NC Department of Insurance
Office of the State Fire Marshal - Engineering Division
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The Use of Lumber Species not Recognized by the Residential Code

Code: 2018 NC Residential Building Code **Date:** June 28, 2021
Section: R502.1.1; R502.3, R502.5, R602.2, R802.4, R802.5 **Rev. Date:** August 9, 2021

Note: This interpretation is currently fluid until more complete information is available.

Question #1:

Can lumber of wood species that are not recognized by the code be used?

Answer #1:

Yes, if the following is applied.

Due to the shortage of framing lumber, wood species, other than those listed in the North Carolina Building Codes, have appeared in lumberyards throughout the state. Some of these species are not among the wood species currently prescriptively recognized in the North Carolina Residential Code for structural applications.

The primary concerns are:

a. The specific gravity or wood density, which affects the performance of fastening devices, such as nails, screws, or gusset plates and

b. The allowable stresses, which affect the span.

A lower specific gravity may result in a decreased resistance capacity of a framing connection, or reduced capacity to resist wind and seismic loads of a braced wall panel. A lower allowable stress will result in shorter span.

Most of the lumber meets or exceeds the specific gravity value of 0.42 (the lowest specific gravity among the four species recognized by the code) except for the following species:

Table #1 Species with Specific Gravity less than 0.42

SPECIES	GRADE STAMP NOMENCLATURE	Specific Gravity
ALASKA SPRUCE	AK SPR	0.41
ASPEN	ASPEN	0.39
COTTONWOOD	COT	0.41
EASTERN HEMLOCK-BALSAM FIR	E HEM B FIR	0.36
EASTERN HEMLOCK-TAMARACK	E HEM-TAM	0.41
EASTERN SOFTWOODS	EASTERN SOFTWOODS	0.36
EASTRN WHITE PINE	EW PINE (N)	0.36
NORTHERN SPECIES	N. SPECIES	0.35
NOTHERN WHITE CEDAR	NW CEDAR	0.31
NORWAY SPRUCE ROMANIA & UKRAINE	N SPR (I) ROM; UKR	0.38
NORWAY SPRUCE (NORTH)	N.SPR	0.4
REDWOOD	REDWOOD	0.37
SPRUCE-PINE-FIR (SOUTH)	SPF(S)	0.36
WESTERN CEDAR	WC	0.36
WESTERN WOODS	WW	0.36

For example, if the stamp shows the wood species that contain N SPR ROM UKR (see the grade stamp in Photo #1), the specific gravity is 0.38. The lumber will not meet the prescriptive fastening and braced wall panel requirements and will automatically require an engineered design. Without engineering, the material should be disqualified for use in a structural application.

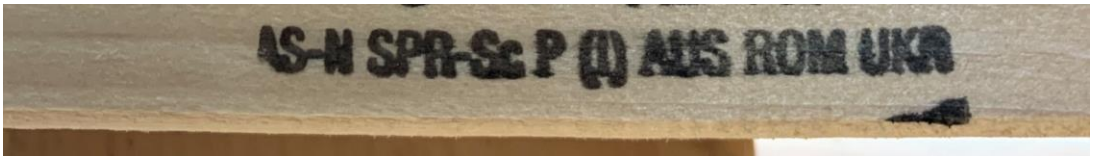

Photo #1 Lumber Grade Stamp

Element of a Grade Stamp

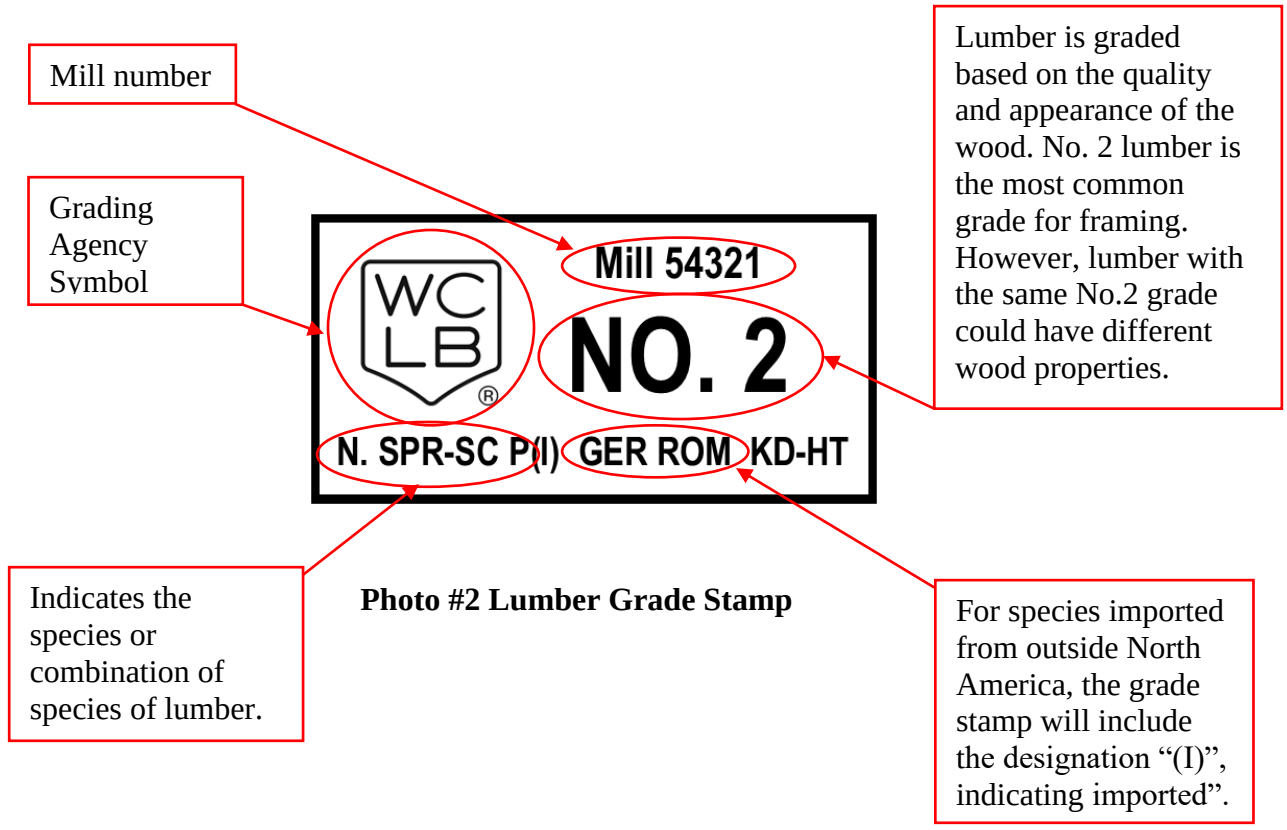

Photo #2 Lumber Grade Stamp

Question #2:

How to determine the allowable span for floor joists, ceiling joists or rafters for a species not recognized by the code?

Answer #2:

There are two methods to determine the allowable span joists and rafters:

1) Span Table published by Pacific Lumber Inspection Bureau

Pacific Lumber Inspection Bureau (PLIB) has developed and published the *Simplified Span Tables for Light Frame Construction Imported Species* which contains span tables for lumber species imported from European. The span table covers allowable span for floor joists, ceiling joists and rafters under the most common loadings in light frame construction.

Link to *Simplified Span Tables for Light Frame Construction Imported Species* published by Pacific Lumber Inspection Bureau

https://www.plib.org/staging/wp-content/uploads/2021/07/Simplified-Span-Tables-Imported-Species-07302021.pdf

2) Span Table published by American Wood Council

According to NCRC Section R502.3, R802.4, and R802.5, the allowable joist span and spans for rafters shall be determined from the *Span Tables for Joists and Rafters* (STJR) published by American Wood Council when other grades, species or loading conditions are used that are not provided in the building codes.
The AWC STJR span tables shall be used with the published design values for the specific species desired to be used to determine its allowable span. Published design values shall be obtained from AWC's *Design Values for Joists and Rafters.*

Link to *Span Tables for Joists and Rafters (STJR)* published by American Wood Council

https://awc.org/pdf/codes-standards/publications/span-tables/AWC-SpanTables2015-1505.pdf

Link to *Design Values for Joists and Rafters* published by American Wood Council

https://awc.org/pdf/codes-standards/publications/span-tables/AWC-SpanTables2015-DVJR-1505.pdf

Design values for Non-North American Visually Graded Dimension Lumber

https://awc.org/docs/default-source/default-document-library/addendum--6-22-21.pdf?sfvrsn=758c06bc_4

Example:

What is the code allowable span for this European 2x10 floor joist spaced 16 inches on center?

Design Criteria:
10 psf Dead Load
40 psf Live Load (Table R301.5)
Live Load Deflection limit = L/360 (Table R301.7)

From PLIB *Simplified Span Tables for Light Frame Construction Imported Species:*

Joist Spacing (inches)	Species and Grade		Residential living areas= 40 psf, L/ Δ = 360									
			Dead Load = 10 psf					Dead Load = 20 psf				
			2x4	2x6	2x8	2x10	2x12	2x4	2x6	2x8	2x10	2x12
			Maximum Floor Joist Spans (ft - in)									
16	Austrian Spruce - Austria & The Czech Republic	SS	6 - 4	9 - 11	13 - 1	16 - 9	20 - 4	6 - 4	9 - 11	13 - 1	16 - 9	20 - 4
		No. 1	6 - 2	9 - 9	12 - 10	16 - 5	19 - 1	6 - 2	9 - 8	12 - 4	15 - 0	17 - 5
		No. 2	6 - 1	9 - 6	12 - 7	15 - 10	18 - 4	6 - 1	9 - 4	11 - 10	14 - 5	16 - 9
		No. 3	5 - 3	7 - 8	9 - 9	11 - 11	13 - 10	4 - 10	7 - 0	8 - 11	10 - 11	12 - 7
	Douglas Fir - France & Germany	SS	6 - 7	10 - 4	13 - 7	17 - 4	21 - 1	6 - 7	10 - 4	13 - 7	17 - 4	21 - 1
		No. 1	6 - 4	9 - 11	13 - 1	16 - 3	18 - 10	6 - 4	9 - 7	12 - 2	14 - 10	17 - 2
		No. 2	6 - 1	9 - 6	12 - 3	14 - 11	17 - 4	6 - 0	8 - 10	11 - 2	13 - 8	15 - 10
		No. 3	5 - 0	7 - 4	9 - 3	11 - 4	13 - 2	4 - 7	6 - 8	8 - 6	10 - 4	12 - 0
	Norway Spruce - Estonia, Latvia, & Lithuania	SS	6 - 2	9 - 9	12 - 10	16 - 5	19 - 11	6 - 2	9 - 9	12 - 10	16 - 5	19 - 1
		No. 1	5 - 11	9 - 4	12 - 3	15 - 2	17 - 7	5 - 11	8 - 11	11 - 4	13 - 10	16 - 1
		No. 2	5 - 9	9 - 1	12 - 0	14 - 9	17 - 1	5 - 9	8 - 8	11 - 0	13 - 5	15 - 7
		No. 3	4 - 11	7 - 2	9 - 0	11 - 0	12 - 10	4 - 5	6 - 6	8 - 3	10 - 1	11 - 8
	Norway Spruce - Finland	SS	6 - 1	9 - 6	12 - 7	16 - 0	19 - 6	6 - 1	9 - 6	12 - 7	16 - 0	19 - 6
		No. 1	5 - 11	9 - 4	12 - 3	14 - 11	17 - 4	5 - 11	8 - 10	11 - 2	13 - 8	15 - 10
		No. 2	5 - 8	8 - 5	10 - 8	13 - 0	15 - 1	5 - 3	7 - 8	9 - 9	11 - 10	13 - 9
		No. 3	4 - 5	6 - 6	8 - 3	10 - 1	11 - 8	4 - 1	5 - 11	7 - 6	9 - 2	10 - 8
	Norway Spruce - Germany, NE France, & Switzerland	SS	6 - 2	9 - 9	12 - 10	16 - 5	19 - 11	6 - 2	9 - 9	12 - 10	16 - 5	19 - 1
		No. 1	5 - 11	9 - 4	12 - 3	14 - 11	17 - 4	5 - 11	8 - 10	11 - 2	13 - 8	15 - 10
		No. 2	5 - 8	8 - 10	11 - 6	14 - 0	16 - 3	5 - 8	8 - 3	10 - 6	12 - 9	14 - 10
		No. 3	4 - 9	6 - 11	8 - 9	10 - 9	12 - 5	4 - 4	6 - 4	8 - 0	9 - 9	11 - 4
	Norway Spruce - Norway	SS	6 - 5	10 - 2	13 - 4	17 - 0	20 - 9	6 - 5	10 - 2	13 - 4	17 - 0	20 - 9
		No. 1	6 - 1	9 - 6	12 - 7	16 - 0	19 - 1	6 - 1	9 - 6	12 - 4	15 - 0	17 - 5
		No. 2	5 - 9	9 - 1	12 - 0	14 - 9	17 - 1	5 - 9	8 - 8	11 - 0	13 - 5	15 - 7
		No. 3	5 - 0	7 - 4	9 - 3	11 - 4	13 - 2	4 - 7	6 - 8	8 - 6	10 - 4	12 - 0
	Norway Spruce - Romania & Ukraine	SS	6 - 1	9 - 6	12 - 7	16 - 0	19 - 6	6 - 1	9 - 6	12 - 7	16 - 0	19 - 6
		No. 1	5 - 11	9 - 4	12 - 3	15 - 2	17 - 7	5 - 11	8 - 11	11 - 4	13 - 10	16 - 1
		No. 2	5 - 8	8 - 10	11 - 6	14 - 0	16 - 3	5 - 8	8 - 3	10 - 6	12 - 9	14 - 10
		No. 3	4 - 9	6 - 11	8 - 9	10 - 9	12 - 5	4 - 4	6 - 4	8 - 0	9 - 9	11 - 4
	Norway Spruce - Sweden	SS	6 - 2	9 - 9	12 - 10	16 - 5	19 - 11	6 - 2	9 - 9	12 - 10	16 - 5	19 - 6
		No. 1	5 - 11	9 - 4	12 - 3	14 - 11	17 - 4	5 - 11	8 - 10	11 - 2	13 - 8	15 - 10
		No. 2	5 - 8	8 - 9	11 - 1	13 - 6	15 - 8	5 - 5	8 - 0	10 - 1	12 - 4	14 - 4
		No. 3	4 - 7	6 - 9	8 - 6	10 - 5	12 - 1	4 - 2	6 - 2	7 - 9	9 - 6	11 - 0
	Scots Pine - Austria & The Czech Republic, Romania, & Ukraine	SS	6 - 4	9 - 11	13 - 1	16 - 9	20 - 4	6 - 4	9 - 11	13 - 1	16 - 9	19 - 10
		No. 1	6 - 2	9 - 9	12 - 9	15 - 7	18 - 1	6 - 2	9 - 3	11 - 8	14 - 3	16 - 6
		No. 2	5 - 11	9 - 4	11 - 10	14 - 6	16 - 10	5 - 10	8 - 7	10 - 10	13 - 3	15 - 4
		No. 3	4 - 11	7 - 2	9 - 0	11 - 0	12 - 10	4 - 5	6 - 6	8 - 3	10 - 1	11 - 8

From AWC *Design Values for Joists and Rafters:*

	Bending F_b (psi)	**Compression perpendicular to grain F_c (psi)**	**Modulus of Elasticity E (psi)**	**Specific Gravity**	**Allowable Span**
Austrian Spruce No.2 from Austria (AS)	1170	260	1500000	0.43	15'-9"
Scots Pine No. 2 from Austria (ScP)	980	270	1400000	0.5	14'-5"
Combined Design Values	980	260	1400000	0.43	**14'-5"**

Question #3:

How do you determine the allowable span of joists and rafters that have a combination of species that are not found prescriptively in the code?

Answer #3:

When a combination species/species group nomenclature is shown in a grade stamp, the user of the lumber would select the weakest species/species group shown on the grade stamp as the appropriate value for the specific allowable property.

The allowable floor joist span for this European species 2x10 at 16 inches on center spacing = 14'-5"

Question #4:

How to determine the allowable span of a girder or header that is fabricated using a species of lumber that is not recognized by the code?

Answer #4:

For European species, the allowable spans for header and girders shall be determined from tables listed in *Technical Report #7* developed by Pacific Lumber Inspection Bureau (PLIB). This technical report provides span tables for girders and headers as well as design criteria for jack studs for European species for use with the prescriptive code for European Species.

Link to *Technical Report #7 Span Tables for Headers and Girders for European Species* by PLIB

https://www.plib.org/staging/wp-content/uploads/2021/06/PLIB-Technical-Report-No-7.pdf

At this point, engineered design is required for headers and girders that are fabricated from lumber other than the four species recognized by the code and the European Species covered in *Technical Report #7*.

Question #5:

Are species of #3 lumber or better allowed to be used for studs and top/bottom plates that are not one of the 4 species listed prescriptively in the code span tables?

Answer #4:

Based on information from the Pacific Lumber Inspection Bureau (PLIB) (see attachment A) any species that is graded #3 or better is allowed to be used for studs and top/bottom plates. DOI is currently verifying this information with the International Code Council (ICC) but recommends acceptance of such lumber until which time ICC confirms or denies this allowance.

ATTACHMENT A

PACIFIC LUMBER INSPECTION BUREAU

July 9, 2021

Update on the Use of European Lumber in North Carolina

Since 1996 when the first design values for European lumber were published, European lumber has been accepted and used in U.S. construction projects. However, many builders and code officials are not familiar with the properties or labeling of the product. Earlier this year, code authorities in North Carolina raised questions about the use of European lumber in residential construction projects in the state despite its over 20-year history of successful use in the state, highlighting the need for additional educational and technical information.

Initial concerns prompted the North Carolina Department of Insurance (NCDOI), to issue a news release on June 11 warning of the use of European lumber in North Carolina. PLIB issued a response to the NCDOI notice on June 17 (see PLIB's Response to North Carolina DOI warning notice | Pacific Lumber Inspection Bureau). On June 18, the American Wood Council (AWC) issued its own response to the NCDOI release that provided additional information aimed at clarifying some of the engineering and code related questions that the NCDOI notice raised (see AWC Response to NCDOI Press Release). On June 28, after considering this and other technical information, NCDOI issued a new interpretation as a follow up to the June 11 notice (see https://www.ncosfm.gov/media/2366/open).

Throughout this discovery process, technical and engineering supporting information has been developed to address the concerns that were being raised. PLIB's engineering staff developed allowable stud length tables for European species in wind zones from 90 mph to 195 mph. These tables were published in a Technical Report No. 5 *Maximum Allowable Stud Length Tables for European Species and Countries in High Wind Regions.* TR-5-Max-Stud-Length-Tables-for-European-Species-1.pdf.

Also, important to note is that for buildings built to the International Residential Code (IRC), any lumber above Utility grade can be used for studs regardless of species and there is no species requirement for wall top and bottom plate material or blocking.

R602.2 Grade. Studs shall be a minimum No. 3, standard or stud grade lumber.

Exception: Bearing studs not supporting floors and non-bearing studs shall be permitted to be utility grade lumber, provided that the studs are spaced in accordance with Table R602.3(5).

Other concerns also surfaced, including lack of span tables for girders and headers for European species. In response, PLIB developed span tables for girders and headers for European species and published these in Technical Report No. 7 *Span Tables for Headers and Girders for European Species* PLIB-Technical-Report-No-7.pdf

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This information was provided to the North Carolina Department of Insurance (NCDOI), code officials and builders providing a pathway for the continued use of European species in residential construction in North Carolina.

A third concern that was raised involved specific gravity, specifically regarding species that have specific gravity values less than 0.42. While there are no specific gravity requirements for the prescriptive connections provided in the International Residential Code (IRC) or the International Building Code (IBC), a few of the connections that are more sensitive to the framing specific gravity have been designed assuming G=0.42. These connections include roof sheathing attachment to roof rafters/trusses and toenailed connections of roof rafters/trusses to wall top plates.

The North Carolina Residential Code (NCRC) is based on the 2015 IRC and has the same prescriptive fastener requirements for wind speeds up to 130 mph. In wind speed zones 130 mph and higher, the NCRC references AWC's Wood-Frame Construction Manual (WFCM) as an acceptable design document for these high wind zones. The NCRC also has included a separate Chapter 45 High Wind Zones which contains several pre-engineered provisions for homes built in the 130-150 mph wind zones, but often refers back to the general fastener requirements.

Specific gravity is not required for use of the prescriptive provisions of the IRC or NCRC. Additionally, information was provided to NCDOI confirming that all European species, with one exception, have a specific gravity value greater than 0.42, thereby meeting the pre-engineered high wind connection requirements in the WFCM and NCRC Chapter 45.

Although the technical materials and communications that have been developed have provided important information that was either previously lacking or required additional explanation, many builders, distributors used and code officials may be unaware that it exists. Some continue to believe that European lumber is not acceptable and cannot be used or are rejecting it on jobsites and within the distribution chain. Some European companies have been targeted (see PLIB notice on mill #703 and #760).

The technical materials and communications that have been developed have provided important information that was either previously lacking or required additional explanation, and they underscore the fact that European lumber is an acceptable building material in North Carolina.

For additional information, please contact PLIB's engineering department at (253) 835-3344 or info@plib.org