



Engineered Wood Products (EWP), including prefabricated wood I-joists and structural composite lumber (SCL), have been successfully used in both interior applications and exterior applications that are protected from precipitation for several decades. However, typical non-preservative treated EWP are not intended to be installed in permanent wet-use conditions.

EWP are like any other structural wood product (e.g., lumber, plywood, OSB, glulam) in that long-term elevated moisture content or repetitive wetting and drying reduce strength and stiffness properties. Additionally, all wood products are susceptible to decay when subject to elevated moisture content for extended time periods. Keeping wood at or below 19% moisture content is effective at preventing decay.

The ASTM standard specifications for wood I-joists (ASTM D5055) and SCL (ASTM D5456) require the use of moisture-durable adhesives (ASTM D2559) and product durability testing such that these EWP are resistant to short-term moisture exposure during typical storage and construction periods. Once installed, EWP structural design values are valid for dry service conditions.

Dry service conditions for EWP are defined similarly in the United States and Canadian building codes. In the U.S., the National Design Specification (NDS) of Wood Construction defines dry service conditions in sections 7.1.4 (wood I-joists) and 8.1.4 (structural composite lumber) as “...where the moisture content of sawn lumber in service is less than 16%, as in most covered structures.”. In Canada, CSA O86 defines the dry service condition as “...a climatic condition in which the average equilibrium moisture content of wood is 15% or less on average over a year without exceeding 19%.”.

Applications in U.S. and Canada where wood products are installed outside the building envelope but protected from precipitation are considered dry service conditions. The USDA Forest Products Laboratory Wood Handbook lists equilibrium moisture contents for sawn lumber in covered outdoor conditions for several U.S. cities (see Table 1), demonstrating that dry service conditions are met throughout the U.S. Likewise, *Introduction to Wood Design* published by the Canadian Wood Council provides both indoor and sheltered outdoor moisture contents for Canadian regions, demonstrating that dry service conditions exist across Canada for EWP in sheltered outdoor conditions (see Table 2).



Table 1: Equilibrium moisture content for outside conditions in several U.S. locations prior to 1997 (from [1])

		Equilibrium moisture content* (%)											
State	City	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
AK	Juneau	16.5	16.0	15.1	13.9	13.6	13.9	15.1	16.5	18.1	18.0	17.7	18.1
AL	Mobile	13.8	13.1	13.3	13.3	13.4	13.3	14.2	14.4	13.9	13.0	13.7	14.0
AZ	Flagstaff	11.8	11.4	10.8	9.3	8.8	7.5	9.7	11.1	10.3	10.1	10.8	11.8
AZ	Phoenix	9.4	8.4	7.9	6.1	5.1	4.6	6.2	6.9	6.9	7.0	8.2	9.5
AR	Little Rock	13.8	13.2	12.8	13.1	13.7	13.1	13.3	13.5	13.9	13.1	13.5	13.9
CA	Fresno	16.4	14.1	12.6	10.6	9.1	8.2	7.8	8.4	9.2	10.3	13.4	16.6
CA	Los Angeles	12.2	13.0	13.8	13.8	14.4	14.8	15.0	15.1	14.5	13.8	12.4	12.1
CO	Denver	10.7	10.5	10.2	9.6	10.2	9.6	9.4	9.6	9.5	9.5	11.0	11.0
DC	Washington	11.8	11.5	11.3	11.1	11.6	11.7	11.7	12.3	12.6	12.5	12.2	12.2
FL	Miami	13.5	13.1	12.8	12.3	12.7	14.0	13.7	14.1	14.5	13.5	13.9	13.4
GA	Atlanta	13.3	12.3	12.0	11.8	12.5	13.0	13.8	14.2	13.9	13.0	12.9	13.2
HI	Honolulu	13.3	12.8	11.9	11.3	10.8	10.6	10.6	10.7	10.8	11.3	12.1	12.9
ID	Boise	15.2	13.5	11.1	10.0	9.7	9.0	7.3	7.3	8.4	10.0	13.3	15.2
IL	Chicago	14.2	13.7	13.4	12.5	12.2	12.4	12.8	13.3	13.3	12.9	14.0	14.9
IN	Indianapolis	15.1	14.6	13.8	12.8	13.0	12.8	13.9	14.5	14.2	13.7	14.8	15.7
IA	Des Moines	14.0	13.9	13.3	12.6	12.4	12.6	13.1	13.4	13.7	12.7	13.9	14.9
KS	Wichita	13.8	13.4	12.4	12.4	13.2	12.5	11.5	11.8	12.6	12.4	13.2	13.9
KY	Louisville	13.7	13.3	12.6	12.0	12.8	13.0	13.3	13.7	14.1	13.3	13.5	13.9
LA	New Orleans	14.9	14.3	14.0	14.2	14.1	14.6	15.2	15.3	14.8	14.0	14.2	15.0
ME	Portland	13.1	12.7	12.7	12.1	12.6	13.0	13.0	13.4	13.9	13.8	14.0	13.5
MA	Boston	11.8	11.6	11.9	11.7	12.2	12.1	11.9	12.5	13.1	12.8	12.6	12.2
MI	Detroit	14.7	14.1	13.5	12.6	12.3	12.3	12.6	13.3	13.7	13.5	14.4	15.1
MN	Minneapolis–St. Paul	13.7	13.6	13.3	12.0	11.9	12.3	12.5	13.2	13.8	13.3	14.3	14.6
MS	Jackson	15.1	14.4	13.7	13.8	14.1	13.9	14.6	14.6	14.6	14.1	14.3	14.9
MO	St. Louis	14.5	14.1	13.2	12.4	12.8	12.6	12.9	13.3	13.7	13.1	14.0	14.9
MT	Missoula	16.7	15.1	12.8	11.4	11.6	11.7	10.1	9.8	11.3	12.9	16.2	17.6
NE	Omaha	14.0	13.8	13.0	12.1	12.6	12.9	13.3	13.8	14.0	13.0	13.9	14.8
NV	Las Vegas	8.5	7.7	7.0	5.5	5.0	4.0	4.5	5.2	5.3	5.9	7.2	8.4
NV	Reno	12.3	10.7	9.7	8.8	8.8	8.2	7.7	7.9	8.4	9.4	10.9	12.3
NM	Albuquerque	10.4	9.3	8.0	6.9	6.8	6.4	8.0	8.9	8.7	8.6	9.6	10.7
NY	New York	12.2	11.9	11.5	11.0	11.5	11.8	11.8	12.4	12.6	12.3	12.5	12.3
NC	Raleigh	12.8	12.1	12.2	11.7	13.1	13.4	13.8	14.5	14.5	13.7	12.9	12.8
ND	Fargo	14.2	14.6	15.2	12.9	11.9	12.9	13.2	13.2	13.7	13.5	15.2	15.2
OH	Cleveland	14.6	14.2	13.7	12.6	12.7	12.7	12.8	13.7	13.8	13.3	13.8	14.6
OK	Oklahoma City	13.2	12.9	12.2	12.1	13.4	13.1	11.7	11.8	12.9	12.3	12.8	13.2
OR	Pendleton	15.8	14.0	11.6	10.6	9.9	9.1	7.4	7.7	8.8	11.0	14.6	16.5
OR	Portland	16.5	15.3	14.2	13.5	13.1	12.4	11.7	11.9	12.6	15.0	16.8	17.4
PA	Philadelphia	12.6	11.9	11.7	11.2	11.8	11.9	12.1	12.4	13.0	13.0	12.7	12.7
SC	Charleston	13.3	12.6	12.5	12.4	12.8	13.5	14.1	14.6	14.5	13.7	13.2	13.2
SD	Sioux Falls	14.2	14.6	14.2	12.9	12.6	12.8	12.6	13.3	13.6	13.0	14.6	15.3
TN	Memphis	13.8	13.1	12.4	12.2	12.7	12.8	13.0	13.1	13.2	12.5	12.9	13.6
TX	Dallas–Ft. Worth	13.6	13.1	12.9	13.2	13.9	13.0	11.6	11.7	12.9	12.8	13.1	13.5
TX	El Paso	9.6	8.2	7.0	5.8	6.1	6.3	8.3	9.1	9.3	8.8	9.0	9.8
UT	Salt Lake City	14.6	13.2	11.1	10.0	9.4	8.2	7.1	7.4	8.5	10.3	12.8	14.9
VA	Richmond	13.2	12.5	12.0	11.3	12.1	12.4	13.0	13.7	13.8	13.5	12.8	13.0
WA	Seattle–Tacoma	15.6	14.6	15.4	13.7	13.0	12.7	12.2	12.5	13.5	15.3	16.3	16.5
WI	Madison	14.5	14.3	14.1	12.8	12.5	12.8	13.4	14.4	14.9	14.1	15.2	15.7
WV	Charleston	13.7	13.0	12.1	11.4	12.5	13.3	14.1	14.3	14.0	13.6	13.0	13.5
WY	Cheyenne	10.2	10.4	10.7	10.4	10.8	10.5	9.9	9.9	9.7	9.7	10.6	10.6

*EMC values were determined from the average of 30 or more years of relative humidity and temperature data available from the National Climatic Data Center of the National Oceanic and Atmospheric Administration.



Table 2: Typical equilibrium moisture content ranges of wood materials in different climates (from [2])

Location		Average EMC (%)	Winter EMC (%)	Summer EMC (%)
West coast	indoors	10 – 11	8	12
	sheltered outdoors	15 – 16	18	13
Prairies	indoors	6 – 7	5	8
	sheltered outdoors	11 – 12	12	10
Central Canada	indoors	7 – 8	5	10
	sheltered outdoors	13 – 14	17	10
East Coast	indoors	8 – 9	7	10
	sheltered outdoors	14 – 15	19	12

References

¹Bergman, R, 2010, Chapter 13: Drying and Control of Moisture Content and Dimensional Changes, in *Wood Handbook – Wood as an Engineering Material*, USDA Forest Service General Technical Report FPL-GTR-190, Madison, WI

²Canadian Wood Council, 2018, *Introduction to Wood Design*, Ottawa, Canada