


**APA**

**Lateral Load Path Basics II:  
Tracing a Seismic Load Through a Wood Framed Structure**



**By Aleeta Dene, P.E.**

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

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**Webinar Attendee Survey**



**Aleeta Dene, PE**



<https://www.apawood.org/lateral-load-path-seismic-survey>

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### Learning Objectives

- Understand the basic lateral load path through a simple building.
- Recognize basic components of the lateral load resisting system in wood buildings.
- Comprehend the role of various connections in completing the lateral load path.
- Understand the consequences of an incomplete load path.

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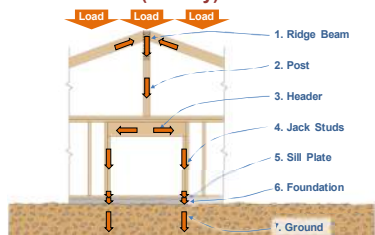
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### Load Path Basics

#### Vertical (Gravity) Load Path



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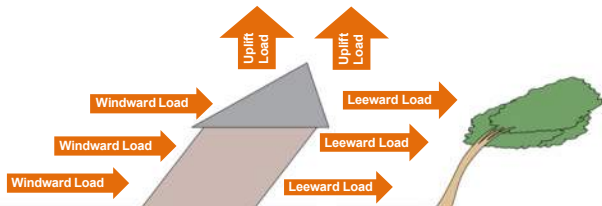
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### Load Path

Lateral load path is not intuitive...



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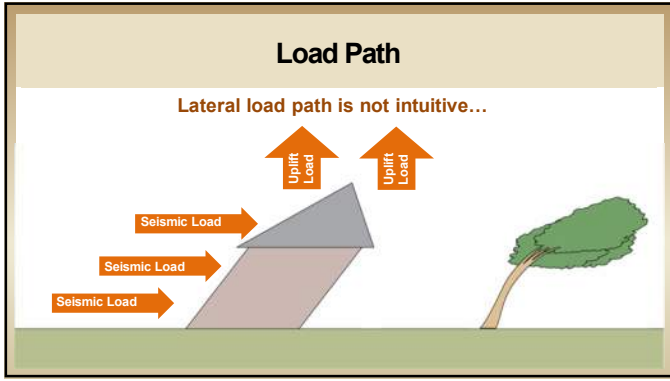
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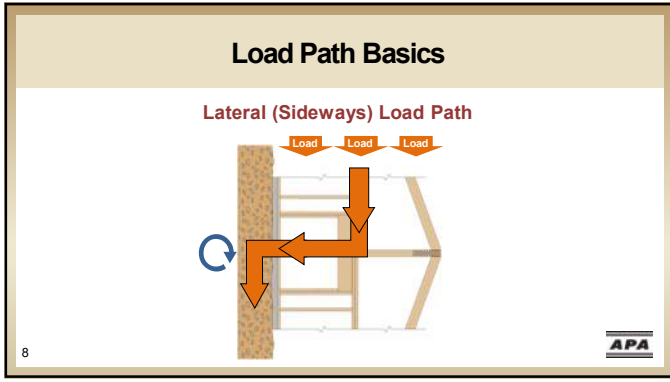
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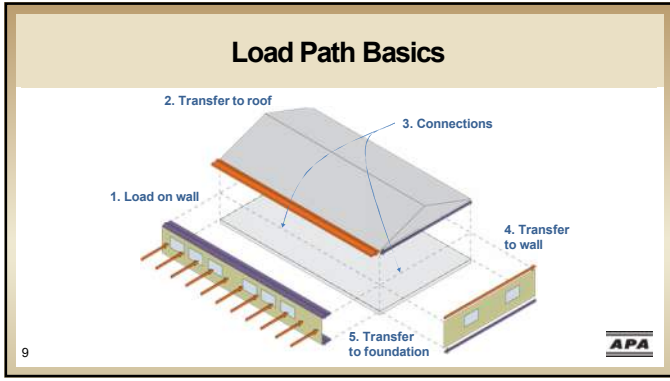
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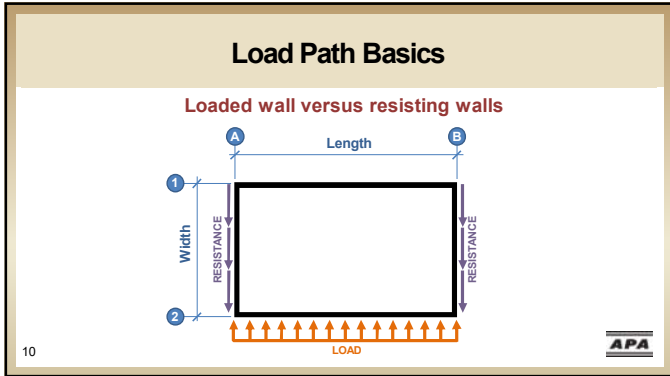
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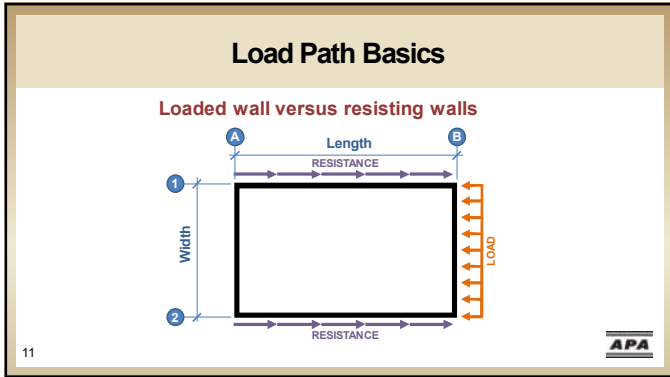
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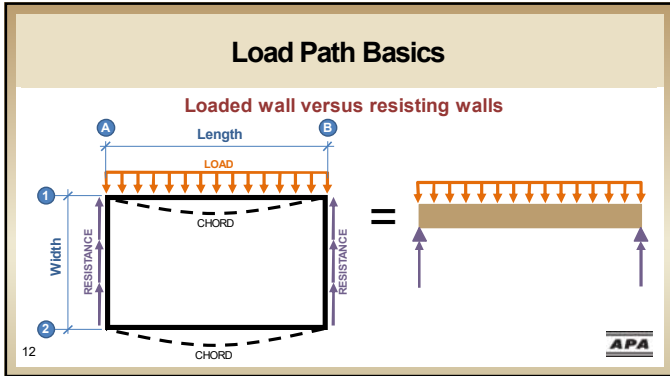
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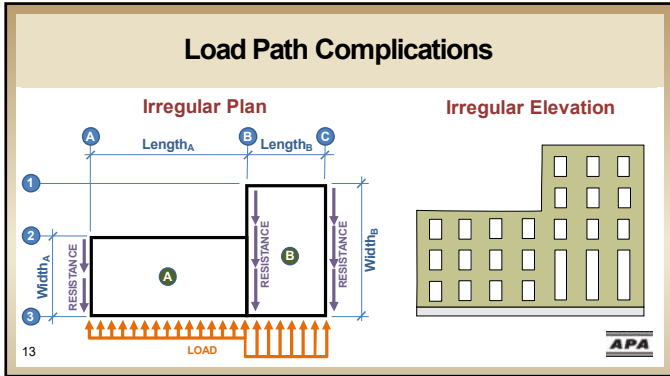
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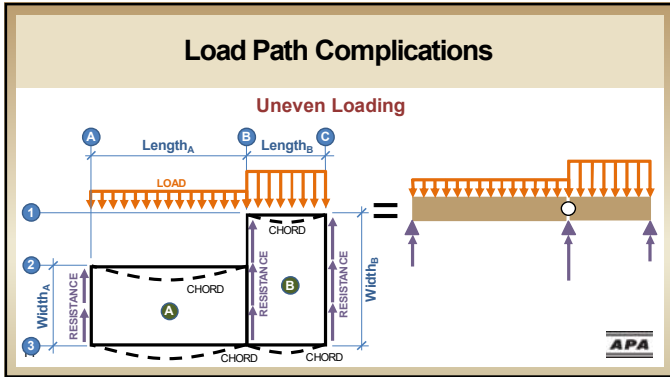
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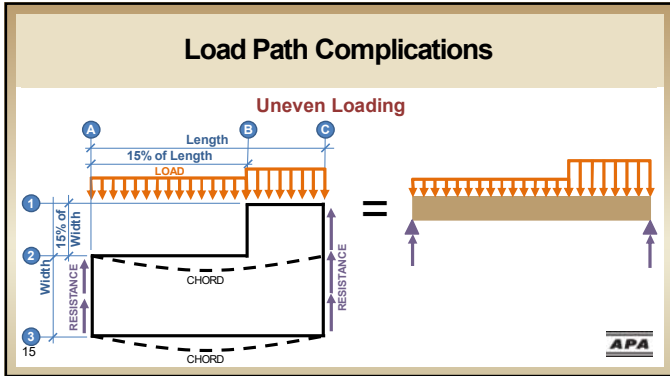
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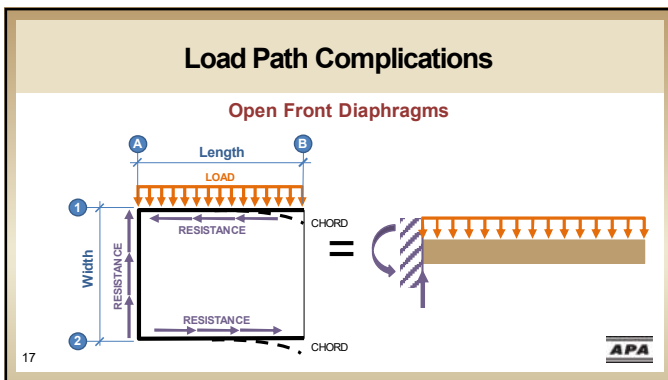
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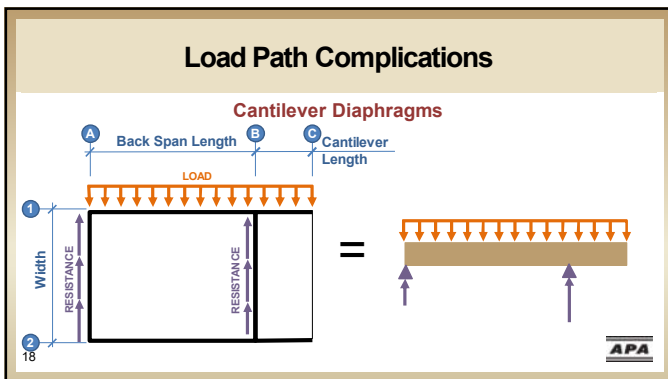
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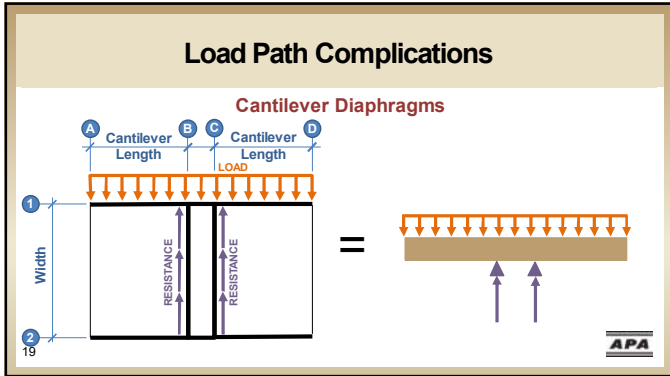
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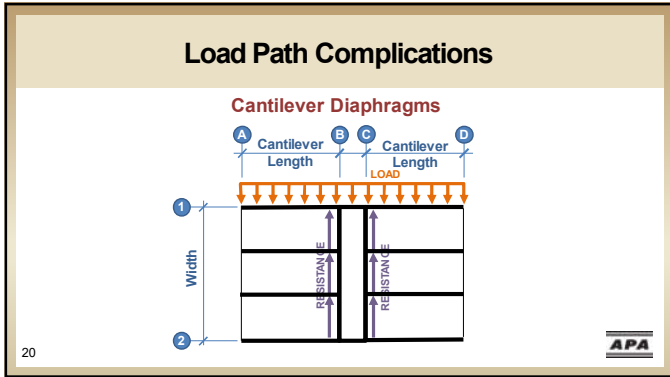
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### Load Path Complications: Flexible v. Rigid

**How rigid is the diaphragm?**

- Traditionally: light frame = flexible
- Diaphragm rigidity based on relative stiffness

Note: Diaphragm is flexible if  $MDD > 2ADVE$

FIGURE 12.3-1 FLEXIBLE DIAPHRAGM

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### Load Path Complications: Flexible v. Rigid

**What's the difference?**

- Torsion
- Force Distribution
- Collector Load
- Connection Load

**FLEXIBLE**                      **RIGID**

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### Load Path Complications: Flexible v. Rigid

Stiffness	K	2K	K
Flexible	$.25wL$	$.50wL$	$.25wL$
Rigid (no Torsion)	$.25wL$	$.50wL$	$.25wL$

$L/2$                        $L/2$

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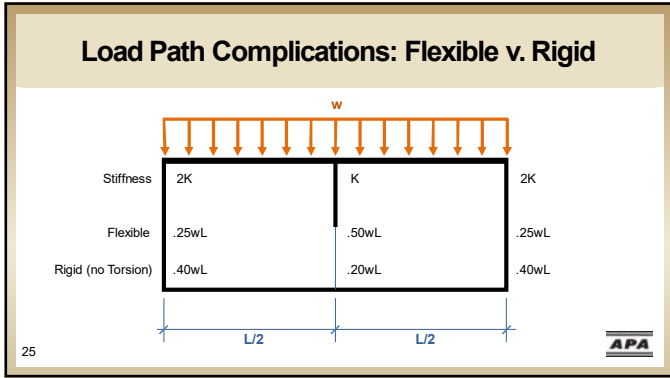
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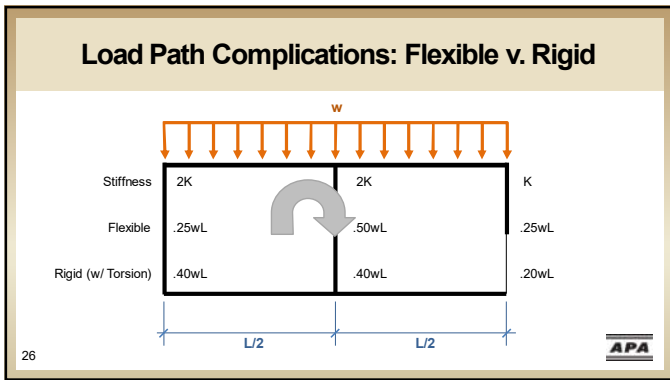
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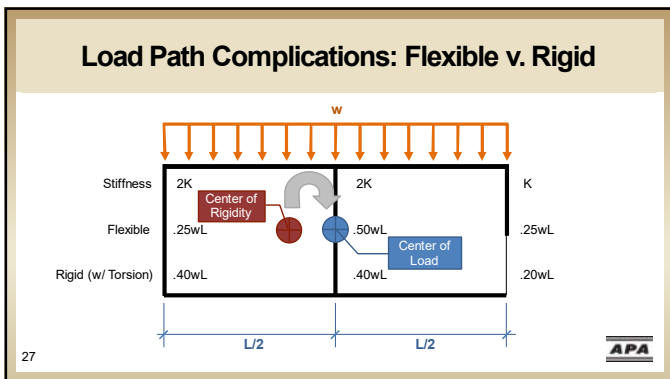
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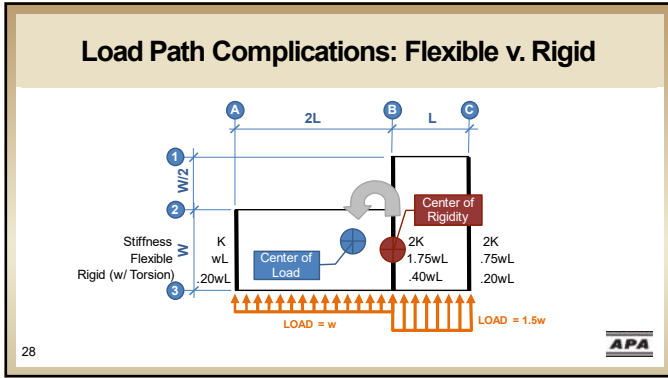
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### Load Path Complications

**So What?**

- Torsion means ALL the walls are participating
- Envelope approach = Rigid + Flexible
  - Higher shear wall loads
  - Higher connection loads

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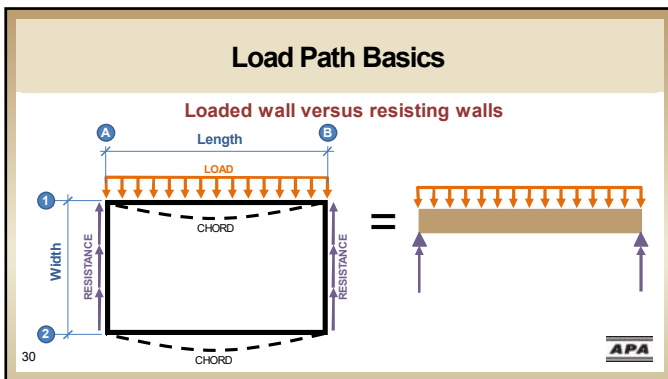
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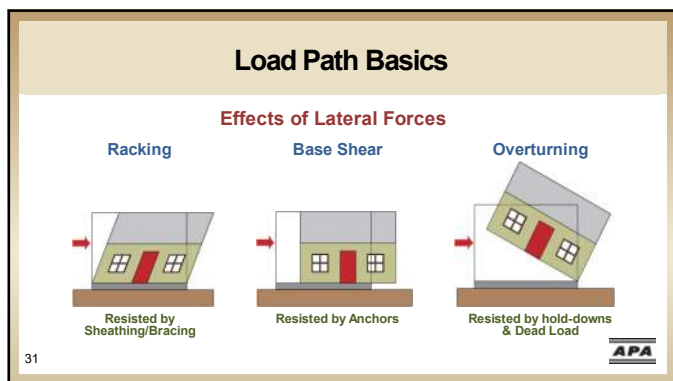
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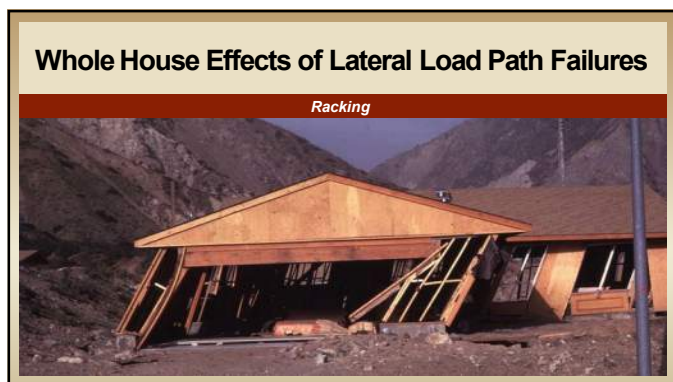
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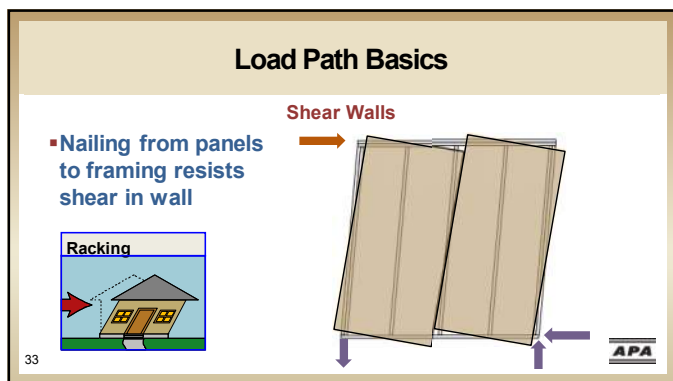
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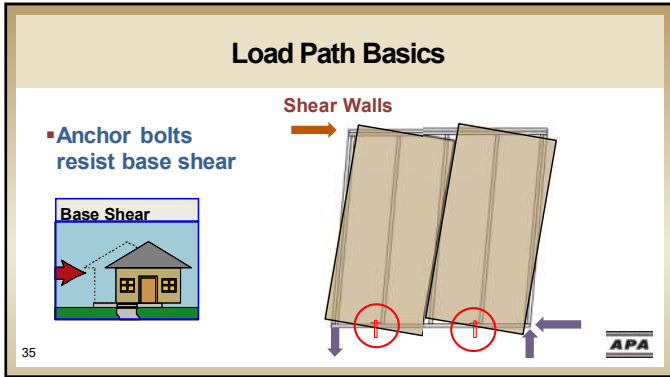
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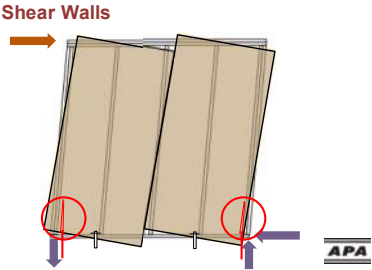
### Load Path Basics

- Hold downs resist overturning

Overturning



Shear Walls



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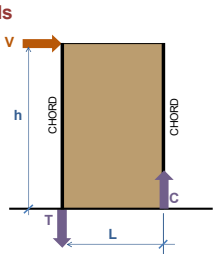
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### Load Path Basics

- Similar to diaphragm
  - Sheathing
  - Blocking
  - Chords
- Higher aspect ratio = higher deflection

Shear Walls



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### Load Path Complications

Vertical Complications:

- Stepped Diaphragm
- Discontinuous Collector Lines
- Discontinuous Shear Wall

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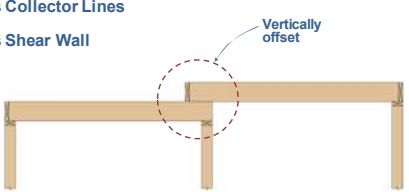
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### Load Path Complications

**Vertical Complications:**

- ✓ Stepped Diaphragm
- Discontinuous Collector Lines
- Discontinuous Shear Wall



Vertically offset

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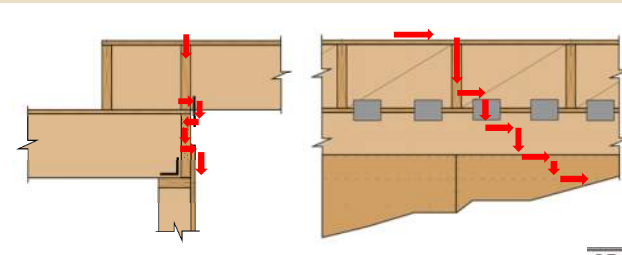
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### Load Path Complications



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### Load Path Complications

**Vertical Complications:**

- ✓ Stepped Diaphragm
- ✓ Discontinuous Collector Lines
- Discontinuous Shear Wall



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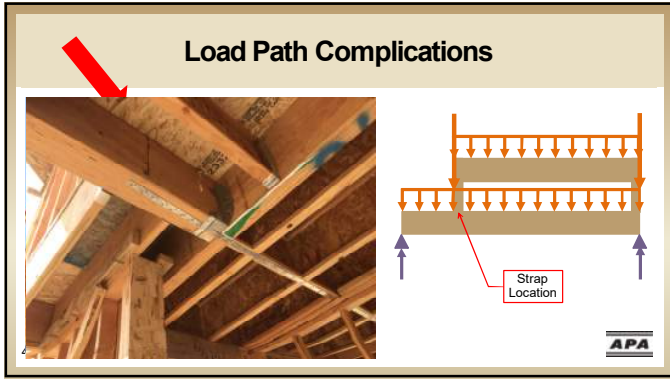
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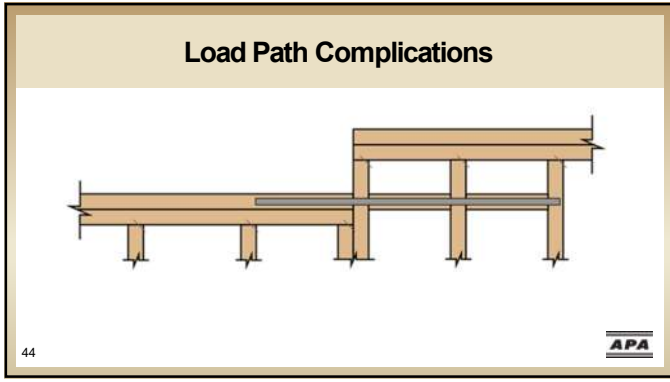
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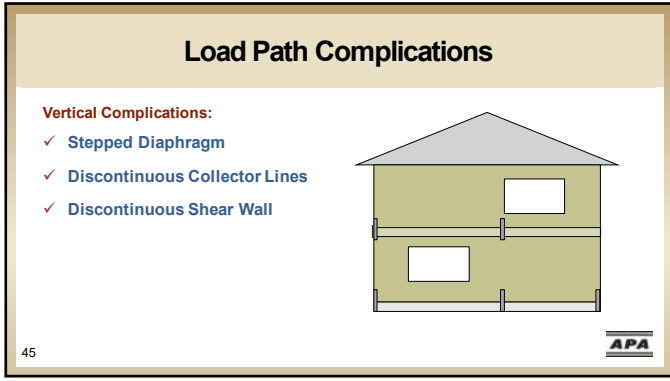
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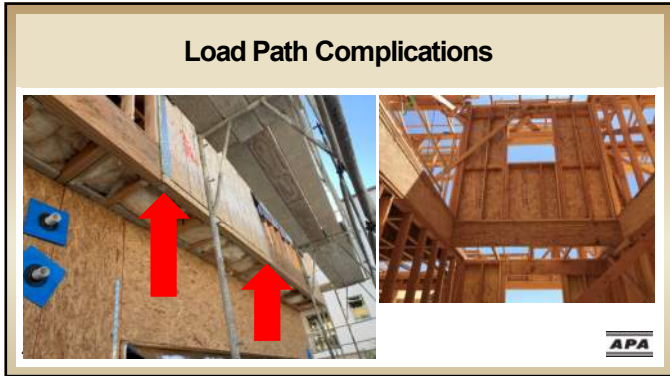
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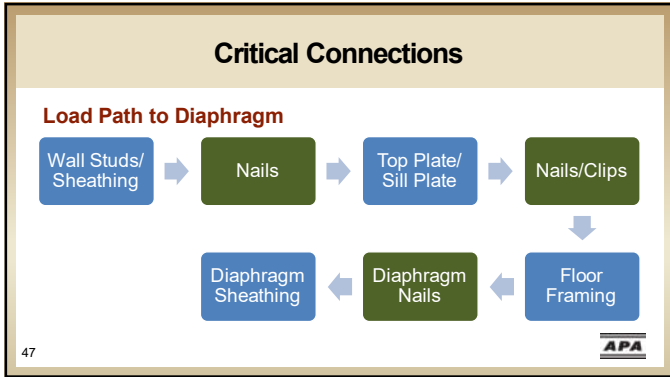
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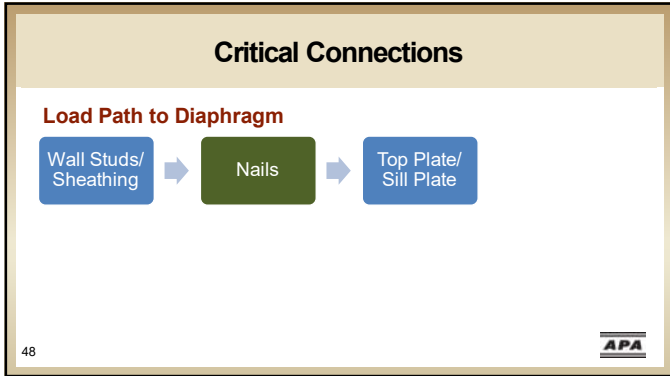
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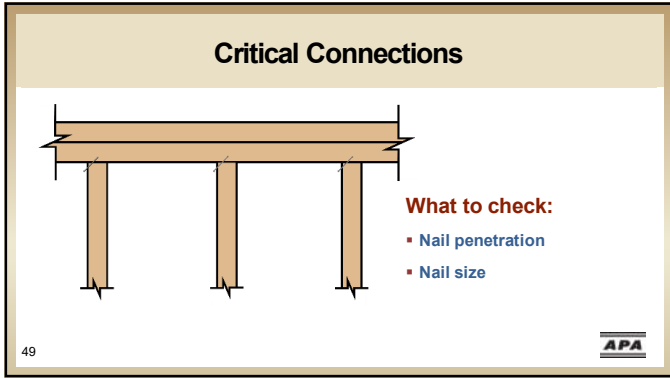
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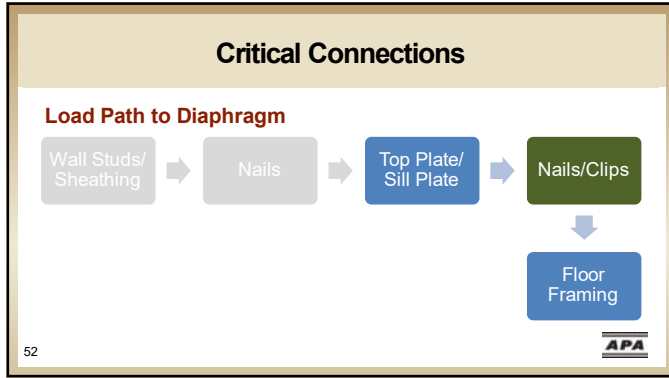
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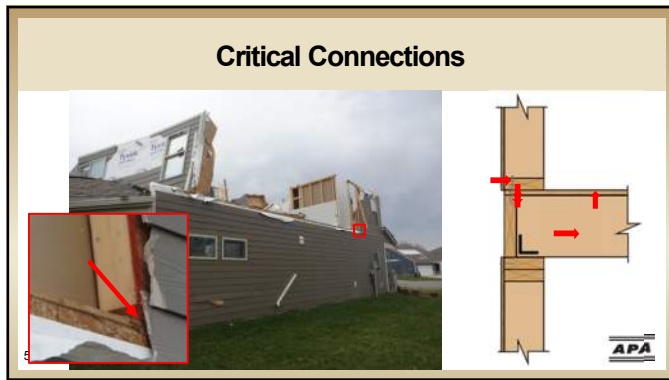
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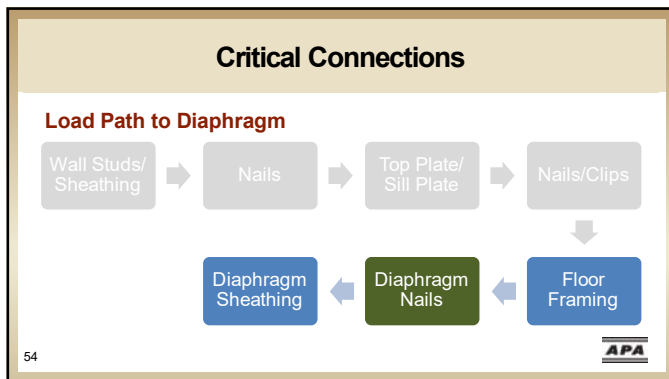
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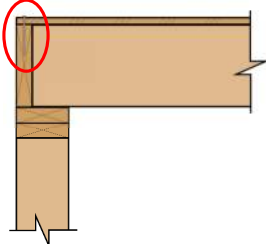
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### Critical Connections: Diaphragm



**What to check:**

- Sheathing nailing size & spacing
- Blocking requirement
- Tight to framing
- Overdriven nails
- Edge distance

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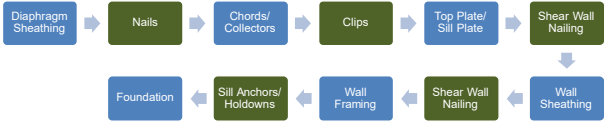
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### Critical Connections: Shear Walls

#### Shear Wall Load Path



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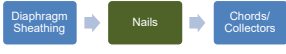
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### Critical Connections: Shear Walls

#### Shear Wall Load Path



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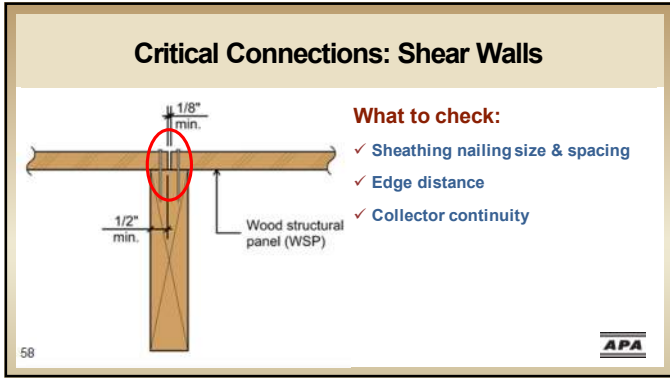
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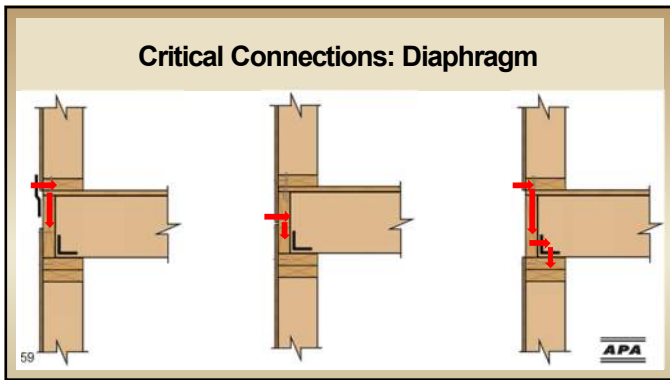
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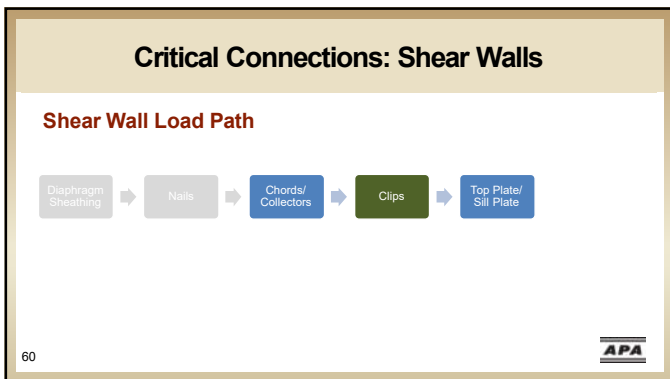
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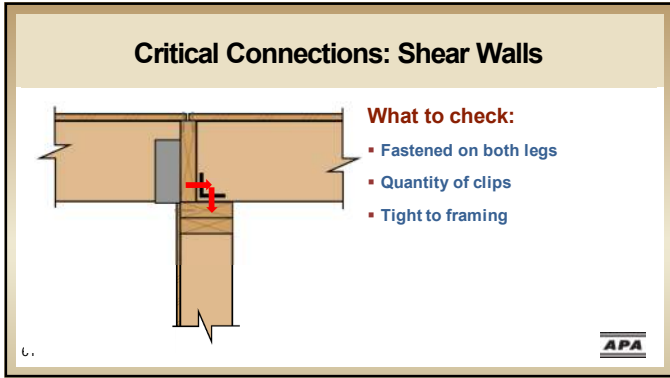
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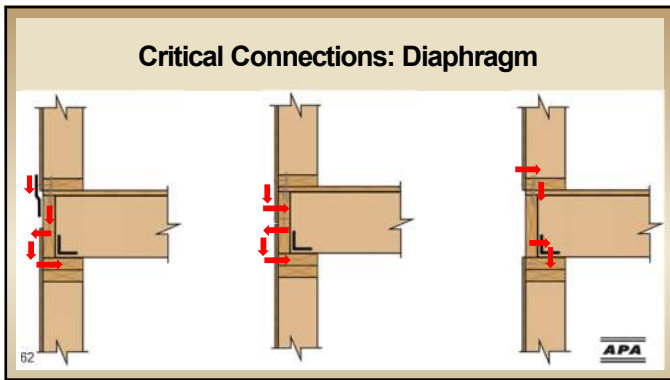
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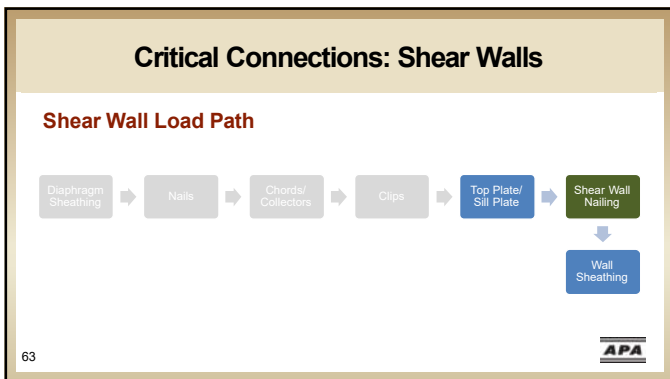
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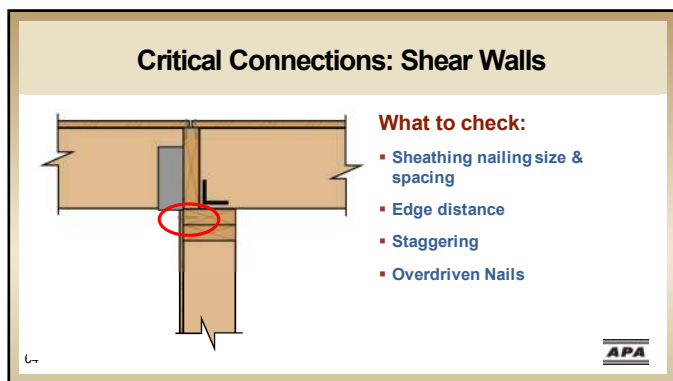
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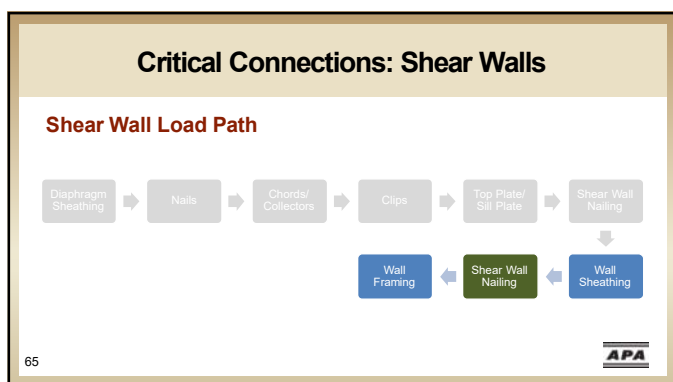
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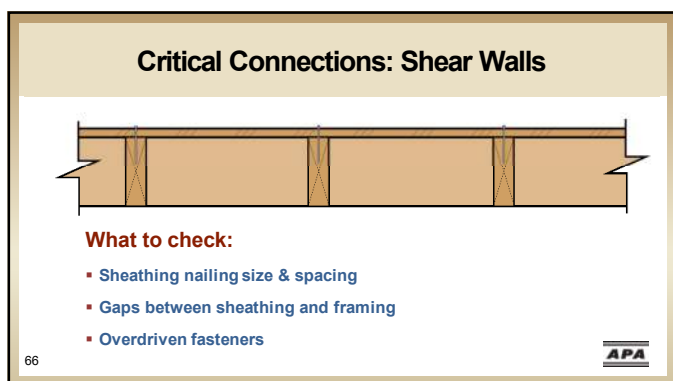
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### Critical Connections: Shear Walls

**If there are gaps...why?**

- Uneven wall surface?
- Is the stud plumb?
- Can the gap be fixed with additional fasteners?

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### Critical Connections: Shear Walls


**If there are overdriven fasteners?**

- Is the panel dry?
- Are they overdriven more than 1/16"?
- Are more than 20% overdriven?

**How can we fix it?**

- Add 1 for every 2 nails overdriven
- Add staples



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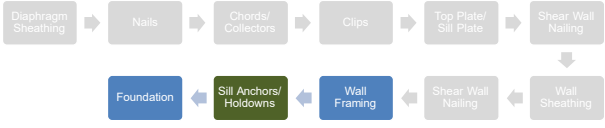
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### Critical Connections: Shear Walls

**Shear Wall Load Path**



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    graph LR
      A[Diaphragm Sheathing] --> B[Nails]
      B --> C[Chords/Collectors]
      C --> D[Clips]
      D --> E[Top Plate/Sill Plate]
      E --> F[Shear Wall Nailing]
      F --> G[Wall Sheathing]
      G --> H[Shear Wall Nailing]
      H --> I[Wall Framing]
      I --> J[Sill Anchors/Holdowns]
      J --> K[Foundation]
  
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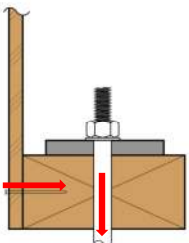
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### Critical Connections: Shear Walls



**What to check:**

- Sheathing nailing size & spacing
- Washer size & clear distance
- Sill anchor size & spacing
- Concrete edge distance

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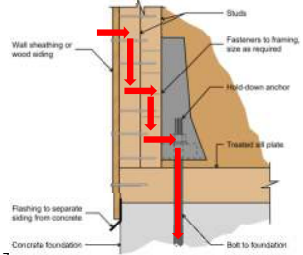
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### Critical Connections: Shear Walls



**What to check:**

- Sheathing nailing size & spacing
- Connection of 2x posts
- Holddown attachment to post
- Holddown anchor size
- Concrete edge distance

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### Critical Connections: Shear Walls



**What to check:**

- Sheathing nailing size & spacing
- Connection of 2x posts
- Tie-Down tension
- Concrete edge distance

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**Critical Connections: Shear Walls**

**What to remember:**

- GOAL = GROUND
- Just because it's wood, doesn't mean it's "FLEXIBLE"
- Load distribution changes depending on how "RIGID"
- Ductility is based on the wood AND the fasteners

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**Questions?**




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