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KING BEAM® 3000, BOISE GLULAM®, and VersaWorks™ Glulam
Boise Cascade Wood Products, LLC

PR-L313
Revised April 4, 2024

Products: KING BEAM® 3000, BOISE GLULAM®, and VersaWorks™ Glulam
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1. Basis of the product report:
   - 2021, 2018, 2015, and 2012 International Building Code (IBC): Section 2303.1.3 Structural glued laminated timber
   - 2021, 2018, and 2015 International Residential Code (IRC): Sections R502.1.3, R602.1.3, and R802.1.2 Structural glued laminated timber
   - 2012 IRC: Sections R502.1.5, R602.1.2, and R802.1.4 Structural glued laminated timber
   - ANSI 117-2020 and ANSI 117-2015 recognized in the 2021 IBC and IRC, and 2018 IBC and IRC, respectively
   - ANSI A190.1-2017, ANSI A190.1-2012, and ANSI/AITC A190.1-2007 recognized in the 2021 and 2018 IBC and IRC, 2015 IBC and IRC, and 2012 IBC and IRC, respectively
   - ASTM D3737-18e1, D3737-12, and D3737-08 recognized in the 2021 IBC and IRC, 2018 and 2015 IBC and IRC, and 2012 IBC and IRC, respectively
   - APA Report T2013P-06, AITC data (June 2010), and other qualification data

2. Product description:
   KING BEAM® 3000, BOISE GLULAM®, and VersaWorks™ Glulam are used as beams, headers, rafters, purlins, or columns. KING BEAM 3000 30F-E4 and 30F-E5 glulam beams are manufactured with a proprietary balanced and unbalanced layup combination, respectively, documented in the in-plant manufacturing standard and approved by APA. KING BEAM 3000 30F-E4 glulam beams use conventional laminating lumber grades of Douglas fir-Larch in the tension and compression zones, and Southern pine in the core with the exception that the outermost tension and outermost compression laminations are made of a proprietary Douglas fir-Larch manufactured lumber tension lamination, as permitted by ANSI A190.1. KING BEAM 3000 30F-E5 glulam beams use the same materials as 30F-E4 glulam beams except that outermost compression laminations are made of conventional 302-24 Douglas fir-Larch laminations. KING BEAM 3000 30F-E4 and 30F-E5 glulam beams have a minimum depth of 7-1/4 inches and a maximum depth of 54 inches.

   BOISE GLULAM and VersaWorks Glulam beams and columns are manufactured in accordance with ANSI A190.1 using layup combinations recognized in the National Design Specification (NDS) Supplement or ANSI 117. BOISE GLULAM and VersaWorks Glulam beams are manufactured in widths of 3-1/8, 3-1/2, 5-1/8, 5-1/2, 6-3/4, 8-3/4, 10-3/4, 12-1/4, and 14-1/4 inches with a minimum depth of 6 inches and lengths up to 66 feet. BOISE GLULAM and VersaWorks Glulam columns are manufactured in widths of 3-1/8 to 10-3/4 inches, depths of 5-1/8 to 12 inches, and lengths up to 30 feet.

3. Design properties:
   Tables 1 and 2 list the allowable design properties for KING BEAM 3000, BOISE GLULAM, and VersaWorks Glulam beams and columns. The allowable spans for KING BEAM 3000, BOISE GLULAM, and VersaWorks Glulam beams and columns shall be in accordance with the recommendations provided by the manufacturer (www.bc.com/ewp) and APA Data Files: *Glued Laminated Beam Design Tables*, Form S475 (www.apawood.org/resource-library),

and *Design of Structural Glued Laminated Timber Columns*, Form Y240 (see link above), as applicable.

4. Product installation:
KING BEAM 3000, BOISE GLULAM, and VersaWorks Glulam beams and columns shall be installed in accordance with the recommendations provided by the manufacturer and APA Construction Guide*: Glulam Connection Details*, Form T300 (see link above). Permissible field notching and drilling shall be in accordance with the recommendations provided by the manufacturer, and APA Technical Notes*: Field Notching and Drilling of Glued Laminated Timber Beams*, Form S560, and *Effect of Large Diameter Horizontal Holes on the Bending and Shear Properties of Structural Glued Laminated Timber*, Form V700 (see link above).

5. Fire-rated assemblies:
Design of fire-resistant exposed wood members in accordance with Chapter 16 of the NDS, Section 722.1 of the 2021, 2018, and 2015 IBC, or Section 722.6.3 of the 2012 IBC shall be applicable to KING BEAM 3000, BOISE GLULAM, and VersaWorks Glulam beams and columns. Fire-rated assemblies shall be constructed in accordance with the recommendations provided by the manufacturer, and APA Design/Construction Guide*: Fire-Rated Systems*, Form W305 (see link above).

6. Limitations:
   a) KING BEAM 3000, BOISE GLULAM, and VersaWorks Glulam beams and columns shall be designed in accordance with the code using the design properties specified in this report.
   b) KING BEAM 3000 glulam beams shall have a minimum depth of 7-1/4 inches and a maximum depth of 54 inches. BOISE GLULAM and VersaWorks Glulam beams and columns shall have a minimum depth of 6 inches.
   c) KING BEAM 3000, BOISE GLULAM, and VersaWorks Glulam beams and columns are produced at Boise Cascade’s Homedale, Idaho facilities under a quality assurance program audited by APA.
   d) This report is subject to re-examination in one year.

7. Identification:
KING BEAM 3000, BOISE GLULAM, and VersaWorks Glulam beams and columns described in this report are identified by a label bearing the manufacturer's name (Boise Cascade) and/or trademark, the APA assigned plant number (1107), the product standard (ANSI A190.1), the APA logo, the combination symbol, the report number PR-L313, and a means of identifying the date of manufacture.

Table 1. Allowable Design Values for KING BEAM 3000, BOISE GLULAM, and VersaWorks Glulam Beams for Normal Duration of Load[1,2,11]

Symbol	Species Outer/ Core[3] (Bal or Unbal[4])	Bending About X-X Axis (Loaded Perpendicular to Wide Faces of Laminations)								Bending About Y-Y Axis (Loaded Parallel to Wide Faces of Laminations)						Axially Loaded		Fasteners	
		Extreme Fiber in Bending[5]		Compression Perpendicular to Grain		Shear Parallel to Grain[6]	Modulus of Elasticity[7]			Extreme Fiber in Bending[8]	Comp. Perpen -dicular to Grain	Shear Parallel to Grain[6]	Modulus of Elasticity[7]			Tension Parallel to Grain	Comp. Parallel to Grain	Specific Gravity for Dowel-Type Fastener Design	
		Bottom of Beam Stressed in Tension (Positive Bending)	Top of Beam Stressed in Tension (Negative Bending)	Ten. Face	Comp. Face		True	App-arent	Beam Stabi-lity				True	App-arent	Beam Stabi-lity			Top or Bottom Face	Side Face
		F_{bx}^{+} (psi)	F_{bx}^{-} (psi)	$F_{c\perp x}$ (psi)		F_{vx} (psi)	$E_{x\,true}$ (10^6 psi)	$E_{x\,app}$ (10^6 psi)	$E_{x\,min}$ (10^6 psi)	F_{by} (psi)	$F_{c\perp y}$ (psi)	F_{vy} (psi)	$E_{y\,true}$ (10^6 psi)	$E_{y\,app}$ (10^6 psi)	$E_{y\,min}$ (10^6 psi)	F_t (psi)	F_c (psi)	SG	
KING BEAM 3000 30F-E4[9]	DF/SP (B)	3,000	3,000	805	805	300	2.4	2.3	1.22	1,900	650	240	2.1	2.0	1.06	1,450	1,800	0.55	0.53[10]
KING BEAM 3000 30F-E5[9]	DF/SP (U)	3,000	2,600	805	805	300	2.4	2.3	1.22	1,900	650	240	2.1	2.0	1.06	1,450	1,800	0.55	0.53[10]
24F-V4	DF/DF (U)	2,400	1,850	650	650	265	1.9	1.8	0.95	1,450	560	230	1.7	1.6	0.85	1,100	1,650	0.50	0.50
24F-V8	DF/DF (B)	2,400	2,400	650	650	265	1.9	1.8	0.95	1,550	560	230	1.7	1.6	0.85	1,100	1,650	0.50	0.50
22F-V14	POC/POC (U)	2,200	1,650	560	560	265	1.8	1.7	0.90	1,700	470	230	1.7	1.6	0.85	1,200	2,100	0.46	0.46
22F-V15	POC/POC (B)	2,200	2,200	560	560	265	1.8	1.7	0.90	1,700	470	230	1.7	1.6	0.85	1,200	2,100	0.46	0.46
20F-V12	AC/AC (U)	2,000	1,400	560	560	265	1.6	1.5	0.79	1,250	470	230	1.5	1.4	0.74	925	1,500	0.46	0.46
20F-V13	AC/AC (B)	2,000	2,000	560	560	265	1.6	1.5	0.79	1,250	470	230	1.5	1.4	0.74	950	1,550	0.46	0.46
20F-V14	POC/POC (U)	2,000	1,450	560	560	265	1.6	1.5	0.79	1,300	470	230	1.5	1.4	0.74	900	1,600	0.46	0.46
20F-V15	POC/POC (B)	2,000	2,000	560	560	265	1.6	1.5	0.79	1,300	470	230	1.5	1.4	0.74	900	1,600	0.46	0.46
16F-V3	DF/DF (U)	1,600	1,250	560	560	265	1.6	1.5	0.79	1,450	560	230	1.6	1.5	0.79	975	1,500	0.50	0.50
Wet-use factor		0.8		0.53		0.875	0.833			0.8	0.53	0.875	0.833			0.8	0.73	see NDS	

(1) The combination in this table is intended primarily for members stressed in bending due to loads applied perpendicular to the wide faces of the laminations. Allowable design values are tabulated, however, for loading both perpendicular and parallel to the wide faces of the laminations.

(2) The tabulated allowable design values are for normal duration of loading. For other durations of loading, see the applicable building code. The tabulated allowable design values are for dry conditions of use. For wet conditions of use, multiply the tabulated values by the wet-use factors shown at the bottom of the table.

(3) AC = Alaska cedar, DF = Douglas fir-Larch, POC = Port Orford cedar, and SP = Southern pine in accordance with the manufacturing standard.

(4) The balanced (B) layup is intended primarily for multiple-span or cantilevered beam applications, but may be used in simple-span applications. The unbalanced (U) layup is intended primarily for simple-span applications, but may be used in multiple-span or cantilevered beam applications.

(5) The values of F_{bx} are based on members 5-1/8 inches in width by 12 inches in depth by 21 feet in length. For members with a larger volume, F_{bx} shall be multiplied by a volume factor, $C_v = (5.125/b)^{1/10}\,(12/d)^{1/10}\,(21/L)^{1/10}$, where b is the beam width (in.), d is the beam depth (in.), and L is the beam length between the points of zero moment (ft).

(6) For non-prismatic members, members subject to impact or cyclic loading, or shear design of bending members at connections (NDS 3.4.3.3), the F_{vx} and F_{vy} values shall be multiplied by a factor of 0.72. The tabulated F_{vy} values are for timbers with laminations made from a single piece of lumber across the width or multiple pieces that have been edge bonded. For timber manufactured from multiple piece laminations (across width) that are not edge bonded, value shall be multiplied by 0.4 for members with 5, 7, or 9 laminations or by 0.5 for all other members.

(7) The tabulated E values include true E (also known as "shear-free E"), apparent E, and E for beam stability calculation (NDS 3.3.3.8). For calculating beam deflections, the tabulated E_{app} values shall be used unless the shear deflection is determined in addition to bending deflection based on the tabulated E_{true}. The axial modulus of elasticity, E_{axial} and $E_{axial\,min}$, shall be equal to the tabulated $E_{y\,true}$ and $E_{y\,min}$ values.

(8) The values of F_{by} are based on members 12 inches in depth. For depths less than 12 inches, F_{by} shall be permitted to be increased by multiplying by the flat use factor, $(12/d)^{1/9}$, where d is the beam depth in inches. When d is less than 3 inches, use the size adjustment factor for 3 inches.

(9) The beam depths are limited to 7-1/4 to 54 inches.

(10) The specific gravity shall be permitted to be increased to 0.55 when the fastener is installed in the outer 25% (top and bottom) and the center 40% of the beam depth.

(11) Vertically curved (horizontally laminated) beams utilizing all 302 Douglas fir tension laminations and with individual laminations planed down to a thickness, where 1-3/8 inches > thickness ≥ 5/8 inch, shall be permitted to be trademarked and designed as a Combination #2 glulam in accordance with Table 2.

Table 2. Allowable Design Values for BOISE GLULAM and VersaWorks Glulam for Normal Duration of Load[1]

Combination Symbol	Species[2]	Grade	All Loading				Axially Loaded			Bending about Y-Y Axis				Bending about X-X Axis		Fasteners
			Modulus of Elasticity[3]			Compression Perpendicular to Grain	Tension Parallel to Grain	Compression Parallel to Grain		Loaded Parallel to Wide Faces of Laminations				Loaded Perpendicular to Wide Faces of Laminations		Specific Gravity for Dowel-Type Fastener Design
										Bending[4]			Shear Parallel to Grain[5,6]	Bending[7]	Shear Parallel to Grain[5]	
							2 or More Lams	4 or More Lams	2 or 3 Lams	4 or More Lams	3 Lams	2 Lams		2 Lams to 15 in. Deep[8]		
			$E_{x\ true}$, $E_{y\ true}$ or E_{axial} (10^6 psi)	**$E_{x\ app}$ or $E_{y\ app}$** (10^6 psi)	**$E_{x\ min}$, $E_{y\ min}$ or $E_{axial\ min}$** (10^6 psi)	**$F_{c\perp}$** (psi)	**F_t** (psi)	**F_c** (psi)	**F_c** (psi)	**F_{by}** (psi)	**F_{by}** (psi)	**F_{by}** (psi)	**F_{vy}** (psi)	**F_{bx}** (psi)	**F_{vx}** (psi)	**SG**
1	DF	L3	1.6	1.5	0.79	560	950	1,550	1,250	1,450	1,250	1,000	230	1,250	265	0.50
2[9]	DF	L2	1.7	1.6	0.85	560	1,250	1,950	1,600	1,800	1,600	1,300	230	1,700	265	0.50
3	DF	L2D	2.0	1.9	1.00	650	1,450	2,300	1,900	2,100	1,850	1,550	230	2,000	265	0.50
5	DF	L1	2.1	2.0	1.06	650	1,650	2,400	2,100	2,400	2,100	1,800	230	2,200	265	0.50
70	AC	L2	1.4	1.3	0.69	470	975	1,450	1,450	1,400	1,250	1,000	230	1,350	265	0.46
74	POC	L2	1.5	1.4	0.74	470	1,050	1,900	1,550	1,450	1,300	1,100	230	1,400	265	0.46
Wet-use factors			0.833			0.53	0.8	0.73		0.8			0.875	0.8	0.875	see NDS

(1) The tabulated allowable design values are for normal duration of loading. For other durations of loading, see applicable building code. The tabulated allowable design values are for dry conditions of use. For wet conditions of use, multiply the tabulated values by the factors shown at the bottom of the table.

(2) AC = Alaska cedar, DF = Douglas fir-Larch, and POC = Port Orford cedar.

(3) The tabulated E values include shear-free (true) modulus of elasticity ($E_{x\ true}$, $E_{y\ true}$, and E_{axial}), apparent modulus of elasticity ($E_{x\ app}$ and $E_{y\ app}$), and 5th percentile modulus of elasticity ($E_{x\ min}$, $E_{y\ min}$, and $E_{axial\ min}$). For column stability calculation (NDS 3.7.1), $E_{axial\ min}$ shall be used. For calculating the total deflection due to bending, the tabulated $E_{x\ app}$ or $E_{y\ app}$ values shall be used, or as an alternative, the true (shear-free) bending deflection shall be calculated using the tabulated $E_{x\ true}$ or $E_{y\ true}$, which shall be added to the calculated shear deflection to determine the total deflection due to bending.

(4) The values of F_{by} are based on members 12 inches in depth. For depths less than 12 inches, F_{by} shall be permitted to be increased by multiplying by the size factor, $(12/d)^{1/9}$, where d is the beam depth in inches. When d is less than 3 inches, use the size adjustment factor for 3 inches.

(5) For non-prismatic members, notched members, members subject to impact or cyclic loading, or shear design of bending members at connections (NDS 3.4.3.3), the tabulated F_{vx} and F_{vy} values shall be multiplied by 0.72.

(6) The tabulated F_{vy} values are for members of 4 or more lams. The tabulated F_{vy} values shall be multiplied by a factor of 0.95 for 3 lams and 0.84 for 2 lams. For members with 5, 7, or 9 lams manufactured from multiple-piece lams with unbonded edge joints, the tabulated F_{vy} values shall be multiplied by a factor of 0.4. For all other members manufactured from multiple-piece lams with unbonded edge joints, the tabulated F_{vy} values shall be multiplied by a factor of 0.5. This adjustment shall be cumulative with the adjustment specified in Footnote 5.

(7) The values of F_{bx} are based on members 5-1/8 inches in width by 12 inches in depth by 21 feet in length. For members with a larger volume, F_{bx} shall be multiplied by a volume factor, $C_v = (5.125/b)^{1/10} (12/d)^{1/10} (21/L)^{1/10}$, where b is the beam width (in.), d is the beam depth (in.), and L is the beam length between the points of zero moment (ft).

(8) The tabulated F_{bx} values are for members without special tension lams up to 15 inches in depth. If the member depth is greater than 15 inches without special tension lams, the tabulated F_{bx} values must be multiplied by a factor of 0.88. If special tension lams are used, the tabulated F_{bx} values are permitted to be increased by a factor of 1.18 regardless of the member depth provided that the increased F_{bx} value does not exceed 2,400 psi. This factor shall be cumulative with the volume factor, C_v, specified in Footnote 7.

(9) Vertically curved (horizontally laminated) beams utilizing all 302 Douglas fir tension laminations and with individual laminations planed down to a thickness, where 1-3/8 inches > thickness ≥ 5/8 inch, shall be permitted to be trademarked and designed as a Combination #2 glulam.

APA – The Engineered Wood Association is an approved national standards developer accredited by American National Standards Institute (ANSI). APA publishes ANSI standards and Voluntary Product Standards for wood structural panels and engineered wood products. APA is an accredited certification body under ISO/IEC 17065 by Standards Council of Canada (SCC), an accredited inspection agency under ISO/IEC 17020 by International Code Council (ICC) International Accreditation Service (IAS), and an accredited testing organization under ISO/IEC 17025 by IAS. APA is also an approved Product Certification Agency, Testing Laboratory, Quality Assurance Entity, Validation Entity, and Product Evaluation Entity by the State of Florida, and an approved testing laboratory by City of Los Angeles.

APA – THE ENGINEERED WOOD ASSOCIATION

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