A P A

The Engineered Wood Association

DESIGN/CONSTRUCTION GUIDE

NONRESIDENTIAL ROOF SYSTEMS

A P A

The Engineered Wood Association

DO THE RIGHT THING RIGHT™

Wood is good. It is the earth's natural, energy efficient and renewable building material.

Engineered wood is a better use of wood. It uses less wood to make more wood products.

That's why using APA trademarked I-joists, glued laminated timbers, laminated veneer lumber, plywood and oriented strand board is the right thing to do.

A few facts about wood.

- ***We're not running out of trees.*** One-third of the United States land base – 731 million acres – is covered by forests. About two-thirds of that 731 million acres is suitable for repeated planting and harvesting of timber. But only about half of the land suitable for growing timber is open to logging. Most of that harvestable acreage also is open to other uses, such as camping, hiking, hunting, etc.

- ***We're growing more wood every day.*** American landowners plant more than two billion trees every year. In addition, millions of trees seed naturally. The forest products industry, which comprises about 15 percent of forestland ownership, is responsible for 41 percent of replanted forest acreage. That works out to more than one billion trees a year, or about three million trees planted every day. This high rate of replanting accounts for the fact that each year, 27 percent more timber is grown than is harvested.

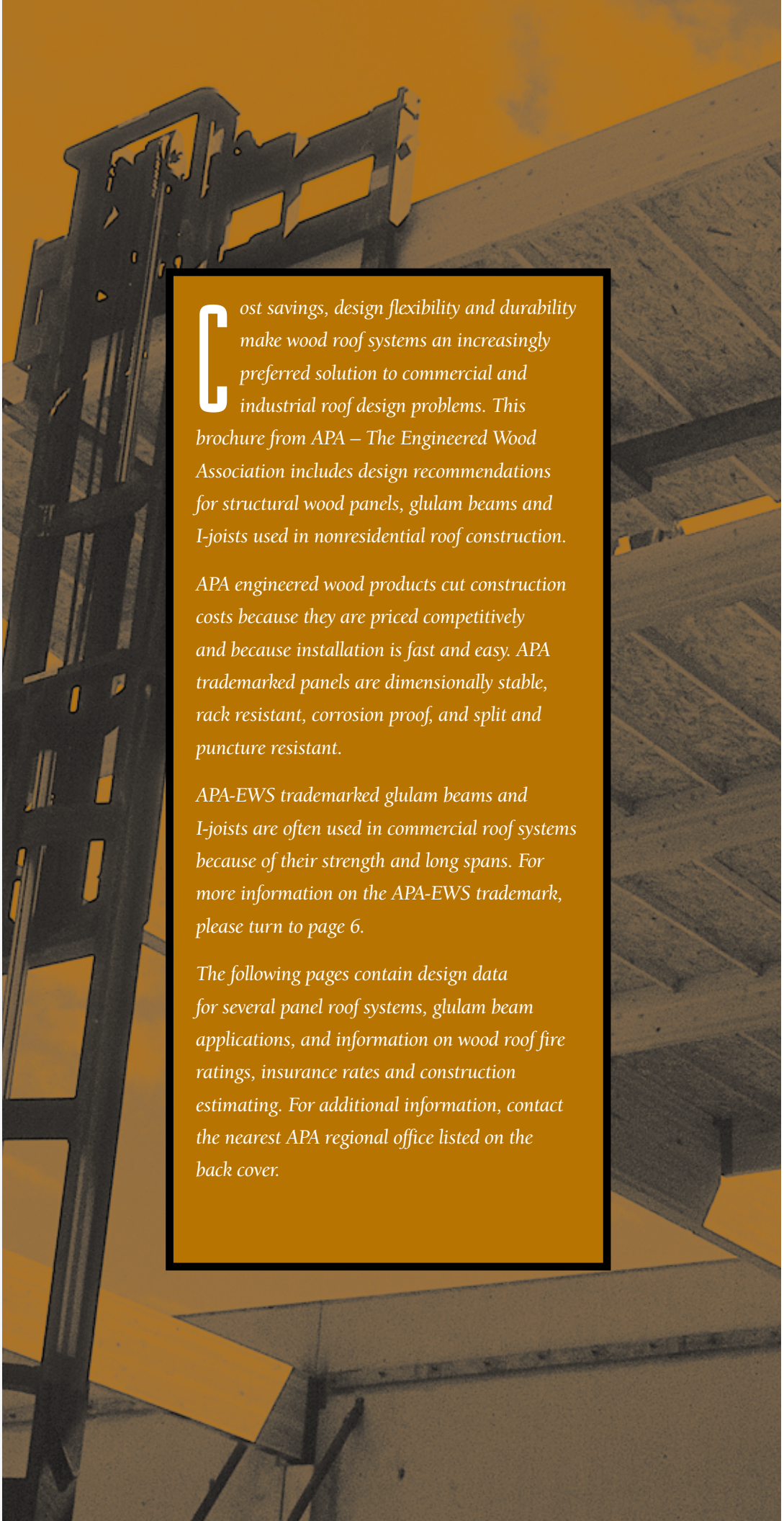
- ***Manufacturing wood is energy efficient.*** Wood products made up 47 percent of all industrial raw materials manufactured in the United States, yet consumed only 4 percent of the energy needed to manufacture all industrial raw materials, according to a 1987 study.

Material	Percent of Production	Percent of Energy Use
Wood	47	4
Steel	23	48
Aluminum	2	8

- ***Good news for a healthy planet.*** For every ton of wood grown, a young forest produces 1.07 tons of oxygen and absorbs 1.47 tons of carbon dioxide.

Wood. It's the right product for the environment.

NOTICE:
The recommendations in this guide apply only to panels that bear the APA trademark. Only panels bearing the APA trademark are subject to the Association's quality auditing program.



Cost savings, design flexibility and durability make wood roof systems an increasingly preferred solution to commercial and industrial roof design problems. This brochure from APA – The Engineered Wood Association includes design recommendations for structural wood panels, glulam beams and I-joists used in nonresidential roof construction.

APA engineered wood products cut construction costs because they are priced competitively and because installation is fast and easy. APA trademarked panels are dimensionally stable, rack resistant, corrosion proof, and split and puncture resistant.

APA-EWS trademarked glulam beams and I-joists are often used in commercial roof systems because of their strength and long spans. For more information on the APA-EWS trademark, please turn to page 6.

The following pages contain design data for several panel roof systems, glulam beam applications, and information on wood roof fire ratings, insurance rates and construction estimating. For additional information, contact the nearest APA regional office listed on the back cover.

CONTENTS

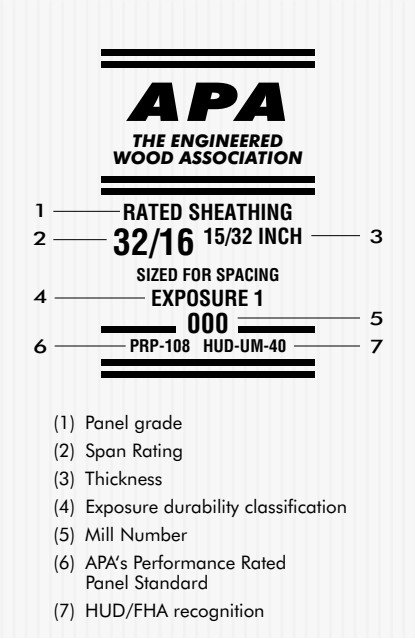
SELECTING AND SPECIFYING APA PANELS

Manufacturing and Performance Standards

Panels for construction and industrial applications can be manufactured in a variety of ways – as plywood (cross-laminated wood veneer), as composites (veneer faces bonded to wood strand cores), or as oriented strand board (OSB).

Some plywood panels are manufactured under the detailed manufacturing specifications or under the performance testing provisions of Voluntary Product Standard PS 1-95 for Construction and Industrial Plywood, developed cooperatively by the plywood industry and the U.S. Department of Commerce. Other plywood panels, however, as well as composite and OSB panels, are manufactured under the provisions of APA PRP-108, Performance Standards and Policies for Structural-Use Panels, or under Voluntary Product Standard PS 2-92, Performance Standard for Wood-Based Structural-Use Panels, that establish performance criteria for specific designated construction applications.

These APA Performance Rated Panels are easy to use and specify because the recommended end use and maximum support spacings are clearly indicated in the APA trademark. By broadening the range of panel configuration and composition, APA Performance Rated Panels allow more efficient use of raw materials. APA PRP-108 Performance Standards are recognized by the National Evaluation Service and



HUD.[a] PRP-108, PS-1 and/or the PS-2 grade conformance where applicable are given in the lower portion of the APA trademark. Plywood panels, depending on glueline classification, veneer species and thickness, etc., are in many instances identical to panel grades as defined in Product Standard PS 1-95.

Refer to the text and tables in this brochure for specific panel grade and composition recommendations for commercial and industrial roof systems.

A typical trademark for one of the APA Performance Rated Panels – APA RATED SHEATHING – is shown above. Other typical trademarks are shown in Table 1.

(a) The National Evaluation Service is sponsored jointly by the three model code organizations – The Building Officials and Code Administrators International, promulgators of the National Building Code; the International Conference of Building Officials, promulgators of the Uniform Building Code; and the Southern Building Code Congress International, promulgators of the Standard Building Code. See National Evaluation Service Report No. NER-108 for allowable values and/or conditions of use concerning material presented in this brochure. It is subjected to reexamination, revisions, and possible cancellation.

HUD recognition of wood-based APA Performance Rated Panels is contained in Use of Materials Bulletin UM-40c, or in UM-64 for APA Rated Siding-303 (plywood).

Grade

Construction and industrial panel grades are identified in terms of the veneer grade used on the face and back of the panel (e.g., A-B, B-C, etc.) or by a name suggesting the panel's intended end use (e.g., APA RATED SHEATHING, APA RATED STURD-I-FLOOR, etc.). See Table 1 for recommended grades for roofs.

Veneer grades define veneer appearance in terms of natural unrepaired growth characteristics and allowable number and size of repairs that may be made during manufacture. Veneer grades are designated by letter – A, B, C-Plugged, C and D – with A and B of the highest quality and D the lowest. The minimum grade of veneer permitted in panels for exterior use is C. D-grade veneer is used only in panels intended for interior use or applications protected from permanent exposure to weather.

Exposure Durability

APA trademarked panels may be produced in four exposure durability classifications – Exterior, Exposure 1, Exposure 2, and Interior.

Exterior panels have a fully waterproof bond and are designed for applications subject to permanent exposure to the weather.

Exposure 1 panels have a fully waterproof bond and are designed for applications where long construction delays may be expected prior to providing protection, or where high moisture conditions may be encountered in service. Exposure 1 panels are made with the same exterior adhesives used in Exterior panels. However, because other compositional factors may affect bond performance, only Exterior panels should be used for permanent exposure to the weather.

TABLE 1

GUIDE TO APA PERFORMANCE RATED PANELS FOR ROOFS[a][b]

Grade Designation and Description	Typical Trademark
APA Rated Sheathing – Manufactured as veneered, composite or OSB panels. See appropriate load-span tables for composition requirements. Exposure Durability Classifications: Exterior, Exposure 1. Common thicknesses: 5/16, 3/8, 7/16, 15/32, 1/2, 19/32, 5/8, 23/32 and 3/4 inch.	
APA Structural I Rated Sheathing[c] – Unsanded panels for applications where shear and cross-panel strength properties are of maximum importance, such as panelized roofs and diaphragms. Exposure Durability Classifications: Exterior, Exposure 1. Common thicknesses: 5/16, 3/8, 15/32, 1/2, 19/32, 5/8, 23/32 and 3/4 inch.	 
APA Rated Sturd-I-Floor – Intended for floors, may also be used for roof construction. The 1-1/8" all-veneer panel (2-4-1) may be used for heavy timber roof construction. Available with square or tongue-and-groove edges. Exposure Durability Classifications: Exterior, Exposure 1. Thicknesses: 19/32, 5/8, 23/32, 3/4, 1 and 1-1/8 inch.	

(a) Specify Performance Rated Panels by thickness and Span Rating.

(b) Other panel grades sometimes used in commercial roof construction are noted in the text.

(c) All plies in Structural I plywood panels are special improved grades and panels marked PS 1 are limited to Group 1 species. Other panels marked Structural I Rated qualify through special performance testing.

Exposure 2 panels (identified as Interior type with intermediate glue under PS-1) are intended for protected construction applications where only moderate delays in providing protection from moisture may be expected.

Interior panels which lack further glueline information in their trademarks are manufactured with interior glue and are intended for interior applications only.

Group Number

Plywood can be manufactured from over 70 species of wood. These species are divided on the basis of strength and stiffness into five Groups under U.S. Product Standard PS-1. Strongest species are in Group 1, the next strongest in Group 2, and so on. The Group number that appears in the trademark on some APA trademarked panels – primarily sanded grades – is based on the species used for face and back veneers. Where face and back veneers are not from the same species Group, the higher Group number is usually indicated. Some species are used widely in plywood manufacture; others rarely. Check local availability if a particular species is desired.

Span Ratings

APA RATED SHEATHING and STURD-I-FLOOR panels are identified by Span Ratings which denote the maximum recommended center-to-center spacing (in inches) of supports over which panels should be placed in construction applications.

The Span Rating in APA RATED SHEATHING trademarks appears as two numbers separated by a slash, such as 32/16, 48/24, etc. (See Table 2.) The left-hand number denotes the maximum recommended spacing of supports when the panel is used for roof sheathing *with the long dimension or strength axis of the panel across three or more supports.* The right-hand number indicates the maximum recommended spacing of supports when the panel is used for subflooring with the long dimension of the panel across three or more supports. A panel marked 32/16, for example, can be used for roof decking over supports 32 inches on center or for subflooring over supports 16 inches on center.

The Span Ratings in the trademarks on APA RATED STURD-I-FLOOR panels appear as a single number – 16, 20, 24, 32 or 48 oc, denoting maximum recommended spacing of floor supports. (See Table 2 for roof recommendations.) All-veneer APA RATED STURD-I-FLOOR 48 oc (2-4-1) qualifies for Heavy Timber roof construction. *Again, the Span Ratings are based on application of the panel with the long dimension or strength axis across three or more supports.*

Ordering and Specifying

To order APA Performance Rated Panels, designate thickness, APA trademark, grade, Span Rating, exposure durability classification, dimensions, number of pieces. For example:

15/32" APA RATED SHEATHING, 32/16, Exposure 1, 48" x 96", 100 pcs.

1-1/8" APA RATED STURD-I-FLOOR 48 oc, Exposure 1, 48" x 96", 100 pcs. (Note "square edge" or "tongue-and-groove" as desired.)

To specify APA trademarked panels for roofs, use this standard form:

Each panel shall be identified with the appropriate trademark of *APA – The Engineered Wood Association.* All

panels which have any edge or surface permanently exposed to weather shall be Exterior, except open soffits or roof sheathing exposed on the underside may be any panel classed Exposure 1 where appearance is not a major consideration.

Structural wood panel roof sheathing shall be (specify appropriate grade): APA RATED SHEATHING Exterior, APA RATED SHEATHING Exposure 1, APA RATED SHEATHING Exposure 2, APA STRUCTURAL I RATED SHEATHING Exterior, APA STRUCTURAL I RATED SHEATHING Exposure 1, APA RATED STURD-I-FLOOR Exposure 1, or other.

Panel thickness shall be as shown on the drawings. The center-to-center spacing (in inches) of supports over which the panels are applied shall not exceed the Span Rating stamped on the panels. Application shall be in accordance with the recommendations of *APA – The Engineered Wood Association*.

(1) Indicates structural use:
B – Simple span bending member.
C – Compression member.
T – Tension member.
CB – Continuous or cantilevered span bending member.

(2) Mill number.

(3) Identification of ANSI Standard A190.1, Structural Glued Laminated Timber.

(4) Applicable laminating specification.

(5) Applicable combination number.

(6) Species of lumber used.

(7) Designates appearance grade, INDUSTRIAL, ARCHITECTURAL, PREMIUM.

SELECTING AND SPECIFYING ENGINEERED WOOD PRODUCTS

Manufacturing and Performance Standards

The following specification and construction recommendations call for glued laminated timber (glulams) that bear the *APA EWS* trademark. This mark signifies that the beam is manufactured by a member of Engineered Wood Systems, a related corporation of APA. *APA EWS* trademarked beams are manufactured in conformance with ANSI Standard A190.1, American National Standards for Structural Glued Laminated Timber. Engineered Wood Systems is recognized by all major model building codes under National Evaluation Service Report NER-QA397. For more information and design tables, write for the *Engineered Wood Systems Data File,* Form EWS S475.

Ordering and Specifying

These specification guidelines apply to glulams used for bending members such as purlins, beams, or girders or for axially loaded members such as columns or truss chords.

General

Structural glued laminated timber shall be furnished as shown on the plans and in accordance with the following specifications.

Shop drawings and details shall be furnished and approved before fabrication is commenced.

The (manufacturer) (seller) (general contractor) shall furnish connection steel and hardware for joining structural glued laminated timber members to each other and to their supports, exclusive of anchorage embedded in masonry or concrete, setting plates, and items field-welded to structural steel. Steel connections shall be finished with one coat of rust-inhibiting paint.

Manufacture

Materials, Manufacture and Quality Assurance. Structural glued laminated timber shall be in conformance with ANSI Standard A190.1, *American National Standard for Structural Glued Laminated Timber,* or other code-approved design, manufacturing and/or quality assurance procedures.

End-Use Application. Structural glued laminated timber members shall be manufactured for the following structural uses as applicable:

Simple span bending member – B

Continuous or Cantilevered span bending member – CB

Compression member – C

Tension member – T

Design Values. Structural glued laminated timber shall have design values as shown in Table 2 for normal load duration and dry-use condition.(1)

Lamination combination number. An alternative to specifying the

TABLE 2

SPECIFIC REQUIRED DESIGN STRESSES FOR GLUED LAMINATED TIMBER

Application	Structural Use (Identification Symbol)	Design Stress	psi
Bending Member	Simple span member (B)	Bending, F_b	_____
	Continuous or cantilevered span member (CB)	Horizontal shear, F_v	_____
		Compression (perpendicular to grain), $F_{c\perp}$	
		Top lamination	_____
		Bottom lamination	_____
		Modulus of elasticity, E	_____
Axially Loaded Member	Tension member (T)	Tension parallel to grain, F_t	_____
		Modulus of elasticity, E	_____
	Compression member (C)	Compression (parallel to grain), F_c	_____
		Modulus of elasticity, E	_____

required design stresses is to specify a specific lamination combination symbol if known.(2)

Appearance Grade. Members shall be (industrial) (architectural) (premium) grade.(3)

Laminating Adhesives. Adhesives used in the manufacture of structural glued laminated timber shall meet requirements for (wet-use) (dry-use) service conditions.(1)

Camber (when applicable). Structural glued laminated timber (shall) (shall not) be manufactured with a built-in camber. Camber shall be specified as a radius in feet or a specific amount of camber may be specified in inches.

Preservative Treatment (when applicable). Members shall be pressure treated after manufacture in accordance with American Wood Preservers Association (AWPA) Standard C28 as required for (soil contact) (above ground) exposure.(4)

Fire Resistance (when applicable). Members shall be sized and manufactured for one-hour fire resistance.(5)

Protective Sealers and Finishes. Unless otherwise specified, sealer shall be applied to the ends of all members. Surfaces of members shall be (not sealed) (sealed with primer/sealer coating) (other).(6)

Trademarks. Members shall be marked with the *APA EWS* trademark indicating conformance with the manufacturing, quality assurance and marking provisions of ANSI Standard A190.1.

Certificates (when applicable). A Certificate of Conformance shall be provided by the (manufacturer) (seller) to indicate conformance with ANSI Standard A190.1.

Protection for Shipment. Members shall be (not wrapped) (load wrapped) (bundle wrapped) (individually wrapped) with a water-resistant covering for shipment.

Footnotes

(1) Dry service condition – moisture content of the member will be at or below 16% in service; wet service condition – moisture content of the member will be above 16% in service. When structural glued laminated timber members are to be preservative treated, wet-use adhesives must be specified.

(2) Laminating combination should be based on design requirements and section capacities or allowable loads published in Engineered Wood Systems' or manufacturer's brochures. National Evaluation Report 486 provides a tabulation of laminating combinations available from EWS member manufacturers.

(3) Appearance grades are described as follows.

INDUSTRIAL. Use where appearance is not of primary importance, or where members are not exposed visually.
Description: Natural lumber growth characteristics may be visible. Voids on edges of laminations are not required to be filled, except voids and knot-holes may be filled in some applications.

ARCHITECTURAL. Use where appearance is important.
Description: Natural lumber growth characteristics may be visible. Knotholes and voids larger than 3/4" are filled or repaired with wood inserts. Exposed surfaces are surfaced smooth and exposed edges (soffit face) are eased (chamfered).

PREMIUM. Use where highest-quality visual appearance is required.
Description: Natural lumber growth characteristics may be visible. All knotholes and voids are filled or repaired with wood inserts. Exposed surface of wide face lamination has limit on knot size and no loose knots. Exposed faces are surfaced smooth, and exposed edges (soffit face) are eased.

(4) When pentachlorophenol in light solvent or waterborne preservative treatments are specified for protection against decay or insect attack, individual laminations usually are treated prior to manufacturing structural glued laminated timber members. These treatments are not available from all manufacturers and the designer should verify availability prior to specification. Note: Waterborne preservatives are not recommended for glulams manufactured using western species.

Where paintable surfaces are required, specify pentachlorophenol in light solvent or a waterborne preservative. Wood treated with creosote, creosote/coal tar solution or pentachlorophenol in oil should not be used in contact with materials subject to staining.

(5) When structural glued laminated timber with one-hour fire resistance is specified, minimum size limitations and additional lamination requirements are applicable. Supporting steel connectors and fasteners also must be protected to achieve a one-hour fire rating. Cover connectors or fasteners with fire-rated (Type X) gypsum wallboard or sheathing, or 1-1/2" wood, to provide the needed protection.

(6) Specify a penetrating sealer when the finish will be natural or a semitransparent stain is to be used. Primer/sealer coatings have a higher solids content and provide greater moisture protection, and are suitable for use with opaque or solid-color finishes.

APA WOOD ROOF SYSTEMS

Built-in-Place Roofs

APA panel roof sheathing is equally effective under built-up roofing; special roof coatings; asphalt or fiberglass shingles; tile roofing; or wood shingles or shakes. It covers fast to speed construction.

And its dimensional stability during temperature fluctuations particularly suits it for built-up roofs.

The recommendations in Table 3 apply to APA RATED SHEATHING and APA RATED STURD-I-FLOOR. Uniform load deflection limits are 1/180 of span under live load plus dead load, and 1/240 under live load only. *Panels are assumed installed with the long dimension or strength axis across three or more supports.*

Special conditions, such as heavy concentrated loads, may require constructions in excess of these minimums, or allowable live loads may have to be decreased for tile roofs with dead loads greater than 10 psf.

Good performance of built-up, single-ply, or modified bitumen roofing applied on low slope roofs requires a stiffer deck than does prepared roofing applied on pitched roofs. Although APA Span Rated panels used as roof sheathing at maximum span are adequate structurally, an upgraded system is recommended for low slope roofs. Table 4 provides recommended maximum spans for low slope roof decks. Recommended live loads can be determined from Table 3, and minimum fastener requirements are given in Table 5.

It is recommended that panels be spaced 1/8 inch at end and edge joints. Nail size, type and spacing recommendations are given in Table 5.

Preframed or Panelized Roofs

Preframed roof panels can save time and labor in commercial structures, and also deliver diaphragm strength to resist lateral loads from high winds or earthquakes. Preframed panels are fabricated by using production line techniques to

TABLE 3

RECOMMENDED UNIFORM ROOF LIVE LOADS FOR APA RATED SHEATHING[a] AND APA RATED STURD-I-FLOOR WITH LONG DIMENSION PERPENDICULAR TO SUPPORTS[b]

Panel Span Rating	Minimum Panel Thickness (in.)	Maximum Span (in.)		Allowable Live Loads (psf)[c]							
				Spacing of Supports Center-to-Center (in.)							
		With Edge Support[d]	Without Edge Support	12	16	20	24	32	40	48	60
APA RATED SHEATHING[a]											
12/0	5/16	12	12	30							
16/0	5/16	16	16	70	30						
20/0	5/16	20	20	120	50	30					
24/0	3/8	24	20[e]	190	100	60	30				
24/16	7/16	24	24	190	100	65	40				
32/16	15/32, 1/2	32	28	325	180	120	70	30			
40/20	19/32, 5/8	40	32	—	305	205	130	60	30		
48/24	23/32, 3/4	48	36	—	—	280	175	95	45	35	
60/32[f]	7/8	60	48	—	—	—	305	165	100	70	35
APA RATED STURD-I-FLOOR[g]											
16 oc	19/32, 5/8	24	24	185	100	65	40				
20 oc	19/32, 5/8	32	32	270	150	100	60	30			
24 oc	23/32, 3/4	48	36	—	240	160	100	50	30	25	
32 oc	7/8	48	40	—	—	295	185	100	60	40	
48 oc	1-3/32, 1-1/8	60	48	—	—	—	290	160	100	65	40

(a) Includes APA RATED SHEATHING/CEILING DECK.

(b) Applies to panels 24 inches or wider applied over two or more spans.

(c) 10 psf dead load assumed.

(d) Tongue-and-groove edges, panel edge clips (one midway between each support, except two equally spaced between supports 48 inches on center or greater), lumber blocking, or other. For low slope roofs, see Table 4.

(e) 24 inches for 15/32-inch and 1/2-inch panels.

(f) Check with supplier for availability.

(g) Also applies to C-C Plugged grade plywood.

TABLE 4

RECOMMENDED MAXIMUM SPANS FOR APA PANEL ROOF DECKS FOR LOW SLOPE ROOFS[a](Long panel dimension perpendicular to supports and continuous over two or more spans)

Grade	Minimum Nominal Panel Thickness (in.)	Minimum Span Rating	Maximum Span (in.)	Panel Clips Per Span[b] (number)
APA RATED SHEATHING	15/32	32/16	24	1
	19/32	40/20	32	1
	23/32	48/24	48	2
	7/8	60/32	60	2
APA RATED STURD-I-FLOOR	19/32	20 oc	24	1
	23/32	24 oc	32	1
	7/8	32 oc	48	2

(a) Low slope roofs are applicable to built-up, single-ply and modified bitumen roofing systems. *For guaranteed or warranted roofs contact membrane manufacturer for acceptable deck.*

(b) Edge support may also be provided by tongue-and-groove edges or solid blocking.

TABLE 5

RECOMMENDED MINIMUM FASTENING SCHEDULE FOR APA PANEL ROOF SHEATHING (Increased nail schedules may be required in high wind zones.)

Panel Thickness[b] (in.)	Nailing[c][d]		
		Maximum Spacing (in.)	
	Size	Supported Panel Edges	Intermediate
5/16 - 1	8d	6	12[a]
1-1/8	8d or 10d	6	12[a]

(a) For spans 48 inches or greater, space nails 6 inches at all supports.

(b) For stapling asphalt shingles to 5/16-inch and thicker panels, use staples with a 15/16-inch minimum crown width and a 1-inch leg length. Space according to shingle manufacturer's recommendations.

(c) Use common smooth or deformed shank nails with panels to 1 inch thick. For 1-1/8-inch panels, use 8d ring- or screw-shank or 10d common smooth-shank nails.

(d) Other code-approved fasteners may be used.

fasten sections of APA panels to lumber stiffeners. Assembly can be done either at the site or in a shop. No elaborate fabrication equipment is needed. Connections are simply nailed.

Spans of 8 to 12 feet are usually the most practical with preframed panel construction, although spans to 30 feet are not uncommon. Unsanded 4x8-foot APA panels with stiffeners preframed at 16 or 24 inches on center (Figure 1) are common. The long dimension of the panel typically runs parallel to supports. Stiffeners and roof purlins provide support for all plywood edges.

In preframed panels 8x8 feet or larger (Figure 2), the long panel dimension may run either parallel or perpendicular to stiffeners spaced 16 or 24 inches on center. Placing the long dimension across supports may require edge support such as panel clips or cleats between stiffeners at midspan in accordance with Table 3.

Recommendations in Table 6 assume the long dimension of the panel parallel to supports. Deflection limits are 1/180 of the span for total load; 1/240 for live load only. See Table 7 for design information on preframed panel stiffeners.

Nailing requirements for preframed panels are the same as for roof sheathing.

TABLE 6

RECOMMENDED UNIFORM ROOF LOADS (PSF) FOR APA RATED SHEATHING WITH LONG DIMENSION PARALLEL TO SUPPORTS[a][b] (OSB, composite and 5-ply/5-layer plywood panels unless otherwise noted)

Panel Grade	Thickness (in.)	Span Rating	Max. Span (in.)	Load at Maximum Span	
				Live	Total
APA STRUCTURAL I RATED SHEATHING	7/16	24/0, 24/16	24[c]	20	30
	15/32	32/16	24	35[d]	45[d]
	1/2	32/16	24	40[d]	50[d]
	19/32, 5/8	40/20	24	70	80
	23/32, 3/4	48/24	24	90	100
APA RATED SHEATHING	7/16[e]	24/0, 24/16	16	40	50
	15/32[e]	32/16	24[c]	20	25
	1/2[e]	24/0, 32/16	24[c]	25	30
	19/32	40/20	24	40[f]	50[f]
	5/8	32/16, 40/20	24	45[f]	55[f]
	23/32, 3/4	40/20, 48/24	24	60[f]	65[f]

(a) *For guaranteed or warranted roofs, contact membrane manufacturer for acceptable deck.*

(b) Provide edge support.

(c) Solid blocking recommended at panel ends for 24-inch span.

(d) For 4-ply plywood marked PS 1, reduce load by 15 psf.

(e) Composite panels must be 19/32-inch or thicker.

(f) For composite and 4-ply plywood panels, reduce load by 15 psf.

TABLE 7

STIFFENER LOAD-SPAN TABLES FOR PREFRAMED APA PANEL ROOF DECKS

Douglas Fir-Larch		Allowable Roof Live Load (psf)[a]											
Center-to Center Purlin Spacing[b] (ft.)	Stiffener Size and Spacing (in.)	Select Structural			No. 1 & Btr			No. 1			No. 2		
			Strength[d]			Strength[d]			Strength[d]			Strength[d]	
		Defl.[c]	1.15	1.25	Defl.[c]	1.15	1.25	Defl.[c]	1.15	1.25	Defl.[c]	1.15	1.25
8	2x4@16	37	64	71	35	49	54	33	41	46	31	35	39
	2x4@24	23	39	44	21	29	33	19	24	27	18	20	22
	2x6@16	144	149	162	136	116	127	129	99	109	121	86	94
	2x6@24	96	96	105	91	74	81	86	63	69	81	54	59
	2x6@32	72	69	76	68	53	58	64	45	49	61	38	42

Southern Pine		Allowable Roof Live Load (psf)[a]											
Center-to Center Purlin Spacing[b] (ft.)	Stiffener Size and Spacing (in.)	Select Structural			No. 1 Dense			No. 1			No. 2		
			Strength[d]			Strength[d]			Strength[d]			Strength[d]	
		Defl.[c]	1.15	1.25	Defl.[c]	1.15	1.25	Defl.[c]	1.15	1.25	Defl.[c]	1.15	1.25
8	2x4@16	35	87	96	35	58	64	33	53	59	31	41	46
	2x4@24	21	55	60	21	35	39	19	32	36	18	24	27
	2x6@16	136	105	123	136	137	150	129	129	141	121	95	104
	2x6@24	91	33	46	91	88	97	86	83	91	81	60	66
	2x6@32	68	97	107	68	64	70	64	59	65	61	43	47

(a) Final allowable load is the lesser of the loads as determined by deflection and stress.

(b) Actual span of stiffeners taken as 3-1/2 inches less than center-to-center spacing of purlins.

(c) Deflection limitations: Span/240 under live load only; Span/180 under total load, assuming a dead load of 10 psf.

(d) Loads limited by stress are based on two conditions of duration of load: 2 months, such as for snow (1.15); and 7 days (1.25); includes effects of 10 psf dead load.

FIGURE 1

PREFRAMED ROOF PANEL
(4' x 8' — APA Structural Panels Parallel to Supports)

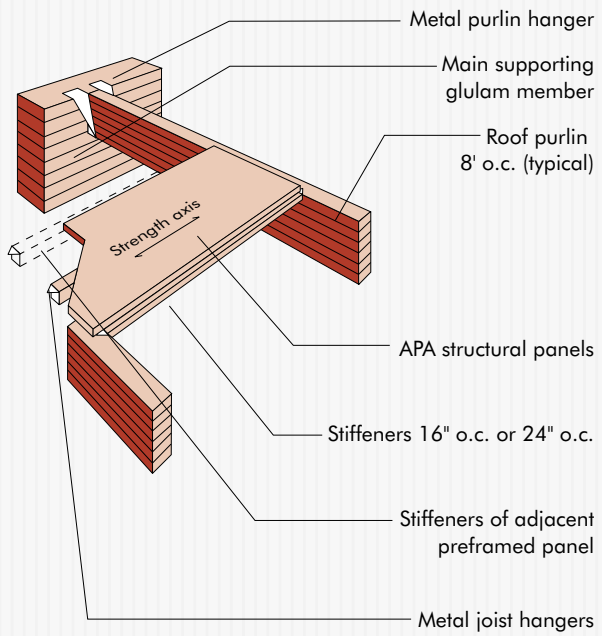
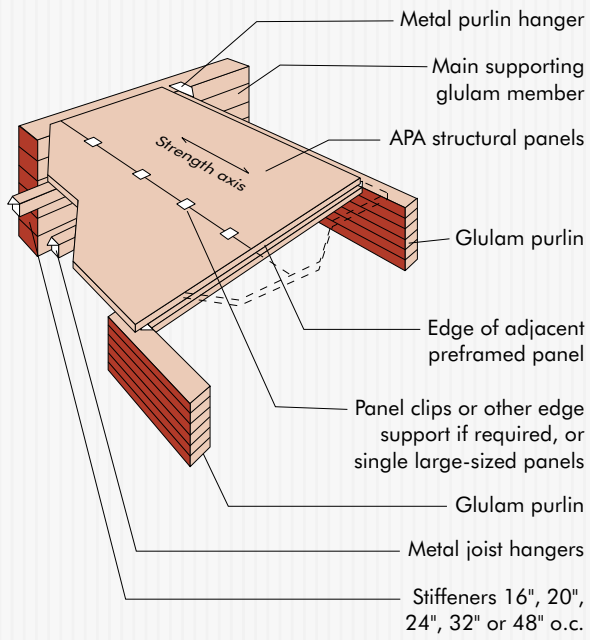


FIGURE 2

PREFRAMED ROOF PANEL
(8' x 8' or larger — APA Structural Panels Perpendicular to Supports)



Wood Roof Construction with Glulam Beams

Wood roof systems constructed with glued laminated beams (glulams), preframed structural panels, and lumber or I-joists are cost-effective and fast to erect. Glulam panelized roof systems also combine overall building aesthetics with improved technology for efficient, high-strength, environmentally friendly commercial roofs.

Panelized roof systems save time because components are included in prefabricated sections that can be installed quickly. The efficiency of the panelized system also reduces on-site labor.

In panelized wood roof systems, glulam beams and girders, both lumber and I-joists, form a grid pattern that provides versatile support for preframed panel sections. The following tables are based on typical wood roof construction systems described in this brochure, including panelized systems where 4x8-foot structural panels are nailed to 2x4-inch or 2x6-inch stiffeners. The stiffeners are commonly 24 inches on center. Preframed panels with pre-attached metal hangers are nailed to the in-place purlin system. Larger panel sections have the purlins attached.

Allowable Loads for Simple Span Glulam Roof Beams

Tables 8 through 11 show allowable loads and spans for both Douglas-fir and southern pine beams with F_b equal to 2400 psi used as simple span roof members in snow load areas and for non-snow construction loads. While other stress level and species combinations may be available in your area, the following tables are provided to allow preliminary member sizing of these two common combinations. Final design should include a complete analysis of locally available materials and include bearing stresses and lateral stability.

See page 25 for an example of preliminary design of a panelized roof using glulam beam load-span tables.

TABLE 8

ALLOWABLE LOADS FOR SIMPLE SPAN *DOUGLAS FIR* GLUED LAMINATED ROOF BEAMS (PLF) — SNOW LOADS

(Load Duration Factor = 1.15) F_b = 2,400 psi, E = 1,800,000 psi, F_v = 190 psi

3-1/8-INCH WIDTH	SPAN (ft)																					
Depth (in)	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
6	535	295	169	105	69	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
7-1/2	837	533	333	208	137	95	68	—	—	—	—	—	—	—	—	—	—	—	—	—	—
9	1206	769	532	362	240	167	120	88	66	51	—	—	—	—	—	—	—	—	—	—	—
10-1/2	1522	1049	726	531	385	268	193	143	108	84	65	52	—	—	—	—	—	—	—	—	—
12	1812	1357	949	695	530	402	291	216	164	127	100	80	64	52	—	—	—	—	—	—	—
13-1/2	2127	1576	1203	881	672	529	417	311	237	184	145	116	94	77	63	52	—	—	—	—	—
15	2472	1809	1426	1089	831	654	528	429	328	255	202	162	132	108	89	74	62	52	—	—	—
16-1/2	2849	2059	1611	1319	1007	793	640	527	439	342	272	219	178	146	121	101	85	72	61	52	—
18	3264	2327	1807	1476	1199	945	763	628	523	440	355	286	234	192	160	134	113	96	81	70	60
19-1/2	3723	2615	2014	1637	1378	1110	896	735	610	513	437	367	299	247	206	173	146	124	106	91	78
21	4233	2925	2233	1805	1514	1288	1039	848	703	592	504	434	377	311	260	218	185	158	135	116	100
22-1/2	4803	3260	2466	1981	1655	1420	1186	967	803	676	576	496	431	378	322	271	230	196	169	145	126
24	5444	3623	2713	2167	1803	1542	1341	1095	909	765	652	562	488	428	377	332	282	241	207	179	155
25-1/2	6171	4018	2976	2362	1956	1669	1455	1229	1021	860	733	632	549	481	425	377	336	291	251	217	189
27	7003	4449	3257	2567	2117	1800	1565	1372	1139	960	818	705	613	537	474	421	376	338	300	260	227

5-1/8-INCH WIDTH	SPAN (ft)																					
Depth (in)	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
12	2971	2225	1557	1140	869	660	477	355	270	209	164	131	105	85	69	57	—	—	—	—	—
13-1/2	3489	2584	1972	1445	1102	867	684	509	389	302	238	191	154	126	103	85	71	59	—	—	—
15	4053	2967	2339	1786	1363	1065	850	693	537	419	332	266	216	177	146	121	101	85	72	60	51
16-1/2	4672	3377	2643	2163	1643	1279	1021	832	689	562	446	358	292	240	199	166	139	118	100	85	72
18	5353	3817	2964	2421	1940	1510	1206	983	815	686	583	470	383	316	262	220	185	157	134	114	98
19-1/2	6105	4289	3303	2684	2259	1760	1406	1146	951	800	681	586	491	405	338	284	240	204	174	149	128
21	6942	4798	3663	2960	2482	2028	1620	1322	1097	923	786	677	587	511	426	358	303	259	221	191	165
22-1/2	7877	5347	4044	3249	2714	2314	1849	1509	1252	1054	898	773	672	588	518	445	377	322	277	239	207
24	8929	5942	4449	3554	2956	2530	2092	1707	1417	1193	1017	876	761	666	588	521	462	395	340	294	255
25-1/2	10121	6590	4881	3873	3209	2737	2349	1917	1592	1341	1143	984	856	750	661	587	524	470	412	356	310
27	11484	7296	5341	4210	3472	2953	2567	2139	1776	1496	1276	1099	956	837	739	656	585	525	473	427	372
28-1/2	13058	8070	5834	4565	3747	3176	2755	2372	1970	1660	1416	1220	1061	930	820	729	651	584	526	476	432
30	14893	8921	6362	4940	4035	3408	2949	2597	2174	1832	1562	1346	1171	1027	906	805	719	645	582	527	478
31-1/2	17063	9862	6928	5336	4336	3650	3149	2769	2387	2011	1716	1479	1287	1128	996	885	791	710	640	579	527
33	19668	10908	7539	5756	4651	3901	3357	2945	2609	2199	1876	1617	1407	1234	1090	968	865	777	701	635	577

See page 13 for notes.

6-3/4-INCH WIDTH	SPAN (ft)																					
Depth (in)	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	
18	5027	3903	3188	2485	1934	1544	1259	1044	878	747	618	504	416	345	289	244	207	176	150	129	110	
19-1/2	5649	4350	3535	2896	2254	1801	1468	1218	1024	872	750	647	534	445	373	316	268	229	197	169	146	
21	6319	4824	3899	3269	2598	2075	1692	1404	1182	1006	866	752	658	561	472	400	341	292	251	217	188	
22-1/2	7042	5326	4280	3575	2964	2368	1932	1603	1349	1150	990	859	752	663	586	497	424	364	314	272	236	
24	7827	5860	4680	3894	3332	2679	2186	1815	1528	1302	1121	974	853	752	667	595	520	447	387	336	292	
25-1/2	8679	6429	5101	4226	3605	3009	2456	2038	1717	1463	1260	1095	959	846	751	670	600	541	469	408	356	
27	9609	7035	5545	4573	3889	3356	2740	2275	1916	1633	1407	1223	1072	945	839	749	672	605	547	490	428	
28-1/2	10629	7684	6012	4935	4183	3628	3038	2523	2125	1812	1562	1358	1190	1050	932	832	747	673	609	553	503	
30	11750	8379	6506	5314	4489	3884	3352	2784	2345	2000	1724	1499	1314	1160	1030	920	825	744	673	612	557	
31-1/2	12989	9125	7028	5711	4807	4148	3647	3056	2576	2197	1894	1647	1444	1275	1132	1012	908	819	741	673	614	
33	14367	9930	7581	6126	5137	4421	3879	3341	2816	2402	2071	1802	1580	1395	1239	1107	994	897	812	738	673	
34-1/2	15907	10798	8167	6562	5482	4704	4118	3638	3066	2616	2256	1963	1721	1520	1351	1207	1084	978	886	805	734	
36	17639	11740	8790	7020	5840	4998	4366	3874	3327	2839	2448	2130	1869	1651	1467	1311	1178	1063	963	875	799	
37-1/2	19603	12763	9454	7502	6215	5302	4621	4093	3597	3070	2648	2304	2022	1786	1588	1419	1275	1151	1043	948	865	
39	21848	13880	10162	8009	6605	5617	4884	4319	3869	3310	2855	2485	2180	1926	1713	1531	1376	1242	1126	1024	934	

8-3/4-INCH WIDTH	SPAN (ft)																					
Depth (in)	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	
24	10146	7596	6067	5047	4234	3383	2760	2291	1928	1643	1415	1229	1076	948	841	750	672	580	501	435	379	
25-1/2	11251	8333	6613	5478	4673	3799	3100	2573	2167	1847	1590	1382	1210	1067	947	845	757	682	608	529	462	
27	12457	9120	7188	5928	5041	4238	3459	2872	2418	2062	1776	1543	1352	1193	1058	945	847	763	690	626	555	
28-1/2	13778	9960	7794	6397	5423	4700	3836	3185	2683	2288	1971	1713	1501	1325	1176	1050	942	848	767	697	634	
30	15231	10861	8433	6888	5819	5035	4232	3514	2961	2525	2176	1892	1658	1463	1299	1160	1041	938	849	771	702	
31-1/2	16838	11829	9110	7403	6231	5377	4646	3859	3251	2773	2390	2079	1822	1608	1429	1276	1145	1032	934	849	774	
33	18624	12872	9827	7941	6660	5731	5028	4218	3555	3032	2614	2274	1994	1760	1564	1397	1254	1131	1024	930	848	
34-1/2	20620	13998	10587	8507	7106	6098	5339	4593	3871	3303	2847	2477	2172	1918	1704	1523	1367	1233	1117	1015	926	
36	22866	15218	11395	9100	7571	6478	5659	4983	4200	3584	3090	2689	2358	2083	1851	1654	1486	1340	1214	1104	1007	
37-1/2	25412	16545	12255	9725	8056	6873	5990	5306	4542	3876	3342	2909	2551	2254	2003	1791	1608	1451	1315	1196	1091	
39	28322	17993	13173	10382	8562	7281	6331	5598	4896	4179	3604	3137	2752	2431	2161	1932	1736	1567	1420	1291	1178	
40-1/2	31680	19579	14154	11075	9091	7706	6684	5899	5263	4492	3875	3373	2959	2615	2325	2079	1868	1686	1528	1390	1269	
42	35599	21324	15206	11807	9644	8146	7048	6209	5546	4817	4155	3617	3174	2805	2494	2230	2004	1810	1640	1492	1363	
43-1/2	40231	23252	16335	12580	10223	8605	7425	6528	5822	5152	4444	3869	3396	3001	2669	2387	2146	1937	1756	1598	1459	
45	45789	25396	17552	13400	10829	9081	7816	6857	6105	5497	4743	4130	3625	3204	2850	2549	2291	2069	1876	1708	1559	

Notes:

(1) Span = simply supported beam.

(2) Tabulated values represent total loads and have taken the dead weight of the beam (assumed 35 pcf) into account.

(3) Maximum deflection = L/180 under total load. Other deflection limits may apply.

(4) Service condition = dry.

(5) Volume effect for western species is included.

(6) Maximum beam shear is located at a distance from the supports equal to the depth of the beam.

(7) Light areas limited by deflection; medium areas limited by bending strength; dark areas limited by shear strength.

TABLE 9

ALLOWABLE LOADS FOR SIMPLE SPAN *DOUGLAS FIR* GLUED LAMINATED ROOF BEAMS (PLF) — NON-SNOW LOADS

(Load Duration Factor = 1.25) F_b = 2,400 psi, E = 1,800,000 psi, F_v = 190 psi

3-1/8-INCH WIDTH	SPAN (ft)																				
Depth (in.)	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
6	581	295	169	105	69	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
7-1/2	910	580	333	208	137	95	68	—	—	—	—	—	—	—	—	—	—	—	—	—	—
9	1312	837	579	362	240	167	120	88	66	51	—	—	—	—	—	—	—	—	—	—	—
10-1/2	1655	1140	790	578	385	268	193	143	108	84	65	52	—	—	—	—	—	—	—	—	—
12	1970	1475	1033	756	577	402	291	216	164	127	100	80	64	52	—	—	—	—	—	—	—
13-1/2	2313	1714	1308	958	731	576	417	311	237	184	145	116	94	77	63	52	—	—	—	—	—
15	2687	1968	1551	1184	904	712	575	429	328	255	202	162	132	108	89	74	62	52	—	—	—
16-1/2	3098	2240	1753	1434	1095	863	696	573	439	342	272	219	178	146	121	101	85	72	61	52	—
18	3549	2531	1965	1606	1305	1028	830	684	570	447	355	286	234	192	160	134	113	96	81	70	60
19-1/2	4048	2844	2191	1780	1499	1208	975	801	664	559	454	367	299	247	206	173	146	124	106	91	78
21	4602	3181	2429	1963	1647	1402	1131	923	766	645	550	460	377	311	260	218	185	158	135	116	100
22-1/2	5222	3545	2682	2155	1801	1545	1290	1053	874	736	628	541	466	385	322	271	230	196	169	145	126
24	5919	3940	2951	2357	1961	1678	1459	1191	989	834	711	612	533	467	393	332	282	241	207	179	155
25-1/2	6710	4369	3237	2569	2128	1816	1583	1338	1111	936	799	688	599	525	463	400	340	291	251	217	189
27	7613	4837	3542	2792	2303	1959	1703	1493	1240	1045	891	768	668	586	517	460	407	348	300	260	227

5-1/8-INCH WIDTH	SPAN (ft)																				
Depth (in)	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
12	3231	2419	1693	1240	946	660	477	355	270	209	164	131	105	85	69	57	—	—	—	—	—
13-1/2	3794	2810	2145	1572	1199	944	684	509	389	302	238	191	154	126	103	85	71	59	—	—	—
15	4407	3227	2544	1942	1483	1160	926	703	537	419	332	266	216	177	146	121	101	85	72	60	51
16-1/2	5080	3673	2874	2352	1788	1392	1111	906	720	562	446	358	292	240	199	166	139	118	100	85	72
18	5820	4151	3223	2633	2111	1644	1313	1071	888	733	583	470	383	316	262	220	185	157	134	114	98
19-1/2	6638	4664	3592	2920	2458	1915	1530	1248	1036	872	743	601	491	405	338	284	240	204	174	149	128
21	7547	5217	3983	3220	2700	2207	1763	1439	1194	1005	857	738	618	511	426	358	303	259	221	191	165
22-1/2	8564	5814	4398	3534	2953	2518	2012	1642	1363	1148	979	843	732	632	528	445	377	322	277	239	207
24	9708	6462	4839	3865	3216	2752	2277	1858	1543	1300	1108	954	830	727	641	544	462	395	340	294	255
25-1/2	11004	7166	5308	4213	3490	2978	2556	2087	1733	1460	1245	1073	933	817	721	641	558	478	412	356	310
27	12486	7933	5809	4579	3777	3212	2793	2328	1934	1629	1390	1198	1042	913	806	716	639	572	493	427	372
28-1/2	14196	8775	6344	4965	4076	3455	2997	2582	2145	1807	1542	1329	1156	1014	895	795	710	638	575	506	441
30	16192	9700	6918	5372	4389	3708	3208	2827	2366	1994	1701	1467	1276	1119	988	878	785	705	636	576	519
31-1/2	18551	10723	7534	5803	4716	3970	3427	3013	2597	2189	1868	1611	1402	1230	1086	965	863	775	699	633	576
33	21381	11860	8198	6260	5059	4243	3652	3205	2839	2394	2043	1762	1533	1345	1188	1056	944	848	765	694	631

See page 15 for notes.

6-3/4-INCH WIDTH	SPAN (ft)																					
Depth (in)	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	
18	5467	4245	3468	2704	2105	1681	1371	1137	957	767	618	504	416	345	289	244	207	176	150	129	110	
19-1/2	6143	4732	3845	3151	2453	1960	1599	1326	1116	951	792	647	534	445	373	316	268	229	197	169	146	
21	6871	5246	4241	3557	2826	2259	1843	1529	1287	1097	944	813	672	561	472	400	341	292	251	217	188	
22-1/2	7658	5793	4655	3889	3225	2577	2103	1746	1470	1253	1079	937	821	696	586	497	424	364	314	272	236	
24	8511	6373	5091	4236	3625	2916	2380	1976	1664	1419	1222	1062	930	821	716	609	520	447	387	336	292	
25-1/2	9438	6991	5549	4597	3922	3274	2673	2219	1870	1594	1373	1194	1046	923	820	732	630	542	469	408	356	
27	10449	7651	6031	4974	4231	3652	2982	2476	2086	1779	1533	1333	1169	1031	916	818	734	649	562	490	428	
28-1/2	11557	8356	6539	5368	4551	3948	3307	2747	2314	1974	1702	1480	1297	1145	1017	909	816	735	666	581	509	
30	12776	9111	7076	5780	4883	4226	3647	3030	2554	2178	1878	1634	1433	1265	1124	1004	902	813	736	669	599	
31-1/2	14123	9923	7643	6212	5229	4513	3968	3327	2804	2392	2063	1795	1574	1390	1235	1104	991	894	810	736	672	
33	15621	10798	8244	6664	5589	4811	4221	3636	3065	2616	2256	1963	1722	1521	1352	1208	1085	979	887	807	736	
34-1/2	17295	11742	8882	7138	5963	5118	4481	3959	3338	2849	2457	2138	1876	1657	1473	1317	1183	1068	968	880	803	
36	19178	12766	9560	7636	6353	5437	4750	4216	3621	3091	2666	2321	2036	1799	1600	1430	1285	1160	1052	957	873	
37-1/2	21313	13879	10281	8160	6760	5768	5028	4454	3916	3342	2883	2510	2203	1947	1731	1548	1391	1256	1139	1036	946	
39	23754	15093	11051	8711	7185	6111	5314	4700	4211	3603	3109	2707	2375	2099	1867	1670	1501	1356	1229	1118	1021	

8-3/4-INCH WIDTH	SPAN (ft)																					
Depth (in)	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	
24	11032	8261	6599	5491	4606	3682	3005	2494	2101	1790	1542	1340	1174	1035	919	789	675	580	501	435	379	
25-1/2	12234	9063	7193	5959	5084	4134	3375	2802	2360	2012	1733	1507	1320	1165	1034	923	816	703	608	529	462	
27	13545	9918	7818	6448	5484	4612	3765	3126	2634	2246	1935	1683	1475	1301	1156	1032	926	834	729	635	555	
28-1/2	14981	10832	8477	6959	5899	5114	4175	3468	2922	2492	2148	1868	1637	1445	1284	1146	1029	927	839	753	660	
30	16561	11811	9172	7493	6330	5478	4605	3826	3224	2750	2370	2062	1808	1596	1418	1267	1137	1025	928	843	769	
31-1/2	18308	12864	9908	8052	6779	5850	5056	4200	3540	3020	2604	2265	1986	1754	1559	1393	1251	1128	1021	928	847	
33	20249	13997	10687	8638	7245	6236	5471	4591	3870	3302	2847	2478	2173	1919	1706	1524	1369	1235	1119	1017	928	
34-1/2	22419	15222	11514	9253	7730	6635	5809	4999	4214	3596	3101	2699	2368	2091	1859	1662	1493	1347	1220	1110	1013	
36	24861	16548	12392	9898	8236	7048	6158	5423	4572	3902	3365	2929	2570	2271	2019	1805	1621	1463	1326	1206	1101	
37-1/2	27629	17991	13328	10577	8763	7477	6517	5774	4944	4220	3640	3168	2780	2457	2184	1953	1755	1584	1436	1307	1193	
39	30792	19565	14325	11292	9314	7922	6889	6092	5329	4549	3924	3417	2998	2650	2356	2107	1894	1710	1550	1411	1288	
40-1/2	34443	21289	15392	12046	9889	8383	7272	6419	5728	4890	4219	3673	3224	2850	2535	2267	2038	1840	1668	1518	1387	
42	38702	23186	16536	12841	10490	8863	7669	6756	6036	5243	4524	3939	3458	3056	2719	2432	2187	1975	1791	1630	1489	
43-1/2	43737	25282	17764	13682	11120	9361	8079	7103	6336	5608	4839	4214	3699	3270	2909	2603	2340	2114	1917	1745	1594	
45	49779	27613	19087	14573	11779	9879	8503	7461	6644	5984	5164	4497	3948	3491	3106	2779	2499	2257	2048	1864	1703	

Notes:

(1) Span = simply supported beam.

(2) Tabulated values represent total loads and have taken the dead weight of the beam (assumed 35 pcf) into account.

(3) Maximum deflection = L/180 under total load. Other deflection limits may apply.

(4) Service condition = dry.

(5) Volume effect for western species is included.

(6) Maximum beam shear is located at a distance from the supports equal to the depth of the beam.

(7) Light areas limited by deflection; medium areas limited by bending strength; dark areas limited by shear strength.

TABLE 10

ALLOWABLE LOADS FOR SIMPLE SPAN *SOUTHERN PINE* GLULAM ROOF BEAMS (PLF) — SNOW LOADS

(Load Duration Factor = 1.15) F_b = 2,400 psi, E = 1,800,000 psi, F_v = 200 psi

3-INCH WIDTH	SPAN (ft)																				
Depth (in)	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
6-7/8	674	428	246	153	101	69	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
8-1/4	972	620	427	267	177	122	87	64	–	–	–	–	–	–	–	–	–	–	–	–	–
9-5/8	1324	845	585	426	283	197	141	104	79	60	–	–	–	–	–	–	–	–	–	–	–
11	1633	1105	765	560	425	296	214	158	120	93	73	57	–	–	–	–	–	–	–	–	–
12-3/8	1908	1400	969	710	541	424	307	228	174	134	106	84	68	55	–	–	–	–	–	–	–
13-3/4	2206	1631	1198	877	669	527	423	315	240	187	148	118	95	78	64	53	–	–	–	–	–
15-1/8	2528	1849	1450	1062	811	638	515	422	322	251	199	160	129	106	88	73	61	51	–	–	–
16-1/2	2879	2081	1629	1266	966	761	614	505	421	328	260	209	170	140	116	97	81	68	58	–	–
17-7/8	3262	2329	1810	1479	1135	894	721	594	497	420	333	269	219	180	150	125	106	89	76	65	55
19-1/4	3682	2593	2000	1627	1317	1038	838	690	575	486	416	338	276	228	189	159	134	114	97	83	72
20-5/8	4143	2876	2201	1781	1495	1192	963	791	659	557	476	412	342	282	235	198	167	142	122	105	90
22	4654	3179	2412	1942	1625	1358	1095	898	749	633	541	468	408	345	288	242	205	175	150	129	112
23-3/8	5222	3505	2636	2111	1759	1507	1234	1012	844	713	610	528	460	404	347	293	249	212	182	157	136
24-3/4	5858	3857	2873	2287	1899	1623	1381	1132	944	799	683	591	515	453	401	350	297	254	219	189	164
26-1/8	6573	4238	3124	2472	2044	1742	1517	1259	1050	888	760	657	574	504	446	397	352	301	259	225	195

5-INCH WIDTH	SPAN (ft)																				
Depth (in)	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
12-3/8	3180	2333	1615	1183	902	707	511	380	289	224	176	141	113	92	75	61	50	–	–	–	–
13-3/4	3676	2718	1996	1462	1115	878	705	525	401	311	246	197	159	130	107	88	73	61	51	–	–
15-1/8	4214	3082	2417	1771	1351	1061	851	697	537	419	331	266	216	177	146	121	101	85	71	60	51
16-1/2	4798	3469	2715	2109	1608	1259	1010	827	689	547	434	349	284	233	193	161	135	114	97	82	70
17-7/8	5437	3882	3016	2465	1882	1473	1183	969	807	681	556	448	365	301	250	209	176	149	127	108	92
19-1/4	6136	4322	3333	2711	2176	1704	1368	1121	934	789	675	563	460	379	316	265	224	190	162	139	119
20-5/8	6906	4793	3668	2968	2491	1951	1567	1284	1070	905	773	668	569	470	392	330	279	237	203	175	151
22	7757	5299	4021	3237	2708	2215	1779	1458	1216	1028	879	759	662	575	480	404	342	292	250	216	186
23-3/8	8704	5842	4393	3518	2932	2494	2004	1643	1370	1158	991	856	747	656	579	488	414	354	304	262	227
24-3/4	9763	6429	4788	3812	3165	2704	2242	1839	1533	1297	1109	959	836	735	650	579	495	424	365	315	274
26-1/8	10955	7063	5207	4120	3407	2903	2493	2045	1705	1442	1234	1067	931	818	724	645	577	502	432	374	326
27-1/2	12307	7750	5651	4444	3659	3108	2701	2262	1887	1596	1366	1181	1031	906	802	714	640	576	508	440	384
28-7/8	13854	8499	6124	4783	3921	3321	2879	2489	2077	1757	1504	1301	1135	998	884	787	705	635	574	514	448
30-1/4	15641	9317	6628	5140	4195	3542	3063	2697	2275	1925	1649	1426	1245	1095	970	864	774	697	630	572	518
31-5/8	17728	10214	7167	5516	4480	3770	3253	2859	2483	2101	1800	1557	1359	1196	1059	944	846	761	689	625	570

See page 17 for notes.

6-3/4-INCH WIDTH	SPAN (ft)																					
Depth (in)	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50
17-7/8	5240	4072	3299	2502	1959	1572	1288	1073	906	750	604	493	406	337	282	238	201	171	146	125	107
19-1/4	5835	4500	3660	2893	2266	1819	1491	1242	1049	897	760	621	512	426	358	302	256	219	187	161	139
20-5/8	6471	4951	4007	3312	2594	2084	1708	1423	1202	1028	888	768	635	529	445	376	320	274	236	203	176
22	7153	5428	4370	3655	2945	2365	1939	1616	1366	1168	1009	880	772	648	545	462	394	338	291	252	218
23-3/8	7887	5931	4749	3958	3317	2665	2185	1821	1540	1317	1138	992	872	771	659	559	478	410	354	307	267
24-3/4	8679	6464	5146	4273	3651	2981	2445	2038	1724	1475	1275	1112	977	864	769	669	572	492	426	370	322
26-1/8	9534	7029	5562	4600	3919	3315	2719	2267	1918	1641	1419	1238	1088	963	857	767	678	584	505	440	384
27-1/2	10463	7629	5999	4940	4196	3646	3007	2508	2122	1816	1570	1370	1205	1066	949	850	765	686	595	518	453
28-7/8	11473	8267	6457	5294	4484	3887	3310	2761	2336	2000	1729	1509	1327	1175	1047	937	843	762	692	604	529
30-1/4	12578	8948	6939	5663	4781	4135	3626	3025	2560	2192	1896	1655	1455	1289	1148	1029	926	837	760	692	613
31-5/8	13789	9675	7446	6048	5089	4391	3860	3302	2794	2393	2070	1807	1589	1408	1254	1124	1012	915	831	757	692
33	15124	10454	7981	6450	5409	4655	4084	3590	3038	2602	2251	1965	1729	1532	1365	1224	1102	996	905	825	754
34-3/8	16603	11289	8545	6870	5741	4928	4315	3837	3292	2820	2440	2131	1875	1661	1481	1327	1195	1081	982	895	819
35-3/4	18250	12188	9142	7309	6085	5210	4553	4041	3556	3046	2636	2302	2026	1795	1601	1435	1293	1170	1062	969	886
37-1/8	20094	13159	9774	7769	6443	5501	4797	4252	3816	3281	2840	2480	2183	1935	1725	1547	1394	1261	1146	1045	956

8-1/2-INCH WIDTH	SPAN (ft)																				
Depth (in)	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50
24-3/4	10929	8140	6481	5380	4597	3710	3043	2537	2145	1835	1586	1383	1215	1075	957	842	720	620	536	465	406
26-1/8	12006	8851	7004	5792	4935	4126	3384	2822	2386	2042	1766	1540	1353	1198	1066	954	854	735	637	554	483
27-1/2	13175	9607	7554	6220	5284	4563	3743	3122	2640	2260	1954	1705	1499	1327	1181	1058	951	859	749	652	570
28-7/8	14448	10411	8131	6666	5646	4895	4119	3436	2907	2488	2152	1878	1651	1462	1302	1166	1049	948	860	761	666
30-1/4	15839	11268	8738	7131	6021	5207	4513	3765	3186	2728	2359	2059	1811	1604	1429	1280	1152	1041	945	861	772
31-5/8	17364	12183	9377	7616	6409	5530	4860	4109	3477	2978	2576	2248	1978	1752	1561	1398	1259	1138	1033	941	860
33	19045	13164	10050	8122	6811	5862	5143	4468	3781	3238	2802	2446	2152	1906	1699	1522	1371	1240	1126	1026	938
34-3/8	20907	14216	10761	8651	7229	6206	5434	4831	4097	3509	3037	2651	2333	2067	1842	1651	1487	1345	1222	1114	1018
35-3/4	22981	15348	11512	9204	7663	6561	5733	5089	4426	3791	3281	2865	2521	2234	1992	1785	1608	1455	1322	1205	1102
37-1/8	25304	16570	12308	9783	8113	6927	6041	5354	4766	4084	3535	3087	2717	2408	2147	1925	1734	1569	1426	1300	1189
38-1/2	27925	17893	13152	10390	8582	7306	6358	5626	5043	4387	3797	3316	2919	2587	2307	2069	1864	1687	1533	1398	1279
39-7/8	30904	19328	14049	11027	9070	7699	6685	5905	5286	4700	4069	3554	3129	2774	2474	2218	1999	1810	1645	1500	1373
41-1/4	34320	20893	15004	11696	9578	8105	7021	6191	5535	5002	4350	3800	3346	2966	2646	2373	2139	1936	1760	1606	1470
42-5/8	38278	22604	16022	12399	10107	8525	7368	6486	5790	5227	4640	4054	3569	3165	2823	2532	2283	2067	1879	1714	1569
44	42917	24484	17111	13140	10659	8961	7727	6788	6051	5456	4939	4316	3800	3370	3006	2697	2431	2202	2002	1827	1673

Notes:

(1) Span = simply supported beam.

(2) Tabulated values represent total loads and have taken the dead weight of the beam (assumed 36 pcf) into account.

(3) Maximum deflection = L/180 under total load. Other deflection limits may apply.

(4) Service condition = dry.

(5) Volume effect for southern pine is included.

(6) Maximum beam shear is located at a distance from the supports equal to the depth of the beam.

(7) Light areas limited by deflection; medium areas limited by bending strength; dark areas limited by shear strength.

(8) Glulam beams are also available in stock sizes of 3-1/2" and 5-1/2" widths. These widths are intended for use in concealed applications and availability should be checked with the distributor and/or manufacturer prior to specification.

TABLE 11

ALLOWABLE LOADS FOR SIMPLE SPAN *SOUTHERN PINE* GLULAM ROOF BEAMS (PLF) — NON-SNOW LOADS

(Load Duration Factor = 1.25) F_b = 2,400 psi, E = 1,800,000 psi, F_v = 200 psi

3-INCH WIDTH	SPAN (ft)																				
Depth (in)	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
6-7/8	733	428	246	153	101	69	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
8-1/4	1057	674	427	267	177	122	87	64	–	–	–	–	–	–	–	–	–	–	–	–	–
9-5/8	1440	919	636	426	283	197	141	104	79	60	–	–	–	–	–	–	–	–	–	–	–
11	1776	1202	832	609	425	296	214	158	120	93	73	57	–	–	–	–	–	–	–	–	–
12-3/8	2075	1522	1054	772	589	424	307	228	174	134	106	84	68	55	–	–	–	–	–	–	–
13-3/4	2398	1773	1303	954	728	573	423	315	240	187	148	118	95	78	64	53	–	–	–	–	–
15-1/8	2749	2011	1577	1156	882	695	561	422	322	251	199	160	129	106	88	73	61	51	–	–	–
16-1/2	3130	2263	1771	1377	1051	828	668	550	421	328	260	209	170	140	116	97	81	68	58	–	–
17-7/8	3547	2533	1968	1609	1235	973	785	647	537	420	333	269	219	180	150	125	106	89	76	65	55
19-1/4	4003	2820	2175	1769	1433	1129	912	751	627	527	419	338	276	228	189	159	134	114	97	83	72
20-5/8	4505	3127	2393	1937	1626	1297	1048	861	718	607	517	418	342	282	235	198	167	142	122	105	90
22	5060	3457	2624	2113	1767	1477	1192	978	815	689	590	509	417	345	288	242	205	175	150	129	112
23-3/8	5678	3812	2867	2296	1914	1640	1343	1101	919	777	665	575	502	416	347	293	249	212	182	157	136
24-3/4	6369	4194	3124	2488	2066	1765	1502	1232	1028	870	744	644	562	494	415	350	297	254	219	189	164
26-1/8	7146	4608	3397	2689	2224	1895	1650	1370	1143	967	828	716	625	550	487	414	352	301	259	225	195

5-INCH WIDTH	SPAN (ft)																				
Depth (in)	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
12-3/8	3458	2537	1757	1287	982	707	511	380	289	224	176	141	113	92	75	61	50	–	–	–	–
13-3/4	3997	2956	2171	1590	1214	955	705	525	401	311	246	197	159	130	107	88	73	61	51	–	–
15-1/8	4582	3352	2629	1926	1470	1155	927	703	537	419	331	266	216	177	146	121	101	85	71	60	51
16-1/2	5217	3772	2952	2294	1750	1370	1100	901	701	547	434	349	284	233	193	161	135	114	97	82	70
17-7/8	5911	4221	3280	2681	2047	1603	1288	1055	879	700	556	448	365	301	250	209	176	149	127	108	92
19-1/4	6672	4700	3625	2949	2367	1854	1489	1221	1017	860	698	563	460	379	316	265	224	190	162	139	119
20-5/8	7508	5212	3989	3229	2710	2123	1706	1398	1166	985	843	696	569	470	392	330	279	237	203	175	151
22	8434	5762	4373	3521	2945	2410	1936	1588	1324	1119	958	828	695	575	480	404	342	292	250	216	186
23-3/8	9463	6353	4778	3826	3189	2714	2181	1789	1492	1261	1080	933	814	693	579	488	414	354	304	262	227
24-3/4	10614	6990	5207	4146	3443	2942	2440	2001	1669	1412	1209	1045	912	802	691	583	495	424	365	315	274
26-1/8	11910	7680	5662	4481	3706	3158	2713	2225	1857	1571	1345	1163	1015	892	790	689	586	502	432	374	326
27-1/2	13380	8427	6145	4833	3980	3382	2939	2461	2054	1738	1488	1287	1123	988	875	780	688	589	508	440	384
28-7/8	15062	9241	6660	5202	4266	3613	3133	2709	2260	1913	1638	1417	1237	1088	964	859	770	686	592	514	448
30-1/4	17004	10130	7208	5590	4563	3853	3333	2935	2477	2096	1795	1554	1356	1193	1057	942	845	761	684	594	518
31-5/8	19273	11106	7793	5999	4873	4101	3539	3111	2703	2288	1960	1696	1481	1303	1155	1029	923	831	752	683	596

See page 19 for notes.

6-3/4-INCH WIDTH	SPAN (ft)																					
Depth (in)	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50
17-7/8	5698	4428	3589	2722	2132	1712	1403	1169	945	750	604	493	406	337	282	238	201	171	146	125	107
19-1/4	6345	4894	3981	3148	2466	1980	1623	1353	1143	942	760	621	512	426	358	302	256	219	187	161	139
20-5/8	7037	5385	4359	3603	2823	2268	1859	1550	1310	1120	940	768	635	529	445	376	320	274	236	203	176
22	7779	5903	4753	3976	3204	2574	2111	1760	1488	1273	1100	938	776	648	545	462	394	338	291	252	218
23-3/8	8577	6450	5166	4306	3608	2900	2378	1983	1677	1435	1241	1082	935	782	659	559	478	410	354	307	267
24-3/4	9437	7030	5597	4648	3972	3244	2661	2219	1877	1607	1389	1212	1065	933	787	669	572	492	426	370	322
26-1/8	10367	7644	6050	5003	4264	3607	2959	2468	2088	1788	1546	1349	1186	1050	931	792	678	584	505	440	384
27-1/2	11377	8296	6524	5373	4565	3967	3273	2730	2310	1978	1711	1493	1313	1163	1036	928	796	686	595	518	453
28-7/8	12475	8990	7023	5759	4878	4229	3602	3005	2543	2178	1884	1645	1447	1281	1142	1023	921	799	693	604	529
30-1/4	13676	9730	7547	6160	5201	4499	3946	3293	2787	2387	2065	1803	1586	1405	1253	1122	1011	914	802	700	613
31-5/8	14993	10521	8098	6579	5537	4778	4200	3593	3041	2605	2255	1969	1732	1535	1368	1226	1105	999	908	805	706
33	16444	11367	8680	7016	5884	5065	4444	3907	3307	2833	2452	2141	1884	1670	1489	1335	1202	1088	988	901	807
34-3/8	18052	12276	9293	7472	6245	5362	4696	4175	3583	3070	2657	2321	2043	1811	1615	1448	1304	1180	1073	978	895
35-3/4	19842	13253	9942	7950	6620	5668	4954	4398	3870	3316	2871	2508	2208	1957	1745	1565	1410	1277	1160	1058	968
37-1/8	21847	14308	10629	8450	7009	5985	5220	4627	4153	3572	3093	2702	2378	2109	1881	1687	1520	1376	1251	1141	1045

8-1/2-INCH WIDTH	SPAN (ft)																				
Depth (in)	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50
24-3/4	11884	8852	7049	5853	5001	4038	3312	2762	2336	1999	1729	1508	1326	1173	991	842	720	620	536	465	406
26-1/8	13055	9626	7618	6300	5369	4489	3683	3072	2599	2225	1924	1679	1476	1307	1164	997	854	735	637	554	483
27-1/2	14326	10447	8216	6766	5749	4965	4073	3398	2875	2462	2129	1858	1634	1447	1289	1155	1002	864	749	652	570
28-7/8	15710	11321	8843	7251	6142	5325	4483	3740	3165	2710	2345	2047	1800	1594	1421	1273	1146	1006	873	761	666
30-1/4	17221	12253	9503	7757	6550	5666	4911	4098	3468	2970	2570	2244	1974	1749	1558	1396	1257	1137	1010	881	772
31-5/8	18880	13249	10198	8284	6972	6016	5289	4472	3785	3242	2806	2450	2156	1910	1702	1526	1374	1243	1129	1013	889
33	20708	14314	10930	8835	7410	6378	5597	4862	4116	3526	3052	2665	2345	2078	1853	1661	1496	1354	1230	1121	1016
34-3/8	22732	15459	11703	9410	7864	6752	5913	5258	4460	3821	3307	2888	2542	2253	2009	1801	1623	1469	1334	1217	1113
35-3/4	24986	16690	12520	10011	8336	7138	6238	5538	4817	4127	3573	3121	2747	2435	2172	1947	1755	1588	1443	1316	1205
37-1/8	27511	18018	13385	10641	8826	7536	6573	5826	5188	4445	3849	3362	2960	2624	2340	2099	1892	1712	1556	1420	1299
38-1/2	30360	19456	14303	11301	9335	7949	6918	6122	5488	4775	4134	3612	3180	2820	2515	2256	2033	1841	1674	1527	1398
39-7/8	33598	21016	15278	11993	9866	8375	7273	6425	5753	5116	4430	3871	3408	3022	2696	2419	2180	1974	1795	1638	1500
41-1/4	37312	22717	16316	12721	10418	8817	7640	6737	6023	5445	4736	4138	3644	3232	2883	2587	2332	2112	1921	1753	1605
42-5/8	41614	24578	17423	13486	10994	9275	8017	7057	6301	5689	5051	4414	3888	3448	3077	2760	2489	2254	2050	1871	1714
44	46657	26621	18607	14291	11594	9749	8407	7387	6585	5939	5377	4699	4139	3671	3276	2940	2651	2401	2184	1994	1826

Notes:

(1) Span = simply supported beam.

(2) Tabulated values represent total loads and have taken the dead weight of the beam (assumed 36 pcf) into account.

(3) Maximum deflection = L/180 under total load. Other deflection limits may apply.

(4) Service condition = dry.

(5) Volume effect for southern pine is included.

(6) Maximum beam shear is located at a distance from the supports equal to the depth of the beam.

(7) Light areas limited by deflection; medium areas limited by bending strength; dark areas limited by shear strength.

(8) Glulam beams are also available in stock sizes of 3-1/2" and 5-1/2" widths. These widths are intended for use in concealed applications and availability should be checked with the distributor and/or manufacturer prior to specification.

Allowable Loads for Cantilevered Glulam Roof Beams

Tables 12 through 15 are for preliminary design of cantilevered beams. The tables are based on balanced (fully loaded) as well as unbalanced loading. They do ***not*** include deflection criteria and limitations. Final designs should include deflection requirements per the applicable building code, in addition to bending and shear strength assessments.

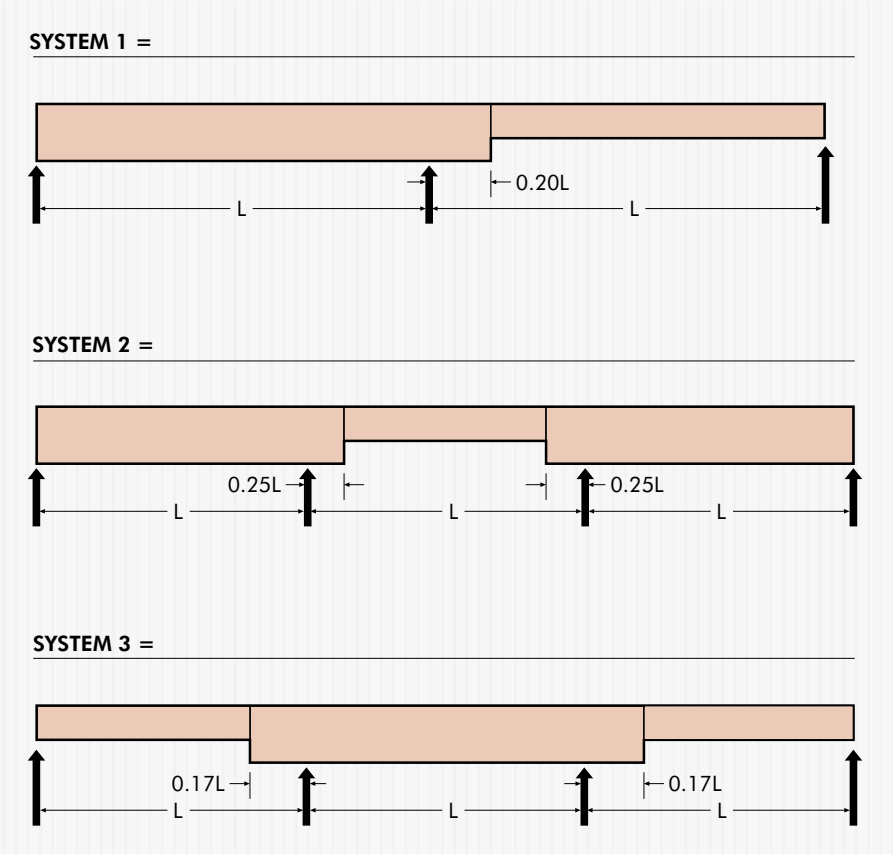
A minimum roof slope of 1/4-inch per foot in addition to camber requirements is recommended to help avoid ponding of water on the roof.

The cantilever beam tables presented here are for three different systems.

System 1 is a two-equal-span cantilever system with the cantilevered beam projecting past the center support by approximately 0.20 x the span, or 0.20L. Its overall length is therefore 1.2L, and the suspended beam's length is 0.8L.

System 2 is a three-equal-span cantilever system, with each of the two outer cantilevered beams projecting past the center support into the middle span by about 0.25L. Their length is therefore 1.25L, and the interior suspended beam's length is 0.5L.

System 3 is also a three-equal-span cantilever system, but the two outer span beams are suspended from the interior, double cantilevered beam, which projects past its two supports by approximately 0.17L. Its length is 1.34L, and the suspended beams are about 0.83L each.



The following are additional notes which apply to Tables 12 through 15:

1. Span = spacing of column supports for cantilevered beams.

2. Tabulated values represent total loads and have taken the dead weight of the beam (assumed 35 pcf for Douglas-fir and 36 pcf for southern pine) into account.

3. Load duration factor = as noted.

4. Deflection is not evaluated.

5. Service condition = dry.

6. Uniform load = total load including beam weight. Live load is assumed to be 0.6 x total load for purposes of checking strength under full unbalanced live load.

7. Volume effect is included.

8. Light areas limited by bending strength; dark areas limited by shear strength.

9. Southern pine glulam beams are also available in stock sizes of 3-1/2" and 5-1/2" widths. These widths are intended for use in concealed applications and availability should be checked with the distributor and/or manufacturer prior to specification.

TABLE 12

ALLOWABLE LOADS FOR CANTILEVERED *DOUGLAS FIR* GLUED LAMINATED ROOF BEAMS (PLF) — SNOW LOADS

(Load Duration Factor = 1.15) F_b = 2,400 psi, F_v = 190 psi

5-1/8-INCH WIDTH	SPAN (ft)																	
Depth (in.)	44			48			52			56			60			64		
	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3
24	453	447	536	372	368	441	310	306	368	261	258	311	222	219	265	190	187	228
25-1/2	510	504	603	419	414	497	350	345	415	295	291	351	251	247	299	215	212	257
27	570	563	674	469	464	556	392	387	464	330	326	393	281	278	335	241	238	288
28-1/2	634	626	748	522	516	617	436	430	516	368	363	437	313	309	373	269	266	321
30	700	692	827	577	570	682	482	476	571	407	402	483	347	343	413	298	295	356
31-1/2	770	761	874	635	627	750	531	524	628	448	443	532	383	378	455	329	325	392
33	843	833	916	695	687	822	581	574	688	492	486	583	420	415	499	361	357	430
34-1/2	919	908	958	758	749	874	634	627	750	537	530	636	459	453	545	395	390	470
36	973	984	999	824	814	912	690	681	815	584	577	691	499	493	592	430	425	511

6-3/4-INCH WIDTH	SPAN (ft)																	
Depth (in.)	44			48			52			56			60			64		
	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3
24	579	572	685	476	470	564	396	391	471	333	329	397	283	279	338	242	239	290
25-1/2	652	644	771	536	530	635	447	441	531	376	372	448	320	316	382	274	271	328
27	729	721	862	600	593	711	500	494	594	422	417	502	359	354	428	308	304	368
28-1/2	811	801	958	667	659	790	557	550	660	470	464	558	400	395	477	344	339	410
30	896	885	1058	738	729	873	616	609	730	520	514	618	444	438	528	381	376	455
31-1/2	985	973	1152	812	802	960	678	670	804	573	566	680	489	483	582	420	415	501
33	1079	1066	1206	889	879	1051	743	734	880	628	621	745	536	530	638	462	456	550
34-1/2	1176	1162	1261	970	958	1146	811	801	960	686	678	814	586	579	696	505	498	601
36	1277	1262	1316	1054	1042	1202	882	871	1043	746	737	884	638	630	757	549	542	654
37-1/2	1335	1350	1371	1141	1128	1252	955	944	1130	809	799	958	691	683	820	596	589	709
39	1389	1404	1426	1232	1217	1302	1032	1019	1197	874	863	1034	747	738	886	644	636	766
40-1/2	1442	1458	1481	1316	1310	1352	1110	1097	1243	941	929	1114	805	795	954	695	686	825
42	1495	1512	1535	1365	1380	1402	1192	1178	1289	1010	998	1192	865	854	1025	747	737	886
43-1/2	1549	1566	1590	1414	1429	1452	1277	1261	1335	1082	1069	1234	927	916	1098	800	790	950
45	1602	1620	1645	1463	1479	1502	1344	1348	1381	1157	1143	1277	991	979	1173	856	845	1015
46-1/2	1656	1674	1700	1511	1528	1552	1389	1405	1427	1233	1219	1319	1057	1044	1226	913	902	1083
48	1709	1728	1755	1560	1577	1602	1434	1450	1473	1312	1297	1362	1125	1111	1266	972	960	1152

8-3/4-INCH WIDTH	SPAN (ft)																	
Depth (in.)	44			48			52			56			60			64		
	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3
36	1611	1592	1706	1329	1314	1558	1112	1098	1316	941	929	1115	803	793	954	692	683	824
37-1/2	1731	1724	1777	1440	1422	1622	1205	1190	1425	1019	1007	1208	871	860	1034	751	741	893
39	1800	1820	1848	1554	1536	1687	1301	1285	1538	1101	1088	1304	942	930	1117	812	802	965
40-1/2	1869	1890	1919	1673	1653	1752	1400	1384	1611	1186	1172	1404	1015	1002	1203	875	864	1040
42	1938	1960	1990	1769	1774	1817	1504	1486	1670	1274	1259	1508	1090	1077	1292	941	929	1117
43-1/2	2008	2030	2062	1833	1853	1882	1610	1591	1730	1365	1348	1600	1168	1154	1384	1008	996	1197
45	2077	2100	2133	1896	1917	1947	1720	1700	1790	1459	1441	1655	1249	1234	1479	1079	1065	1280
46-1/2	2146	2170	2204	1959	1981	2012	1801	1812	1849	1555	1537	1710	1332	1316	1578	1151	1137	1365
48	2215	2240	2275	2022	2045	2077	1859	1879	1909	1655	1635	1765	1418	1401	1641	1225	1210	1453
49-1/2	2285	2310	2346	2085	2108	2142	1917	1938	1969	1758	1737	1821	1506	1488	1692	1302	1286	1543
51	2354	2380	2417	2149	2172	2206	1975	1997	2028	1826	1841	1876	1597	1578	1743	1381	1364	1628
52-1/2	2423	2450	2488	2212	2236	2271	2033	2056	2088	1880	1901	1931	1691	1670	1795	1462	1444	1676
54	2492	2520	2559	2275	2300	2336	2091	2114	2148	1934	1955	1986	1786	1765	1846	1546	1527	1723
55-1/2	2561	2590	2630	2338	2364	2401	2149	2173	2207	1987	2009	2041	1847	1862	1897	1631	1611	1771
57	2631	2660	2701	2401	2428	2466	2207	2232	2267	2041	2064	2096	1897	1918	1949	1719	1698	1819
58-1/2	2700	2730	2772	2465	2492	2531	2265	2291	2327	2095	2118	2152	1947	1969	2000	1809	1787	1867
60	2769	2800	2843	2528	2556	2596	2324	2349	2386	2148	2172	2207	1997	2019	2051	1864	1878	1915

See page 20 for notes and description of cantilever systems.

TABLE 13

ALLOWABLE LOADS FOR CANTILEVERED *DOUGLAS FIR* GLUED LAMINATED ROOF BEAMS (PLF) — NON-SNOW LOADS

(Load Duration Factor = 1.25) F_b = 2,400 psi, F_v = 190 psi

5-1/8-INCH WIDTH	SPAN (ft)																	
Depth (in.)	44			48			52			56			60			64		
	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3
24	495	489	585	407	402	482	340	335	403	286	283	341	244	241	291	209	206	250
25-1/2	557	550	658	459	453	543	383	378	454	323	319	384	275	272	328	236	233	282
27	623	615	735	513	507	607	428	423	508	362	357	430	309	305	367	265	262	316
28-1/2	692	684	816	570	563	674	477	471	564	403	398	478	344	339	409	296	292	352
30	764	755	902	630	623	745	527	521	624	446	440	529	381	376	452	328	324	390
31-1/2	840	830	954	693	685	819	580	573	686	491	485	582	419	414	498	361	357	430
33	920	909	999	759	750	897	635	628	751	538	531	637	460	454	546	396	391	471
34-1/2	1003	991	1045	828	818	954	693	685	819	587	580	695	502	496	596	433	428	515
36	1062	1073	1090	899	889	995	753	744	890	638	631	755	546	540	648	471	465	560

6-3/4-INCH WIDTH	SPAN (ft)																	
Depth (in.)	44			48			52			56			60			64		
	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3
24	633	625	748	521	514	617	434	429	515	366	361	435	311	307	371	267	263	319
25-1/2	713	704	842	587	579	694	489	483	580	413	408	491	351	347	419	302	298	360
27	797	787	941	656	648	776	548	541	649	462	457	549	394	389	469	339	334	404
28-1/2	885	875	1045	729	721	863	609	602	722	515	508	611	439	434	522	378	373	450
30	978	966	1154	806	797	953	674	666	798	570	563	676	486	480	578	418	413	499
31-1/2	1075	1063	1256	887	877	1048	742	733	878	628	620	744	536	529	637	461	456	549
33	1177	1163	1316	971	960	1147	813	803	961	688	679	815	588	580	698	506	500	602
34-1/2	1283	1268	1376	1059	1047	1251	887	876	1048	751	742	889	642	634	762	553	546	658
36	1393	1377	1436	1151	1137	1311	964	952	1139	816	806	966	698	690	828	602	595	716
37-1/2	1457	1473	1496	1246	1231	1366	1044	1031	1233	884	874	1047	757	748	897	653	645	776
39	1515	1531	1555	1345	1329	1420	1127	1113	1306	955	944	1130	818	808	969	706	697	838
40-1/2	1573	1590	1615	1436	1430	1475	1213	1198	1356	1028	1016	1216	881	870	1043	761	751	903
42	1631	1649	1675	1490	1506	1530	1302	1286	1407	1104	1091	1301	946	935	1120	817	807	969
43-1/2	1690	1708	1735	1543	1560	1584	1394	1377	1457	1183	1169	1348	1014	1001	1200	876	865	1039
45	1748	1767	1795	1596	1614	1639	1468	1471	1507	1264	1249	1394	1083	1070	1282	937	925	1110
46-1/2	1806	1826	1854	1649	1667	1694	1517	1533	1557	1347	1331	1441	1155	1141	1340	999	987	1184
48	1864	1885	1914	1703	1721	1748	1565	1583	1608	1433	1416	1487	1229	1215	1383	1064	1051	1259

8-3/4-INCH WIDTH	SPAN (ft)																	
Depth (in.)	44			48			52			56			60			64		
	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3
36	1758	1737	1861	1452	1434	1700	1215	1201	1437	1029	1017	1219	880	869	1044	759	749	902
37-1/2	1888	1880	1939	1572	1553	1770	1316	1300	1556	1115	1102	1320	954	942	1131	823	813	978
39	1964	1985	2016	1696	1676	1841	1421	1404	1679	1204	1190	1425	1031	1018	1222	890	879	1056
40-1/2	2039	2062	2094	1825	1804	1912	1530	1511	1758	1297	1281	1534	1110	1097	1315	959	947	1138
42	2115	2138	2171	1931	1936	1983	1642	1623	1823	1393	1376	1647	1193	1178	1412	1030	1018	1222
43-1/2	2190	2214	2249	2000	2022	2054	1758	1737	1889	1492	1474	1747	1278	1262	1513	1104	1091	1309
45	2266	2291	2326	2069	2092	2125	1878	1856	1954	1594	1575	1807	1366	1349	1616	1181	1166	1399
46-1/2	2341	2367	2404	2138	2162	2195	1966	1978	2019	1699	1679	1868	1457	1439	1723	1259	1244	1492
48	2417	2443	2481	2207	2231	2266	2029	2052	2084	1808	1786	1928	1550	1531	1793	1341	1324	1588
49-1/2	2492	2520	2559	2276	2301	2337	2093	2116	2149	1920	1897	1988	1646	1627	1849	1424	1407	1687
51	2568	2596	2637	2345	2371	2408	2156	2180	2214	1994	2010	2048	1746	1725	1905	1511	1492	1779
52-1/2	2643	2672	2714	2414	2440	2479	2220	2244	2279	2053	2076	2109	1847	1825	1961	1599	1580	1831
54	2719	2749	2792	2483	2510	2549	2283	2308	2344	2112	2135	2169	1952	1928	2017	1690	1669	1883
55-1/2	2794	2825	2869	2552	2580	2620	2346	2372	2410	2170	2194	2229	2018	2034	2073	1783	1762	1936
57	2870	2902	2947	2621	2650	2691	2410	2436	2475	2229	2254	2289	2072	2095	2129	1879	1856	1988
58-1/2	2946	2978	3024	2690	2719	2762	2473	2501	2540	2288	2313	2350	2127	2151	2185	1977	1953	2040
60	3021	3054	3102	2759	2789	2833	2537	2565	2605	2346	2372	2410	2181	2206	2241	2037	2052	2093

See page 20 for notes and description of cantilever systems.

TABLE 14

ALLOWABLE LOADS FOR CANTILEVERED *SOUTHERN PINE* GLULAM ROOF BEAMS (PLF) — SNOW LOADS

(Load Duration Factor = 1.15) F_b = 2,400 psi, F_v = 200 psi

5-INCH WIDTH	SPAN (ft)																	
Depth (in.)	44			48			52			56			60			64		
	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3
24-3/4	505	499	594	417	412	492	349	345	413	296	292	350	253	250	300	218	215	259
26-1/8	563	556	662	465	460	548	390	385	461	330	326	391	283	279	335	243	240	290
27-1/2	623	616	733	516	510	608	433	428	511	367	362	434	314	310	372	271	267	322
28-7/8	687	679	808	569	562	670	478	472	563	405	400	479	347	343	411	300	296	356
30-1/4	754	746	863	625	618	736	525	518	619	445	440	526	382	377	452	330	326	391
31-5/8	824	815	902	683	675	804	574	567	676	487	482	575	418	413	494	361	357	428
33	897	887	942	744	735	860	625	618	737	531	525	627	456	450	539	394	389	467
34-3/8	955	962	981	807	798	896	679	671	799	577	570	681	495	489	585	429	423	507
35-3/4	994	1004	1020	873	863	931	734	726	856	625	617	736	536	530	633	464	459	549

6-3/4-INCH WIDTH	SPAN (ft)																	
Depth (in.)	44			48			52			56			60			64		
	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3
24-3/4	671	663	790	554	548	654	464	458	548	393	388	465	335	331	398	289	285	344
26-1/8	747	739	880	618	611	729	518	512	612	439	433	519	375	370	445	323	319	384
27-1/2	828	819	975	685	677	808	575	568	678	487	481	576	417	412	494	359	355	427
28-7/8	913	903	1074	756	747	891	634	627	749	538	532	636	461	455	546	398	393	472
30-1/4	1002	991	1165	830	821	978	697	689	822	592	584	699	507	501	600	438	432	519
31-5/8	1096	1083	1218	908	897	1068	762	753	899	647	640	764	555	548	657	480	474	569
33	1193	1179	1271	989	977	1161	831	821	979	706	697	833	605	598	716	523	517	620
34-3/8	1290	1279	1324	1073	1060	1209	902	891	1062	766	757	904	658	650	777	569	562	674
35-3/4	1341	1356	1377	1160	1147	1257	976	964	1149	830	820	978	712	704	841	617	609	730
37-1/8	1393	1408	1430	1251	1237	1306	1053	1040	1200	895	885	1055	769	760	908	666	658	788
38-1/2	1444	1460	1483	1319	1330	1354	1132	1119	1245	963	952	1135	828	818	977	717	709	848
39-7/8	1496	1512	1536	1366	1381	1402	1215	1200	1289	1034	1022	1192	889	878	1048	770	761	910
41-1/4	1548	1565	1589	1413	1428	1451	1299	1285	1334	1107	1094	1234	952	940	1122	825	815	975
42-5/8	1599	1617	1642	1460	1476	1499	1342	1357	1378	1182	1168	1275	1017	1005	1185	882	871	1041
44	1651	1669	1695	1507	1524	1548	1385	1401	1423	1260	1245	1316	1084	1071	1223	940	929	1110
45-3/8	1702	1721	1748	1554	1571	1596	1429	1445	1467	1321	1325	1357	1153	1140	1261	1001	989	1178
46-3/4	1754	1773	1801	1601	1619	1644	1472	1488	1512	1361	1376	1398	1225	1210	1300	1063	1051	1213

8-1/2-INCH WIDTH	SPAN (ft)																	
Depth (in.)	44			48			52			56			60			64		
	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3
37-1/8	1754	1773	1801	1557	1539	1644	1309	1294	1512	1114	1100	1313	956	945	1129	828	818	980
38-1/2	1819	1839	1868	1660	1655	1705	1408	1392	1568	1198	1184	1412	1030	1017	1215	892	881	1054
39-7/8	1884	1905	1934	1720	1739	1766	1511	1493	1624	1286	1271	1502	1105	1092	1304	958	946	1132
41-1/4	1949	1970	2001	1779	1799	1827	1617	1598	1680	1377	1361	1553	1184	1170	1396	1026	1014	1212
42-5/8	2014	2036	2068	1838	1859	1888	1690	1707	1736	1471	1453	1605	1265	1250	1491	1097	1084	1295
44	2079	2102	2134	1898	1919	1949	1745	1764	1792	1567	1549	1657	1348	1332	1540	1170	1156	1381
45-3/8	2144	2167	2201	1957	1979	2010	1799	1819	1848	1664	1648	1709	1435	1418	1588	1245	1230	1469
46-3/4	2209	2233	2268	2016	2039	2071	1854	1874	1904	1714	1733	1761	1523	1506	1637	1322	1307	1528
48-1/8	2274	2299	2335	2076	2099	2131	1908	1929	1960	1764	1784	1812	1615	1596	1685	1402	1385	1573
49-1/2	2339	2364	2401	2135	2158	2192	1963	1984	2016	1815	1835	1864	1687	1689	1733	1484	1467	1618
50-7/8	2404	2430	2468	2194	2218	2253	2017	2039	2072	1865	1886	1916	1734	1753	1781	1568	1550	1663
52-1/4	2468	2496	2535	2254	2278	2314	2072	2095	2128	1916	1937	1968	1781	1801	1829	1655	1636	1708
53-4/8	2533	2561	2601	2313	2338	2375	2126	2150	2184	1966	1988	2019	1827	1848	1877	1706	1723	1753
55	2598	2627	2668	2372	2398	2436	2181	2205	2240	2017	2039	2071	1874	1895	1925	1750	1770	1798
56-3/8	2663	2693	2735	2431	2458	2497	2235	2260	2296	2067	2090	2123	1921	1943	1974	1794	1814	1843
57-3/4	2728	2758	2801	2491	2518	2558	2290	2315	2352	2117	2141	2175	1968	1990	2022	1837	1858	1888
59-1/8	2793	2824	2868	2550	2578	2619	2344	2370	2408	2168	2192	2227	2015	2037	2070	1881	1902	1933

See page 20 for notes and description of cantilever systems.

TABLE 15

ALLOWABLE LOADS FOR CANTILEVERED *SOUTHERN PINE* GLULAM ROOF BEAMS (PLF) — NON-SNOW LOADS

(Load Duration Factor = 1.25) F_b = 2,400 psi, F_v = 200 psi

5-INCH WIDTH	SPAN (ft)																	
Depth (in.)	44			48			52			56			60			64		
	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3
24-3/4	551	545	649	456	451	538	382	378	451	324	320	383	277	274	329	239	236	284
26-1/8	614	607	722	509	503	599	427	422	503	362	358	428	310	306	367	267	264	318
27-1/2	681	673	800	564	557	664	473	468	558	402	397	475	344	340	407	297	294	353
28-7/8	750	742	882	622	615	732	522	516	616	444	438	524	380	376	450	329	325	390
30-1/4	823	814	942	683	675	803	574	567	676	487	482	575	418	413	494	362	357	428
31-5/8	899	889	984	746	737	877	627	620	739	533	527	629	458	452	541	396	391	469
33	979	968	1027	812	803	938	683	675	804	581	574	685	499	493	589	432	427	511
34-3/8	1042	1050	1070	881	871	977	741	733	872	631	623	743	542	536	640	470	464	555
35-3/4	1084	1096	1113	953	942	1016	802	793	935	683	675	804	587	580	692	509	502	601

6-3/4-INCH WIDTH	SPAN (ft)																	
Depth (in.)	44			48			52			56			60			64		
	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3
24-3/4	733	724	862	606	599	714	508	502	600	431	425	509	368	364	437	317	313	377
26-1/8	816	807	960	676	668	796	567	560	669	481	475	568	411	406	488	355	351	422
27-1/2	904	894	1063	749	740	882	629	621	742	534	527	630	457	452	541	395	390	468
28-7/8	997	986	1172	826	817	972	694	686	818	589	582	696	505	499	598	436	431	517
30-1/4	1094	1081	1271	907	896	1067	762	753	898	647	640	764	555	549	657	480	474	569
31-5/8	1195	1182	1329	991	980	1166	833	824	981	708	700	836	608	601	718	526	520	623
33	1301	1286	1387	1079	1067	1266	908	897	1069	772	763	910	663	655	783	574	567	679
34-3/8	1407	1395	1444	1171	1158	1319	985	974	1159	838	828	988	720	711	850	624	616	737
35-3/4	1463	1479	1502	1267	1252	1372	1066	1053	1254	907	896	1069	779	770	920	675	667	798
37-1/8	1519	1536	1560	1366	1350	1425	1149	1136	1310	979	967	1153	841	831	992	729	721	862
38-1/2	1576	1593	1618	1439	1451	1477	1236	1222	1359	1053	1040	1240	905	895	1067	785	776	927
39-7/8	1632	1650	1675	1490	1507	1530	1326	1311	1407	1130	1116	1302	972	960	1145	843	833	995
41-1/4	1688	1707	1733	1542	1559	1583	1418	1403	1456	1209	1195	1347	1041	1028	1226	903	892	1065
42-5/8	1744	1764	1791	1593	1611	1636	1465	1481	1504	1291	1276	1392	1112	1098	1294	965	953	1138
44	1801	1820	1849	1645	1663	1689	1512	1529	1553	1376	1360	1437	1185	1171	1336	1029	1017	1213
45-3/8	1857	1877	1907	1696	1715	1741	1560	1577	1601	1443	1446	1482	1260	1246	1378	1095	1082	1287
46-3/4	1913	1934	1964	1747	1767	1794	1607	1625	1650	1486	1503	1527	1338	1322	1420	1163	1149	1326

8-1/2-INCH WIDTH	SPAN (ft)																	
Depth (in.)	44			48			52			56			60			64		
	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3	sys 1	sys 2	sys 3
37-1/8	1913	1934	1964	1699	1679	1794	1430	1413	1650	1217	1203	1434	1046	1034	1234	907	896	1072
38-1/2	1984	2006	2037	1812	1806	1861	1538	1520	1711	1310	1294	1542	1126	1113	1328	976	965	1153
39-7/8	2055	2078	2110	1877	1897	1927	1650	1631	1772	1405	1389	1640	1209	1194	1425	1048	1036	1238
41-1/4	2126	2149	2183	1941	1963	1993	1765	1745	1833	1504	1487	1696	1294	1279	1525	1123	1110	1325
42-5/8	2197	2221	2255	2006	2028	2060	1845	1863	1894	1606	1588	1753	1383	1366	1629	1200	1186	1416
44	2268	2292	2328	2071	2094	2126	1904	1925	1956	1712	1692	1809	1474	1456	1682	1280	1264	1509
45-3/8	2338	2364	2401	2136	2159	2193	1964	1986	2017	1817	1799	1866	1568	1549	1735	1362	1345	1605
46-3/4	2409	2436	2474	2200	2224	2259	2023	2046	2078	1872	1893	1922	1665	1645	1788	1446	1429	1670
48-1/8	2480	2507	2546	2265	2290	2326	2083	2106	2139	1927	1948	1979	1764	1744	1840	1533	1515	1719
49-1/2	2551	2579	2619	2330	2355	2392	2142	2166	2200	1982	2004	2035	1843	1845	1893	1622	1603	1768
50-7/8	2622	2651	2692	2394	2421	2459	2202	2226	2261	2037	2059	2092	1894	1915	1945	1714	1694	1817
52-1/4	2693	2722	2765	2459	2486	2525	2261	2286	2322	2092	2115	2148	1945	1967	1998	1809	1787	1866
53-5/8	2764	2794	2837	2524	2552	2591	2321	2347	2383	2147	2171	2205	1996	2019	2050	1864	1883	1915
55	2835	2866	2910	2589	2617	2658	2380	2407	2444	2202	2226	2262	2047	2070	2103	1912	1934	1964
56-3/8	2905	2937	2983	2653	2682	2724	2440	2467	2506	2257	2282	2318	2099	2122	2156	1960	1982	2013
57-3/4	2976	3009	3056	2718	2748	2791	2499	2527	2567	2312	2338	2375	2150	2174	2208	2008	2030	2062
59-1/8	3047	3080	3128	2783	2813	2857	2559	2587	2628	2367	2393	2431	2201	2226	2261	2056	2079	2112

See page 20 for notes and description of cantilever systems.

Panelized Roof Design Example

A warehouse/office building is to be 180 ft x 85 ft. It has a "flat" roof with a minimum slope of 1/4:12. The design live load is the minimum required by the building code, with a load duration factor (LDF) of 1.25. It is desired to minimize the number of interior columns.

Three 60-ft bays equal 180 ft, and two 42.5-ft bays equal 85 ft, requiring two interior columns.

Main Beam Design – Option 1 Try System 3 (double cantilever) in Douglas-fir with three 60-ft bays. The tributary area for each cantilever beam's main span is 60 x 42.5 = 2550 square feet. The suspended beam's tributary area is 0.83 x 60 x 42.5 = 2117 square feet. Per Table 16-C (Method 1) of the 1994 Uniform Building Code, the minimum design live load is 12 psf for tributary areas greater than 600 square feet per beam. Therefore, the design live load for these beams is 12 x 42.5 = 510 plf.

The dead load is calculated by the designer at 8 psf. Therefore, the dead load carried by the beam is 8 x 42.5 = 340 plf, plus the weight of the beam. Total load, excluding beam weight, is 510 + 340 = 850 plf.

Assume availability of Douglas-fir beams of F_b = 2400 psi and E = 1,800,000 psi. From Table 13, a double cantilever beam (System 3) with 60-ft span, 6-3/4 inches wide and 37.5 inches deep can carry 897 plf in addition to its own weight. 850 < 897 plf allowable _ _ _ _ ok.

From Table 8, a simple span Douglas-fir beam 50 ft (0.83 x 60) long, 6-3/4 inches wide and 36 inches deep can carry 873 plf in addition to its own weight. 850 < 873 plf allowable _ _ _ _ ok.

Option 2 System 2 (single cantilever with suspended center beam) in southern pine with three 60-ft bays.

Loads are the same as for Option 1, since all members carry more than 600 square feet of tributary area.

From Table 15, a single cantilever southern pine beam (System 2) with a 60-ft main span, 6-3/4 inches wide and 40.5 inches deep can carry 870 plf in addition to its own weight. 850 < 870 plf allowable _ _ _ _ ok.

From Table 10, a simple span southern pine beam 30 ft (2 x .25 x 60) long, 5 inches wide and 23-3/8 inches deep can carry 933 plf in addition to its own weight. 850 < 933 allowable _ _ _ _ ok.

Note: A 6-3/4 x 20-5/8-inch beam can carry 940 plf, and it is also ok, but its area of 139 $in.^2$ is greater than the area of the 5 x 23-3/8 beam (117 $in.^2$), suggesting it may be less economical.

The two options can then be compared by volume, which may indicate the most economical option.

Secondary Beam Design Secondary beams, all perpendicular to the main beams and all simple spans, could be spaced at 8 ft on center to receive a panelized deck. Or, they could be at some greater spacing, say 20 ft on center, with purlins between these members at 8 ft. on center.

For purposes of example these secondary beams will be designed for Douglas-fir.

The secondary beams will have a simple span of approximately 42 ft.

At 8 ft. on center, the tributary area is 42 x 8 = 336 square feet. Per Method 1 of 1994 U.B.C. Table 16-C, the design live load is 16 psf. Total load, excluding beam weight, is 8 (16 + 8) = 192 plf. From Table 9, a simple span beam 42 ft long, 3-1/8 inches wide and 22.5 inches deep can carry 196 plf in addition to its own weight. 192 < 196 plf allowable _ _ _ _ ok.

At 20 ft on center, the tributary area is 42 x 20 = 840 square feet. Again, per U.B.C. Table 16-C, the design live load is 12 psf. Total load, excluding beam weight, is 20 (12 + 8) = 400 plf. From Table 9, a simple span beam 42 ft long, 5-1/8 inches wide and 25.5 inches deep can carry 478 plf in addition to its own weight. 400 < 478 plf allowable _ _ _ _ ok.

VOLUME FOR OPTION 1

$$\frac{6.75 \times 37.5}{144}(1 + 2 \times 0.17)\,60 + 2\left(\frac{6.75 \times 36}{144}\right)(0.83 \times 60) = 309.4 \text{ cu. ft}$$

VOLUME FOR OPTION 2:

$$2\left(\frac{6.75 \times 40.5}{144}\right)(1 + 0.25)\,60 + \left(\frac{5 \times 23.375}{144}\right)(2 \times 0.25 \times 60) = 309.1 \text{ cu. ft}$$

Option 2 may be slightly more economical than Option 1.

Purlins spanning 20 ft at 8 ft on center carry a tributary area of 20 x 8 = 160 square feet. Table 16-C of the 1994 U.B.C. requires a design live load of 20 psf. Total load, excluding beam weight is 8 (20 + 8) = 224 plf. From Table 9, a simple span beam 20 ft long, 3-1/8 inches wide and 12 inches deep can carry 291 plf in addition to its own weight. 224 < 291 plf allowable _ _ _ _ ok.

Other types of framing members, such as solid-sawn lumber, splitter beams, or I-joists, can also be used as purlins in this application.

A comparison of wood volume required by the above schemes as was done for the main beam design will provide guidance as to their relative economies. Hardware (hanger) requirements, as well as any labor differences, need to be considered in order to obtain complete economic comparison of the systems.

Stiffener Design From Table 7, a minimum of No. 1 and better Douglas-fir 2x4s at 24 inches on center can carry the 20 psf design live load plus the 8 psf dead load. Another option is the use of 2x6s of other species at 24 inches on center.

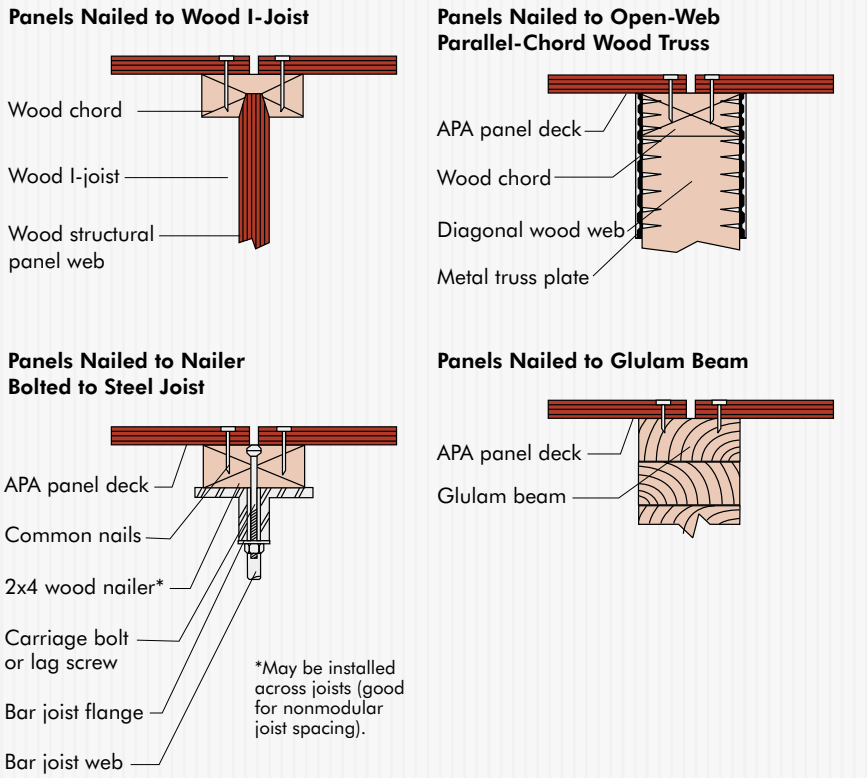
Deck Design There are a number of options available for the deck. For warehouse/office buildings, a preframed system having the panel oriented with long dimension parallel to framing as shown in Table 6 is widely used. In this system, all panel edges are supported by framing; therefore, footnote (d) is satisfied.

Although APA Structural I Rated Sheathing 7/16-inch thick, or 15/32-inch-thick 4-ply Structural I plywood can carry the vertical design load adequately, roofing material requirements for low slope roofs usually dictate a stiffer deck for their satisfactory performance. Therefore, a 15/32-inch-thick OSB, or 5-ply/5-layer plywood panel Span Rated at 32/16 is a good choice. Note footnote (e), however.

APA Rated Sheathing 19/32-inch thick, with a Span Rating of 40/20, of OSB, composite, or 5-ply/5-layer plywood is approximately comparable to the 15/32-inch-thick Structural I cited above.

FIGURE 3

TYPICAL CONNECTIONS TO ENGINEERED FLAT ROOF MEMBERS



Long Span Systems

APA panel long span roof systems perform superbly with either metal or wood framing. Both preframed panel systems and direct application of sheathing to secondary or primary framing are common approaches in long span roof construction. Bay spacing and type of framing govern the choice.

Experience shows that panels over supports 48 inches on center often yield maximum economy. Panels with a Span Rating of 48/24 are good for 35 psf snow load and meet the requirements for most guaranteed or warranted roofs.

Engineered flat roof systems with wood chords and webs of dimensional lumber, steel tubing or structural panels (wood I-joists) are widely available and provide highly compatible supports for APA panel decks. They offer the advantages of light weight and easy installation of deck, ceiling, soffit, fascia and mechanical runs to nailable chords. Absent are the warping, cupping, splitting, checking, shrinking and twisting problems often associated with solid-sawn lumber supports. Figure 3 illustrates typical connections to engineered flat roof members.

Glued Structural Components

Glued structural components offer the commercial building planner broad design freedom. And their advantages during and after construction – high strength-to-weight ratio, efficient use of materials, uniformity of size and quality resulting from production-line manufacture, and fast close-in time – make glued structural components an important option in modern commercial construction.

Structural Insulated Panels

Structural insulated panels are hybrid construction products that can be used in place of traditional sheathing in floor, wall and roof applications. The panels are composed of a foam core infused between face and back wood structural panels, which may be oriented strand board or plywood. Because of this layered composition, the panels are sometimes referred to as "sandwich panels."

The foam core gives the panels high values, while the structural panel face and back provide strength and shear capabilities. The superior strength of insulated panels makes long spans possible and contributes to construction of a more rigid building.

Structural insulated panels are typically manufactured in 8-foot widths, with lengths ranging from 14 to 24 feet. The panels can be cut to size or custom-manufactured to meet specific size requirements. The oversize panels are well suited for commercial roof construction because large areas can be covered quickly.

The speed of installation, combined with the energy-saving benefits, often make structural insulated panels cost competitive when the overall costs of a building are considered.

The insulative values of the foam core makes structural insulated panel construction highly energy efficient, without sacrificing interior wall space for added blanket-type insulation. Because the panels act as one solid unit, the insulation properties of the foam are not interrupted by studs, sills, or headers.

The most common types of foams used in structural insulated panels are expanded polystyrene (EPS), extruded polystyrene (XEPS), Urethane, and Polyisocyanurate. Expanded polystyrene is most common. These foams have good structural integrity and maintain their shapes indefinitely. They are formaldehyde-free and made from inert, organic materials. The foams also have a closed cell structure that prevents the transfer and build-up of excessive moisture.

Plywood Under Special Roof Coatings

New chemical coatings for roofs have increased the range of design possibilities, particularly in larger commercial structures with contoured or steeply pitched roof surfaces exposed to view.

The plywood thickness and span recommendations in Table 16 for plywood under special coatings assume installation with the **long dimension of the panel perpendicular to supports** and liquid coatings applied directly to the plywood. Check local building codes for any required deviation from these recommendations. Allowable roof live load is based on the same deflection criteria as described in Table 3 for APA panel roof sheathing.

Exterior plywood is recommended for use under special roof coatings. Where the coating requires a very smooth base, use APA A-C Exterior or APA B-C Exterior plywood. Where maximum smoothness is not essential, use APA C-C PLUGGED Exterior. Tongue-and-groove plywood (15/32-inch or thicker) or lumber blocking at panel edges is recommended. A 1/8-inch space is recommended at all edge and end joints unless otherwise indicated by panel manufacturer. If high-performance coatings are to be used for finish, check the coating manufacturer's recommendations for panel joint treatment. Nail size, type and spacing recommendations are also given in Table 16.

Grades recommended above should also be specified when the structural wood deck is to be overlaid with a separate plywood layer to serve as substrate for special roof coatings. A 1/8-inch space is recommended at all edge and end joints unless otherwise indicated by panel manufacturer. Although minimum 1/4-inch plywood may be used over structural decks, 15/32-inch or thicker panels should be considered for best performance over uneven surfaces or when rain or high humidity is anticipated prior to application of roof coating. Use corrosion-resistant fasteners sized and spaced as recommended in Table 16.

TABLE 16

PLYWOOD THICKNESS AND MAXIMUM SPANS FOR ROOF DECKS UNDER SPECIAL COATINGS[a]

Grade	Minimum Plywood Thickness (in.)	Maximum Support Spacing (in.)			Nail Type & Size[b]	Maximum Nail Spacing (in.)	
		Group 1	Groups 2 & 3	Group 4		Supported Panel Edges	Intermediate Supports
APA A-C EXT APA B-C EXT APA C-C PLUGGED EXT	11/32	16	—	—	8d common smooth[c] or ring- or screw-shank	6	12
	15/32, 1/2	24	24	16	8d common smooth[c] or ring- or screw-shank	6	12
	19/32, 5/8	32	24	24	8d ring- or screw-shank	6	12
	23/32, 3/4	40	32	32	8d ring- or screw-shank	6	12
	7/8	48	40	40	8d ring- or screw-shank	6	12[d]

(a) All panels will support at least 30 psf live load plus 10 psf dead load at maximum span.

(b) Nail type, size and spacing may vary for diaphragm designs.

(c) Use only deformed-shank nails for curved surfaces.

(d) For spans 48 inches or greater, space nails maximum 6 inches at all supports.

DIAPHRAGM DESIGN

With only slight design modifications, any APA panel roof system described previously will also function as an engineered diaphragm to resist high wind and seismic loading. An APA panel diaphragm combines the inherent strength, stiffness and impact resistance of wood. If pushed to ultimate capacity, the diaphragm will gradually yield while continuing to carry the load.

In a roof diaphragm, the panel skin functions as the web of a thin, deep beam resisting shear, while the edge members, or chords, act as beam flanges to resist bending stresses. When a series of diaphragms (walls, roofs and floors) are properly tied together, the entire building functions as a unit against lateral loads.

A diaphragm's ability to function effectively as a beam that transfers loads to shear walls depends on the quality of the connections. Nailing is critical since shears are transmitted through these fasteners. Common nails provide required strength. Other nail types may be used when their lateral bearing values are considered in the design. Load-carrying capacity is highest when the diaphragm is blocked. Blocking allows better shear transfer by providing a nailed connection at all panel edges. Blocked diaphragm values may be used when all panel edges are nailed to framing or to 2x4 nailers between supports.

Table 17 gives APA panel and fastening recommendations for diaphragm roofs. Panels and framing are assumed designed for perpendicular loads. To design an APA panel roof diaphragm, follow these steps:

1) Determine lateral loads and resulting shears;

2) Determine nailing schedule (Table 17). Consider load direction with respect to joints;

3) Compute chord stress due to bending moment. Provide adequate splices. Check deflection. Check anchorage of boundary framing (e.g., chords) to walls.

For more design information, write for *Design/Construction Guide: Diaphragms*, Form L350.

TABLE 17

RECOMMENDED SHEAR (POUNDS PER FOOT) FOR HORIZONTAL APA PANEL DIAPHRAGMS WITH FRAMING OF DOUGLAS-FIR, LARCH OR SOUTHERN PINE[a] FOR WIND OR SEISMIC LOADING

Panel Grade	Common Nail Size	Minimum Nail Penetration in Framing (inches)	Minimum Nominal Panel Thickness (inch)	Minimum Nominal Width of Framing Member (inches)	Blocked Diaphragms: Nail Spacing (in.) at diaphragm boundaries (all cases), at continuous panel edges parallel to load (Cases 3 & 4), and at all panel edges (Cases 5 & 6)[b] — 6	4	2-1/2[c]	2[c]	Blocked Diaphragms: Nail Spacing (in.) at other panel edges (Cases 1, 2, 3 & 4)[b] — 6	6	4	3	Unblocked Diaphragms: Nails Spaced 6" max. at Supported Edges[b] — Case 1 (No unblocked edges or continuous joints parallel to load)	All other configurations (Cases 2, 3, 4, 5 & 6)
APA STRUCTURAL I grades	6d[e]	1-1/4	5/16	2	185	250	375	420	165	125
				3	210	280	420	475	185	140
	8d	1-1/2	3/8	2	270	360	530	600	240	180
				3	300	400	600	675	265	200
	10[d]	1-5/8	15/32	2	320	425	640	730	285	215
				3	360	480	720	820	320	240
APA RATED SHEATHING APA RATED STURD-I-FLOOR and other APA grades except Species Group 5	6d[e]	1-1/4	5/16	2	170	225	335	380	150	110
				3	190	250	380	430	170	125
			3/8	2	185	250	375	420	165	125
				3	210	280	420	475	185	140
	8d	1-1/2	3/8	2	240	320	480	545	215	160
				3	270	360	540	610	240	180
			7/16	2	255	340	505	575	230	170
				3	285	380	570	645	255	190
			15/32	2	270	360	530	600	240	180
				3	300	400	600	675	265	200
	10d[d]	1-5/8	15/32	2	290	385	575	655	255	190
				3	325	430	650	735	290	215
			19/32	2	320	425	640	730	285	215
				3	360	480	720	820	320	240

(a) For framing of other species: (1) Find specific gravity for species of lumber in AFPA National Design Specification. (2) Find shear value from table above for nail size for Structural I panels (regardless of actual grade). (3) Multiply value by 0.82 for species with specific gravity of 0.42 or greater, or 0.65 for all other species.

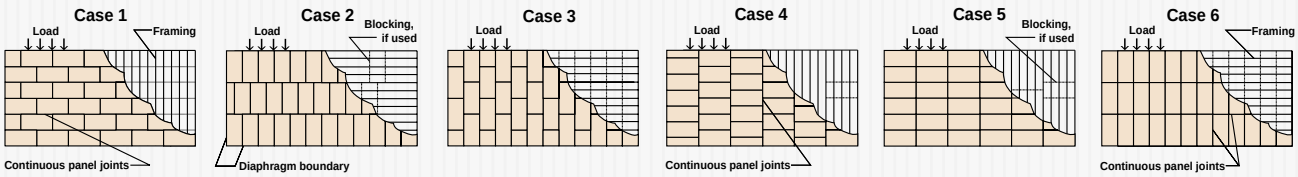
(b) Space nails maximum 12 in. o.c. along intermediate framing members (6 in. o.c. when supports are spaced 48 in. o.c.).

(c) Framing at adjoining panel edges shall be 3-in. nominal or wider, and nails shall be staggered where nails are spaced 2 in. o.c. or 2-1/2 in. o.c.

(d) Framing at adjoining panel edges shall be 3-in. nominal or wider, and nails shall be staggered where 10d nails having penetration into framing of more than 1-5/8 in. are spaced 3 in. o.c.

(e) 8d is recommended minimum for roofs due to negative pressures of high winds.

Notes: Design for diaphragm stresses depends on direction of continuous panel joints with reference to load, not on direction of long dimension of sheet. Continuous framing may be in either direction for blocked diaphragms.



ROOF DECK INSULATION

Dwindling fuel supplies, rising heating and cooling costs, and increasingly stringent nonresidential thermal regulations make the selection of an economical and effective roof deck insulation system critically important today.

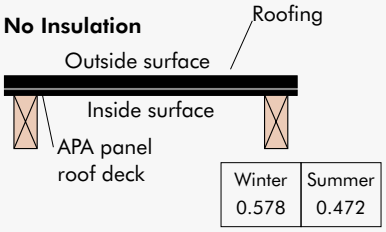
Insulating APA panel roof decks is simpler, faster and less expensive than other decks since cost-effective nonrigid blanket insulation can be applied on the underside of the deck when ventilation is provided – and built-up roofing on top – without further preparation. Most metal roof systems, on the other hand, require special rigid insulation on top of the deck to provide the smooth surface needed for hot-mopping. The APA panel deck with blanket insulation provides better sound absorption, an important consideration in commercial, industrial and institutional construction. Even when rigid insulation is desired over a panel deck, wood's natural thermal resistance yields better insulating values.

A wood-frame panel roof deck system can be effectively insulated with various techniques. Figure 4 illustrates four typical systems – three with insulation and one without. U values for below-deck insulation include the effects of 8 percent framing.

FIGURE 4

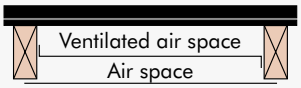
AVERAGE "U" VALUES OF APA PANEL ROOF DECKS

No Insulation



Winter	Summer
0.578	0.472

Reflective Insulation[a]



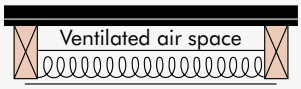
No. of equal air spaces	Winter	Summer
1	0.254	0.100
2	0.183	0.075
3	0.117	0.066

(a) Foil sheets assumed reflective both sides except exposed bottom.

Rigid Insulation

		Winter	Summer
Fiberboard/ perlite board	1 in.	0.222	0.204
	1-1/2 in.	0.169	0.159
	2 in.	0.143	0.136
Composite board	1-1/2 in.	0.119	0.114
	2 in.	0.085	0.083
Polyurethane board	1 in.	0.099	0.096
	1-1/2 in.	0.070	0.068

Batt Insulation



	Winter	Summer
R11[b]	0.082	0.079

(b) Min. 2x6 joists required to provide air space.

RATED ROOF SYSTEMS

There is no such thing as "fireproof" construction. However, proper construction in conformance with codes and recognition of such key factors as occupancy, type of contents and type of fire detection system **can** produce a wood building that is "firesafe."

In many cases, wood frame and plywood roof assemblies without special ratings or sprinklers provide ample fire safety, are accepted by the major model building codes, and are the most cost-effective building material combination. There are many instances, however, where special fire-rated construction is required due to certain occupancies, fire zone locations, or building heights and areas. This section describes several APA panel roof decks that meet these special building code requirements.

There are three basic categories of fire-rated wood roof construction recognized by building codes and insurance rating bureaus – **protected, heavy timber** and **treated construction**.

Protected Construction

Protected construction includes any normal wood-and-panel assembly with a fire-resistive material such as gypsum wallboard, plaster or mineral acoustical tile added to give primary protection to framing. The panels slow flame passage and temperature rise while reinforcing supports against collapse under load.

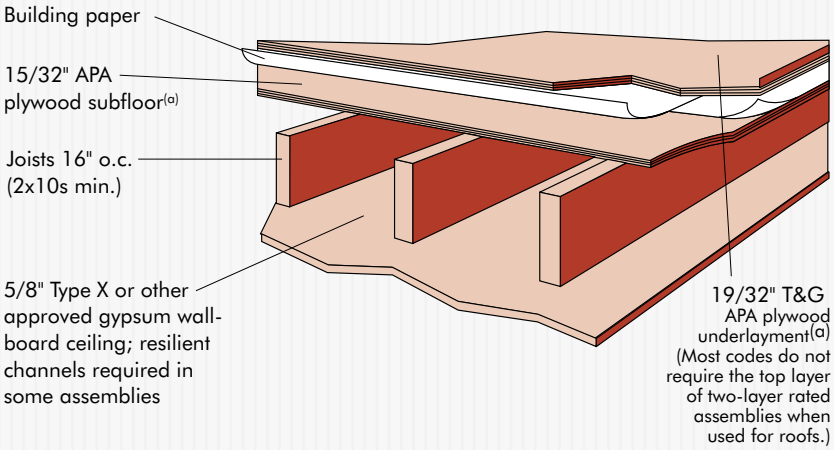
Over 40 wood-and-panel protected roof assemblies in the Underwriters Laboratories *Fire Resistance Directory* are accepted by building codes. Typical assemblies are shown in Figure 5.

FIGURE 5

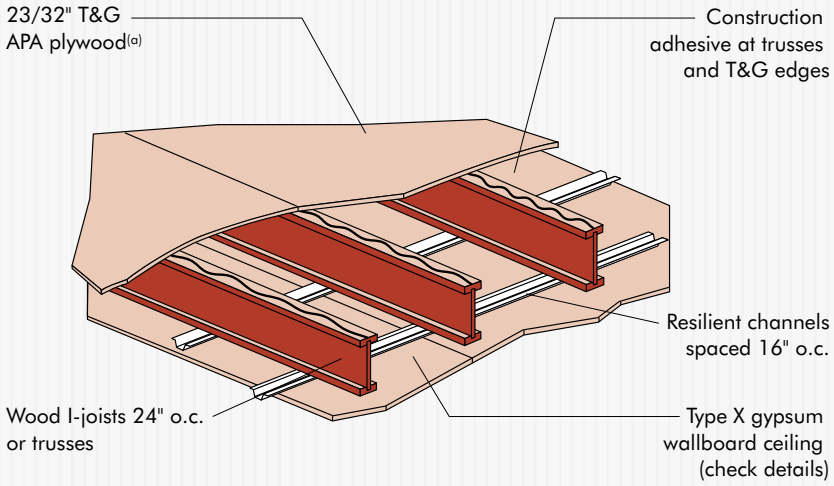
ONE-HOUR FIRE-RATED COMBUSTIBLE ROOF/CEILING ASSEMBLIES

Some rated assemblies incorporate proprietary products. When designing and specifying, check the Underwriters Laboratories Fire Resistance Directory for complete details on a particular assembly. A change in details may affect fire resistance of the assembly.

Joisted systems. For details, see U.L. Design Nos. L501, L502, L503, L512, L514, L515, L519, L522, L525, L526, L535 and L537. Also see U.L. Design No. L524 with steel joists spaced 24" o.c.



Flat truss or I-joist systems. For details, see U.L. Design Nos. L528, L529, L531 and L534.



Note:
(a) Tests have shown that substitution of OSB or composite APA RATED SHEATHING subfloor and APA RATED STURD-I-FLOOR underlayment for the plywood panels in rated assemblies will not jeopardize fire-resistance ratings. Substitution is based on equivalent panel thickness, except that 7/16" OSB subfloor panels may be used in place of 15/32" plywood subfloor panels in two-layer assemblies.

While protective materials provide rated fire resistance for light-frame construction assemblies, more massive framing members such as glulam beams can be designed for one-hour fire resistance without such protection. For detailed information, see *Engineered Wood Systems Product and Applications Guide: Glulams*, Form EWS Q455.

Heavy Timber Construction

Heavy Timber Construction is a specific classification that uses massive, slow-burning timbers and no concealed spaces. Although the outside of the timbers may char during a fire, the surface char insulates against further oxidation, and the strength of the wood continues to support its load and reduces the chance of building collapse.

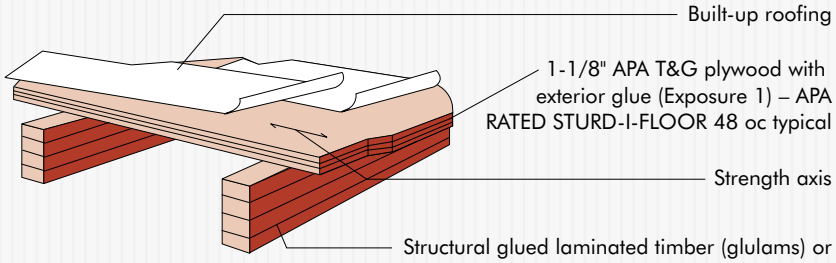
Until recent years, roof decks qualifying for the Heavy Timber rating had to consist of planks at least two inches thick, or of laminated planks at least three inches wide on edge. Insurance rating bureaus and all of the model building codes, however, now accept 1-1/8-inch tongue-and-groove plywood with exterior glue (Exposure 1). Typical construction (Figure 6) consists of tongue-and-groove 2-4-1 (APA RATED STURD-I-FLOOR 48 oc) or 1-1/8-inch tongue-and-groove APA RATED SHEATHING Exposure 1. (Check local availability of 1-1/8-inch tongue-and-groove APA RATED SHEATHING before specifying.) Heavy timber beams must be 4x6 minimum and are normally spaced 48 inches on center. For an exposed-beam ceiling between beams, 1-1/8-inch textured plywood can also be used.

The performance of Heavy Timber construction markedly surpasses most unprotected "noncombustible" structures under fire conditions. There are no concealed spaces where fire can spread, and fire fighting is safer because heavy timber will carry its load longer than unprotected metal.

In some heavy timber constructions, glulam beams can be adapted for one-hour fire ratings. Refer to the *APA Design/Construction Guide: Fire Rated Systems*, Form W305, for a description of one-hour assemblies.

FIGURE 6

HEAVY TIMBER ROOF CONSTRUCTION



Treated Construction

In any projected use of fire-retardant treatments, thorough investigation should first determine that it is the best overall solution, in view of long-term insurance costs and adequate fire protection at lowest construction cost. It is more expensive than untreated plywood and wood, which in most cases perform satisfactorily in regard to both life safety and protection of property.

FRT (fire-retardant-treated) wood or plywood is pressure-impregnated with chemicals in water solution to permanently inhibit combustion. This qualifies it for lower flame spread (at least as low as gypsum wallboard) and smoke generation ratings, hence reduces its fire hazard classification and when it is identified as such by the UL label, it is rated on a parity with noncombustible constructions by many insurance rating bureaus.

Precisely defined, FRT plywood has been impregnated with fire-retardant chemicals in accordance with American Wood Preservers Association Standard AWPA C27. When tested for thirty minutes under ASTM Standard E-84 (the tunnel test), it has a flame spread not over 25 and shows no evidence of significant progressive combustion.

Span Ratings and load capacities are based on untreated panels, and may not apply following fire-retardant treatment. Obtain structural performance characteristics of FRT panels from the company providing the treatment and redrying service.

Roof Coverings

The fire resistance ratings of roofing materials are listed as Class A, B, or C in descending order of fire protection afforded. Their use is prescribed by building codes and also affects insurance rates. Untreated APA panel roof sheathing is a recognized deck for rated roof coverings. For individual requirements, see the UL *Building Materials Directory.*

Wind-Rated Construction

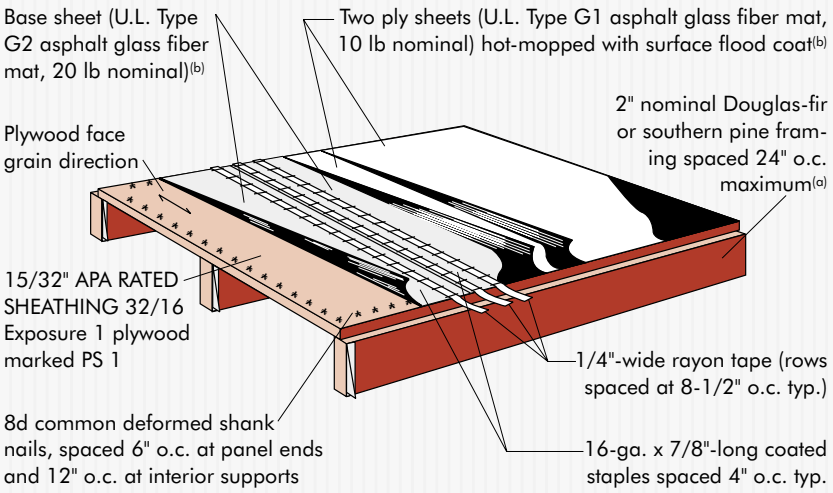
Wind resistance of a structure largely determines Extended Coverage Endorsement (ECE) and is an important factor in determining total insurance costs.

Underwriters Laboratories (U.L.) and Factory Mutual Research Corporation rate roof systems for wind resistance, based on their performance in a wind uplift test. Many fire-rated wood roof assemblies can also qualify for wind uplift ratings. Systems meeting U.L. requirements are assigned a semi-wind-resistive classification (Class 30 or 60) or fully-wind-resistive classification (Class 90).

Conventional Roofs Two plywood roof systems with hot-mopped built-up roofing over a mechanically-fastened roofing base sheet are qualified for fully-wind-resistive ratings (Class 90). One of these systems, U.L. Construction No. NM519, is illustrated in Figure 7. It uses 15/32-inch APA RATED SHEATHING Exposure 1 marked PS 1 (untreated CDX plywood), installed across nominal 2-inch wood joists spaced 24 inches o.c. For a fully-wind-resistive rating (Class 90), the three-ply built-up roofing consists of a fiberglass mat base sheet (U.L. Type G2) which is mechanically fastened to the plywood roof deck at lapped edges and along three intermediate rows with a staple/tape system, and two plies of fiberglass mat ply sheets (U.L. Type G1) which are hot-mopped to the base sheet.

FIGURE 7

FULLY-WIND-RESISTIVE ROOF ASSEMBLY — U.L. CLASS 90 (NM519)

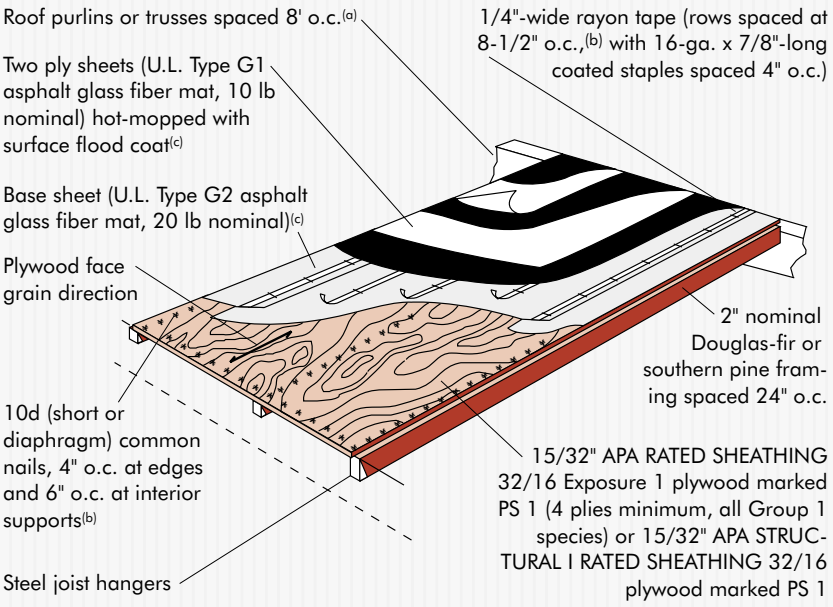


(a) Design in accordance with local building code requirements for roof loads and anchorage. All framing must have 2" nominal or greater width for plywood deck nailing.

(b) Install roofing base and ply sheets with roll direction parallel to plywood face grain directions.

FIGURE 8

FULLY-WIND-RESISTIVE ROOF ASSEMBLY — U.L. CLASS 90 (NM520)



(a) Trusses or I-joists used for purlins must have chords or flanges of 1-3/4" minimum depth for plywood deck nailing.

(b) For semi-wind-resistive assemblies (Class 60), plywood deck nailing spaced 6" o.c. at all supports and roofing base sheet attached with rayon tape rows spaced 11-1/3" o.c.

(c) Install roofing base and ply sheets with roll direction parallel to plywood face grain direction.

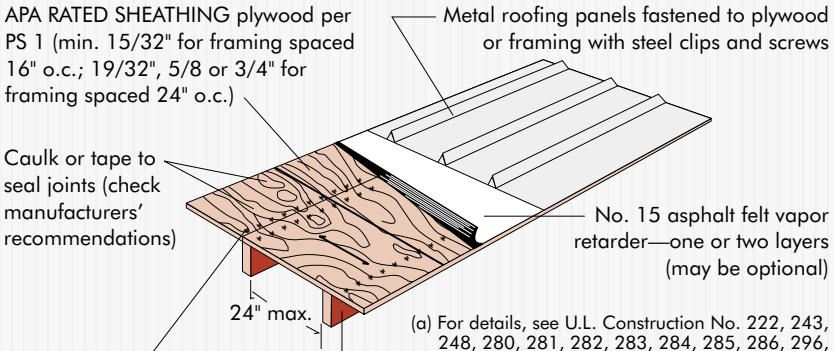
The second is U.L. Construction No. NM520, a panelized roof deck of 15/32-inch APA RATED SHEATHING Exposure 1 marked PS 1 (untreated CDX plywood). The panels are installed parallel to 2x4 joists spaced 24 inches o.c., which span 8 feet between purlins framed into glulam beams (Figure 8). For a fully-wind-resistive (Class 90), the three-ply built-up roofing is installed as described above for NM519 construction. If the roofing base sheet is fastened to the plywood roof deck at lapped edges and along two intermediate rows with a staple/tape system, the roofing system qualifies for a semi-wind-resistive rating (Class 60).

Panelized roofs are commonly used on the west coast for seismic or wind resistance, and are becoming increasingly popular in Texas and gulf coast regions where wind-rated roofing systems can be used with the diaphragm shear strength of wood roof decks to provide economical, wind-resistant structures.

Another type of wind-rated roof construction uses proprietary metal roofing panels, available from several sources, installed over plywood roof sheathing as shown in Figure 9. These constructions use APA RATED SHEATHING Exposure 1 marked PS 1 (untreated CDX plywood), installed across wood or steel framing spaced up to 24 inches o.c. Plywood thickness depends on details of the proprietary construction, with a minimum of 15/32 inch (Span Rating 32/16) for some constructions, and 5/8 or 3/4 inch (Span Rating 40/20 or 48/24, respectively) for others. Metal roofing panels are fastened to the plywood roof sheathing or framing with special clips and screws.

FIGURE 9

METAL ROOFING PANELS — U.L. CLASS 90[(a)(b)(c)]



(a) For details, see U.L. Construction No. 222, 243, 248, 280, 281, 282, 283, 284, 285, 286, 296, 297, 301, 318, 320, 333, 340, 343, 344, 346, 347, 350, 351, 352, and 353.

(b) For semi-wind-resistive constructions (Class 30 or 60), see U.L. Construction No. 223, 247, and 257. Some constructions listed in (a) also have Class 30 or 60 provisions.

(c) Also see U.L. Construction No. 308, 308A, 308B, 309, and 310 for details of fully-wind-resistive constructions (Class 90) with metal roofing panels fastened to 1/2" plywood panels as a roofing substrate over rigid foam insulation and steel roof decking (min. 22 gage), with steel framing spaced 60" o.c.

(Some rated assemblies and constructions incorporate proprietary products. When designing and specifying, check the Underwriters Laboratories (U.L.) Roofing Materials and Systems Directory for complete details on a particular assembly or construction. A change in details may affect the wind uplift classification of the assembly or construction.)

Other types of proprietary roofing products, such as prepared roof covering (hardboard shakes per U.L. Construction No. NM522 or slate shingles per U.L. Construction No. NM527) or steel tile or shake panels also are rated for wind uplift resistance when installed over 15/32-inch plywood roof sheathing. Other constructions use a single-ply roofing membrane over minimum 7/16-inch OSB panels as roofing substrate over steel roof decking, or 15/32-inch plywood roof sheathing. For details, consult the U.L. *Building Materials Directory* under Product Categories TGIK and TGKX.

WOOD ROOF DECK INSURANCE RATES

Despite a steady increase in usage, there is still considerable confusion and misunderstanding about insurance rates for wood-roofed buildings. Many factors influence rates, including type of construction, contents, whether sprinklers are used and the area's fire-protection ratings. Automatic sprinkler systems, for example, can often significantly reduce rates.

Although the insurance rates for APA wood roof decks are sometimes higher than those for buildings with roofs of other materials, the total cost of the wood roof structure – material and construction costs, insurance premiums and mortgage interest – is often less in the long run than for a building of noncombustible materials, such as steel. The annual interest earned on the construction savings alone can often more than offset any additional insurance premiums for a wood roof building.

METAL FRAMING SYSTEMS

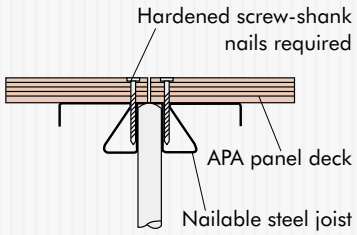
Modern fastening methods are rapidly expanding the use of APA panels over metal framing. Self-drilling, self-tapping fasteners commonly are used to attach panels up to 1-1/8-inch thick to steel flanges up to 3/16-inch thick. Panels also can be fastened to lighter members, such as formed steel joists, with screw-shank nails and self-drilling, self-tapping screws. Construction adhesives are often recommended with hardened screw-shank nails. Consult metal framing manufacturers for recommended adhesives. Since threads usually extend only a portion up the shank of self-drilling, self-tapping screws and screw-shank nails, it is important to specify a length sufficient to engage the metal framing.

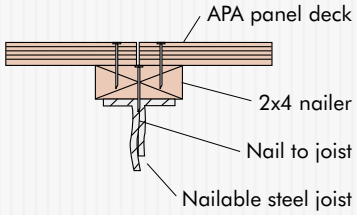
Typical panel-to-metal framing systems are illustrated in Figure 10. Load-span recommendations for wood structural panels are the same as for wood-frame systems.

FIGURE 10

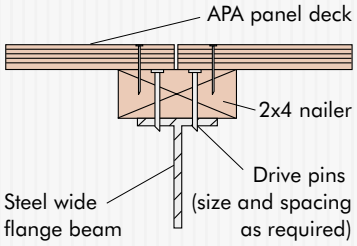
TYPICAL PANEL-TO-METAL FRAMING SYSTEMS

Panels Nailed to Nailable Steel Joists

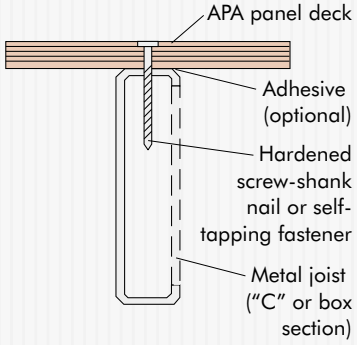




Panels Nailed to Nailer Anchored with Power Driven Fasteners



Panels Attached Directly to Formed Steel Joist



ADDITIONAL INFORMATION

About APA – The Engineered Wood Association and Engineered Wood Systems

APA – The Engineered Wood Association is a nonprofit trade association whose member mills produce approximately 75 percent of the structural wood panel products manufactured in North America.

The Association's trademark appears only on products manufactured by member mills and is the manufacturer's assurance that the product conforms to the standard shown on the trademark. That standard may be an APA performance standard, the Voluntary Product Standard PS 1-95 for Construction and Industrial Plywood or Voluntary Product Standard PS 2-92, Performance Standards for Wood-Based Structural-Use Panels. Panel quality of all APA trademarked products is subject to verification through APA audit.

APA's services go far beyond quality testing and inspection. Research and promotion programs play important roles in developing and improving plywood and other panel construction systems, and in helping users and specifiers to better understand and apply panel products.

Always insist on panels bearing the ***mark of quality –*** *the APA trademark. Your APA panel purchase is not only your highest possible assurance of product quality, but an investment in the many trade services that APA provides on your behalf.*

The APA EWS trademark appears only on engineered wood products manufactured by members of Engineered Wood Systems, a related corporation of APA. The mark signifies that the manufacturer is committed to a rigorous program of quality verification and testing and that products are manufactured in conformance with an APA or national standard such as ANSI Standard A190.1, American National Standard for Structural Glued Laminated Timber.

For additional information *on wood construction systems, contact APA – The Engineered Wood Association, P.O. Box 11700, Tacoma, Washington 98411-0700, or the nearest APA regional field office listed on the back cover. For a list of additional APA and Engineered Wood Systems publications, request the:*
APA Publications Index, *Form B300*
EWS Publications Index, *Form S400*

The product use recommendations in this publication are based on the continuing programs of laboratory testing, product research, and field experience of *APA – The Engineered Wood Association* and Engineered Wood Systems. However, because APA and Engineered Wood Systems have no control over quality of workmanship or the conditions under which structural panels and engineered wood products are used, those organizations cannot accept responsibility for product performance or designs as actually constructed. Because engineered wood product performance requirements vary geographically, consult your local architect, engineer or design professional to assure compliance with code, construction, and performance requirements.

NONRESIDENTIAL ROOF SYSTEMS

DESIGN/CONSTRUCTION GUIDE

We have field representatives in most major U.S. cities and in Canada who can help answer questions involving APA trademarked products. For additional assistance in specifying APA engineered wood products, get in touch with your nearest APA regional office. Call or write:

WESTERN REGION
7011 So. 19th St. ▪ P.O. Box 11700
Tacoma, Washington 98411-0700
(253) 565-6600 ▪ Fax: (253) 565-7265

EASTERN REGION
2130 Barrett Park Drive, Suite 102
Kennesaw, Georgia 30144-3681
(770) 427-9371 ▪ Fax: (770) 423-1703

U.S. HEADQUARTERS AND INTERNATIONAL MARKETING DIVISION
7011 So. 19th St. ▪ P.O. Box 11700
Tacoma, Washington 98411-0700
(253) 565-6600 ▪ Fax: (253) 565-7265

Web Address: @
www.apawood.org

PRODUCT SUPPORT HELP DESK
(253) 620-7400
E-mail Address: help@apawood.org

(Offices: Antwerp, Belgium; Bournemouth, United Kingdom; Hamburg, Germany; Mexico City, Mexico; Tokyo, Japan.) For Caribbean/Latin America, contact headquarters in Tacoma.

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Form No. A310K/Revised May 1996/0300

A P A

The Engineered Wood Association