

# Use of Connectors and Brackets

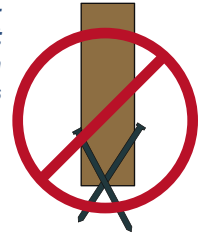


FEMA



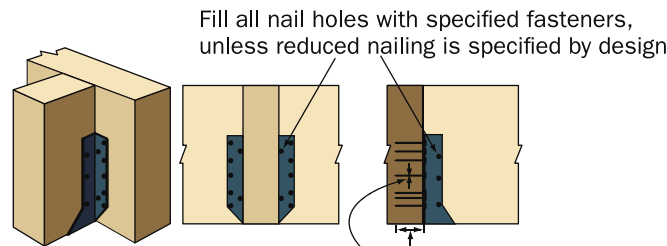
**Purpose:** To highlight important building connections and illustrate the proper use of various types of connection hardware.

*Never rely on toe-nailing for uplift connections in high-wind areas*



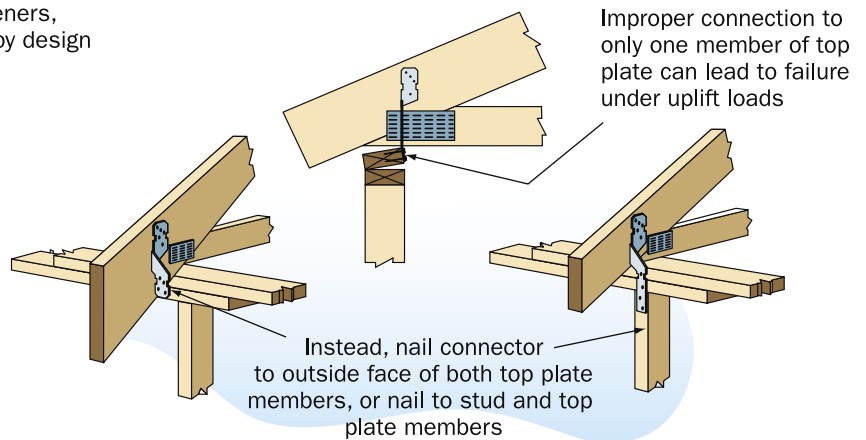
## Key Issues

- In high-wind regions, special hardware is used for most framing connections. Toe-nailing is not an acceptable method for resisting uplift loads in high-wind regions.
- Hardware must be installed according to the manufacturer's or engineer's specifications.
- The correct number of the specified fasteners (length and diameter) must be used with connection hardware.
- Avoid cross-grain tension in connections.
- Metal hardware must be adequately protected from corrosion (see NFIP Technical Bulletin 8-96).
- Connections must provide a continuous load path (see Fact Sheet No. 10).

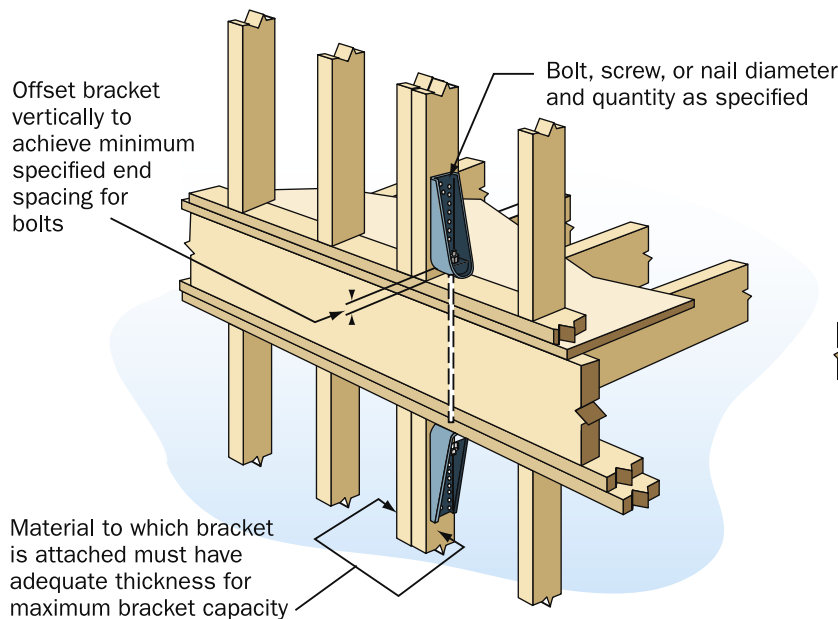


The length and diameter of the fasteners must be as specified by the manufacturer or engineer; some specifications require non-standard nails

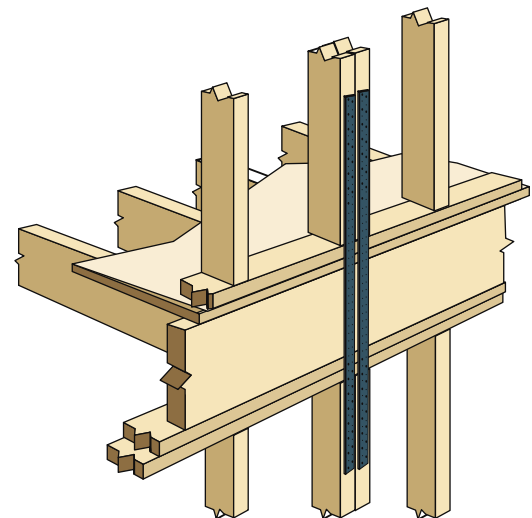
**Proper fasteners must be used with connection hardware.**



**Avoid load path failure at roof-to-wall connections.**



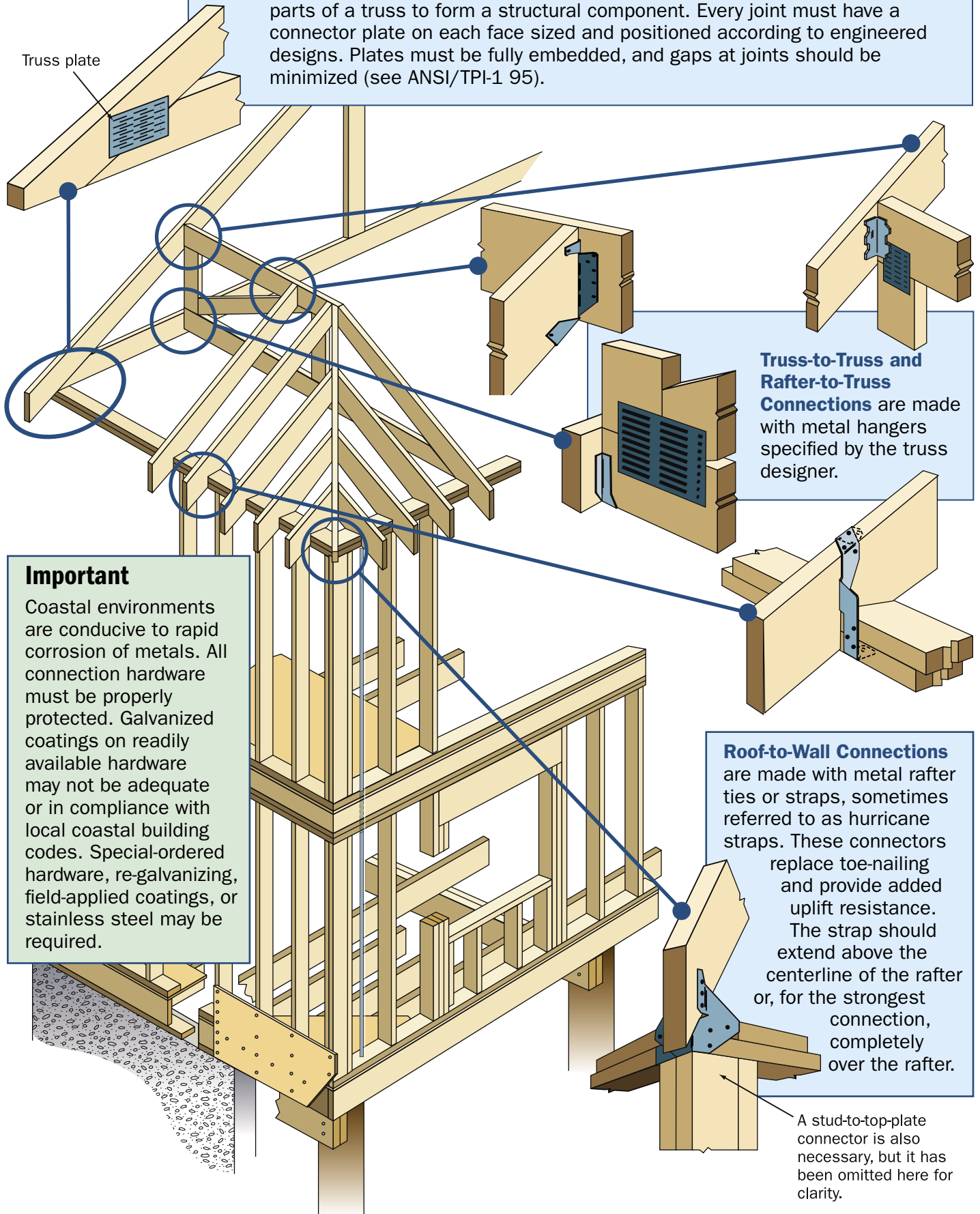
**Proper bracket connection.**



**Proper strap connection.**

**Truss Member Connections** are made with metal plates that connect the individual parts of a truss to form a structural component. Every joint must have a connector plate on each face sized and positioned according to engineered designs. Plates must be fully embedded, and gaps at joints should be minimized (see ANSI/TPI-1 95).

Truss plate



**Truss-to-Truss and Rafter-to-Truss Connections** are made with metal hangers specified by the truss designer.

**Roof-to-Wall Connections** are made with metal rafter ties or straps, sometimes referred to as hurricane straps. These connectors replace toe-nailing and provide added uplift resistance. The strap should extend above the centerline of the rafter or, for the strongest connection, completely over the rafter.

A stud-to-top-plate connector is also necessary, but it has been omitted here for clarity.

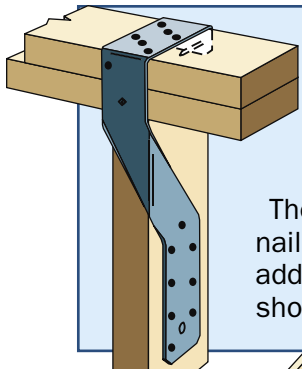
**Important**

Coastal environments are conducive to rapid corrosion of metals. All connection hardware must be properly protected. Galvanized coatings on readily available hardware may not be adequate or in compliance with local coastal building codes. Special-ordered hardware, re-galvanizing, field-applied coatings, or stainless steel may be required.

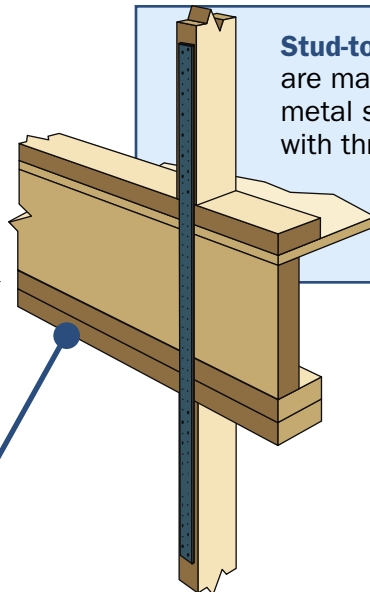
Solid wall foundation building

Pile foundation building

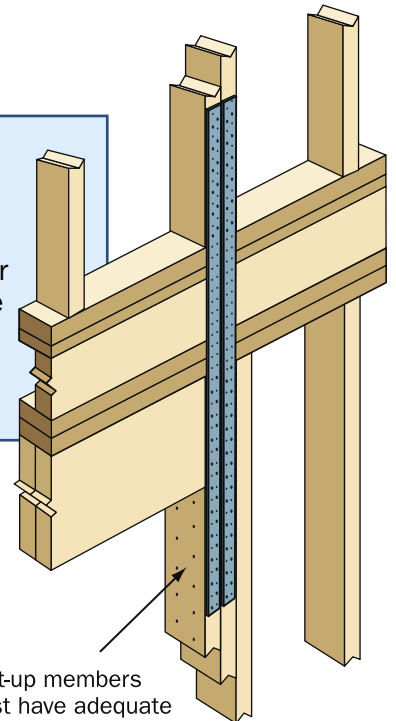
**Connection Hardware Applications**



**Stud-to-Top-Plate Connections** are made with metal straps, nailed to the side and/or face of the stud and the top of the top plate. These connections replace toenailing or end-nailing and provide added uplift resistance. The strap should wrap over the top plate.



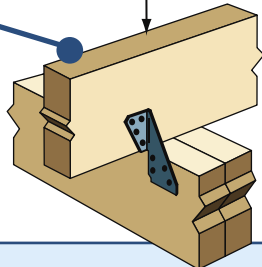
**Stud-to-Stud Connections** are made with nailed metal straps, or brackets with threaded rods, that connect one story to the next.



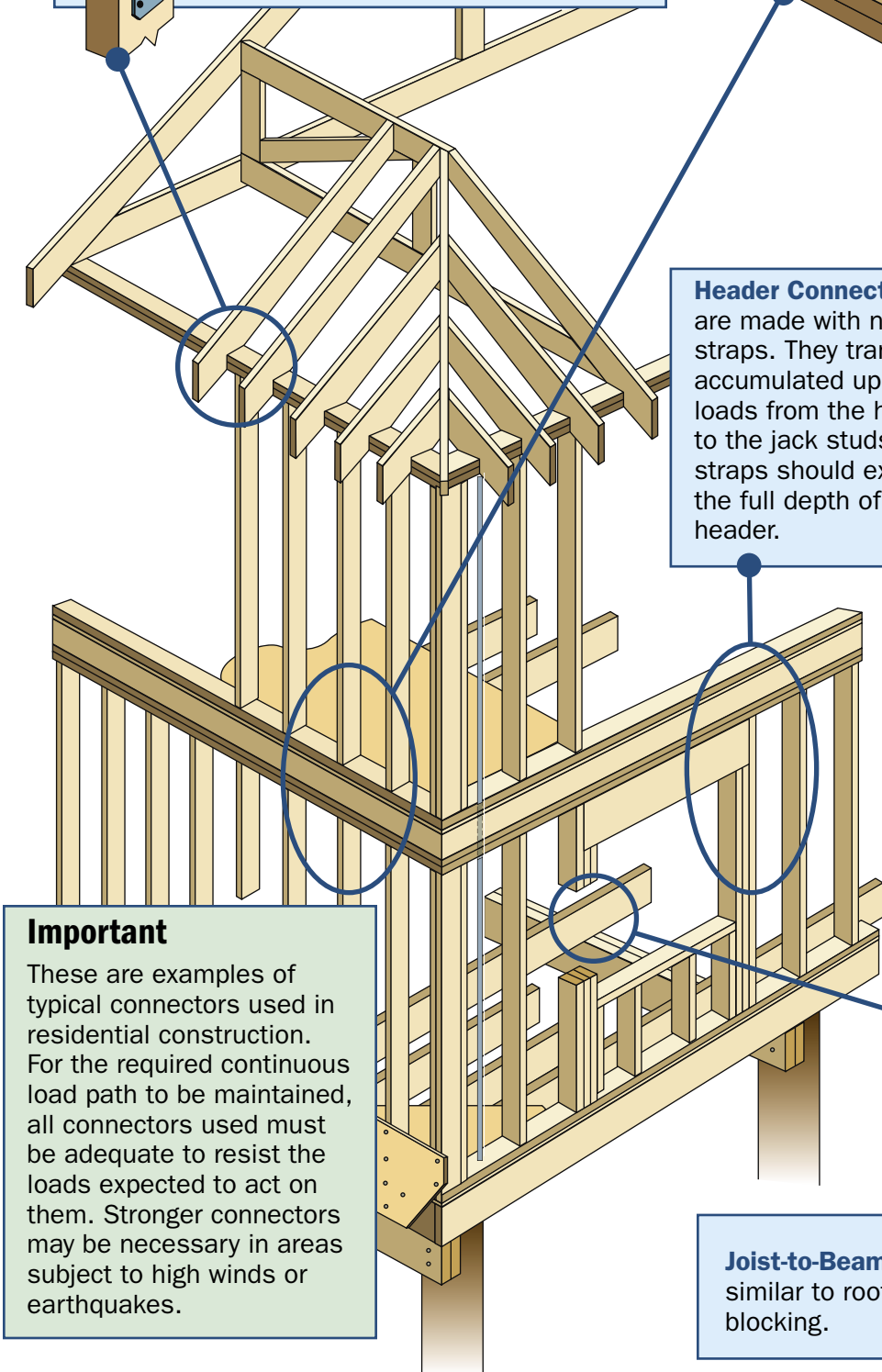
**Header Connections** are made with nailed straps. They transfer accumulated uplift loads from the header to the jack studs. The straps should extend the full depth of the header.

Built-up members must have adequate nailing to ensure that members resist loads together.

For greater uplift resistance, use connectors on both sides of joist.



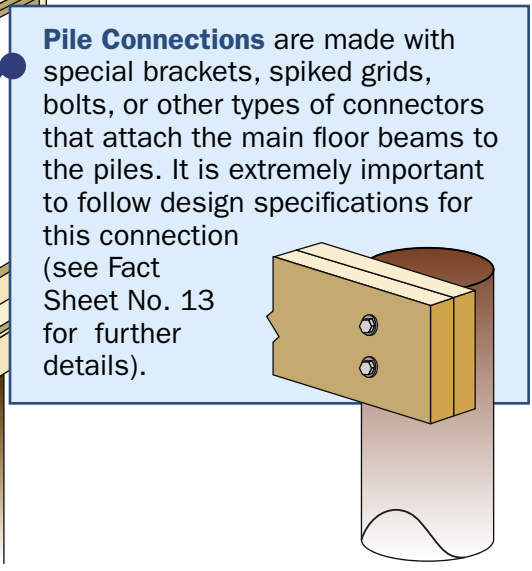
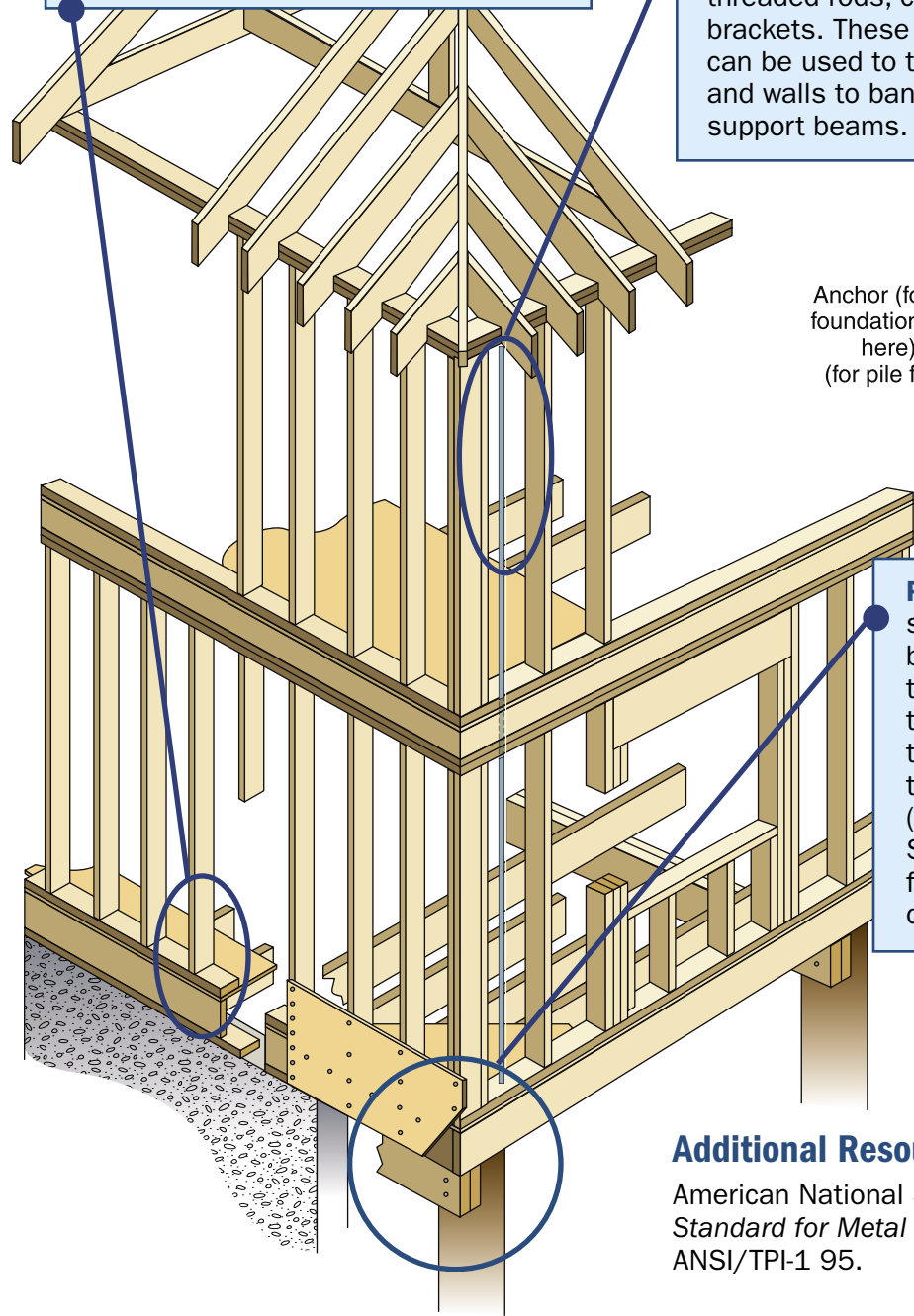
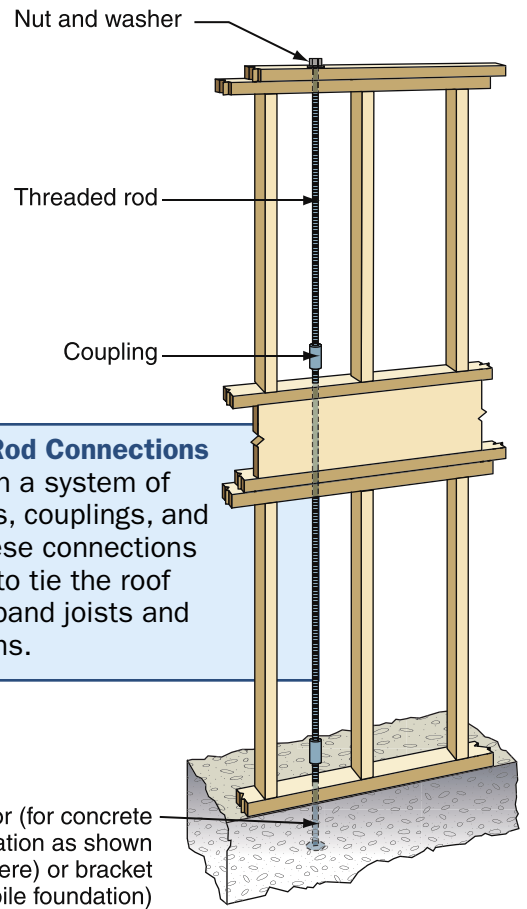
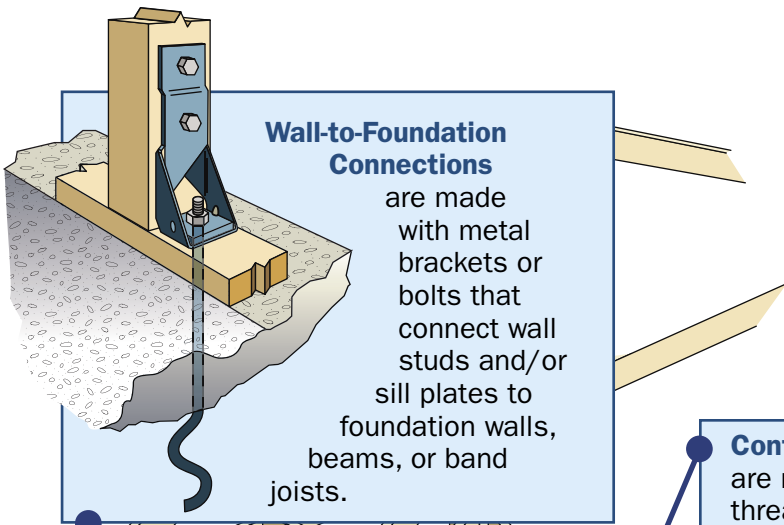
**Joist-to-Beam Connections** are made with ties similar to roof-to-wall connections or with wood blocking.



**Important**  
These are examples of typical connectors used in residential construction. For the required continuous load path to be maintained, all connectors used must be adequate to resist the loads expected to act on them. Stronger connectors may be necessary in areas subject to high winds or earthquakes.

← Solid wall foundation building      Pile foundation building →

**Connection Hardware Applications**



**Additional Resources**

American National Standards Institute. *National Design Standard for Metal Plate Connected Timber Trusses*, ANSI/TPI-1 95.



**Connection Hardware Applications**