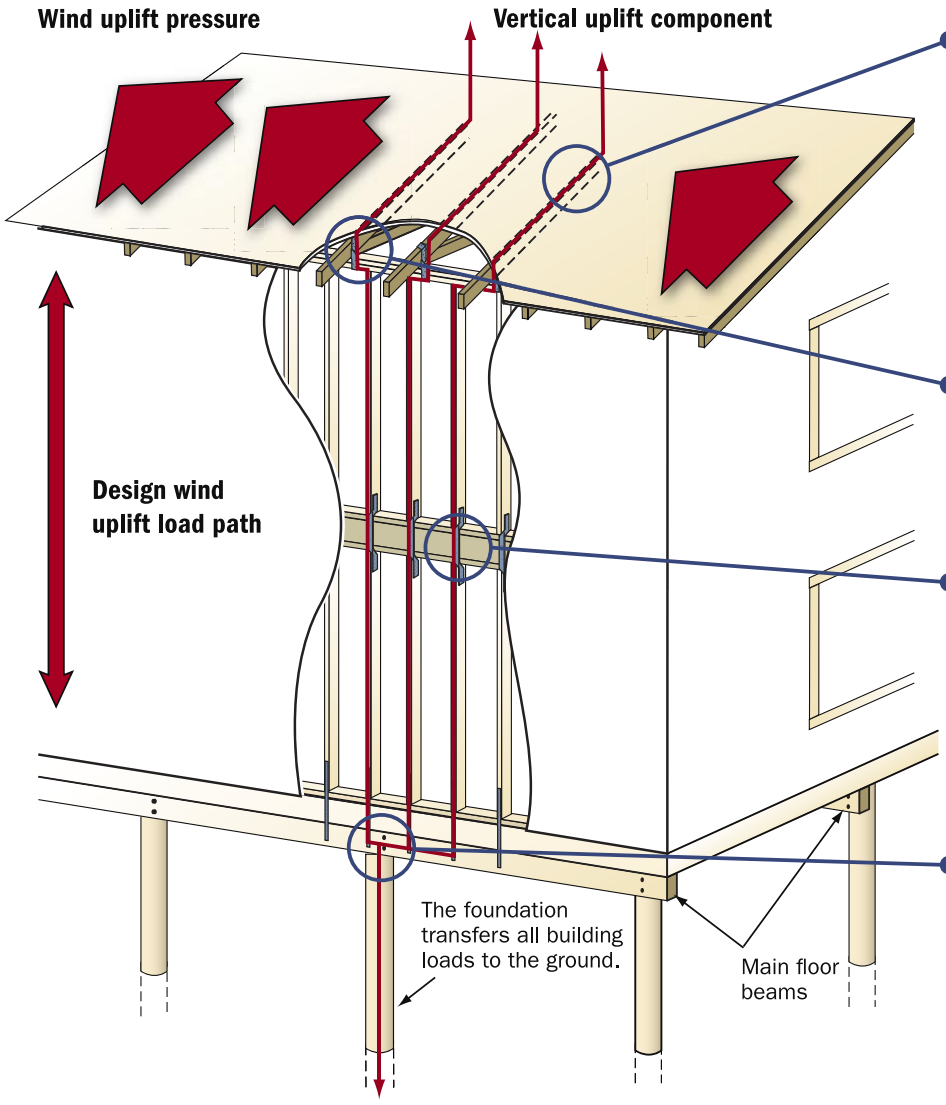
Load Paths

HOME BUILDER'S GUIDE TO COASTAL CONSTRUCTION FEMA 499/August 2005 Technical Fact Sheet No. 10

Purpose: To illustrate the concept of load paths and highlight important connections in a ***wind uplift load path***.

Key Issues

- Loads acting on a building follow many paths through the building and must eventually be resisted by the ground, or the building will fail.
- Loads accumulate as they are routed through key connections in a building.
- Member connections are usually the weak link in a load path.
- Failed or missed connections cause loads to be rerouted through unintended load paths.



Vertical load path from roof to ground on a platform-and-pile-construction building. Note: Load paths will vary depending on construction type and design. Adjacent framing members will receive more load if a connection fails.

LINK 1
High winds lift the roof upward. Roofing fasteners link the roof covering to the sheathing*, and sheathing fasteners link the sheathing to the roof framing members (see Fact Sheet No. 18).

* Although not a structural connection, the attachment of the roof covering to the roof sheathing is an essential part of protecting the building envelope.

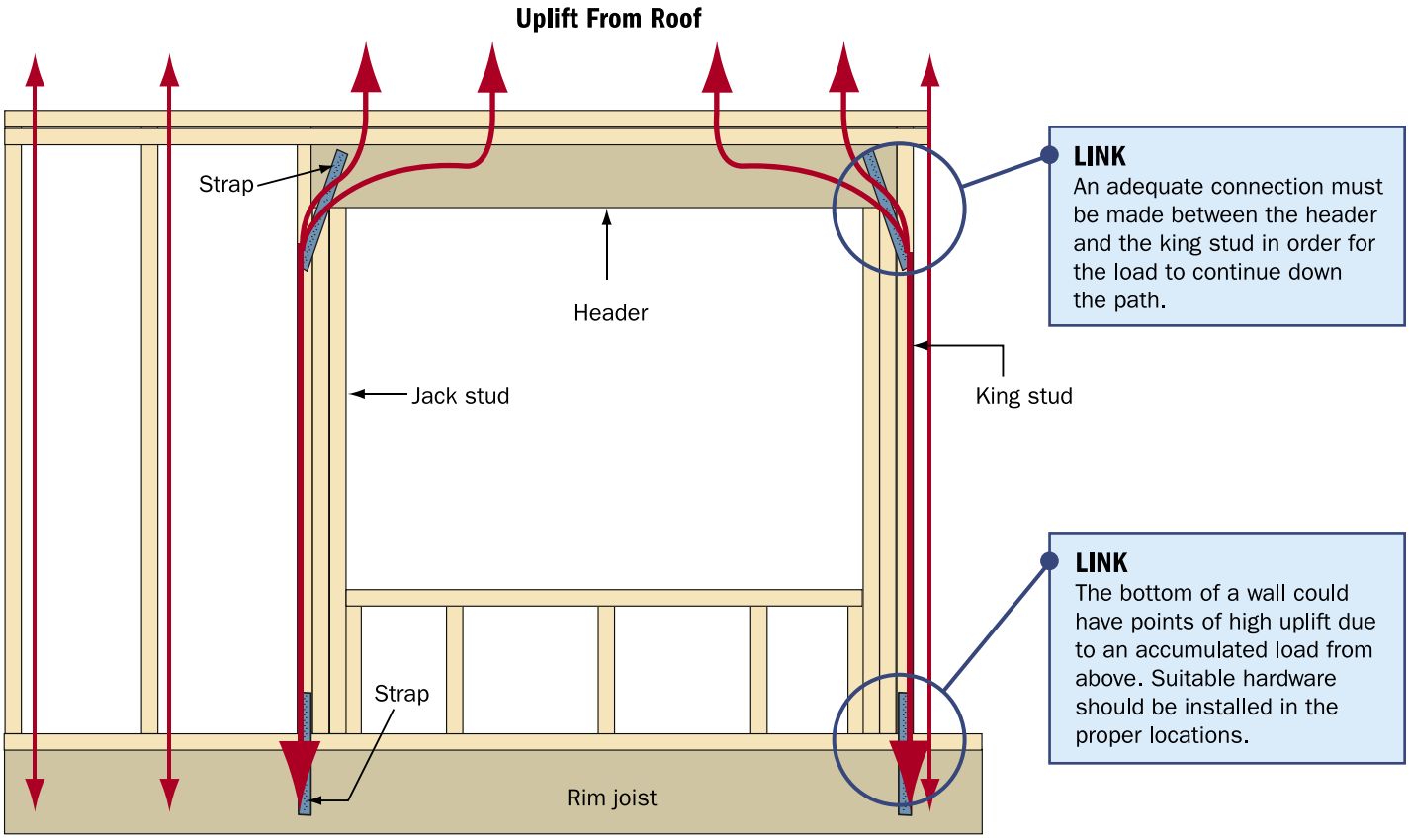
LINK 2
Accumulated roof load is routed through roof-to-wall connections. Special roof ties connect the roof framing to the bearing walls (see Fact Sheet No. 17).

LINK 3
Upper walls transfer loads directly to the lower walls. The floor framing is bypassed by using metal straps or extended exterior sheathing that directly connects upper wall studs to the lower wall studs. A similar connection is used to connect the lower wall to the main floor beam.

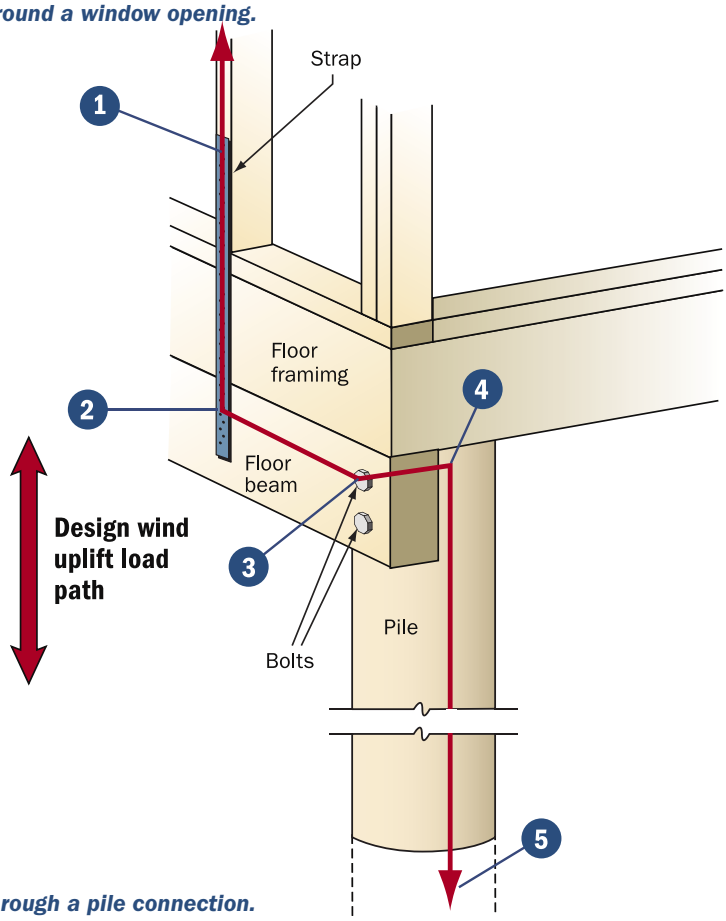
LINK 4
The accumulated uplift force is transferred from the main floor beams to the pile foundation with special brackets or bolts (see Fact Sheet No. 13). **Note:** Some of this load is offset by the weight of the building.

Note: Horizontal load paths transferring shear from upper stories to the ground must also be analyzed.

If a connection fails, an alternative load path will form. If the members and connections in the new load path have inadequate resistance, progressive failure can occur. Loads must be routed around openings, such as windows and doors. Accumulated loads on headers are transferred to the studs on the sides of the opening.



Load path around a window opening.



Load path through a pile connection.

Load paths can be complex through a connection. It is important that each link within the connection be strong enough to transfer the full design load.

The detail at left shows a typical floor-to-pile connection. Uplift loads are transferred through the joint in the following order.

1. from upper story to strap
2. from strap to floor beam
3. from floor beam to bolts
4. from bolts to pile
5. from pile to ground