) would probably not be expected to exceed current wood usage rates for applications which are principally built from wood.

For example, if a wood framed hotel used, on average, 2.4 ft^2 of structural panels per square foot of floor area for roof sheathing, and a non-wood framed hotel used 0.9 ft^2 of structural panels per square foot of floor area for roof sheathing, then the structural panel maximum potential for roofs would be the diffenecse between 2.4 and 0.9 multiplied by the floor area in non-wood framed hotels. A realistic limit to the maximum potential for wood products in new nonresidential buildings would be the additional amounts of each wood product that would be used if concrete and metal upper story floors, exterior and interior walls, roofs, and siding were built principally with wood at current wood framed usage rates.

In 2008 an additional 4,630 million bf of lumber and 3,686 million ft^2 of structural

panels, 28 million ft^2 of nonstructural panels, and 572 million bf of engineered wood could have been used in new nonresidential buildings if all concrete and metal building

Figure 11. Potential wood product increase for new nonresidential construction, by building type, 2008.



applications, except foundations and ground level floors, were built with wood at usage rates similar to those for wood-based building applications (Table 13). This was equivalent to over 7.0 billion bf of wood products (Fig. 11). Roofs had the greatest incremental potential for all wood products, accounting for nearly 57 percent of the lumber, 46 percent of the structural panels, 33 percent of the nonstructural panels, and 69 percent of total engineered wood potential (Table 14). The South region had the highest share of each wood product's. Potential varied considerably by wood product, building type and application. In general, stores, and office buildings had the highest potential for increasing the use of nearly all wood products.

Summary and Conclusions

The construction of low-rise nonresidential buildings in the United States is an important, but changing, market for lumber, wood-based panels, and engineered wood products. Unlike residential construction where wood is the dominate building material and limited variability in construction techniques exist, nonresidential building construction uses a diverse mixture of new and changing building products and construction techniques. The mix of building types also affects the amounts and types of wood used. When construction of buildings which tend to use more wood per unit of construction activity, such as hotels and religious buildings, is high, overall wood use tends to increase. When construction of buildings which tend to use less wood per unit of construction, such as public and industrial buildings, is high, lesser amounts of wood are used. Building size also affects overall wood use. Smaller buildings tend to use wood more intensively than larger buildings, and both tend to use more wood than alterations and renovations. Variability best describes the overall nonresidential building market, and the types and amounts of building products used.

The construction of low-rise nonresidential buildings in 2008 was valued at $412 billion, or about $328 billion constant 2005 dollars. This level of construction translated into an estimated 84,000 new nonresidential buildings, plus alterations and renovations to existing buildings. A total of 2.5 billion ft^2 of new floor area, 0.5 billion ft^2 of exterior wall area, and 1.9 billion ft^2 of roof area were constructed. In total, an estimated 1,758 million bf of lumber, 2,677 million ft^2, 3/8-in. basis, of structural panels, 79 million ft^2, 3/8-in. basis, of nonstructural panels, 68 million lf of wood I-joists, 56 million bf of glulam timber, and 4 million ft^3 of structural composite lumber were used.

If all wood products are converted to their equivalent board foot volumes and combined, hotels used more wood than any other building type in 2008, 937 million bf equivalents. Public buildings used the least. More wood was used in the South than other region.

In terms of overall combined amounts of wood used per unit of construction activity, In 2008, hotels used nearly 4 times more wood per $1,000 of construction value than average. Religious buildings used about 2.5 times as much. Conversely, public and industrial buildings used one-half the amount of wood or less than average. Buildings in the West used 60 percent more wood per $1,000 of construction than average..

The value of low-rise nonresidential buildings in 2008 was nearly $9 billion, or 3 percent greater than it was in 2003, measured in constant 2005 dollars. Combined wood products consumption was also greater in 2008 by nearly 30 percent, or 770 million bf. Much of this difference was due to large increase in lumber and structural panel use. Changes in nonstructural panel and engineered wood use were minimal compared to lumber and structural panels. Combined use per constant 2005 dollar of construction value was about 26 percent higher in 2008 than in 2003.

Overall, the construction of new low-rise nonresidential buildings and the alteration and renovation to existing buildings was, and still is, an important market for wood products, but one which should not be taken for granted. Nonwood building products are continually challenging wood in many nonresidential building applications, as evidenced by reduced market shares for some wood products, and stagnant growth for others. Product uniformity and consistency, availability, cost advantage, performance, and acceptance all affect the choice of building materials used. Changes in building codes which permit wood construction in a wider range of applications has positively affected the use of wood products. Wood products continue to be a viable alternative to non-wood building products in low-rise nonresidential construction.

hotels far exceeded all other building types.

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Tables

Table 1. Value of all construction, and area and wood products consumption for nonresidential building construction in the United States, 2003 and 2008.

Value of construction (Bil. $)[1,2]	**2003[3]**		**2008**	
Residential	451	51%	357	33%
Nonresidential				
Buildings	277	31%	456	43%
Nonbuildings	163	18%	259	24%
Total, nonresidential	440	49%	715	67%
Total, all construction	891	100%	1,072	100%
Value of construction, low-rise nonresidential buildings[2,4]	**263**	30%	412	38%
Area in new low-rise nonresidential buildings (Mil. ft^2)[4,5]				
Floor area	2,460		2,547	
Exterior wall area	642		546	
Roof area	1,953		1,853	
Wood consumption in low-rise nonresidential buildings[3]	**2003[3]** (Mil.)		**2008** (Mil.)	
Lumber (Bf)	1,290		1,758	
Structural panels (Ft^2, 3/8" basis)				
Softwood plywood	879		1,099	
OSB	1,325		1,578	
Total, structural panels	2,204		2,677	
Nonstructural panels (Ft^2, 3/8" basis)	74		79	
Engineered wood				
I-joist (Lf)	47		68	
Glulam (Bf)	55		56	
Structural composite lumber (Ft^3)	3		4	
Number of new, low-rise nonresidential buildings[4,5]	82,187		84,389	

[1]Current dollars.

[2]Includes all construction.

[3]Revised.

[4]Buildings with 4 or fewer stories.

[5]Includes new construction and additions only. Alterations and renovations have no associated floor area.

Sources: McGraw Hill Corp. 2009; McKeever, Adair, O'Connor 2006, U.S Dept. of Commerce 2010a.

Table 2. Estimated value of low-rise nonresidential building construction, floor area built, and value per square foot of floor area, by building type, 2003 and 2008.

	Value of new construction[1]				Floor area		Per ft^2 of floor area[1]	
	2003[2]		2008		2003[2]	2008	2003[2]	2008
Building type	All construc-tion (Bil. $)	New & additions only[3] (Bil. $)	All construc-tion (Bil. $)	New & additions only[3] (Bil. $)	New & additions only[3] (Mil. ft^2)	New & additions only[3] (Mil. ft^2)	New & additions only[3] ($)	New & additions only[3] ($)
Stores	72.6	63.8	65.0	50.2	920	899	69.3	55.9
Industrial	25.9	22.7	48.6	41.6	372	412	61.2	100.9
Office	44.8	39.3	47.4	33.4	287	281	136.9	118.8
Hotels	9.9	8.7	23.5	14.4	71	180	122.7	79.7
Schools	62.5	54.9	52.7	41.8	286	297	191.7	140.8
Colleges	26.6	23.3	26.5	19.6	133	113	175.8	173.2
Religious	10.4	9.1	5.7	4.7	86	56	106.8	83.5
Health	30.0	26.3	26.8	20.4	140	132	187.6	155.0
Public	8.0	7.0	8.4	6.7	32	39	219.5	172.0
Recreation	19.9	17.5	15.9	12.8	102	79	172.0	161.1
Misc.	9.7	8.5	8.3	5.2	31	59	274.0	88.1
Total	320.2	281.3	328.7	250.7	2,460	2,547	114.4	98.4

[1]Constant 2005 $.

[2]Revised.

[3]Alterations and renovations have no associated floor area.

Sources: McGraw Hill Corp. 2009; McKeever, Adair, O'Connor 2006, U.S Dept. of Commerce 2010a, 2010b.

Table 3. Floor, exterior wall and roof area[1] in low-rise nonresidential buildings, 2003 and 2008.

	Floor area		Exterior wall area		Roof area	
Building type	2003[2] (Mil. ft^2)	2008 (Mil. ft^2)	2003[2] (Mil. ft^2)	2008 (Mil. ft^2)	2003[2] (Mil. ft^2)	2008 (Mil. ft^2)
Stores	920	899	219	177	821	744
Industrial	372	412	65	45	347	365
Offices	287	281	92	65	202	181
Hotels	71	180	25	65	26	55
Schools	286	297	69	65	212	203
Colleges	133	113	42	33	71	55
Religious	86	56	34	20	67	43
Health	140	132	44	35	80	67
Public	32	39	11	3	23	33
Recreation	102	79	34	23	78	55
Misc.	31	59	9	15	26	52
Total	2,460	2,547	642	546	1,953	1,853

[1]Includes new construction and additions only. Alterations and renovations have no associated areas.

[2]Revised.

Sources: McGraw Hill Corp. 2009; McKeever, Adair, O'Connor 2006.

Table 4. Principal framing type[1] incidence in low-rise nonresidential building construction, by building type, 2003 and 2008.

	2003[2]			2008		
	Percentage of buildings:			Percentage of buildings:		
Building type	Wood (%)	Concrete (%)	Metal (%)	Wood (%)	Concrete (%)	Metal (%)
Stores	7	29	63	13	26	62
Industrial	2	38	61	1	39	60
Office	12	33	55	12	32	57
Hotels	59	11	30	58	19	23
Schools	11	26	63	6	24	71
Colleges	15	21	64	17	16	67
Religious	22	21	58	27	21	52
Health	25	16	59	30	14	56
Public	7	39	55	2	11	88
Recreation	12	29	60	10	23	67
Misc.	6	22	72	7	20	72
Total	10	29	61	11	26	63

[1]Principal framing type is determined by predominant exterior wall framing material.

[2]Revised.

Source: McGraw Hill Corp. 2009.

Table 5. Wood used in low-rise nonresidential building construction, all building types, by characteristic, 2003 and 2008.

Building type, and characteristic	Lumber[1] (Mil. bf)	Structural panels: Softwood plywood (Mil. ft^2, 3/8")	Structural panels: OSB (Mil. ft^2, 3/8")	Structural panels: Total (Mil. ft^2, 3/8")	Non-structural panels[2] (Mil. ft^2, 3/8")	Engineered wood: I-joist (Mil. lf)	Engineered wood: Glulam (Mil. bf)	Engineered wood: SCL[3] (Mil. ft^3)	Engineered wood: Total (Mil. bf equivalent)[4]
2003[5]									
Region									
Northeast	129.5	109.6	156.0	265.7	16.7	3.5	4.3	0.2	14.1
Midwest	270.4	194.8	286.6	481.4	16.2	7.2	7.3	0.7	32.5
South	462.3	301.6	434.1	735.7	24.0	10.2	8.4	0.5	36.9
West	427.5	272.9	448.2	721.1	17.0	26.0	34.6	1.3	107.6
Total	1,289.8	879.0	1,324.9	2,203.8	73.9	46.9	54.6	2.7	191.1
Application									
Floors	70.7	175.0	66.3	241.3	1.0	17.0	2.0	0.5	43.8
Exterior walls	347.5	188.2	221.6	409.8	2.0	0.0	2.1	0.6	11.0
Interior walls	142.1	126.5	32.9	159.4	6.2	0.0	0.2	0.5	8.0
Roofs	721.3	333.3	991.4	1,324.7	63.5	29.9	50.3	1.1	128.3
Siding	8.2	56.0	12.7	68.7	1.2	0.0	0.0	0.0	0.0
Total	1,289.8	879.0	1,324.9	2,203.8	73.9	46.9	54.6	2.7	191.1
2008									
Region									
Northeast	210.4	151.3	219.0	370.3	14.1	9.8	2.6	0.4	29.2
Midwest	292.5	200.9	289.0	489.9	16.2	5.1	4.5	0.8	26.8
South	701.0	436.5	592.7	1,029.2	31.5	19.5	7.9	1.0	62.5
West	553.9	309.8	477.6	787.4	16.6	34.0	40.7	1.7	136.1
Total	1,757.8	1,098.5	1,578.3	2,676.8	78.5	68.4	55.7	3.9	254.6
Application									
Floors	130.6	300.0	96.9	397.0	1.2	32.7	2.0	1.0	84.0
Exterior walls	491.7	209.4	282.5	491.9	2.6	0.0	2.9	0.8	16.0
Interior walls	264.6	150.6	28.9	179.4	6.7	0.0	0.2	0.6	10.5
Roofs	862.8	378.3	1,156.4	1,534.7	66.9	35.7	50.6	1.4	144.0
Siding	8.1	60.2	13.6	73.8	1.2	0.0	0.0	0.0	0.0
Total	1,757.8	1,098.5	1,578.3	2,676.8	78.5	68.4	55.7	3.9	254.6

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

[2]Includes hardboard, insulation board, particleboard, MDF, and hardwood plywood.

[3]Structural composite lumber (SCL) includes laminated veneer lumber, parallam, and timberstrand.

[4]Based on 2 bf per lf of I-joists and 16 bf per ft^3 of SCL.

[5]Revised.

Source: McKeever, Adair, O'Connor 2006.

Table 6. Wood used in low-rise nonresidential building construction, by building type, region and section, 2008.

Building type, and region	Lumber[1] (Mil. bf)	Structural panels: Softwood plywood (Mil. ft^2, 3/8")	Structural panels: OSB (Mil. ft^2, 3/8")	Structural panels: Total (Mil. ft^2, 3/8")	Non-structural panels[2] (Mil. ft^2, 3/8")	Engineered wood: I-joist (Mil. lf)	Engineered wood: Glulam (Mil. bf)	Engineered wood: SCL[3] (Mil. ft^3)
Stores								
Northeast	25.1	22.1	35.1	57.3	0.5	1.5	0.2	0.0
New England	10.3	8.2	13.1	21.3	0.2	0.7	0.1	0.0
Middle Atlantic	14.8	13.9	22.0	35.9	0.3	0.9	0.1	0.0
Midwest	43.1	49.5	65.5	115.0	0.3	1.6	0.3	0.0
East North Central	30.4	34.4	45.7	80.1	0.2	1.1	0.2	0.0
West North Central	12.7	15.1	19.8	34.9	0.1	0.5	0.1	0.0
South	52.0	52.6	51.5	104.1	1.5	1.8	0.4	0.0
South Atlantic	27.9	31.3	29.4	60.8	1.0	1.1	0.2	0.0
East South Central	6.5	6.2	6.4	12.6	0.1	0.2	0.0	0.0
West South Central	17.6	15.0	15.7	30.7	0.4	0.5	0.2	0.0
West	139.4	65.9	136.7	202.5	3.8	16.3	17.5	0.2
Mountain	32.0	21.1	41.8	62.9	0.7	3.0	2.7	0.0
Pacific	107.5	44.8	94.9	139.7	3.1	13.3	14.8	0.1
United States	259.6	190.1	288.8	478.9	6.1	21.3	18.3	0.2
MN, WI, MI	12.8	15.5	20.2	35.7	0.1	0.5	0.1	0.0
NC, SC, GA	11.4	12.1	12.0	24.0	0.3	0.4	0.1	0.0
CA	73.6	29.8	63.3	93.1	2.1	9.2	10.3	0.1
Industrial								
Northeast	5.7	2.6	1.7	4.4	0.0	0.0	0.3	0.1
New England	0.6	0.5	0.2	0.7	0.0	0.0	0.1	0.0
Middle Atlantic	5.1	2.2	1.5	3.7	0.0	0.0	0.2	0.1
Midwest	15.5	10.7	4.7	15.4	0.0	0.2	0.2	0.0
East North Central	12.4	8.7	3.7	12.4	0.0	0.1	0.1	0.0
West North Central	3.1	2.0	1.0	3.0	0.0	0.0	0.1	0.0
South	13.0	5.8	7.8	13.6	0.0	0.1	0.5	0.0
South Atlantic	5.9	2.7	3.5	6.2	0.0	0.1	0.2	0.0
East South Central	1.5	0.7	0.7	1.4	0.0	0.0	0.1	0.0
West South Central	5.6	2.4	3.5	6.0	0.0	0.0	0.1	0.0
West	8.4	6.9	10.9	17.8	0.0	0.3	0.3	0.5
Mountain	2.9	2.6	3.9	6.5	0.0	0.1	0.1	0.2
Pacific	5.5	4.3	7.0	11.3	0.0	0.2	0.2	0.3
United States	42.5	26.1	25.2	51.2	0.0	0.6	1.2	0.7
MN, WI, MI	4.6	3.3	1.3	4.6	0.0	0.1	0.0	0.0
NC, SC, GA	2.3	1.1	1.3	2.4	0.0	0.0	0.1	0.0
CA	3.5	3.0	4.9	7.8	0.0	0.1	0.1	0.2

Table 6. Wood used in low-rise nonresidential building construction, by building type, region and section, 2008 -- cont.

Building type, and region	Lumber[1] (Mil. bf)	Structural panels: Softwood plywood (Mil. ft^2, 3/8")	Structural panels: OSB (Mil. ft^2, 3/8")	Structural panels: Total (Mil. ft^2, 3/8")	Non-structural panels[2] (Mil. ft^2, 3/8")	Engineered wood: I-joist (Mil. lf)	Engineered wood: Glulam (Mil. bf)	Engineered wood: SCL[3] (Mil. ft^3)
Office								
Northeast	77.0	32.9	67.3	100.2	2.1	2.2	0.0	0.1
New England	23.9	9.5	19.0	28.5	0.3	0.8	0.0	0.0
Middle Atlantic	53.1	23.4	48.3	71.7	1.7	1.4	0.0	0.1
Midwest	21.1	9.9	20.2	30.1	0.4	1.1	1.1	0.0
East North Central	9.5	4.5	9.1	13.6	0.2	0.5	0.5	0.0
West North Central	11.5	5.5	11.1	16.5	0.2	0.6	0.6	0.0
South	157.9	47.4	93.7	141.2	3.3	1.3	0.2	0.0
South Atlantic	94.6	29.5	55.4	84.9	2.3	0.7	0.1	0.0
East South Central	11.1	3.0	6.9	9.8	0.1	0.1	0.0	0.0
West South Central	52.2	14.9	31.4	46.4	0.9	0.4	0.1	0.0
West	78.6	55.8	127.0	182.8	0.1	4.7	11.9	0.1
Mountain	18.2	23.3	47.2	70.5	0.0	1.6	4.9	0.0
Pacific	60.4	32.6	79.7	112.3	0.1	3.1	7.0	0.1
United States	334.6	146.1	308.2	454.3	5.9	9.2	13.2	0.2
MN, WI, MI	4.7	2.2	4.5	6.8	0.1	0.2	0.3	0.0
NC, SC, GA	20.6	5.8	12.5	18.3	0.3	0.2	0.0	0.0
CA	27.2	14.3	34.8	49.1	0.0	1.4	3.0	0.0
Hotels								
Northeast	38.1	28.5	23.0	51.5	0.0	4.1	0.1	0.1
New England	4.5	3.4	2.8	6.1	0.0	0.5	0.0	0.0
Middle Atlantic	33.7	25.1	20.3	45.3	0.0	3.6	0.1	0.1
Midwest	86.0	38.3	54.1	92.3	0.1	0.8	1.1	0.1
East North Central	55.5	24.7	34.9	59.6	0.0	0.5	0.7	0.0
West North Central	30.5	13.6	19.2	32.7	0.0	0.3	0.4	0.0
South	305.5	170.2	200.9	371.0	0.8	14.4	0.6	0.8
South Atlantic	125.8	72.0	88.5	160.5	0.2	3.8	0.3	0.2
East South Central	43.1	23.8	27.6	51.4	0.1	2.3	0.1	0.1
West South Central	136.6	74.4	84.7	159.1	0.5	8.3	0.3	0.4
West	111.9	72.8	50.1	122.9	0.1	5.6	2.8	0.5
Mountain	73.6	47.7	32.9	80.6	0.0	3.7	1.9	0.3
Pacific	38.3	25.1	17.2	42.3	0.0	1.9	1.0	0.2
United States	541.6	309.7	328.0	637.8	1.0	24.8	4.6	1.4
MN, WI, MI	13.9	6.2	8.7	14.9	0.0	0.1	0.2	0.0
NC, SC, GA	54.3	30.5	36.4	66.9	0.1	2.4	0.1	0.1
CA	23.0	15.1	10.3	25.4	0.0	1.1	0.6	0.1

Table 6. Wood used in low-rise nonresidential building construction, by building type, region and section, 2008 -- cont.

Building type, and region	Lumber[1] (Mil. bf)	Structural panels: Softwood plywood (Mil. ft^2, 3/8")	Structural panels: OSB (Mil. ft^2, 3/8")	Structural panels: Total (Mil. ft^2, 3/8")	Non-structural panels[2] (Mil. ft^2, 3/8")	Engineered wood: I-joist (Mil. lf)	Engineered wood: Glulam (Mil. bf)	Engineered wood: SCL[3] (Mil. ft^3)
Schools								
Northeast	16.9	17.2	21.4	38.6	9.5	0.1	0.3	0.0
New England	3.8	4.0	5.0	9.0	2.2	0.0	0.1	0.0
Middle Atlantic	13.1	13.2	16.4	29.6	7.3	0.1	0.2	0.0
Midwest	17.1	13.9	17.2	31.1	12.6	0.3	0.2	0.0
East North Central	12.0	9.7	12.5	22.1	10.4	0.2	0.1	0.0
West North Central	5.1	4.2	4.7	8.9	2.3	0.1	0.0	0.0
South	41.7	47.7	72.7	120.4	21.9	0.1	0.2	0.0
South Atlantic	20.4	21.1	33.7	54.8	11.8	0.1	0.1	0.0
East South Central	7.0	6.8	11.2	18.0	4.4	0.0	0.0	0.0
West South Central	14.3	19.9	27.7	47.6	5.7	0.1	0.1	0.0
West	58.0	33.7	44.2	77.9	10.3	4.2	4.0	0.2
Mountain	21.5	10.8	14.7	25.4	5.2	0.9	1.2	0.1
Pacific	36.5	23.0	29.5	52.5	5.1	3.3	2.8	0.1
United States	133.7	112.6	155.5	268.0	54.2	4.8	4.7	0.3
MN, WI, MI	3.8	3.1	3.6	6.8	2.0	0.1	0.0	0.0
NC, SC, GA	9.6	12.4	17.7	30.1	4.4	0.0	0.0	0.0
CA	25.9	16.6	21.4	38.0	3.2	2.5	2.0	0.1
Colleges								
Northeast	17.5	13.5	15.0	28.5	0.4	1.2	1.2	0.0
New England	4.8	3.0	3.4	6.4	0.1	0.2	0.5	0.0
Middle Atlantic	12.7	10.5	11.6	22.1	0.3	1.0	0.8	0.0
Midwest	18.0	7.5	13.8	21.3	1.1	0.1	0.0	0.0
East North Central	10.6	4.3	7.8	12.1	0.6	0.0	0.0	0.0
West North Central	7.4	3.2	6.0	9.2	0.5	0.0	0.0	0.0
South	34.2	19.2	33.4	52.5	1.1	0.1	2.1	0.0
South Atlantic	16.8	9.9	17.2	27.2	0.6	0.1	1.0	0.0
East South Central	7.6	4.0	6.9	10.9	0.2	0.0	0.3	0.0
West South Central	9.8	5.2	9.2	14.4	0.3	0.0	0.7	0.0
West	85.6	23.5	31.6	55.1	1.0	0.1	0.2	0.0
Mountain	11.9	4.1	6.4	10.5	0.2	0.0	0.0	0.0
Pacific	73.7	19.4	25.2	44.6	0.8	0.1	0.1	0.0
United States	155.2	63.7	93.7	157.4	3.6	1.5	3.5	0.1
MN, WI, MI	3.9	1.8	3.8	5.5	0.3	0.0	0.0	0.0
NC, SC, GA	12.7	6.4	11.1	17.5	0.3	0.0	0.6	0.0
CA	54.5	14.3	18.6	32.9	0.6	0.0	0.1	0.0

Table 6. Wood used in low-rise nonresidential building construction, by building type, region and section, 2008 -- cont.

Building type, and region	Lumber[1] (Mil. bf)	Structural panels: Softwood plywood (Mil. ft^2, 3/8")	Structural panels: OSB (Mil. ft^2, 3/8")	Structural panels: Total (Mil. ft^2, 3/8")	Non-structural panels[2] (Mil. ft^2, 3/8")	Engineered wood: I-joist (Mil. lf)	Engineered wood: Glulam (Mil. bf)	Engineered wood: SCL[3] (Mil. ft^3)
Religious								
Northeast	4.9	1.9	3.8	5.7	0.0	0.1	0.1	0.0
New England	2.0	0.7	1.4	2.1	0.0	0.0	0.0	0.0
Middle Atlantic	3.0	1.2	2.4	3.6	0.0	0.1	0.1	0.0
Midwest	25.0	8.5	19.4	27.9	0.1	0.6	1.0	0.2
East North Central	16.8	5.7	13.2	18.9	0.1	0.4	0.7	0.1
West North Central	8.1	2.8	6.2	9.0	0.0	0.2	0.4	0.1
South	24.5	10.6	21.3	31.9	0.1	0.3	2.4	0.0
South Atlantic	12.0	5.8	11.8	17.6	0.1	0.1	1.4	0.0
East South Central	5.0	1.9	3.8	5.7	0.0	0.1	0.4	0.0
West South Central	7.5	2.9	5.7	8.6	0.0	0.1	0.6	0.0
West	29.5	10.4	26.3	36.7	0.2	1.0	1.4	0.2
Mountain	14.4	5.2	13.1	18.3	0.1	0.5	0.8	0.1
Pacific	15.1	5.2	13.2	18.4	0.1	0.5	0.6	0.1
United States	83.9	31.3	70.8	102.1	0.4	2.0	4.9	0.4
MN, WI, MI	4.6	1.7	4.0	5.7	0.0	0.1	0.2	0.0
NC, SC, GA	5.8	2.1	4.4	6.6	0.0	0.1	0.4	0.0
CA	8.6	3.0	7.5	10.5	0.1	0.3	0.3	0.1
Health								
Northeast	10.8	15.6	18.1	33.7	0.5	0.2	0.1	0.0
New England	2.7	4.4	5.4	9.8	0.1	0.0	0.0	0.0
Middle Atlantic	8.0	11.2	12.8	23.9	0.3	0.2	0.1	0.0
Midwest	49.2	45.1	62.9	108.0	0.5	0.1	0.3	0.1
East North Central	36.0	32.6	45.4	78.0	0.3	0.1	0.2	0.1
West North Central	13.2	12.5	17.5	30.0	0.1	0.0	0.1	0.0
South	39.5	52.0	71.1	123.1	0.9	0.8	0.5	0.0
South Atlantic	15.9	22.4	29.8	52.2	0.4	0.3	0.2	0.0
East South Central	8.3	10.4	14.6	25.0	0.2	0.2	0.1	0.0
West South Central	15.2	19.1	26.8	45.9	0.3	0.3	0.2	0.0
West	21.7	23.0	24.8	47.8	0.2	0.3	0.4	0.0
Mountain	11.3	11.1	11.9	23.0	0.1	0.2	0.2	0.0
Pacific	10.5	11.9	12.9	24.8	0.1	0.1	0.2	0.0
United States	121.1	135.6	177.0	312.7	2.0	1.4	1.3	0.2
MN, WI, MI	19.0	17.2	23.8	41.0	0.2	0.0	0.1	0.0
NC, SC, GA	6.3	8.4	11.5	19.9	0.2	0.1	0.1	0.0
CA	5.8	6.7	7.2	13.9	0.1	0.1	0.1	0.0

Table 6. Wood used in low-rise nonresidential building construction, by building type, region and section, 2008 -- cont.

Building type, and region	Lumber[1] (Mil. bf)	Structural panels: Softwood plywood (Mil. ft^2, 3/8")	Structural panels: OSB (Mil. ft^2, 3/8")	Structural panels: Total (Mil. ft^2, 3/8")	Non-structural panels[2] (Mil. ft^2, 3/8")	Engineered wood: I-joist (Mil. lf)	Engineered wood: Glulam (Mil. bf)	Engineered wood: SCL[3] (Mil. ft^3)
Public								
Northeast	4.3	3.5	5.1	8.6	1.1	0.1	0.0	0.0
New England	1.4	1.1	1.7	2.8	0.4	0.0	0.0	0.0
Middle Atlantic	2.9	2.3	3.4	5.8	0.7	0.1	0.0	0.0
Midwest	3.5	4.4	8.4	12.9	0.9	0.1	0.0	0.0
East North Central	2.0	2.4	4.5	6.9	0.5	0.0	0.0	0.0
West North Central	1.5	2.0	3.9	5.9	0.4	0.0	0.0	0.0
South	5.5	4.0	3.5	7.5	1.7	0.3	0.0	0.0
South Atlantic	2.5	1.8	1.3	3.0	1.0	0.2	0.0	0.0
East South Central	1.0	0.6	0.7	1.3	0.2	0.0	0.0	0.0
West South Central	2.0	1.6	1.6	3.2	0.6	0.1	0.0	0.0
West	3.8	3.8	3.7	7.4	0.6	0.5	0.1	0.0
Mountain	2.0	2.3	2.5	4.8	0.3	0.2	0.1	0.0
Pacific	1.8	1.5	1.2	2.7	0.3	0.3	0.1	0.0
United States	17.0	15.6	20.8	36.4	4.4	1.0	0.2	0.0
MN, WI, MI	1.6	2.1	3.9	6.0	0.4	0.0	0.0	0.0
NC, SC, GA	2.0	1.2	1.4	2.6	0.4	0.1	0.0	0.0
CA	0.9	0.7	0.6	1.3	0.2	0.2	0.0	0.0
Recreation								
Northeast	5.0	3.6	6.9	10.5	0.1	0.2	0.2	0.0
New England	2.1	1.2	2.4	3.6	0.0	0.1	0.1	0.0
Middle Atlantic	2.9	2.4	4.5	7.0	0.0	0.1	0.2	0.0
Midwest	6.1	7.1	8.7	15.8	0.2	0.1	0.3	0.0
East North Central	4.3	4.9	6.1	11.0	0.1	0.1	0.2	0.0
West North Central	1.8	2.2	2.6	4.8	0.1	0.0	0.1	0.0
South	20.8	18.8	26.7	45.6	0.2	0.3	0.7	0.0
South Atlantic	11.2	9.3	14.0	23.3	0.1	0.1	0.4	0.0
East South Central	3.1	3.2	4.2	7.4	0.0	0.1	0.1	0.0
West South Central	6.5	6.3	8.6	14.9	0.1	0.1	0.2	0.0
West	12.8	10.4	17.1	27.4	0.4	1.0	1.9	0.0
Mountain	5.7	5.2	8.8	14.0	0.2	0.5	1.0	0.0
Pacific	7.1	5.1	8.3	13.4	0.2	0.5	0.8	0.0
United States	44.7	39.9	59.5	99.4	0.8	1.6	3.1	0.1
MN, WI, MI	2.0	2.2	2.8	5.0	0.1	0.0	0.1	0.0
NC, SC, GA	4.3	3.7	5.4	9.1	0.0	0.1	0.1	0.0
CA	5.0	3.5	5.9	9.4	0.1	0.3	0.6	0.0

Table 6. Wood used in low-rise nonresidential building construction, by building type, region and section, 2008 -- cont.

Building type, and region	Lumber[1] (Mil. bf)	Structural panels: Softwood plywood (Mil. ft^2, 3/8")	Structural panels: OSB (Mil. ft^2, 3/8")	Structural panels: Total (Mil. ft^2, 3/8")	Non-structural panels[2] (Mil. ft^2, 3/8")	Engineered wood: I-joist (Mil. lf)	Engineered wood: Glulam (Mil. bf)	Engineered wood: SCL[3] (Mil. ft^3)
Misc.								
Northeast	5.3	9.8	21.5	31.3	0.0	0.0	0.0	0.0
New England	3.5	6.7	14.8	21.5	0.0	0.0	0.0	0.0
Middle Atlantic	1.8	3.1	6.7	9.8	0.0	0.0	0.0	0.0
Midwest	8.0	6.0	14.0	20.1	0.0	0.0	0.2	0.3
East North Central	3.9	3.2	7.4	10.5	0.0	0.0	0.1	0.2
West North Central	4.1	2.9	6.7	9.5	0.0	0.0	0.1	0.2
South	6.5	8.3	10.1	18.4	0.0	0.0	0.1	0.0
South Atlantic	3.6	4.4	5.2	9.6	0.0	0.0	0.1	0.0
East South Central	0.7	1.0	1.2	2.2	0.0	0.0	0.0	0.0
West South Central	2.2	2.9	3.7	6.6	0.0	0.0	0.1	0.0
West	4.0	3.6	5.2	8.9	0.0	0.0	0.3	0.0
Mountain	1.4	1.3	1.9	3.2	0.0	0.0	0.1	0.0
Pacific	2.7	2.4	3.3	5.7	0.0	0.0	0.2	0.0
United States	23.9	27.8	50.8	78.6	0.0	0.0	0.6	0.4
MN, WI, MI	2.3	1.8	4.2	6.0	0.0	0.0	0.1	0.1
NC, SC, GA	1.5	1.8	2.1	3.9	0.0	0.0	0.0	0.0
CA	1.3	1.4	1.9	3.3	0.0	0.0	0.1	0.0
All buildings								
Northeast	210.4	151.3	219.0	370.3	14.1	9.8	2.6	0.4
New England	59.6	42.7	69.1	111.9	3.4	2.3	0.9	0.1
Middle Atlantic	150.9	108.5	149.9	258.4	10.7	7.5	1.7	0.4
Midwest	292.5	200.9	289.0	489.9	16.2	5.1	4.5	0.8
East North Central	193.5	135.0	190.3	325.3	12.5	3.2	2.8	0.5
West North Central	99.0	65.9	98.7	164.6	3.7	1.9	1.8	0.3
South	701.0	436.5	592.7	1,029.2	31.5	19.5	7.9	1.0
South Atlantic	336.7	210.2	289.9	500.1	17.3	6.5	4.0	0.3
East South Central	94.9	61.5	84.2	145.7	5.4	3.0	1.3	0.2
West South Central	269.4	164.9	218.6	383.5	8.8	10.0	2.6	0.5
West	553.9	309.8	477.6	787.4	16.6	34.0	40.7	1.7
Mountain	194.8	134.6	185.1	319.7	6.8	10.6	12.9	0.7
Pacific	359.0	175.2	292.4	467.7	9.8	23.3	27.7	1.0
United States	1,757.8	1,098.5	1,578.3	2,676.8	78.5	68.4	55.7	3.9
MN, WI, MI	73.1	57.1	80.9	138.0	3.2	1.2	1.1	0.2
NC, SC, GA	130.5	85.4	115.7	201.2	6.1	3.3	1.6	0.2
CA	229.3	108.4	176.4	284.8	6.4	15.3	17.3	0.6

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

[2]Includes hardboard, insulation board, particleboard, MDF, and hardwood plywood.

[3]Structural composite lumber (SCL) includes laminated veneer lumber, parallam, and timberstrand.

Table 7. Wood used in low-rise nonresidential building construction, by building type and application, 2008.

Building type and application	Lumber[1] (Mil. bf)	Structural panels: Softwood plywood (Mil. ft^2, 3/8")	Structural panels: OSB (Mil. ft^2, 3/8")	Structural panels: Total (Mil. ft^2, 3/8")	Non-structural panels[2] (Mil. ft^2, 3/8")	Engineered wood: I-joist (Mil. lf)	Engineered wood: Glulam (Mil. bf)	Engineered wood: SCL[3] (Mil. ft^3)
Stores								
Floors	11.4	21.2	6.3	27.5	0.4	1.0	0.1	0.0
Exterior wall	101.4	56.9	69.1	126.0	1.6	0.0	0.7	0.1
Interior wall	29.8	30.3	6.5	36.8	2.2	0.0	0.0	0.0
Roof	116.7	68.2	204.7	272.9	1.7	20.2	17.5	0.2
Siding	0.1	13.5	2.2	15.7	0.2	0.0	0.0	0.0
Total	259.6	190.1	288.8	478.9	6.1	21.3	18.3	0.2
Industrial								
Floors	2.0	0.4	0.1	0.5	0.0	0.1	0.4	0.0
Exterior wall	9.6	7.1	4.1	11.2	0.0	0.0	0.2	0.0
Interior wall	1.2	10.2	1.2	11.4	0.0	0.0	0.0	0.0
Roof	29.6	6.0	18.9	24.9	0.0	0.5	0.7	0.7
Siding	0.1	2.3	0.9	3.2	0.0	0.0	0.0	0.0
Total	42.5	26.1	25.2	51.2	0.0	0.6	1.2	0.7
Offices								
Floors	4.0	17.5	6.6	24.2	0.4	5.3	0.1	0.0
Exterior wall	53.4	17.6	23.2	40.7	0.0	0.0	0.1	0.0
Interior wall	13.2	6.4	1.8	8.2	1.3	0.0	0.1	0.0
Roof	263.8	86.3	271.9	358.2	3.7	4.0	12.9	0.1
Siding	0.1	18.3	4.7	23.0	0.4	0.0	0.0	0.0
Total	334.6	146.1	308.2	454.3	5.9	9.2	13.2	0.2
Hotels								
Floors	69.3	150.9	42.8	193.7	0.0	22.8	0.6	0.5
Exterior wall	148.4	31.3	81.2	112.5	0.4	0.0	0.8	0.4
Interior wall	151.4	52.8	5.0	57.8	0.4	0.0	0.0	0.3
Roof	171.7	66.8	198.0	264.8	0.1	2.0	3.2	0.1
Siding	0.6	7.9	1.0	9.0	0.0	0.0	0.0	0.0
Total	541.6	309.7	328.0	637.8	1.0	24.8	4.6	1.4
Schools								
Floors	7.5	13.5	3.0	16.5	0.1	1.4	0.8	0.0
Exterior wall	65.1	46.7	40.2	86.8	0.1	0.0	0.2	0.0
Interior wall	7.7	11.6	2.7	14.3	0.7	0.0	0.0	0.1
Roof	53.1	38.7	109.2	148.0	53.0	3.5	3.6	0.2
Siding	0.2	2.0	0.3	2.3	0.2	0.0	0.0	0.0
Total	133.7	112.6	155.5	268.0	54.2	4.8	4.7	0.3
Colleges								
Floors	21.3	23.5	11.2	34.7	0.1	0.2	0.0	0.0
Exterior wall	38.8	7.7	13.4	21.1	0.2	0.0	0.0	0.0
Interior wall	38.1	11.2	3.1	14.4	0.2	0.0	0.0	0.0
Roof	50.8	21.0	65.8	86.8	3.1	1.3	3.4	0.0
Siding	6.2	0.3	0.1	0.4	0.1	0.0	0.0	0.0
Total	155.2	63.7	93.7	157.4	3.6	1.5	3.5	0.1

Table 7. Wood used in low-rise nonresidential building construction, by building type and application, 2008 -- cont.

Building type and application	Lumber[1] (Mil. bf)	Structural panels: Softwood plywood (Mil. ft^2, 3/8")	Structural panels: OSB (Mil. ft^2, 3/8")	Structural panels: Total (Mil. ft^2, 3/8")	Non-structural panels[2] (Mil. ft^2, 3/8")	Engineered wood: I-joist (Mil. lf)	Engineered wood: Glulam (Mil. bf)	Engineered wood: SCL[3] (Mil. ft^3)
Religious								
Floors	1.9	9.8	7.1	16.9	0.0	0.1	0.0	0.0
Exterior wall	11.7	4.8	11.9	16.7	0.2	0.0	0.0	0.2
Interior wall	5.6	2.8	1.5	4.3	0.0	0.0	0.0	0.2
Roof	64.6	13.5	50.2	63.7	0.1	1.9	4.9	0.0
Siding	0.2	0.4	0.2	0.6	0.0	0.0	0.0	0.0
Total	83.9	31.3	70.8	102.1	0.4	2.0	4.9	0.4
Health								
Floors	8.4	42.8	15.1	58.0	0.0	1.3	0.0	0.0
Exterior wall	36.8	21.7	26.5	48.2	0.0	0.0	0.3	0.0
Interior wall	12.7	20.7	5.9	26.6	1.8	0.0	0.1	0.0
Roof	62.9	40.5	126.5	166.9	0.1	0.2	0.9	0.1
Siding	0.4	10.0	3.0	13.0	0.1	0.0	0.0	0.0
Total	121.1	135.6	177.0	312.7	2.0	1.4	1.3	0.2
Public								
Floors	1.1	5.8	1.3	7.0	0.0	0.2	0.0	0.0
Exterior wall	2.7	1.4	1.1	2.5	0.0	0.0	0.0	0.0
Interior wall	0.1	1.7	0.3	2.0	0.0	0.0	0.0	0.0
Roof	13.1	6.1	17.9	24.0	4.3	0.8	0.2	0.0
Siding	0.0	0.7	0.2	0.9	0.0	0.0	0.0	0.0
Total	17.0	15.6	20.8	36.4	4.4	1.0	0.2	0.0
Recreation								
Floors	2.7	10.2	2.7	12.9	0.0	0.4	0.0	0.0
Exterior wall	16.2	9.2	8.9	18.1	0.0	0.0	0.4	0.0
Interior wall	2.8	2.4	0.7	3.1	0.0	0.0	0.0	0.0
Roof	23.0	14.9	46.5	61.4	0.7	1.2	2.7	0.0
Siding	0.0	3.2	0.7	3.9	0.0	0.0	0.0	0.0
Total	44.7	39.9	59.5	99.4	0.8	1.6	3.1	0.1
Misc.								
Floors	1.0	4.3	0.7	5.0	0.0	0.0	0.0	0.4
Exterior wall	7.5	5.2	2.9	8.1	0.0	0.0	0.0	0.0
Interior wall	1.9	0.5	0.1	0.6	0.0	0.0	0.0	0.0
Roof	13.5	16.3	46.9	63.3	0.0	0.0	0.6	0.0
Siding	0.0	1.5	0.2	1.7	0.0	0.0	0.0	0.0
Total	23.9	27.8	50.8	78.6	0.0	0.0	0.6	0.4
All buildings								
Floors	130.6	300.0	96.9	397.0	1.2	32.7	2.0	1.0
Exterior wall	491.7	209.4	282.5	491.9	2.6	0.0	2.9	0.8
Interior wall	264.6	150.6	28.9	179.4	6.7	0.0	0.2	0.6
Roof	862.8	378.3	1,156.4	1,534.7	66.9	35.7	50.6	1.4
Siding	8.1	60.2	13.6	73.8	1.2	0.0	0.0	0.0
Total	1,757.8	1,098.5	1,578.3	2,676.8	78.5	68.4	55.7	3.9

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

[2]Includes hardboard, insulation board, particleboard, MDF, and hardwood plywood.

[3]Structural composite lumber (SCL) includes laminated veneer lumber, parallam, and timberstrand.

Table 8. Wood used per $1,000 of construction value put in place in low-rise nonresidential building construction, 2008.

	Construction value			Structural panels			Non-	Engineered wood			
				Softwood			structural				Wood
	Current $	2005 $	Lumber[1]	plywood	OSB	Total	panels[2]	I-joist	Glulam	SCL[3]	use
Characteristic	(Bil.)	(Bil.)	(Bf)	(Ft^2, 3/8")	(Ft^2, 3/8")	(Ft^2, 3/8")	(Ft^2, 3/8")	(Lf)	(Bf)	(Ft^3)	index[4]
Building type											
Stores	81.5	65.0	3.99	2.93	4.44	7.37	0.09	0.33	0.28	0.00	0.85
Industrial	60.9	48.6	0.88	0.54	0.52	1.06	0.00	0.01	0.03	0.01	0.16
Offices	59.5	47.4	7.06	3.08	6.50	9.58	0.12	0.19	0.28	0.00	1.23
Hotels	29.4	23.5	23.09	13.20	13.99	27.19	0.04	1.06	0.20	0.06	3.88
Schools	66.1	52.7	2.54	2.14	2.95	5.09	1.03	0.09	0.09	0.00	0.58
Colleges	33.2	26.5	5.86	2.41	3.54	5.95	0.14	0.06	0.13	0.00	0.89
Religious	7.1	5.7	14.78	5.52	12.48	18.00	0.07	0.35	0.87	0.07	2.57
Health	33.7	26.8	4.51	5.06	6.60	11.66	0.08	0.05	0.05	0.01	1.03
Public	10.6	8.4	2.02	1.85	2.46	4.31	0.52	0.12	0.02	0.00	0.46
Recreation	20.0	15.9	2.81	2.51	3.74	6.25	0.05	0.10	0.19	0.00	0.62
Misc.	10.4	8.3	2.88	3.35	6.15	9.50	0.00	0.00	0.07	0.04	0.82
Total	412.4	328.7	5.35	3.34	4.80	8.14	0.24	0.21	0.17	0.01	1.00
Region											
Northeast	80.5	64.2	3.28	2.36	3.41	5.77	0.22	0.15	0.04	0.01	0.65
New England	17.8	14.2	4.21	3.02	4.88	7.90	0.24	0.16	0.06	0.01	0.85
Middle Atlantic	62.7	50.0	3.02	2.17	3.00	5.17	0.21	0.15	0.03	0.01	0.60
Midwest	74.7	59.6	4.91	3.37	4.85	8.22	0.27	0.09	0.08	0.01	0.93
East North Central	53.1	42.3	4.57	3.19	4.49	7.68	0.29	0.08	0.07	0.01	0.87
West North Central	21.6	17.2	5.75	3.82	5.73	9.55	0.22	0.11	0.10	0.02	1.09
South	174.8	139.3	5.03	3.13	4.25	7.39	0.23	0.14	0.06	0.01	0.90
South Atlantic	83.2	66.3	5.08	3.17	4.37	7.54	0.26	0.10	0.06	0.00	0.90
East South Central	25.6	20.4	4.65	3.01	4.13	7.14	0.27	0.15	0.06	0.01	0.86
West South Central	66.0	52.6	5.12	3.13	4.16	7.29	0.17	0.19	0.05	0.01	0.91
West	82.4	65.7	8.43	4.72	7.27	11.99	0.25	0.52	0.62	0.03	1.61
Mountain	30.8	24.5	7.95	5.49	7.55	13.04	0.28	0.43	0.53	0.03	1.60
Pacific	51.7	41.2	8.72	4.26	7.10	11.36	0.24	0.57	0.67	0.02	1.62
United States	412.4	328.7	5.35	3.34	4.80	8.14	0.24	0.21	0.17	0.01	1.00
MN, WI, MI	19.9	15.8	4.62	3.61	5.11	8.72	0.20	0.08	0.07	0.01	0.92
NC, SC, GA	31.8	25.3	5.16	3.38	4.57	7.95	0.24	0.13	0.06	0.01	0.94
CA	33.7	26.9	8.54	4.03	6.57	10.60	0.24	0.57	0.64	0.02	1.56
Application											
Floors	--	--	0.40	0.91	0.29	1.21	0.00	0.10	0.01	0.00	0.12
Exterior wall	--	--	1.50	0.64	0.86	1.50	0.01	0.00	0.01	0.00	0.22
Interior wall	--	--	0.80	0.46	0.09	0.55	0.02	0.00	0.00	0.00	0.11
Roof	--	--	2.62	1.15	3.52	4.67	0.20	0.11	0.15	0.00	0.53
Siding	--	--	0.02	0.18	0.04	0.22	0.00	0.00	0.00	0.00	0.01
Total	412.4	328.7	5.35	3.34	4.80	8.14	0.24	0.21	0.17	0.01	1.00

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

[2]Includes hardboard, insulation board, particleboard, MDF, and hardwood plywood.

[3]Structural composite lumber (SCL) includes laminated veneer lumber, parallam, and timberstrand.

[4]Relative magnitude of wood products use compared to the total use average, based on board foot equivalent.

Sources: U.S. Dept. of Commerce, 2010a, 2010b.

Table 9. Wood used per 1,000 square feet of floor area in low-rise nonresidential buildings new and additions construction, 2008.

Characteristic	Floor area (Mil. ft^2)	Lumber[2] (Bf)	Structural panels: Softwood plywood (Ft^2, 3/8")	Structural panels: OSB (Ft^2, 3/8")	Structural panels: Total (Ft^2, 3/8")	Non-structural panels[3] (Ft^2, 3/8")	Engineered wood: I-joist (Lf)	Engineered wood: Glulam (Bf)	Engineered wood: SCL[4] (Ft^3)	Wood use index[5]
Building type										
Stores	898.8	269.9	188.7	285.7	474.4	6.0	23.4	20.3	0.3	0.5
Industrial	412.0	94.9	58.8	58.2	117.0	0.0	1.4	3.0	1.6	0.2
Offices	280.9	821.2	336.8	646.6	983.3	20.7	27.8	11.7	0.6	1.2
Hotels	180.2	2,967.0	1,692.3	1,809.6	3,502.0	5.5	137.4	25.7	7.5	4.5
Schools	296.9	398.6	268.6	395.0	663.6	89.5	13.7	12.5	0.8	0.7
Colleges	113.1	1,242.7	481.6	722.4	1,204.0	7.9	11.6	30.7	0.8	1.7
Religious	56.5	1,333.8	502.6	1,111.7	1,614.3	6.5	31.1	49.1	6.9	2.1
Health	131.6	811.1	804.0	1,136.8	1,940.8	2.1	10.7	6.5	1.2	1.6
Public	39.0	306.1	223.3	337.1	560.4	1.2	21.6	4.0	0.3	0.6
Recreation	79.5	428.8	395.8	662.1	1,057.9	1.6	18.6	36.8	0.7	0.9
Misc.	58.7	277.9	198.8	327.1	525.8	0.5	0.4	9.5	0.2	0.5
Total	2,547.1	608.6	358.7	504.4	863.1	15.9	25.6	16.4	1.3	1.0
Region										
Northeast	328.0	488.9	325.1	439.2	764.3	8.1	29.5	7.8	1.2	0.8
New England	95.2	475.2	287.9	439.5	727.4	5.7	23.8	9.4	0.8	0.8
Middle Atlantic	232.7	494.6	340.3	439.0	779.3	9.0	31.8	7.1	1.4	0.9
Midwest	462.8	572.7	375.0	536.0	911.0	23.9	10.0	6.8	0.9	1.0
East North Central	317.5	559.5	371.5	522.7	894.2	29.3	9.3	6.3	0.9	0.9
West North Central	145.4	601.7	382.7	565.0	947.7	12.0	11.4	7.7	0.9	1.0
South	1,224.6	499.3	310.2	424.2	734.4	14.9	15.1	5.5	0.8	0.8
South Atlantic	643.9	443.8	281.4	389.4	670.8	17.3	9.3	5.4	0.5	0.7
East South Central	168.7	507.0	317.8	444.8	762.6	21.0	17.1	6.4	0.9	0.8
West South Central	412.0	582.9	352.0	470.1	822.1	8.6	23.4	5.5	1.2	0.9
West	531.7	965.6	476.9	701.9	1,178.8	16.2	60.7	55.3	3.1	1.6
Mountain	239.1	739.2	456.1	578.9	1,035.0	13.8	41.2	32.7	2.9	1.3
Pacific	292.5	1,150.7	493.8	802.4	1,296.3	18.2	76.6	73.7	3.2	1.8
United States	2,547.1	608.6	358.7	504.4	863.1	15.9	25.6	16.4	1.3	1.0
MN, WI, MI	140.8	462.1	342.2	480.3	822.5	11.7	7.8	5.1	0.7	0.8
NC, SC, GA	266.3	435.0	276.8	380.8	657.6	10.0	11.9	5.3	0.6	0.7
CA	182.0	1,190.7	506.0	813.1	1,319.0	19.2	81.5	79.5	3.4	1.9
Application										
Floors	--	46.3	98.2	35.8	134.0	0.4	12.5	0.6	0.3	0.1
Exterior wall	--	179.4	73.9	100.4	174.3	1.0	0.0	1.1	0.3	0.2
Interior wall	--	99.2	54.6	10.6	65.1	1.4	0.0	0.1	0.3	0.1
Roof	--	282.3	114.0	353.5	467.6	12.6	13.1	14.7	0.5	0.5
Siding	--	1.5	18.0	4.1	22.1	0.4	0.0	0.0	0.0	0.0
Total	2,547.1	608.6	358.7	504.4	863.1	15.9	25.6	16.4	1.3	1.0

[1]Includes new construction and additions only. Alterations and renovations have no associated floor area.

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

[3]Includes hardboard, insulation board, particleboard, MDF, and hardwood plywood.

[4]Structural composite lumber (SCL) includes laminated veneer lumber, parallam, and timberstrand.

[5]Relative magnitude of wood products use compared to the total use average, based on board foot. equivalent.

Table 10. Total wood used in low-rise nonresidential building construction, by building type, 2003 and 2008.

		Structural panels			Non-	Engineered wood			Combined use[1]		
Building type a	Lumber[2] (Mil. bf)	Softwood plywood (Ft^2, 3/8")	OSB (Ft^2, 3/8")	Total (Ft^2, 3/8")	structural panels[3] (Ft^2, 3/8")	I-joist (Lf)	Glulam (Bf)	SCL[4] (Ft^3)	(Mil. bf equiv.)	Usage change	% change
Stores											
2003[5]	228.8	188.9	277.7	466.6	4.3	13.8	10.5	0.2	505.5	--	--
2008	259.6	190.1	288.8	478.9	6.1	21.3	18.3	0.2	566.9	61.3	12
Industrial											
2003[5]	46.8	25.6	21.4	47.0	0.0	0.5	3.4	0.5	82.1	--	--
2008	42.5	26.1	25.2	51.2	0.0	0.6	1.2	0.7	81.4	-0.8	-1
Offices											
2003[5]	305.6	142.4	299.1	441.5	4.2	9.3	14.8	0.2	564.7	--	--
2008	334.6	146.1	308.2	454.3	5.9	9.2	13.2	0.2	599.5	34.8	6
Hotels											
2003[5]	140.0	93.1	101.9	194.9	0.3	7.4	0.9	0.5	260.6	--	--
2008	541.6	309.7	328.0	637.8	1.0	24.8	4.6	1.4	937.4	676.8	260
Schools											
2003[5]	163.6	129.5	174.6	304.1	53.8	8.4	7.3	0.4	372.8	--	--
2008	133.7	112.6	155.5	268.0	54.2	4.8	4.7	0.3	313.3	-59.5	-16
Colleges											
2003[5]	120.2	56.9	86.4	143.4	3.8	1.1	4.9	0.1	202.4	--	--
2008	155.2	63.7	93.7	157.4	3.6	1.5	3.5	0.1	244.1	41.7	21
Religious											
2003[5]	100.9	37.7	84.8	122.6	0.6	2.4	7.0	0.5	182.1	--	--
2008	83.9	31.3	70.8	102.1	0.4	2.0	4.9	0.4	150.5	-31.6	-17
Health											
2003[5]	97.5	127.9	161.8	289.7	2.2	0.8	1.3	0.1	248.1	--	--
2008	121.1	135.6	177.0	312.7	2.0	1.4	1.3	0.2	285.1	37.0	15
Public											
2003[5]	15.4	13.8	17.7	31.5	3.6	0.9	0.2	0.0	35.2	--	--
2008	17.0	15.6	20.8	36.4	4.4	1.0	0.2	0.0	40.0	4.8	14
Recreation											
2003[5]	57.1	48.8	73.3	122.1	1.1	2.3	3.9	0.1	128.4	--	--
2008	44.7	39.9	59.5	99.4	0.8	1.6	3.1	0.1	102.1	-26.3	-21
Misc.											
2003[5]	13.9	14.3	26.2	40.5		0.0	0.4	0.2	37.8	--	--
2008	23.9	27.8	50.8	78.6	0.0	0.0	0.6	0.4	69.8	32.0	85
All buildings											
2003[5]	1,289.8	879.0	1,324.9	2,203.8	73.9	46.9	54.6	2.7	2,619.8	--	--
2008	1,757.8	1,098.5	1,578.3	2,676.8	78.5	68.4	55.7	3.9	3,390.0	770.2	29

[1]Includes lumber plus the board foot equivalent of structural and nonstructural panels (1 ft^2 (3/8-inch basis) = 0.5 bf), glulam, and the board foot equivalent of I-joists and structural composite lumber (1 lf I-joist =2 bf; 1 ft^3 SCL=16 bf).

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

[3]Includes hardboard, insulation board, particleboard, MDF, and hardwood plywood.

[4]Structural composite lumber (SCL) includes laminated veneer lumber, parallam, and timberstrand.

[5]Revised.

Source: McKeever, Adair, O'Connor 2006.

Table 11.-Wood used per $1,000 of construction value, and wood used per square foot of floor area in nonresidential building construction, by building type, 2003 and 2008.

		Use per $1,000 of construction value							Use per ft^2 of floor area (new and additions only)					
Building type and year	Construction value[2] (Bil. $)	Lumber[3] (Bf)	Structural panels[4] (Ft^2, 3/8")	Non-structural panels[5] (Ft^2, 3/8")	Engineered wood[6] (Bf)	Combined use[1] (Bf equiv.)	Combined use[1] % change	Floor area[7] (Mil ft^2)	Lumber[3] (Bf)	Structural panels[4] (Ft^2, 3/8")	Non-structural panels[5] (Ft^2, 3/8")	Engineered wood[6] (Bf)	Combined use[1] (Bf equiv.)	Combined use[1] % change
Stores														
2003[8]	72.6	3.15	6.43	0.06	0.57	6.96	--	920	0.25	0.51	0.00	0.04	0.55	--
2008	65.0	3.99	7.37	0.09	1.00	8.72	25%	899	0.29	0.53	0.01	0.07	0.63	15%
Industrial														
2003[8]	25.9	1.81	1.82	0.00	0.46	3.17	--	372	0.13	0.13	0.00	0.03	0.22	--
2008	48.6	0.88	1.06	0.00	0.27	1.68	-47%	412	0.10	0.12	0.00	0.03	0.20	-11%
Offices														
2003[8]	44.8	6.82	9.86	0.09	0.81	12.61	--	287	1.06	1.54	0.01	0.13	1.96	--
2008	47.4	7.06	9.58	0.12	0.73	12.64	0%	281	1.19	1.62	0.02	0.12	2.13	9%
Hotels														
2003[8]	9.9	14.22	19.79	0.03	2.33	26.46	--	71	1.98	2.76	0.00	0.33	3.69	--
2008	23.5	23.09	27.19	0.04	3.26	39.96	51%	180	3.01	3.54	0.01	0.42	5.20	41%
Schools														
2003[8]	62.5	2.62	4.87	0.86	0.48	5.97	--	308	0.53	0.99	0.17	0.10	1.21	--
2008	52.7	2.54	5.09	1.03	0.35	5.94	0%	297	0.45	0.90	0.18	0.06	1.06	-13%
Colleges														
2003[8]	26.6	4.52	5.39	0.14	0.32	7.62	--	114	1.06	1.26	0.03	0.08	1.78	--
2008	26.5	5.86	5.95	0.14	0.32	9.22	21%	113	1.37	1.39	0.03	0.07	2.16	21%
Religious														
2003[8]	10.4	9.71	11.79	0.05	1.89	17.52	--	86	1.18	1.43	0.01	0.23	2.13	--
2008	5.7	14.78	18.00	0.07	2.71	26.52	51%	56	1.49	1.81	0.01	0.27	2.67	25%
Health														
2003[8]	30.0	3.25	9.67	0.07	0.16	8.28	--	140	0.69	2.07	0.02	0.03	1.77	--
2008	26.8	4.51	11.66	0.08	0.25	10.63	28%	132	0.92	2.38	0.02	0.05	2.17	23%
Public														
2003[8]	8.0	1.92	3.95	0.45	0.29	4.41	--	32	0.48	0.99	0.11	0.07	1.10	--
2008	8.4	2.02	4.31	0.52	0.31	4.74	7%	39	0.44	0.93	0.11	0.07	1.03	-7%

Table 11. Wood used per $1,000 of construction value, and wood used per square foot of floor area in nonresidential building construction, by building type, 2003 and 2008 -- cont.

		Use per $1,000 of construction value							Use per ft^2 of floor area (new and additions only)					
Building type and year	Construction value[2] (Bil. $)	Lumber[3] (Bf)	Structural panels[4] (Ft^2, 3/8")	Non-structural panels[5] (Ft^2, 3/8")	Engineered wood[6] (Bf)	Combined use[1] (Bf equiv.)	Combined use[1] % change	Floor area[7] (Mil ft^2)	Lumber[3] (Bf)	Structural panels[4] (Ft^2, 3/8")	Non-structural panels[5] (Ft^2, 3/8")	Engineered wood[6] (Bf)	Combined use[1] (Bf equiv.)	Combined use[1] % change
Recreation														
2003[8]	19.9	2.87	6.13	0.06	0.48	6.44	--	102	0.56	1.20	0.01	0.09	1.26	--
2008	15.9	2.81	6.25	0.05	0.45	6.41	0%	79	0.56	1.25	0.01	0.09	1.28	2%
Misc.														
2003[8]	9.7	1.43	4.16	0.00	0.38	3.88	--	47	0.29	0.86	0.00	0.08	0.80	--
2008	8.3	2.88	9.50	0.00	0.80	8.44	117%	59	0.41	1.34	0.00	0.11	1.19	48%
All buildings														
2003[8]	320.2	4.03	6.88	0.23	0.60	8.18	--	2,478	0.52	0.89	0.03	0.08	1.06	--
2008	328.7	5.35	8.14	0.24	0.77	10.31	26%	2,547	0.69	1.05	0.03	0.10	1.33	26%

[1]Includes lumber plus the board foot equivalent of structural and nonstructural panels (1 ft^2 (3/8-inch basis) = 0.5 bf), glulam, and the board foot equivalent of I-joists, and structural composite lumber (1 lf I-joist =2 bf; 1 ft^3 SCL=16 bf).

[2]Constant 2005 dollars.

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

[4]Includes softwood plywood and oriented strandboard.

[5]Includes hardboard, insulation board, particleboard, MDF, and hardwood plywood.

[6]Includes glulam and the board foot equivalent of I-joists, and structural composite lumber.

[7]New and additions floor area only. Alterations and renovations have no associated floor area.

[8]Revised.

Source: McKeever, Adair, O'Connor 2006.

Table 12. Total wood products consumption in the United States, and consumption for low-rise nonresidential building construction, 2008.

Wood product		Consumption		
		Total U.S.	Nonresidential building construction	Nonresidential as a % of total U.S.
Lumber	(Mil. bf)	49,864	1,758	4%
Structural panels				
Softwood plywood	(Mil. ft^2, 3/8")	10,375	1,099	11%
OSB	(Mil. ft^2, 3/8")	16,154	1,578	10%
Total	(Mil. ft^2, 3/8")	23,478	2,677	11%
Nonstructural panels[1]	(Mil. ft^2, 3/8")	18,874	79	0%
Engineered wood				
I-joists	(Mil. lf)	510	68	13%
Glulam	(Mil. bf)	260	56	21%
SCL[2]	(Mil. ft^3)	62	4	6%
Total	(Mil. bf equivalent)	2,268	255	11%
Total, all wood products	(Mil. bf equivalent)	63,871	3,390	5%

[1]Includes hardboard, insulation board, particleboard, MDF, and hardwood plywood.

[2]Structural composite lumber (SCL) includes laminated veneer lumber, parallam, and timberstrand.

Sources: Adair 2009, Howard 2010.

Table 13. Potential incremental wood product volumes[1] in new nonresidential building construction, 2008.

	Application					Region					WPC Target markets		
Building type	Floors	Exterior walls	Interior walls	Roofs	Siding	Northeast	Midwest	South	West	Total	MN, WI, MI	NC, SC, GA	CA
						Lumber[2] (Mil. bf)							
Stores	6.8	506.1	184.1	886.8	0.5	320.1	315.9	771.3	176.9	1,584.2	106.3	183.7	34.5
Industrial	13.8	76.5	1.2	424.9	12.9	0.0	231.1	194.1	104.2	529.4	71.6	41.8	41.9
Offices	3.4	264.2	103.9	803.9	2.0	174.4	56.8	799.9	146.5	1,177.5	15.9	95.8	25.2
Hotels	10.3	75.9	72.7	31.8	0.5	39.1	15.7	92.6	43.6	191.1	4.2	16.7	16.3
Schools	8.2	45.4	29.1	62.7	4.8	8.9	24.7	47.4	69.3	150.2	6.9	13.8	20.6
Colleges	81.0	113.5	127.9	44.9	8.5	34.8	41.1	82.9	217.0	375.7	12.9	23.1	113.3
Religious	0.2	19.3	13.6	108.9	0.4	7.4	23.7	101.4	10.0	142.5	6.2	18.8	1.3
Health	7.8	57.0	21.5	63.6	0.9	13.1	62.0	43.7	31.9	150.8	27.6	9.3	10.2
Public	0.6	23.2	3.5	85.0	0.1	15.2	22.6	55.7	18.7	112.3	10.7	13.5	4.5
Recreation	11.3	50.4	18.0	108.2	0.1	28.4	19.6	118.9	21.1	188.1	6.2	21.6	6.1
Misc.	0.4	11.3	2.3	13.4	0.1	5.6	5.0	9.4	7.6	27.6	2.4	2.0	3.5
Total	143.7	1,242.8	577.7	2,634.3	30.9	646.8	818.4	2,317.3	846.9	4,629.5	270.8	440.1	277.4
						Structural panels[3] (Mil. ft[2], 3/8" basis)							
Stores	32.7	472.4	99.0	435.0	43.6	155.4	444.4	317.7	165.3	1,082.7	149.9	75.9	32.5
Industrial	33.7	50.0	0.8	306.7	13.4	1.9	197.8	167.6	37.3	404.6	61.2	36.2	14.4
Offices	96.1	151.5	13.6	478.9	52.4	103.6	76.1	517.1	95.6	792.4	21.3	61.7	15.7
Hotels	106.8	72.0	42.6	0.0	6.6	58.7	20.3	94.8	54.3	228.0	5.4	16.2	20.4
Schools	38.4	56.1	55.5	135.1	0.2	28.8	38.0	98.7	119.8	285.3	11.0	27.3	33.7
Colleges	128.1	52.0	53.8	48.2	1.0	72.5	34.2	71.3	105.1	283.1	10.2	20.4	56.0
Religious	33.5	30.3	12.1	77.3	0.0	5.1	22.6	114.9	10.7	153.3	5.5	22.1	1.4
Health	63.2	24.4	39.2	49.1	8.4	10.5	57.1	101.2	15.5	184.3	28.0	22.0	4.9
Public	1.6	11.6	0.0	58.0	15.8	8.1	18.0	52.4	8.6	87.1	8.4	12.6	2.6
Recreation	17.5	42.3	2.5	109.1	9.9	16.2	16.9	142.1	6.0	181.3	5.4	25.7	1.6
Misc.	0.1	0.0	1.8	0.1	1.8	0.0	3.8	0.0	0.0	3.9	1.9	0.0	0.0
Total	551.8	962.7	321.0	1,697.4	153.1	460.7	929.3	1,677.7	618.3	3,685.9	308.2	320.0	183.2
						Nonstructural panels[4] (Mil. ft[2], 3/8" basis)							
Stores	1.8	7.0	6.1	7.1	0.0	7.9	1.8	6.8	5.6	22.0	0.6	1.7	1.1
Industrial	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Offices	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.0	0.0	0.1
Hotels	0.0	0.4	0.4	0.1	0.0	0.0	0.0	1.0	0.0	1.0	0.0	0.2	0.0
Schools	0.3	1.0	0.3	0.0	0.0	0.2	0.0	1.3	0.2	1.6	0.0	0.0	0.4
Colleges	0.4	0.6	0.2	1.9	0.0	0.6	0.3	0.3	1.9	3.1	0.1	0.1	1.0

Table 13. Potential incremental wood product volumes[1] in new nonresidential building construction, 2008 -- cont.

	Application					Region					WPC Target markets		
Building type	Floors	Exterior walls	Interior walls	Roofs	Siding	Northeast	Midwest	South	West	Total	MN, WI, MI	NC, SC, GA	CA
Nonstructural panels[4] (Mil. ft[2], 3/8" basis) -- continued													
Religious	0.1	0.0	0.0	0.2	0.0	0.0	0.0	0.3	0.1	0.3	0.0	0.1	0.0
Health	0.1	0.1	0.0	0.3	0.0	0.0	0.1	0.3	0.1	0.5	0.0	0.1	0.0
Public	0.1	0.1	0.0	0.4	0.0	0.0	0.4	0.1	0.1	0.6	0.2	0.0	0.0
Recreation	0.1	0.1	0.1	0.5	0.0	0.0	0.2	0.4	0.3	0.8	0.1	0.1	0.1
Misc.	0.1	0.1	0.1	0.3	0.0	0.0	0.0	0.6	0.0	0.6	0.0	0.1	0.0
Total	2.6	9.3	7.1	9.2	0.0	8.8	2.1	9.3	8.0	28.2	0.7	1.9	2.5
Engineered wood[5] (Mil. bf equivalent)													
Stores	0.1	7.7	0.7	221.3	0.0	67.4	24.7	53.8	84.0	229.87	8.5	13.0	16.3
Industrial	0.0	1.0	0.0	61.7	0.0	0.0	39.8	9.6	13.2	62.72	12.3	2.0	5.3
Offices	53.9	2.0	4.7	15.2	0.0	26.9	11.5	21.8	15.6	75.78	3.1	2.6	2.6
Hotels	52.2	6.2	4.0	5.4	0.0	11.4	1.1	45.4	9.7	67.70	0.2	8.5	3.6
Schools	17.8	4.3	3.3	71.9	0.0	12.1	29.4	24.8	31.0	97.34	7.6	6.5	8.4
Colleges	0.7	0.6	3.0	0.0	0.0	2.2	0.4	0.2	1.5	4.36	0.1	0.1	0.8
Religious	0.7	2.9	1.7	4.5	0.0	0.6	2.7	5.2	1.3	9.85	0.8	0.9	0.2
Health	6.8	1.6	0.5	2.8	0.0	1.3	2.4	5.8	2.2	11.72	1.0	1.3	0.7
Public	0.0	0.1	0.0	4.1	0.0	0.9	1.8	0.9	0.6	4.20	0.8	0.2	0.1
Recreation	0.9	0.9	0.4	3.7	0.0	1.0	1.3	2.2	1.4	5.92	0.4	0.4	0.4
Misc.	0.2	0.8	0.5	0.3	0.0	0.1	0.3	0.7	0.7	1.79	0.1	0.2	0.3
Total	133.3	28.1	18.8	391.0	0.0	124.0	115.4	170.4	161.4	571.25	35.0	35.7	38.8

[1]Volumes of wood products likely to be used if concrete and metal framed applications were built with wood at the same usage rates as wood framed applications. Does not include alterations and rennovations.

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

[3]Includes softwood plywood and oriented strandboard.

[4]Includes hardboard, insulation board, particleboard, MDF, and hardwood plywood.

[5]Includes glulam and the board foot equivalent of I-joists, and structural composite lumber: 1 lf I-joist =2 bf; 1 ft³ SCL=16 bf.

Table 14. Percentage potential incremental wood product volumes[1] in new nonresidential building construction, 2008.

	Application					Region					WPC Target markets		
Building type	Floors	Exterior walls	Interior walls	Roofs	Siding	Northeast	Midwest	South	West	Total	MN, WI, MI	NC, SC, GA	CA
						Lumber[2] (%)							
Stores	0.1	10.9	4.0	19.2	0.0	6.9	6.8	16.7	3.8	34.2	2.3	4.0	0.7
Industrial	0.3	1.7	0.0	9.2	0.3	0.0	5.0	4.2	2.3	11.4	1.5	0.9	0.9
Offices	0.1	5.7	2.2	17.4	0.0	3.8	1.2	17.3	3.2	25.4	0.3	2.1	0.5
Hotels	0.2	1.6	1.6	0.7	0.0	0.8	0.3	2.0	0.9	4.1	0.1	0.4	0.4
Schools	0.2	1.0	0.6	1.4	0.1	0.2	0.5	1.0	1.5	3.2	0.1	0.3	0.4
Colleges	1.7	2.5	2.8	1.0	0.2	0.8	0.9	1.8	4.7	8.1	0.3	0.5	2.4
Religious	0.0	0.4	0.3	2.4	0.0	0.2	0.5	2.2	0.2	3.1	0.1	0.4	0.0
Health	0.2	1.2	0.5	1.4	0.0	0.3	1.3	0.9	0.7	3.3	0.6	0.2	0.2
Public	0.0	0.5	0.1	1.8	0.0	0.3	0.5	1.2	0.4	2.4	0.2	0.3	0.1
Recreation	0.2	1.1	0.4	2.3	0.0	0.6	0.4	2.6	0.5	4.1	0.1	0.5	0.1
Misc.	0.0	0.2	0.1	0.3	0.0	0.1	0.1	0.2	0.2	0.6	0.1	0.0	0.1
Total	3.1	26.8	12.5	56.9	0.7	14.0	17.7	50.1	18.3	100.0	5.8	9.5	6.0
						Structural panels[3] (%)							
Stores	0.9	12.8	2.7	11.8	1.2	4.2	12.1	8.6	4.5	29.4	4.1	2.1	0.9
Industrial	0.9	1.4	0.0	8.3	0.4	0.1	5.4	4.5	1.0	11.0	1.7	1.0	0.4
Offices	2.6	4.1	0.4	13.0	1.4	2.8	2.1	14.0	2.6	21.5	0.6	1.7	0.4
Hotels	2.9	2.0	1.2	0.0	0.2	1.6	0.5	2.6	1.5	6.2	0.1	0.4	0.6
Schools	1.0	1.5	1.5	3.7	0.0	0.8	1.0	2.7	3.3	7.7	0.3	0.7	0.9
Colleges	3.5	1.4	1.5	1.3	0.0	2.0	0.9	1.9	2.9	7.7	0.3	0.6	1.5
Religious	0.9	0.8	0.3	2.1	0.0	0.1	0.6	3.1	0.3	4.2	0.1	0.6	0.0
Health	1.7	0.7	1.1	1.3	0.2	0.3	1.6	2.7	0.4	5.0	0.8	0.6	0.1
Public	0.0	0.3	0.0	1.6	0.4	0.2	0.5	1.4	0.2	2.4	0.2	0.3	0.1
Recreation	0.5	1.1	0.1	3.0	0.3	0.4	0.5	3.9	0.2	4.9	0.1	0.7	0.0
Misc.	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.0	0.0
Total	15.0	26.1	8.7	46.0	4.2	12.5	25.2	45.5	16.8	100.0	8.4	8.7	5.0
						Nonstructural panels[4] (%)							
Stores	6.2	24.7	21.8	25.3	0.1	27.9	6.3	24.0	19.9	78.2	2.1	5.9	3.9
Industrial	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0
3Includes new	0.3	1.0	0.0	0.0	0.0	0.0	0.1	0.0	1.3	1.4	0.1	0.0	0.2
Hotels	0.2	1.5	1.5	0.5	0.0	0.1	0.1	3.4	0.1	3.6	0.0	0.6	0.0
Schools	1.1	3.7	1.0	0.0	0.0	0.8	0.0	4.4	0.6	5.8	0.0	0.0	1.4
Colleges	1.4	2.0	0.7	6.8	0.0	2.2	1.0	1.1	6.6	10.9	0.3	0.3	3.4

Table 14. Percentage potential incremental wood product volumes[1] in new nonresidential building construction, 2008 -- cont.

	Application					Region					WPC Target markets		
Building type	Floors	Exterior walls	Interior walls	Roofs	Siding	Northeast	Midwest	South	West	Total	MN, WI, MI	NC, SC, GA	CA
Nonstructural panels[4] (%) -- continued													
Religious	0.3	0.0	0.1	0.8	0.0	0.0	0.0	1.0	0.2	1.2	0.0	0.2	0.0
Health	0.3	0.3	0.1	0.9	0.0	0.0	0.3	1.0	0.3	1.6	0.1	0.2	0.1
Public	0.2	0.4	0.1	1.4	0.0	0.1	1.5	0.2	0.4	2.2	0.7	0.1	0.1
Recreation	0.5	0.5	0.2	1.8	0.0	0.1	0.6	1.3	1.0	3.0	0.2	0.2	0.3
Misc.	0.4	0.3	0.2	1.1	0.0	0.0	0.0	2.0	0.0	2.0	0.0	0.4	0.0
Total	9.3	32.9	25.1	32.5	0.1	31.2	7.5	32.9	28.5	100.0	2.5	6.9	8.9
Engineered wood[5] (%)													
Stores	0.0	1.4	0.1	38.7	0.0	11.8	4.3	9.4	14.7	40.2	1.5	2.3	2.9
Industrial	0.0	0.2	0.0	10.8	0.0	0.0	7.0	1.7	2.3	11.0	2.2	0.4	0.9
Offices	9.4	0.3	0.8	2.7	0.0	4.7	2.0	3.8	2.7	13.3	0.5	0.4	0.5
Hotels	9.1	1.1	0.7	0.9	0.0	2.0	0.2	8.0	1.7	11.9	0.0	1.5	0.6
Schools	3.1	0.8	0.6	12.6	0.0	2.1	5.1	4.3	5.4	17.0	1.3	1.1	1.5
Colleges	0.1	0.1	0.5	0.0	0.0	0.4	0.1	0.0	0.3	0.8	0.0	0.0	0.1
Religious	0.1	0.5	0.3	0.8	0.0	0.1	0.5	0.9	0.2	1.7	0.1	0.2	0.0
Health	1.2	0.3	0.1	0.5	0.0	0.2	0.4	1.0	0.4	2.1	0.2	0.2	0.1
Public	0.0	0.0	0.0	0.7	0.0	0.2	0.3	0.2	0.1	0.7	0.1	0.0	0.0
Recreation	0.2	0.2	0.1	0.6	0.0	0.2	0.2	0.4	0.2	1.0	0.1	0.1	0.1
Misc.	0.0	0.1	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.3	0.0	0.0	0.0
Total	23.3	4.9	3.3	68.5	0.0	21.7	20.2	29.8	28.3	100.0	6.1	6.2	6.8

[1]Volumes of wood products likely to be used if concrete and metal framed applications were built with wood at the same usage rates as wood framed applications. Does not include alterations and rennovations.

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

[3]Includes softwood plywood and oriented strandboard.

[4]Includes hardboard, insulation board, particleboard, MDF, and hardwood plywood.

[5]Includes glulam and the board foot equivalent of I-joists, and structural composite lumber: 1 lf I-joist =2 bf; 1 ft^3 SCL=16 bf.

Appendix

Building Characteristics

Value of new construction put in place– A measure of the value of construction installed or erected at the site during a given period, including:

1. Cost of materials installed or erected.
2. Cost of labor and a proportionate share of construction equipment rental cost.
3. Contractor's profit.
4. Cost of architectural and engineering work.
5. Miscellaneous overhead and office costs chargeable to the project on the owner's books.
6. Interest and taxes paid during construction.

Floor area–Area measured from the outside of the exterior walls, and including all enclosed, usable floor space.

Building application–Major systems in a building including foundation, first and upper floors, exterior and interior walls, roofs, and exterior siding.

Principal construction type–Classification of the principal type of construction activity. Principal construction types are:

New–New construction not associated with any other existing building.

Addition–Attached or free-standing additions to existing buildings or structures.

Alterations and renovations– Changes made to existing buildings and structures for maintenance, upgrades, improvements, change of use, etc. Typically, no new floor area is added, and framing type is not applicable.

Principal framing type–Classification by the principal type of building material used to build the exterior wall of a new building, or a major addition to a building. Principal framing types are:

Wood–Exterior walls are primarily framed with lumber, or other wood products.

Concrete–Concrete, masonry, stone, brick or block exterior walls.

Metal–Steel framed or supported exterior walls.

Nonresidential Building Types

Stores–Wholesale, retail, or service trade buildings. Includes shopping centers and malls, department stores, low-rise banks and financial institutions, drug stores, parking garages, auto service stations and repair garages, beauty schools, grocery stores, restaurants, and dry cleaning stores. Also includes warehouses and storage buildings not located at industrial sites.

Industrial–All buildings and structures at manufacturing sites. Office buildings and warehouses owned by industrial companies but not located at industrial sites are excluded.

Offices–Office and professional buildings used primarily for office space. Excludes office buildings by public utilities for their own use, and office buildings at industrial sites.

Hotels–Hotels, motels, tourist courts and cabins, and similar facilities. Excludes dormitories built on college campuses and military barracks.

Schools–Schools for grades K through 12, either public or private, and associated buildings. Includes libraries, cafeteria, gymnasiums, indoor swimming pools, etc.

Colleges–Colleges, universities, community colleges, technical schools, other academic buildings, and associated buildings. Includes libraries, cafeteria, dormitories, student unions, etc., and noncommercial museums, art galleries, and similar establishments. Beauty schools and dance schools are classified as ‘‘Stores.’’

Religious–Houses of worship and other religious buildings. Excludes educational or charitable institutions, hospitals, and publishing houses owned by religious organizations.

Health–Health car, institutional and assisted living facilities. Includes assisted living facilities, convalescent and rest homes, nursing homes, orphanages, and similar establishments for prolonged care, and surgical or outpatient clinics affiliated with a hospital.

Public–Publicly owned general administrative buildings, jails and prisons, courthouses, police and fire stations, civic centers, passenger terminals, space facilities, postal facilities, and customs houses. Excludes military owned buildings.

Recreation–Includes motion picture studios, theaters, casinos, health clubs, and buildings which provide amusement and recreational services.

Miscellaneous–Nonresidential buildings not classified in any of the above categories, including radio and television stations, bus and airline terminal buildings, and animal hospitals.

Regions and Divisions

Regions and divisions of the U.S. are standard U.S. Department of Commerce, Bureau of the Census region and divisions.

Northeast:
- **New England:**
  Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut
- **Middle Atlantic:**
  New York, New Jersey, Pennsylvania

Midwest:
- **East North Central:**
  Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota
- **West North Central**
  Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas

South
- **South Atlantic**
  Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida
- **East South Central**
  Kentucky, Tennessee, Alabama, Mississippi
- **West South Central**
  Arkansas, Louisiana, Oklahoma, Texas

West
- **Mountain**
  Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada
- **Pacific**
  Washington, Oregon, California, Alaska, Hawaii

Wood Products

Lumber–Solid sawn timber, including dimension, boards and squares.

Structural panels–Wood panels suitable for structural building applications such as floor decking, wall and roof sheathing, exterior siding and concrete forming. Includes softwood plywood and oriented strand board.

> **Softwood plywood–**Performance rated wood panels made from softwood veneers arranged in

perpendicular layers and adhesively bonded.

Oriented strand board (OSB)– Performance rated wood panels consisting of layered and oriented wood strands adhesively bonded. Both softwood and hardwood species are used.

Nonstructural panels–Wood-based panels not specifically designed for structural applications. Includes particleboard, medium density fiberboard, hardboard, insulation board, and hardwood plywood. Uses include siding, floor underlayment, interior wall paneling, and numerous industrial applications.

Engineered wood–Composite wood products designed to substitute directly for dimension lumber in many building and structural applications. Includes prefabricated wood I-joists, glued laminated timber and structural composite lumber (laminated veneer lumber, parallel strand lumber and oriented strand lumber).

Prefabricated wood I-joists (I-joists)–Structural, load-carrying members designed for roof and floor joist applications, offering long lengths with low material weights. The I-joist flange is typically dimension lumber or structural composite lumber; the web material, softwood plywood or oriented strand board.

Glued laminated timber (Glulam)– Engineered, stress-rated product created by adhesively bonding individual pieces of lumber having a thickness of 2 inches or less. It is versatile and can be shaped into forms ranging from straight to complex curved beams. Uses include headers, girders, purlins, beams, and arches.

Structural composite lumber (SCL)–Composite products designed to be dimension lumber substitutes. Includes laminated veneer lumber, parallel strand lumber and oriented strand lumber.

Laminated veneer lumber (LVL)–A structural composite lumber product made by adhesively bonding thin sheets of wood veneer into a large billet. The grain of the veneers are all parallel in the “long” direction. The billet is then sawn to desired dimensions. Uses include headers, beams, rafters, scaffold planking, and flanges for prefabricated wood I-joists.

Parallel strand lumber (PSL)–A structural composite lumber product made by adhesively bonding veneer that has been chopped into strands to take out knots and other imperfections. A billet is formed with the grain of the strands in the long direction and then sawn. Uses include beams and garage door headers.

Oriented strand lumber (OSL)–A structural composite lumber product made from flaked wood strands that have a high length-to-thickness ratio. The strands are oriented with the grain in the long direction into a billet and then sawn to desired dimension. Uses include millwork parts, studs and flanges for prefabricated wood I-joists.

McKeever, David 2010. Wood Products used in the construction of Low-rise nonresidential buildings in the United States, 2008. APA-- The engineered wood association, Tacoma, WA. 47 p.