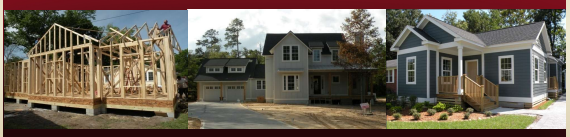
Converting to Advanced Framing:
Learn from Experience



Warren Hamrick, APA

American Institute of Architects (AIA) Continuing Professional Education

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Course Description

As energy codes become more strict, builders and designers are seeking options for energy-efficient construction that maintain strength, durability, sustainability, and cost-effectiveness. Advanced framing is a system of construction framing techniques designed to optimize material usage and increase energy efficiency. Common advanced framing techniques will be shared along with the challenges and benefits that builders find during the conversion from traditional framing to advanced framing.

Learning Objectives

1. Understand that advanced framing includes many techniques including the implementation of a direct load path where roof, wall and floor members are all vertically aligned.
2. Acquire the ability to apply energy efficiency enhancements to projects using by minimizing thermal bridging and increasing the volume of insulation to the thermal envelope.
3. Download and understand advanced framing details including: ladder blocking at wall junctions, 2-stud corners, energy efficient headers, and raised heel trusses.
4. Understand the obstacles and benefits of implementing advanced framing in lieu of traditional construction methods.

Agenda

- What is advanced framing?
- Why do people use it?
- The challenges
- Summary

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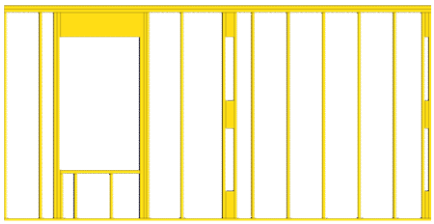
The Concept of 2x6 Advanced Framing

Any techniques that

- Optimize building material usage and reduce waste
- Minimize thermal bridging
- Increase cavity insulation volume to provide maximum energy efficiency
- Withstand all design loads

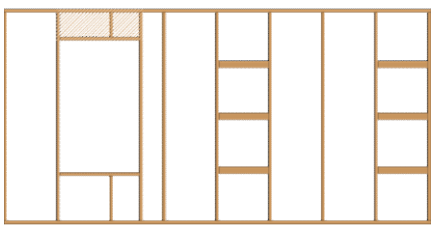
Conventional Framing
16" o.c. Member Spacing

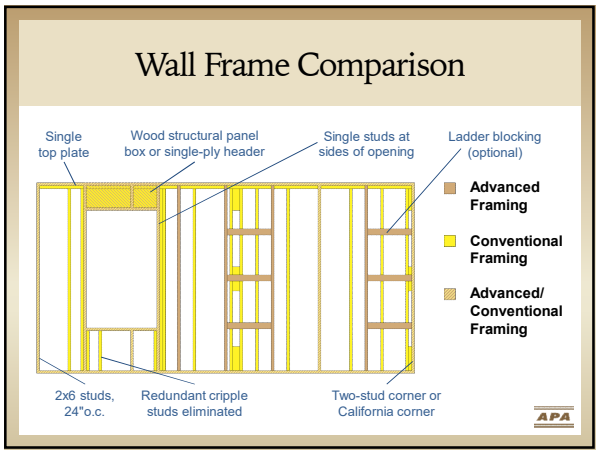
CONVENTIONAL FRAMING: 2x4 Studs at 16" o.c., Double top plate, 3-Stud corners, 2-Stud 'T' junctions, Double 2x12 header on jack studs, Redundant cripples at ends of window sill plate



2x6 Advanced Framing
24" o.c. Member Spacing

ADVANCED FRAMING: 2x6 Studs at 24"o.c., Single top plate, 2-Stud corners, Ladder junctions, Wood structural panel headers, Single studs at sides of openings, Redundant cripples omitted




Wall Frame Comparison
Single top plate
Wood structural panel box or single-ply header
Single studs at sides of opening
Ladder blocking (optional)
Advanced Framing
Conventional Framing
Advanced/ Conventional Framing
2x6 studs, 24"o.c.
Redundant cripple studs eliminated
Two-stud corner or California corner
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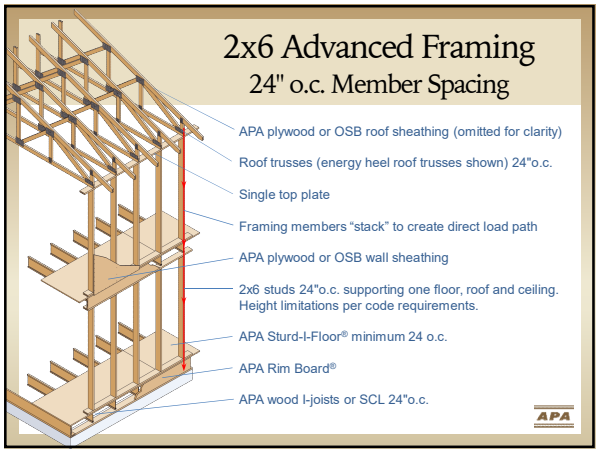
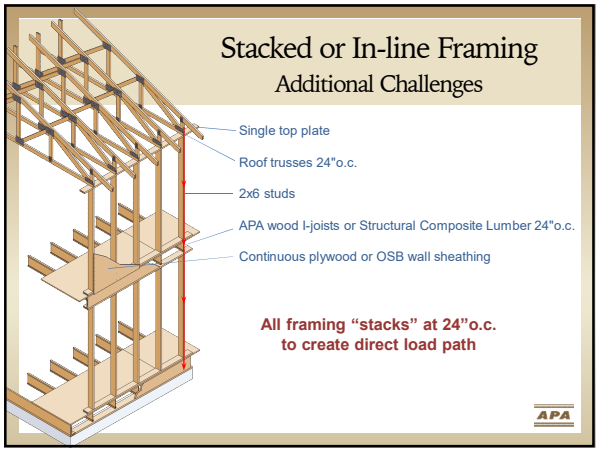
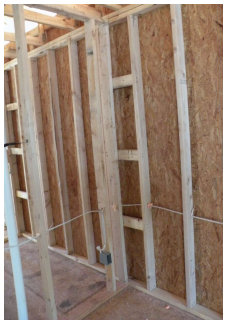

2x6 Advanced Framing
24" o.c. Member Spacing
APA plywood or OSB roof sheathing (omitted for clarity)
Roof trusses (energy heel roof trusses shown) 24"o.c.
Single top plate
Framing members "stack" to create direct load path
APA plywood or OSB wall sheathing
2x6 studs 24"o.c. supporting one floor, roof and ceiling. Height limitations per code requirements.
APA Sturd-I-Floor® minimum 24 o.c.
APA Rim Board®
APA wood I-joists or SCL 24"o.c.
APA


Stacked or In-line Framing
Additional Challenges
Single top plate
Roof trusses 24"o.c.
2x6 studs
APA wood I-joists or Structural Composite Lumber 24"o.c.
Continuous plywood or OSB wall sheathing
All framing "stacks" at 24"o.c. to create direct load path
APA

Suite of Framing Techniques

- Advanced Framing is not a "take all or leave all" concept.
- Using any or some of the techniques is still "Advanced"
- The more holistic the approach, the more savings.



Agenda

- What is advanced framing?
- Why do people use it?
- The challenges
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Advantages of Advanced Framing

- Energy Efficiency
- Cost Effectiveness
- Structural Integrity
- Sustainability

Make It Right (Brad Pitt's New Orleans Project) builds safe, sustainable and affordable homes for working families. The wood-framed homes in the Make It Right project employ Advanced Framing.

Finding the Balance

Meeting Energy Codes

Burden is on the builder to produce homes that are:

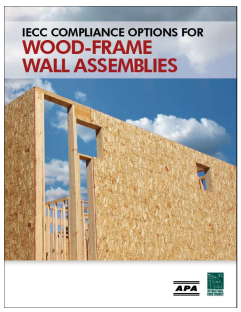
1. Cost-effective to build
2. Strong and safe
3. Energy efficient

Balancing Cost, Structure and Energy

The History of Energy Codes

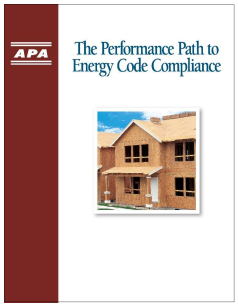
- The 2015 IECC is 4% more efficient than the 2012 IECC.

Meeting Energy Codes with Advanced Framing



- Joint publication between ICC and APA
- Advanced Framing options for meeting R20 or R13+5 insulation values
- Allows builders to use cheaper cavity insulation to meet IECC requirements

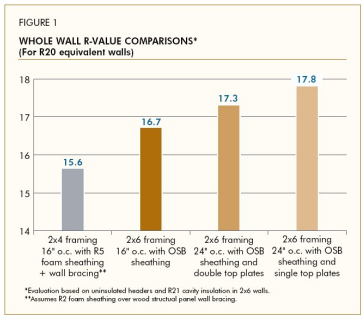
Performance Energy Code Publication



- Provides options to meet energy codes using the Simulated Performance Path or ERI Method
- Intended to be a guide to generate conversations between raters and builders

Energy Efficiency

- Maximize space for cavity insulation
- Minimize insulation voids
- Reduce thermal bridging



Energy Star 3
Thermal Enclosure System Rater Checklist

4.4 Reduced thermal bridging at above-grade walls separating conditioned from unconditioned space (rim/band joists exempted) using one of the following options:[12,13]

- 4.4.1 Continuous rigid insulation, insulated siding, or combination of the two ≥ R-3 in Climate Zones 1 to 4, ≥ R-5 in Climate Zones 5 to 8[14,15], **OR**;
- 4.4.2 Structural Insulated Panels (SIPs), **OR**;
- 4.4.3 Insulated Concrete Forms (ICFs), **OR**;
- 4.4.4 Double-wall Framing[16], **OR**;

Energy Star 3
Thermal Enclosure System Rater Checklist

4.4 Reduced thermal bridging at above-grade walls separating conditioned from unconditioned space (rim/band joists exempted) using one of the following options:[12,13]

- 4.4.5 Advanced Framing, including all of the items below

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Energy Star 3
Thermal Enclosure System Rater Checklist

4.4 Reduced thermal bridging at above-grade walls separating conditioned from unconditioned space (rim/band joists exempted) using one of the following options:[12,13]

- 4.4.5 Advanced Framing, including all of the items below:
- 4.4.5a All corners insulated ≥ R-6 to edge[17], **AND**;
- 4.4.5b All headers above windows & doors insulated[18], **AND**;
- 4.4.5c Framing limited at all windows and doors[19], **AND**;
- 4.4.5d All interior/exterior wall intersections insulated to same R-value as the rest of the exterior wall[20], **AND**;
- 4.4.5e Minimum stud spacing of 16" o.c. for 2x4 framing in all Climate Zones, and in Climate Zones 5 – 8, 24" o.c. for 2x6 framing *or* achieve R-20 Wall Assembly[21]

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Cost Effectiveness

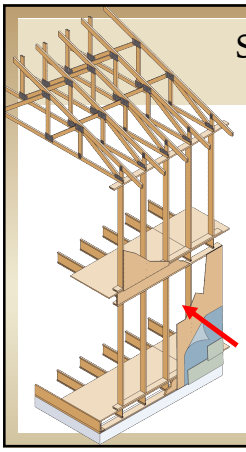
- More resource efficient than conventional framing
- Optimizing lumber usage reduces material costs
- Reduced framing labor
- Increase efficiency of other trades:
  - Fewer studs for plumbers and electricians to drill
  - Fewer cavities to fill
  - Less waste and dumpster costs

Agenda

- What is advanced framing?
- Why do people use it?
- The challenges
  - Homeowner perception
  - Coordination with other trades
  - Different than normal is hard
- Summary

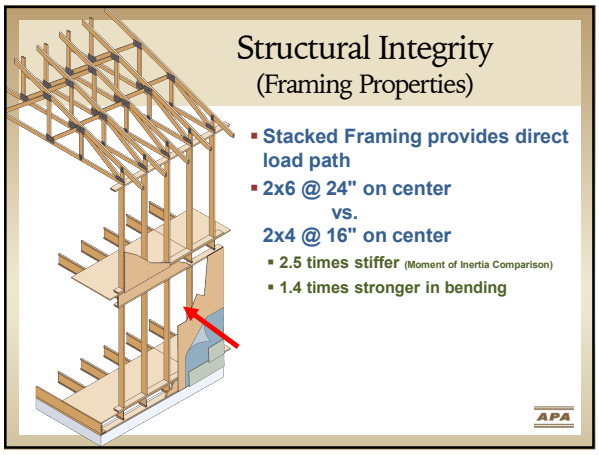
The Challenges

- Homeowner Perception: "My walls aren't as strong!"



Structural Integrity
(Framing Properties)

- Stacked Framing provides direct load path
- 2x6 @ 24" on center
  vs.
  2x4 @ 16" on center


Structural Integrity
(Framing Properties)
Stacked Framing provides direct load path
2x6 @ 24" on center
vs.
2x4 @ 16" on center
2.5 times stiffer (Moment of Inertia Comparison)
1.4 times stronger in bending
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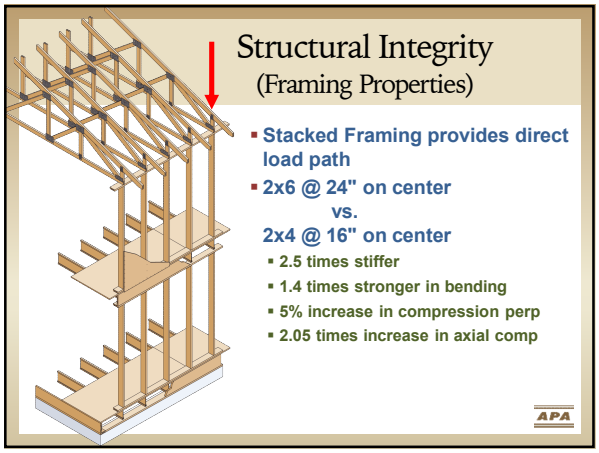
Structural Integrity
(Framing Properties)
Stacked Framing provides direct load path
2x6 @ 24" on center
vs.
2x4 @ 16" on center
2.5 times stiffer
1.4 times stronger in bending
5% increase in compression perp
2.05 times increase in axial comp
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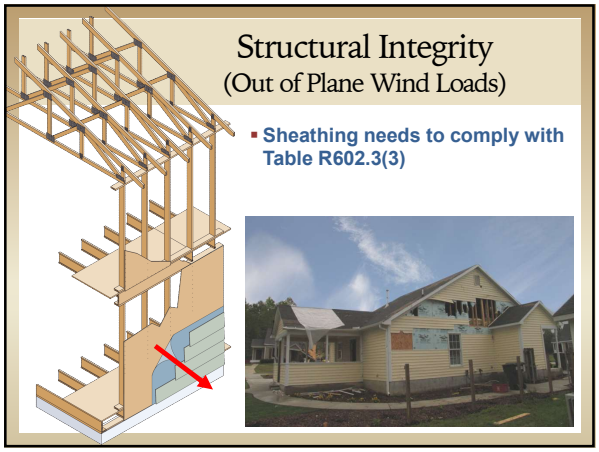
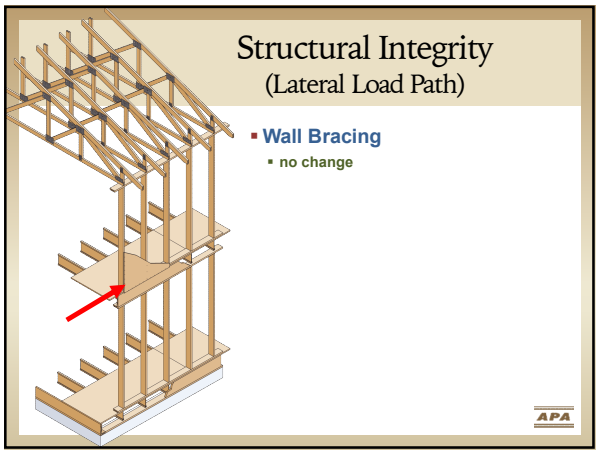

Structural Integrity
(Out of Plane Wind Loads)
Sheathing needs to comply with Table R602.3(3)


Structural Integrity
(Lateral Load Path)
Wall Bracing
no change
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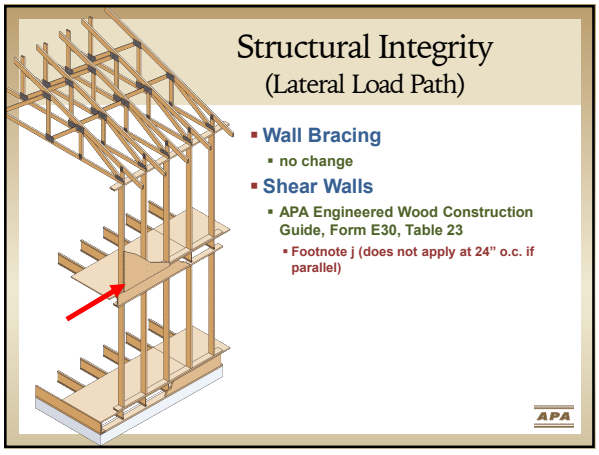
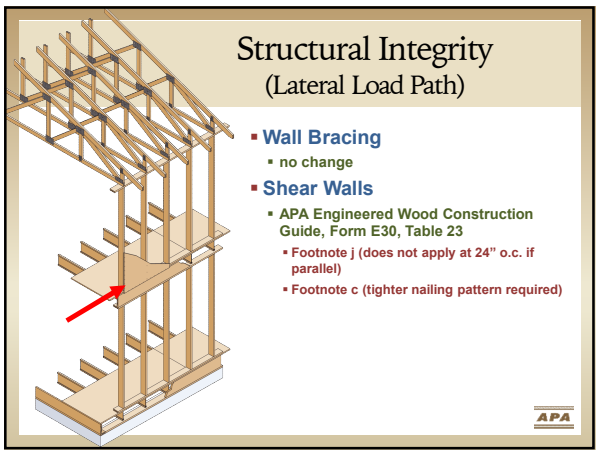
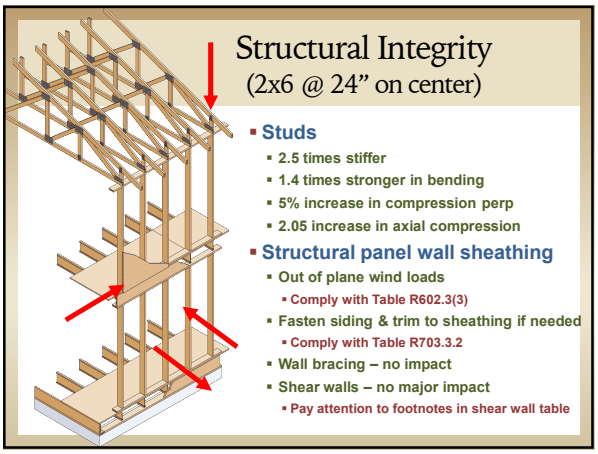
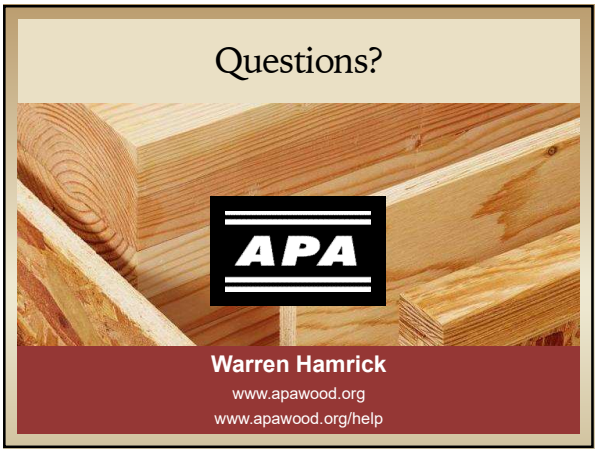

Structural Integrity
(Lateral Load Path)
Wall Bracing
no change
Shear Walls
APA Engineered Wood Construction Guide, Form E30, Table 23
Footnote j (does not apply at 24" o.c. if parallel)
APA


Structural Integrity
(Lateral Load Path)
Wall Bracing
no change
Shear Walls
APA Engineered Wood Construction Guide, Form E30, Table 23
Footnote j (does not apply at 24" o.c. if parallel)
Footnote c (tighter nailing pattern required)
APA


Structural Integrity
(2x6 @ 24" on center)
Studs
2.5 times stiffer
1.4 times stronger in bending
5% increase in compression perp
2.05 increase in axial compression
Structural panel wall sheathing
Out of plane wind loads
Comply with Table R602.3(3)
Fasten siding & trim to sheathing if needed
Comply with Table R703.3.2
Wall bracing – no impact
Shear walls – no major impact
Pay attention to footnotes in shear wall table


Questions?
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www.apawood.org
www.apawood.org/help


The Challenges
Coordination with trades
Designers
Framers
Insulation, siding, and trim
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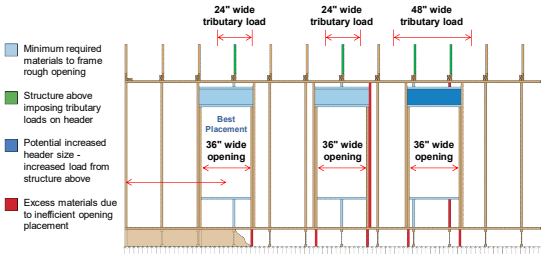
Rough Opening Placement

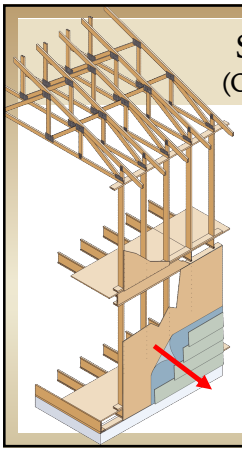
The placement of openings in load-bearing walls and the layout of framing members above openings have significant impact on header sizing for advanced framing.



Note: Jack studs may not be required if using wood structural panel headers.

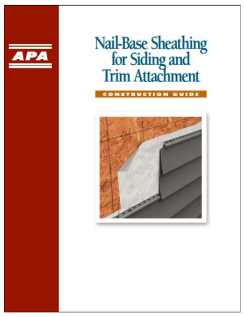
Keep Spacing Consistent

Structural Integrity
(Out of Plane Wind Loads)



- Sheathing needs to comply with Table R602.3(3)

Structural Integrity
(Out of Plane Wind Loads)



- **Sheathing needs to comply with Table R602.3(3)**
- **Siding fasted to sheathing only: Comply with Table R703.3.2**

Structural Integrity
(Out of Plane Wind Loads)

TABLE 1

Fastener Substitution Schedule for Nail-Base Sheathing[a][b][c]

Fastener Diameter	Fastener Type	Sheathing Performance Category				
		3/8	7/16	15/32	1/2	19/32
Use same diameter for all types of fastener as the smooth-shank nail diameter recommended by siding manufacturer	Smooth- or screw-shank nails	4:1 (use 3 additional fasteners per specified fastener spacing)	3:1 (use 2 additional fasteners per specified fastener spacing)	3:1 (use 2 additional fasteners per specified fastener spacing)	3:1 (use 2 additional fasteners per specified fastener spacing)	3:1 (use 2 additional fasteners per specified fastener spacing)
	Ring-shank nails[d]	1:1	1:1	1:1	1:1	1:1
	Wood screws[d]	1:1	1:1	1:1	1:1	1:1

Notes:
(a) The table above is based on the siding manufacturer's installation recommendations for 1.25-inch penetration into spruce-pine-fir lumber framing by smooth-shank nails.
(b) The table above is based on the use of a siding product with a weight of not more than 3 psf.
(c) Additional nails may be required if the siding manufacturer's installation recommendations are based on framing lumber with a specific gravity (SG) greater than 0.42.
(d) Use same number of fasteners and fastener spacing recommended by the siding manufacturer for fastening to studs.

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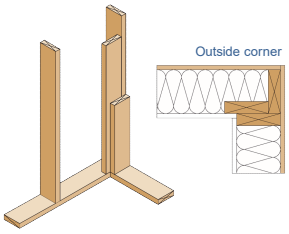
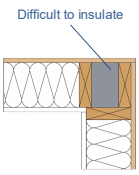
Three-stud Corners

Insulated Three-stud Corner (California Corner)



Traditional Corner



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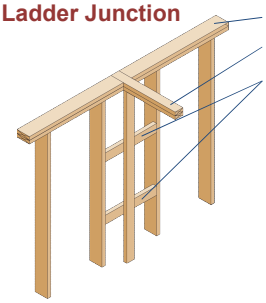
Interior Wall
Intersection Options

Ladder Junction



Double top plate

Interior wall

2x ladder blocking at 24"o.c.

Install blocking with wide face vertical for maximum backing to wall finish and for maximum insulation in exterior walls.

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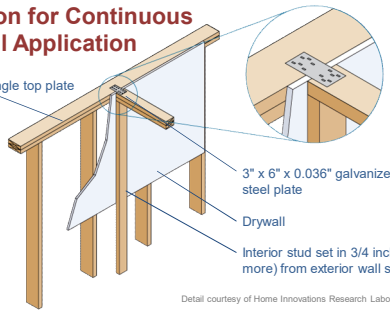
Interior Wall
Intersection Options

Junction for Continuous Drywall Application



Double or single top plate

3" x 6" x 0.036" galvanized steel plate

Drywall

Interior stud set in 3/4 inch (or more) from exterior wall studs

Detail courtesy of Home Innovations Research Laboratory

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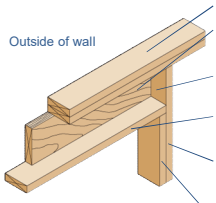
Engineered Wood & Lumber Headers

Single-Ply Header at Top Plate



Outside of wall

Top plate

Single-ply load-bearing header (flush outer face of header with outer edge of studs)

Cavity insulation space (to stud depth less single header thickness)

Header bottom plate (to complete rough opening at header)

For many openings 4 feet wide or less in one-story buildings, single studs at sides of rough openings may be adequate. 2012 IRC Table R502.5(1).

Jack stud or approved framing connector 2012 IRC Tables R502.5(1) & R502.5(2)

2012 IRC Section R602.7.1

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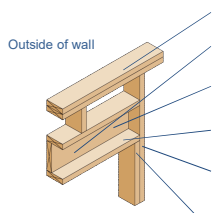
Engineered Wood & Lumber Headers

Single-Ply Header with Cripple



Top plate

Single-ply load-bearing header
(flush outer face of header with outer edge of studs)

Cavity insulation space
(to stud depth less single header thickness)

Header bottom plate
(to complete rough opening at header)

For many openings 4 feet wide or less in one-story buildings, single studs at sides of rough openings may be adequate. 2012 IRC Table R502.5(1).

Jack stud or approved framing connector
2012 IRC Tables R502.5(1) & R502.5(2)

2012 IRC Section R602.7.1

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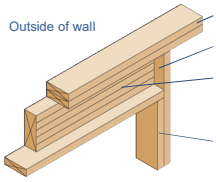
Engineered Wood & Lumber Headers

Large Opening Single Headers



Top plate

Cavity insulation space

3-1/8" or 3-1/2" glued laminated timbers (glulam), or multiple-ply structural composite lumber (SCL), or sawn lumber header

Jack studs as required

2012 IRC Section R602.7.1

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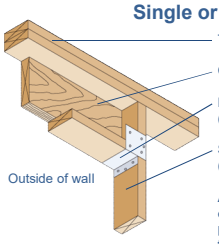
Engineered Wood & Lumber Headers

Approved Framing Connector Option
Single or Double-ply Headers



Top Plate

Cavity insulation space

Header hanger
(such as Simpson Strong-Tie HH or equivalent)

Single stud at sides of rough openings
(most openings up to 48" wide)

Alternate Header Connection: Where the number of required jack studs equal one, the header is permitted to be supported by an approved framing anchor attached to the full-height wall stud and to the header.

2012 IRC Section R602.7.1

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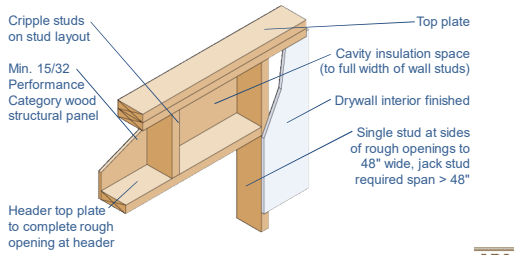
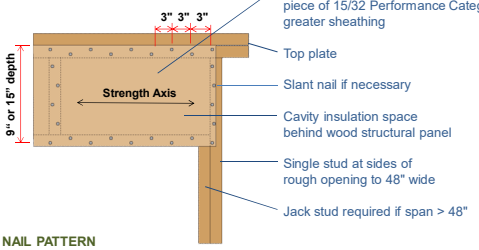
Wood Structural Panel Box Header for Load-Bearing Walls

One-sided Wood Structural Panel Box Header



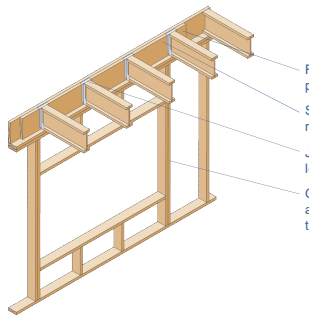
Wood Structural Panel Box Header for Load-Bearing Walls

Nail Pattern



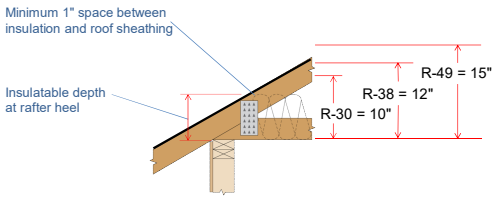
NAIL PATTERN
2012 IRC, Table R602.7.2
8d common nails minimum 3"o.c. spacing stagger nails ½"

Integrated Rim Headers



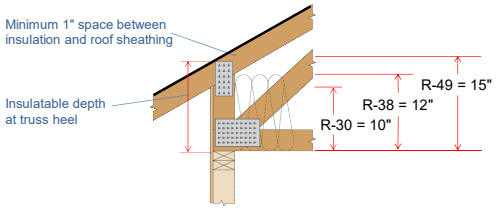
Ceiling Frame – Attic Insulation

Typical Attic Insulation with "Regular Heel"



Ceiling Frame – Attic Insulation

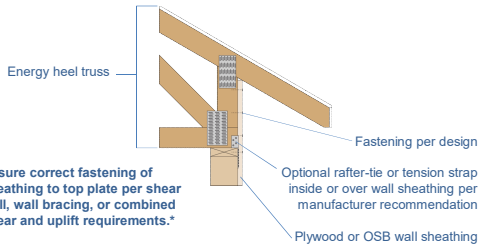
Typical Attic Insulation with "Energy Heel"



2009 IRC, N1102.2.1 or 2009 IECC, 402.2.1 Ceilings with attic spaces. When Section N1102.1 would require R-38 in the ceiling, R-30 shall be deemed to satisfy the requirement for R-38 whenever the full height of uncompressed R-30 insulation extends over the wall top plate at the eaves. Similarly, R-38 shall be deemed to satisfy the requirement for R-49…….

Energy Heel Truss to Wall

Wood Structural Panel Overlap



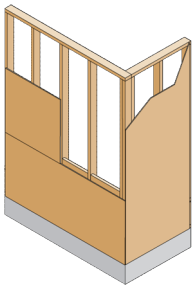
Ensure correct fastening of sheathing to top plate per shear wall, wall bracing, or combined shear and uplift requirements.*

*See rafter-tie manufacturer's instructions for installation of strap over sheathing and into framing.

Wall Sheathing Installation

Recommendations for 24" o.c. studs

- Fasten panels as recommended with 8d nails
  - 6" o.c. at all panel edges
  - 12" o.c. in the field
- Space panels 1/8" at all panel ends and edges
- Use minimum 7/16 category panels
- Some OSB panels alter strength-axis orientation to allow vertical placement with strength axis across studs



APA

Keep Spacing Consistent

APA

Recommended WSP for Stucco Exterior Finish

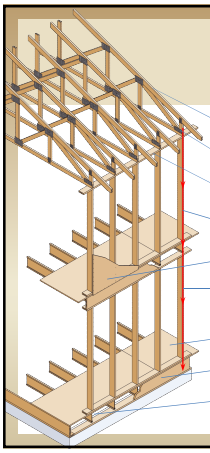
Stud Spacing	Panel Orientation	APA Rated Sheathing	
		Performance Category	Span Rating
16"	Horizontal	3/8	24/0
	Vertical	7/16 Structural 1 OSB	24/16
		15/32, 1/2 5-ply or OSB	32/16
24"	Horizontal	7/16	24/16
	Vertical	19/32, 5/8 5-ply or OSB	40/20

- Blocking recommended between studs along horizontal panel joints

APA

The Challenges

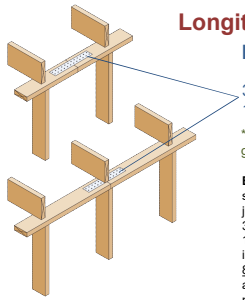
- **Different is hard**



2x6 Advanced Framing
24" o.c. Member Spacing

- APA plywood or OSB roof sheathing (omitted for clarity)
- Roof trusses (energy heel roof trusses shown) 24"o.c.
- Single top plate
- Framing members "stack" to create direct load path
- APA plywood or OSB wall sheathing
- 2x6 studs 24"o.c. supporting one floor, roof and ceiling. Height limitations per code requirements.
- APA Sturd-I-Floor® minimum 24 o.c.
- APA Rim Board®
- APA wood I-joists or SCL 24"o.c.

Single Top Plate Connections



Longitudinal Top Plate Splice

Prescriptive Connection

3" x 12" x 0.036" Galvanized steel plate
12- 8d (2-1/2" x 0.113") Nails each side*

*Plate size and number of fasteners required is greater than 2009 International Residential Code.

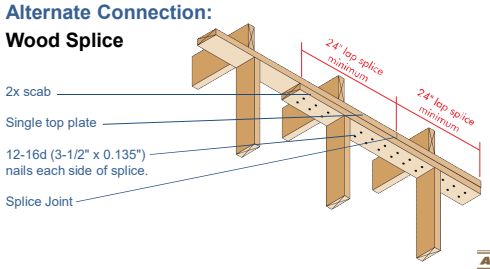
Exception: A single top plate may be installed in stud walls, provided the plate is adequately tied at joints, corners and intersecting walls by a minimum 3-inch-by-6-inch by a 0.036-inch-thick (76 mm by 152 mm by 0.914 mm) galvanized steel plate that is nailed to each wall or wall segment of wall by six 8d nails on each side, provided the rafters or joists are centered over the studs with a tolerance of no more than 1 inch(25 mm).

Single Top Plate Connections

Longitudinal Top Plate Splice

Alternate Connection:

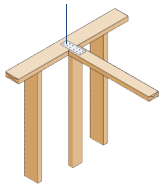
Wood Splice



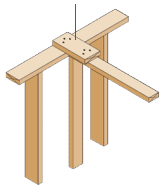
Single Top Plate Connections

Intersecting Wall Connection

Prescriptive Connection
3" x 6" x 0.036" galvanized steel plate
6-8d (2-1/2" x 0.113") nails each side
2012 IRC, Section R602.3.2



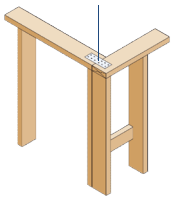
Alternate Connection
2x6 lumber splice
2-10d (3" x 0.128") nails each side
2012 IRC, Table R602.3(1), Item 19



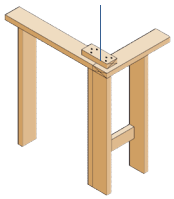
Single Top Plate Connections

Corner Framing

Prescriptive Connection
3" x 6" x 0.036" galvanized steel plate
6-8d (2-1/2" x 0.113") nails each side
2012 IRC, Section R602.3.2

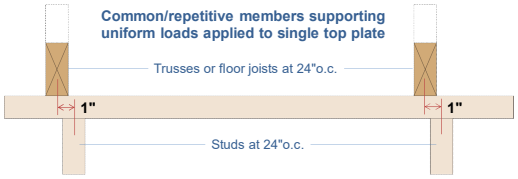


Alternate Connection
2x6 lumber splice
2-10d (3" x 0.128") nails each side
2012 IRC, Table R602.3(1), Item 19



Single Top Plate
Offsets

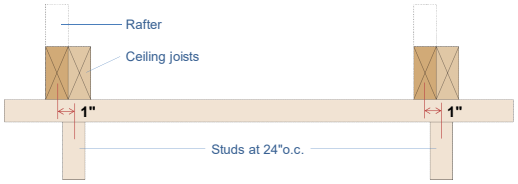
Prescriptive Member Placement for Single Top Plate Wall Construction



2012 IRC Section R602.3.2 Top plate. Wood studs shall be capped with a double top plate...
Exception: A single top plate may be installed in stud walls…provided the rafters or joists are centered over the studs with a tolerance of no more than 1 inch…

Single Top Plate
Offsets

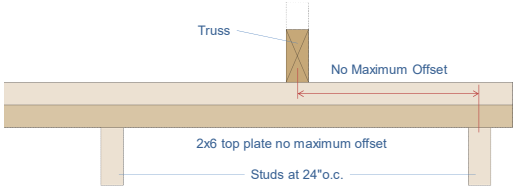
Prescriptive Member Placement for Single Top Plate Wall Construction



2012 IRC Section R602.3.2 Top plate. Wood studs shall be capped with a double top plate...
Exception: A single top plate may be installed in stud walls…provided the rafters or joists are centered over the studs with a tolerance of no more than 1 inch…

Double Top Plate Offsets
(2x6 Framing)

Prescriptive Member Placement for Double Top Plates with 2x6 Walls

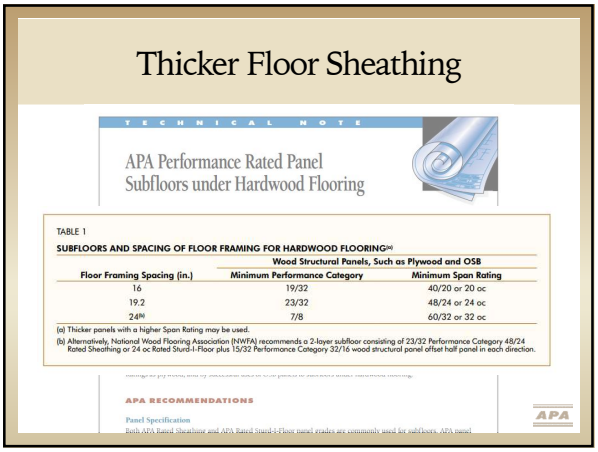


2012 IRC Section R602.3.3 Bearing studs. Where joists, trusses or rafters are spaced more than 16 inches o.c. and the bearing studs below are spaced 24 inches o.c., such members shall bear within 5 inches of studs beneath.
Exception: 1. The top plates are two 2x6 inch or two 3x4 members.

Floor Joists at 24” o.c.

Floor Joists at 24” o.c.

Thicker Floor Sheathing



TECHNICAL NOTE

APA Performance Rated Panel Subfloors under Hardwood Flooring

TABLE 1

SUBFLOORS AND SPACING OF FLOOR FRAMING FOR HARDWOOD FLOORING[a,b]

	Wood Structural Panels, Such as Plywood and OSB	
Floor Framing Spacing (in.)	Minimum Performance Category	Minimum Span Rating
16	19/32	40/20 or 20 oc
19.2	23/32	48/24 or 24 oc
24[a]	7/8	60/32 or 32 oc

(a) Thicker panels with a higher Span Rating may be used.

(b) Alternatively, National Wood Flooring Association (NWFA) recommends a 2-layer subfloor consisting of 23/32 Performance Category 48/24 Rated Sheathing or 24 oc Rated Sturd-I-Floor plus 15/32 Performance Category 32/16 wood structural panel offset half panel in each direction.

APA RECOMMENDATIONS

Panel Specification

Both APA Rated Sheathing and APA Rated Sturd-I-Floor panel grades are commonly used for subfloors. APA panel

Thicker Floor Sheathing

Lighter Walls

Phasing In Advanced Framing

1. Switch to 2x6 studs to increase cavity insulation depth and R20 energy code requirements.
2. Change wall framing module from 16" o.c. to 24" o.c. Retain the use of double top plates to avoid in-line framing.
3. Incorporate intersecting wall techniques and energy efficient corners, beginning with three-stud corners, that allow for greater insulation volume. Implement energy-efficient headers and single-member framing around openings.
4. Eliminate double top plates.

Agenda

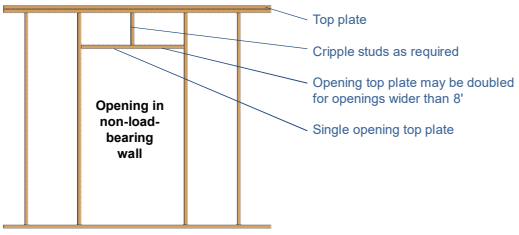
- What is advanced framing?
- Why do people use it?
- The challenges
- Summary

Listen to the Culture of Lean

Having the right culture is the key to making lean work in an organization. To demonstrate what a culture of commitment looks like, Scott Sedam profiles builders that truly "get it" when in comes to Lean operation.

Openings Non-Load-Bearing Walls

Conventional Headers Not Required

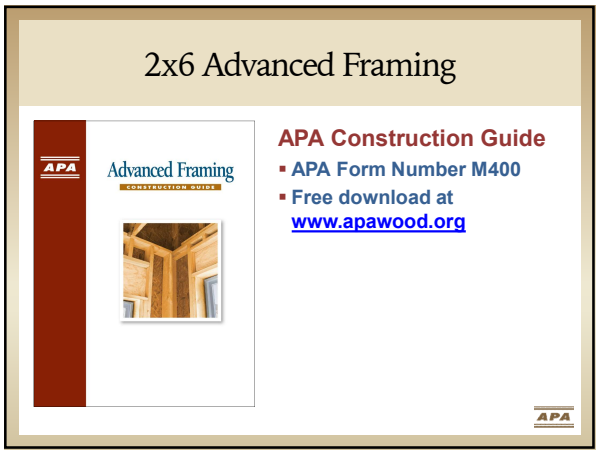


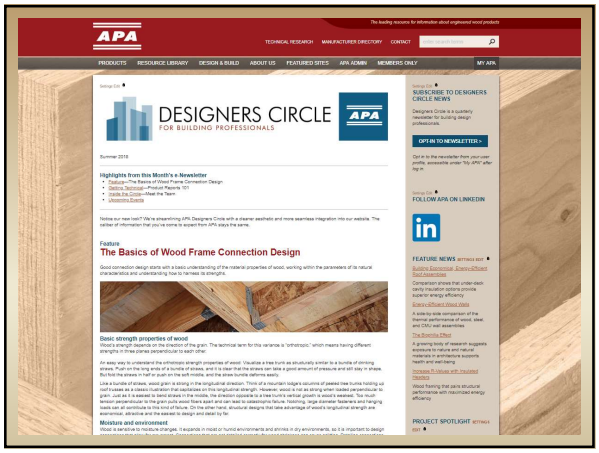
Note: Use jack studs as required.

Not Advanced Framing

Utilize Scrap Material

Case Study


2x6 Advanced Framing
APA
Advanced Framing
CONSTRUCTION GUIDE
APA Construction Guide
APA Form Number M400
Free download at
www.apawood.org
APA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FOR BUILDING PROFESSIONALS
Highlights from this Month's e-Newsletter
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The Basics of Wood Frame Connection Design
Basic strength properties of wood
Moisture and environment
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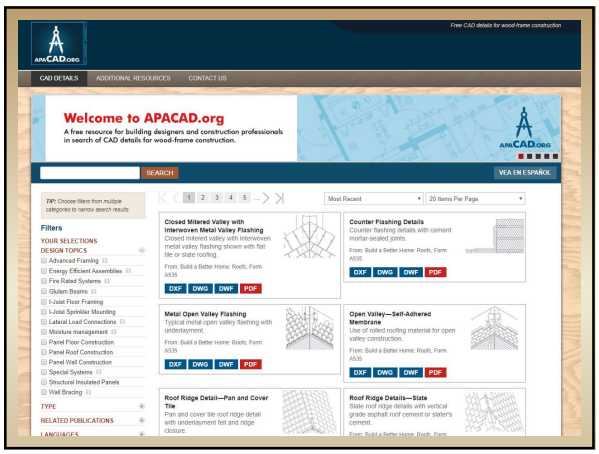
FEATURE NEWS
PROJECT SPOTLIGHT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Open Valley—Self-Adhered Membrane
Roof Ridge Detail—Pan and Cover Tile
Roof Ridge Details—Slate

Questions?

Warren Hamrick
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APA Update Newsletter (www.apawood.org)

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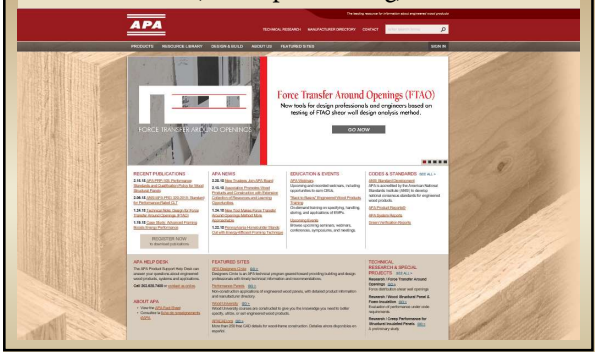

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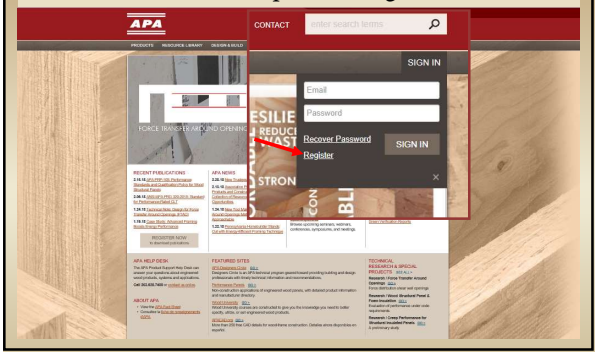
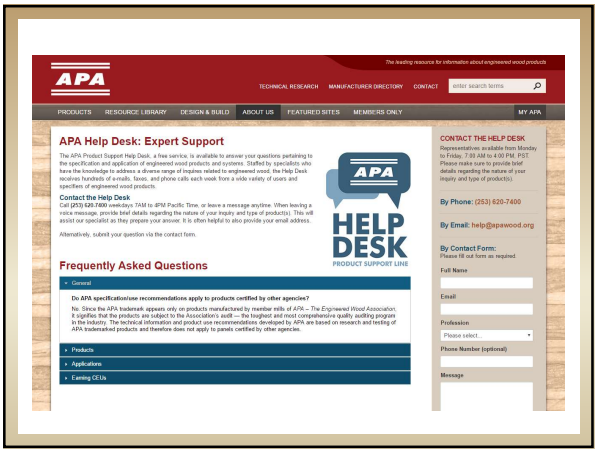
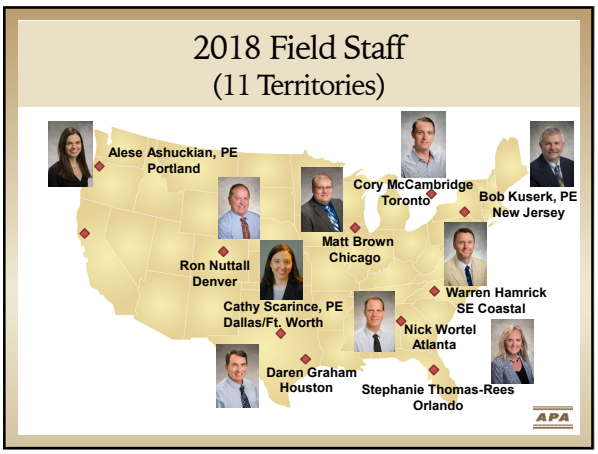
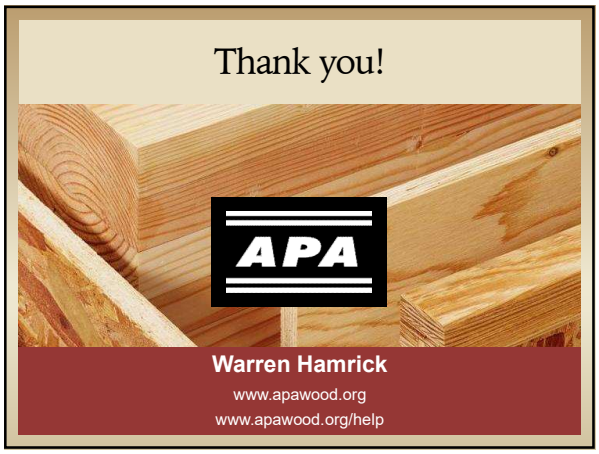




2018 Field Staff
(11 Territories)

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Warren Hamrick
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