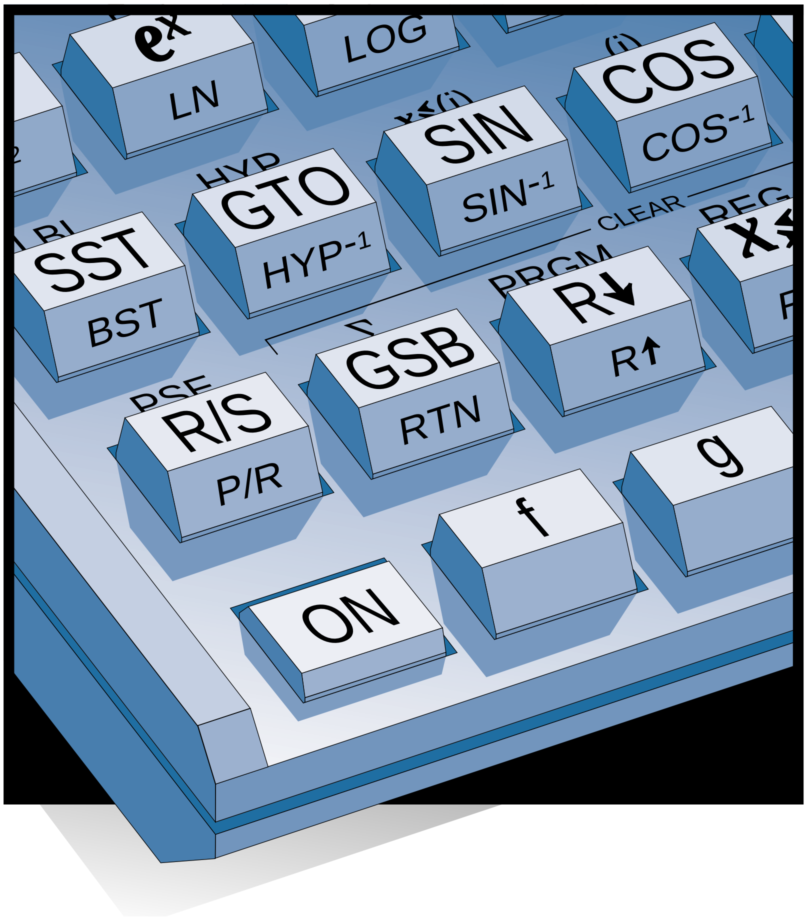
SUPPLEMENT 4

Design And Fabrication Of Plywood Sandwich Panels

March 1990



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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 products 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.

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THE ENGINEERED WOOD ASSOCIATION
RATED SHEATHING
32/16 15/32 INCH
SIZED FOR SPACING
EXPOSURE 1
000
PS 1-95 C-D PRP-108

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

FOREWORD

This publication presents the recommended method for the design and fabrication of flat plywood sandwich panels.

Working stresses and other design criteria are given in the PLYWOOD DESIGN SPECIFICATION, abbreviated PDS.

The recommended design method is based on recognized engineering formulas, further developed by the United States Forest Products Laboratory, and refined and verified in a series of tests reported in *APA – The Engineered Wood Association* Laboratory Report No. 93.

Presentation of this design method is not intended to preclude further development. Where adequate test data are available, therefore, the design provisions may be appropriately modified. If they are modified, any such change should be noted when referring to this publication.

The plywood use recommendations contained in this publication are based on *APA – The Engineered Wood Association*'s continuing program of laboratory testing, product research and comprehensive field experience. However, there are wide variations in quality of workmanship and in the conditions under which plywood is used. Because the Association has no control over those elements, it cannot accept responsibility for plywood performance or designs as actually constructed.

Technical Services Division
APA – The Engineered Wood Association

A WORD ON COMPONENTS

Plywood-lumber components are structural members which depend on the glued joints to integrate the separate pieces into an efficient unit capable of carrying the design loads. Materials in these components may be stressed to an appreciably higher level than in non-engineered construction.

Since improperly designed or fabricated components could constitute a hazard to life and property, it is strongly recommended that components be designed by qualified architects or engineers, using recognized design and fabrication methods, and that adequate quality control be maintained during manufacture.

To be sure that such quality control has been carefully maintained, we recommend the services of an independent testing agency. A requirement that each unit bear the trademark of an approved agency will assure adequate independent inspection.

C O N T E N T S – D E S I G N A N D F A B R I C A T I O N O F P L Y W O O D S A N D W I C H P A N E L S

Part 1 – Design of Plywood Sandwich Panels

Part 2 – Fabrication of Plywood Sandwich Panels

PART 1 – DESIGN OF PLYWOOD SANDWICH PANELS

1. General

1.1 Definition

A structural sandwich panel is an assembly consisting of a lightweight core securely laminated between two relatively thin, strong facings.

1.2 Load Direction

Part 1 of this publication presents a method for design of sandwich panels for horizontal, vertical or combined loadings. The method may be used for panels with only one type of loading by eliminating the equations which do not apply.

1.3 Panel Behavior

Axial forces in a structural sandwich panel are carried by compression in the facings, stabilized by the core material against buckling; bending moments are resisted by an internal couple composed of forces in the facings; shearing forces are resisted by the core.

1.4 Materials

Plywood serves as an ideal material for the facings of sandwich panels. It is strong, light in weight, easily finished, dimensionally stable, and easily repaired if damaged. A variety of core materials may be used with plywood to complete the panel. Among these are polystyrene foams, polyurethane foams, and paper honeycombs. Besides resistance to shearing forces, for some applications such as exterior wall panels and roof panels the core should possess high resistance to heat and vapor transmission. The designer should consider the suitability of the core material to his application. Factors to consider include resistance to degradation by heat, age, and moisture; compatibility with glues; etc.

1.5 Bond Between Faces and Core

The bond between the facing and the core is extremely important, since the structural performance of the assembly depends on its integrity. Several types of bond may be acceptable – for instance, glues, and in the case of some of the foam materials, direct adhesion of the foam to the faces during expansion. In exterior wall panels, the bond should be waterproof. The combination of core material and bond should be such as not to creep excessively under the long-term loads and temperatures anticipated.

2. Panel Design for Combined Loading

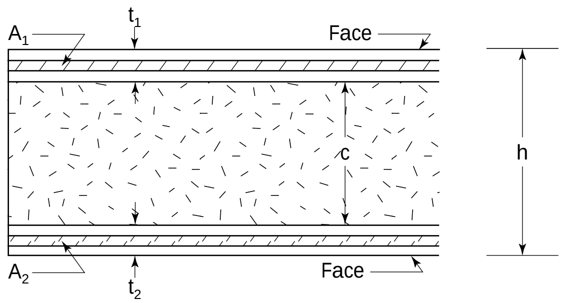
All equations which follow have been adjusted with constants so that substitution of values with dimensions given in the legends will produce answers with the desired dimension.

2.1 General

In general, the structural design of a sandwich panel may be compared to that of an “I” beam. Facings carry the compressive and tensile stresses, and the core resists shear. This core should be thick enough to space the facings so that they provide bending stiffness. The core also supports the facings against buckling. The composite structure must be checked for possible buckling as a column, and for wrinkling or buckling of the skins. Bending stiffness of the core (parallel to facings) is assumed to be insignificant. Tests have proven this assumption correct for panels with facing thicknesses up to 15% of the total panel thickness.

Note: This design method assumes a distribution of stresses based on principles of mechanics and has been verified by testing. Stress distributions around supports should be checked to confirm that stresses in components are within allowable limits. Verification by testing may be advisable in some cases.

2.1.1 Symbols



A_1 = Area of outside skin (in.^{2}/ft)

A_2 = Area of inside skin (in.^{2}/ft)
(For plywood skins, A_1 and A_2 are taken as parallel-grain area per foot of panel width. See PLYWOOD DESIGN SPECIFICATION Table 1 or 2, column 4.)

C_{cr} = Theoretical skin stress at buckling (wrinkling)

c = Core depth (in.)

E = Modulus of elasticity of plywood (psi). This value normally will include a 10% increase over published data to restore an allowance made when shear deflection is not computed separately.

E_c = Modulus of elasticity of the core (perpendicular to skin) (psi)

F_c = Allowable compressive stress in parallel plys of plywood (psi)

F_t = Allowable tensile stress in parallel plys of plywood (psi)

F_v = Allowable shear stress in the core (psi)

f_b = Applied bending stress in the facings (psi)

f_v = Applied shear stress in the core (psi)

G_c = Modulus of rigidity of core (shear modulus) in direction of span (psi)

h = Panel depth (in.)

I = Panel moment of inertia (in.^{4} per foot of width).(Stiffnesses of the plywood faces about their own axes are insignificant in comparison with the over-all construction.)

L = Span length (ft)

P = Axial load (lb per foot of panel width)

P_{cr} = Theoretical column buckling load (lb per foot of panel width)

p = Desired pressure on core in psi. (See section 3.3.2.)

S = Section modulus of panel (in.^{3} per foot of width)

S_1 = Section modulus with A_1 face in tension

S_2 = Section modulus with A_2 face in tension

t = Minimum skin thickness (t_1 or t_2) (in.)

t_1 = Thickness of outside (top) skin (in.)

t_2 = Thickness of inside (bottom) skin (in.)

w = Normal uniform load (psf)

$\bar{y}$ = Distance from neutral axis to outermost fiber (in.)

Δ = Deflection due to transverse loading (in.)

Δ_b = Deflection due to bending (in.)

Δ_{fc} = Amount that framing is “shallower” than core (in.)

Δ_s = Deflection due to shear (in.)

2.2 Trial Section

Since in many cases the core thickness will be determined by requirements for insulation rather than for strength, the suggested design method is to select a given construction and to check it for all possible modes of failure under the design loads. Also see the note in Section 2.1.

2.2.1 Plywood Faces

Figure Approximate Plywood Area Required.

Having the design loads w and P, the required parallel-grain plywood area is determined by

$$A_1 + A_2 = \frac{P}{F_c}$$

2.2.2 Core

Determine Core Thickness.

For simply supported end conditions, the maximum bending moment (in.-lb per foot of panel width) is

$$M = \frac{12wL^2}{8} = 1.5wL^2$$

To obtain the approximate core thickness required, assume that $A_1 = A_2 = A$. Then the section modulus

$$S = \frac{2I}{h} = \frac{A(h + c)^2}{4h}$$

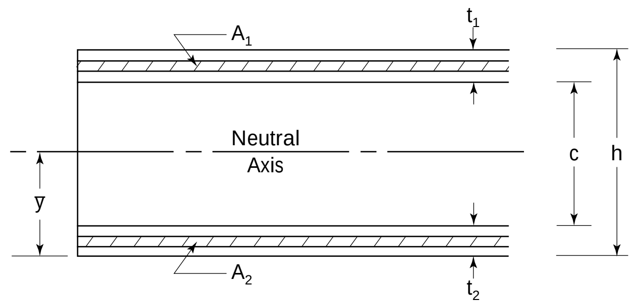
This equation can be most easily solved by assuming values of c. The value of c thus obtained usually will be too low for insulation and deflection purposes. A minimum c of 3-1/2" is suggested for load-bearing wall panels subjected to wind loads.

With trial values of c, A_1, A_2, and h, the panel may be checked for all possible modes of failure.

2.3 Neutral Axis

Find Neutral Axis

$$\bar{y} = \frac{A_1(h - \frac{t_1}{2}) + A_2(\frac{t_2}{2})}{A_1 + A_2}$$



2.4 I and S

Find Moment of Inertia and Section Modulus.

$$I = \frac{A_1A_2(h + c)^2}{4(A_1 + A_2)}$$

$$S_1 = \frac{I}{h - \bar{y}}, S_2 = \frac{I}{\bar{y}}$$

2.5 Column Buckling

Determine Column Buckling Load.

$$P_{cr} = \frac{\pi^2 EI}{(12L)^2 \left[1 + \frac{\pi^2 EI}{(12L)^2 \times 6(h + c)G_c}\right]}$$

2.6 Skin Buckling

Compute Approximate Skin Stress at Buckling.

$C_{cr} = 0.5 \sqrt[3]{EE_cG_c}$ For foam or balsa core

$C_{cr} = 0.82 \sqrt{E_ct/Ec}$ For honeycomb core

Note: Allowable should be approximately 1/3 C_{cr} for design. Skins are assumed to be flat.

2.7 Deflection

Find Deflection.

Deflection due to transverse loading only is equal to

$$\Delta = \Delta_b + \Delta_s = \frac{5wL^4 \times 1728}{384EI} + \frac{wL^2}{4(h + c)Gc}$$

Total deflection including the effects of axial load is approximately equal to

$$\Delta_{max} = \frac{\Delta}{1 - P/P_{cr}}$$

The deflection is usually limited to L/240, L/360, or some other predetermined allowable amount.

2.8 Bending Stress

Calculate Maximum Bending Stress.

This stress includes the bending due to the axial load acting through the initial transverse load deflection and is equal to

$$f_{b\ max} = \frac{1.5wL^2 + P\Delta_{max}}{S_1}$$

2.9 Combined Stress

Determine Maximum Combined Stress.

This stress will occur at mid-length or mid-height of the panel. It is the sum of the axial stress and the compressive bending stress in the concave side of the panel.

$$f_{c\ max} = \frac{P}{A_1 + A_2} + f_{b\ max}$$

$f_{c\ max}$ must be less than F_c, and less than 1/3 C_{cr}

2.10 Shear Stress

Compute Shear Stress.

$$f_v = \frac{wL}{(h + c)12} \leq F_v$$

In addition to the structural design, there are also numerous architectural details which must be considered, such as connections, joint details, and finishes. They are not covered in this design method.

PART 2 – FABRICATION OF PLYWOOD SANDWICH PANELS

1. General

1.1

This specification covers the fabrication of glued plywood sandwich panels, with preformed cores of paper honeycomb, foamed plastic, or other material of demonstrated strength and durability for which accepted shear strength, shear modulus, compressive strength and compressive modulus values are available. The core may be used with or without auxiliary wood members.

1.2

Plywood sandwich panels should be designed by a qualified architect or engineer in accordance with the latest edition of *APA – The Engineered Wood Association* PLYWOOD DESIGN SPECIFICATION (PDS), using the method set forth in Part 1 of this PDS Supplement. Other design methods may be employed, provided they are supported by adequate test data.

1.3

Plywood sandwich panels shall be fabricated and assembled in accordance with engineering drawings and specifications, except that minimum requirements herein shall be observed.

1.4

The plywood use recommendations contained in this publication are based on *APA – The Engineered Wood Association*'s continuing program of laboratory testing, product research and comprehensive field experience. However, there are wide variations in quality of workmanship and in the conditions under which plywood is used. Because the Association has no control over those elements, it cannot accept responsibility for plywood performance or designs as actually constructed.

2. Materials

2.1 Plywood

2.1.1

Plywood shall conform with the latest edition of U.S. Product Standard PS 1 for Construction and Industrial Plywood. Each original panel shall bear the trademark of *APA – The Engineered Wood Association*. Any precut plywood shall be accompanied by an affidavit from the pre-cutter certifying that each original panel was of the specified type and grade, and carried the trademark of *APA – The Engineered Wood Association*.

2.1.2

At time of gluing, the plywood shall be conditioned to a moisture content between 7% and 16%. Pieces to be assembled into a single sandwich panel shall be selected for moisture content to conform with Section 3.3.1.

2.1.3

Surfaces of plywood to be glued shall be clean and free from oil, dust, paper tape, and other material which would be detrimental to satisfactory gluing. Medium Density Overlaid surfaces shall not be relied on for a structural glue bond.

2.2 Lumber

2.2.1

Grades shall be in accordance with current lumber grading rules, except that knotholes up to the same size as the sound and tight knots specified for the grade by the grading rules may be permitted. When lumber is resawn, it shall be regraded on the basis of the new size.

2.2.2

At time of gluing, the lumber shall be conditioned to a moisture content between 7% and 16%. Pieces to be assembled into a single sandwich panel shall be selected for moisture content to conform with Section 3.3.1.

2.2.3

Surfaces of lumber to be glued shall be clean and free from oil, dust, and other foreign matter which would be detrimental to satisfactory gluing. Each piece of lumber shall be machine finished, but not sanded, to a smooth surface with a maximum allowable variation of 1/32" in the surface to be glued. Warp, twist, cup or other characteristics which would prevent intimate contact of mating glued surfaces shall not be permitted.

2.3 Glue

2.3.1

Glue shall be of the type specified by the designer for anticipated exposure conditions and must be compatible with the core material being used.

2.3.2

Interior-type glue shall conform with ASTM Specification D3024. Exterior-type glue shall conform with ASTM Specification D2559.

2.3.3

Mixing, spreading, storage-, pot-, and working-life, and assembly time and temperature shall be in accordance with the manufacturers' recommendations for the specific core and facing materials used.

2.4 Core Material

2.4.1

Properties of foamed plastic and other materials shall be in accordance with the design, and compatible with the glue being used.

2.4.2

Paper honeycomb shall be pre-expanded, resin-impregnated kraft of specified paper weight, resin content and cell size.

3. Fabrication

3.1 Skins

3.1.1

When skins are composed of panels less than full length, end joints shall be scarfed and glued prior to gluing to the core. Slope of scarf joints in plywood skins shall not be steeper than 1 in 8 in the tension skin, and 1 in 5 in the compression skin. Scarf joints shall be glued under pressure over their full contact area, and shall meet the requirements of PS 1, Section 3.9. In addition, the aggregate width of all knots and knotholes falling wholly within the critical section shall be not more than 10 inches on each face of the jointed panel for a 4-ft-wide panel, and proportionately for other widths. The critical section for a scarf joint shall be defined as a 12-inch-wide strip, 6 inches on each side of the joint in the panel face, extending across the width of the panel.

3.1.2

Surfaces of high density overlaid plywood to be glued shall be roughened, as by a light sanding, before gluing.

3.2 Framing

3.2.1

Scarf and finger joints may be used in auxiliary lumber framing members, provided the joints are as required for the grade and stress used in the design. Knots or knotholes in the end joints shall be limited to those permitted by the lumber grade, but in any case shall not exceed 1/4 the nominal width of the piece.

3.2.2

The edges of the framing members to which the plywood skins are to be glued shall be surfaced prior to assembly to provide a maximum variation in depth of 1/16" for all members in a panel.

3.2.3

In order to provide gluing pressure for the core material and auxiliary framing members simultaneously, wood framing members shall be surfaced so that they are "shallower" than the core. The difference in depth shall be as given by the following equation:

$$\Delta_{fc} = cp/E_c$$

3.3 Assembly

3.3.1

The range of moisture content of the various pieces assembled into a single sandwich panel shall not exceed 5%.

3.3.2

Plywood skins shall be glued to auxiliary framing members and core material over their full contact area, using mechanical pressure-gluing in a press. The pressure on the net framing area shall be sufficient to provide adequate contact and ensure good glue bond, and shall be uniformly distributed by caul plates, beams, or other effective means. 100 to 150 psi on the net glued area is recommended for wood-to-wood joints. A pressure equal to from 40% to 60% of the compressive yield strength of the core is suggested.

Application of pressure may start at any point, but shall progress to an end or ends. In any case, it shall be the responsibility of the fabricator to produce a continuous glue bond which meets or exceeds applicable specifications.

3.3.3

Where a tongue-and-groove type panel edge joint is specified (and not otherwise detailed), the longitudinal framing member forming the tongue shall be of at least 2" nominal width, set out 3/4" ± 1/16" from the plywood edge. Edges of the tongue shall be eased so as to provide a flat area at least 3/8" wide. Any corresponding framing member forming the base of the groove shall be set back 1/4" to 1" more than the amount by which the tongue protrudes. One skin may be cut back slightly to provide a tight fit for the opposite skin.

3.3.4

Unless otherwise specified, panel length and width shall be accurate within ± 1/8". Panel edges shall be straight within 1/16" for an 8-ft length and proportionately for other lengths. Panels in the same group shall not vary in thickness by more than 1/16," nor differ from design thickness by more than 1/8." Panels shall be square, as measured on the diagonals, within 1/8" for a 4-ft-wide panel and proportionately for other widths. Panels shall lie flat at all points within 1/4" for 4-ft x 8-ft panels, and proportionately for other sizes. Panel edge cross sections shall be square within 1/16" for constructions with lumber stringers 4" deep, and proportionately for other sizes.

4. Test Samples

4.1

When glue-bond test samples are taken from a member, if not otherwise obtained from trim, they shall be taken as cores approximately 2" in diameter, drilled perpendicular to the plane of the skins, and no deeper than 3/4" into any framing member. Cores may be cut either partially or entirely through the panel if they do not occur at framing.

4.2

No samples shall be taken from the same skin at cross sections closer together than 12" along the span of the panel. No more than 4 cores shall be taken from a 4-ft-wide panel, with a proportionate number from other widths. Samples shall be taken at a distance from the panel ends not greater than twice the panel depth, except as follows:

4.2.1

One sample may be taken from one of the outside longitudinal framing members, within the outer quarters of the panel length, provided the framing member is notched no deeper than 1/2" below its edge. The other outside longitudinal framing member may be sampled similarly, but at the opposite end of the panel.

4.3

Where glue-bond test samples have been taken, holes shall be neatly plugged with glued wood inserts.

5. Identification

Each member shall be identified by the appropriate trademark of an independent inspection and testing agency, legibly applied so as to be clearly visible. Locate trademark approximately 2 feet from either end, except appearance of installed panel shall be considered.

Appendix

A1. Design Example

A1.1 General

Since this example is intended for use as a general guide through this publication and the PDS, review of those sections pertinent to your specific design is recommended before proceeding.

Preliminary considerations as to the grade of plywood to be used for a given design should include a check on availability.

A1.2 Problem

DESIGN AN EXTERIOR BEARING WALL

Design Criteria

Application	– Residence exterior bearing wall
Height (L)	– 8'-0"
Axial Load	– 900 plf (due to snow load)
Normal Load	– 20 psf (due to wind load)
Deflection Limitation	– L/240 = 0.40 in.
Face Materials	– APA A-C Group 1 EXT plywood
Core Material	– Commercially available 1 pcf expanded polystyrene

Material Properties

Plywood Design Values

E – 1,980,000 psi (Increase of 10% over usually published value, since shear deflection will be computed separately)

F_c – 1640 psi (normal duration of load)

F_t – 2000 psi (normal duration of load)

For snow loads F_c and F_t stresses may be increased 15%. A 33% increase over normal-duration values may be taken for wind loadings.

Core Material Design Values

E_c – 200 psi

G_c – 300 psi

F_v – 6 psi (from manufacturer's information)

Note: Manufacturer's F_v is often an ultimate value and should be reduced by a factor of approximately 3 for design.

A1.3 Trial Section (See Part 1, Section 2.2)

Figure Approximate Plywood Area Required

$$A_1 + A_2 = \frac{P}{F_c} = \frac{900}{1640 \times 1.15} = 0.477 \text{ in.}^2/\text{ft}$$

Try 3/8" Exterior sanded plywood both sides. Area for tension or compression is 1.307 in.^{2}/ft.

Determine Core Thickness.

Assume that, for insulation purposes, a minimum core thickness of 3.5" is required.

Then $c = 3.5"$

$h = 3.5 + 2 \times 0.375 = 4.25"$

A1.4 Neutral Axis (See Part 1, Section 2.3)

Because of the symmetrical construction, the neutral axis is at the center of the panel.

A1.5 I and S (See Section 2.4)

$$\text{Then } I = \frac{A_1 A_2 (h + c)^2}{4(A_1 + A_2)} = \frac{1.307^2 \times 7.75^2}{4 \times 2 \times 1.307} = 9.81 \text{ in.}^4/\text{ft}$$

$$S = S_1 = S_2 = \frac{I}{y} = \frac{9.81}{2.125} = 4.62 \text{ in.}^3/\text{ft}$$

A1.6 Column Buckling (See Part 1, Section 2.5)

$$P_{cr} = \frac{\pi^2 EI}{(12L)^2 \left[1 + \frac{\pi^2 EI}{(12L)^2 \times 6(h + c)G_c}\right]}$$

$$= \frac{\pi^2 \times 1{,}980{,}000 \times 9.81}{96^2 \left[1 + \frac{\pi^2 \times 1{,}980{,}000 \times 9.81}{96^2 \times 6 \times 7.75 \times 300}\right]}$$

$$= 8350 \text{ lb/ft}$$

A1.7 Skin Buckling (See Part 1, Section 2.6)

$$C_{cr} = 0.5 \sqrt[3]{E E_c G_c}$$

$$= 0.5 \sqrt[3]{1{,}980{,}000 \times 200 \times 300}$$

$$= 0.5 \sqrt[3]{118{,}800{,}000{,}000} = 2458 \text{ psi}$$

A1.8 Deflection (See Part 1, Section 2.7)

$$\Delta = \Delta_b + \Delta_s = \frac{5wL^4 \times 1728}{384EI} + \frac{wL^2}{4(h+c)G_c}$$

$$= \frac{5 \times 20 \times 8^4 \times 1728}{384 \times 1,980,000 \times 9.81} + \frac{20 \times 8^2}{4 \times 7.75 \times 300}$$

$$= 0.095 + 0.138 = 0.233"$$

$$\Delta_{max} = \frac{\Delta}{1 - \frac{P}{P_{cr}}} = \frac{0.233}{1 - \frac{900}{8350}} = 0.261" \ (< 0.40" \text{ O.K.})$$

A1.9 Bending Stress (See Part 1, Section 2.8)

$$f_{b\,max} = \frac{1.5wL^2 + P\Delta_{max}}{S_1}$$

$$= \frac{1.5 \times 20 \times 8^2 + 900 \times 0.261}{4.62}$$

$$= \frac{1920 + 235}{4.62} = 466 \text{ psi}$$

A1.10 Combined Stress (See Part 1, Section 2.9)

$$f_{c\,max} = \frac{P}{A_1 + A_2} + f_{b\,max}$$

$$= \frac{900}{2 \times 1.307} + 466 =$$

$$= 811 \text{ psi } (< 1/3\ C_{cr}\ [= 819] \text{ and}$$
$$< F_c\ [= 1640 \times 1.33] \text{ O.K.})$$

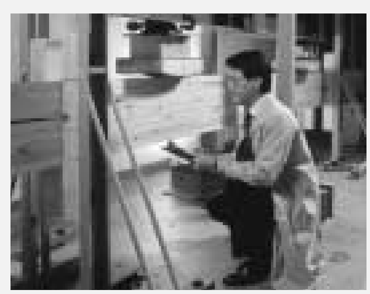
A1.11 Shear Stress (See Part 1, Section 2.10)

$$f_v = \frac{wL}{(h + c)12} = \frac{20 \times 8}{7.75 \times 12} = 1.72 \text{ psi } (< 6 \text{ psi O.K.})$$

A1.12 Conclusion

The proposed panel has met all structural requirements.

Note: Support conditions not analyzed.



APA RESEARCH AND TESTING

APA – The Engineered Wood Association's 37,000-square-foot Research Center in Tacoma, Washington is the most sophisticated facility for basic panel research and testing in the world. The center is staffed with an experienced corps of engineers, wood scientists, and wood product technicians. Their research and development assignments directly or indirectly benefit all specifiers and users of engineered wood products.

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:

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The product use recommendations in this publication are based on APA – The Engineered Wood Association's continuing programs of laboratory testing, product research, and comprehensive field experience. However, because the Association has no control over quality of workmanship or the conditions under which engineered wood products are used, it 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.

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