

# FOUNDATIONS

## PIER FOUNDATIONS

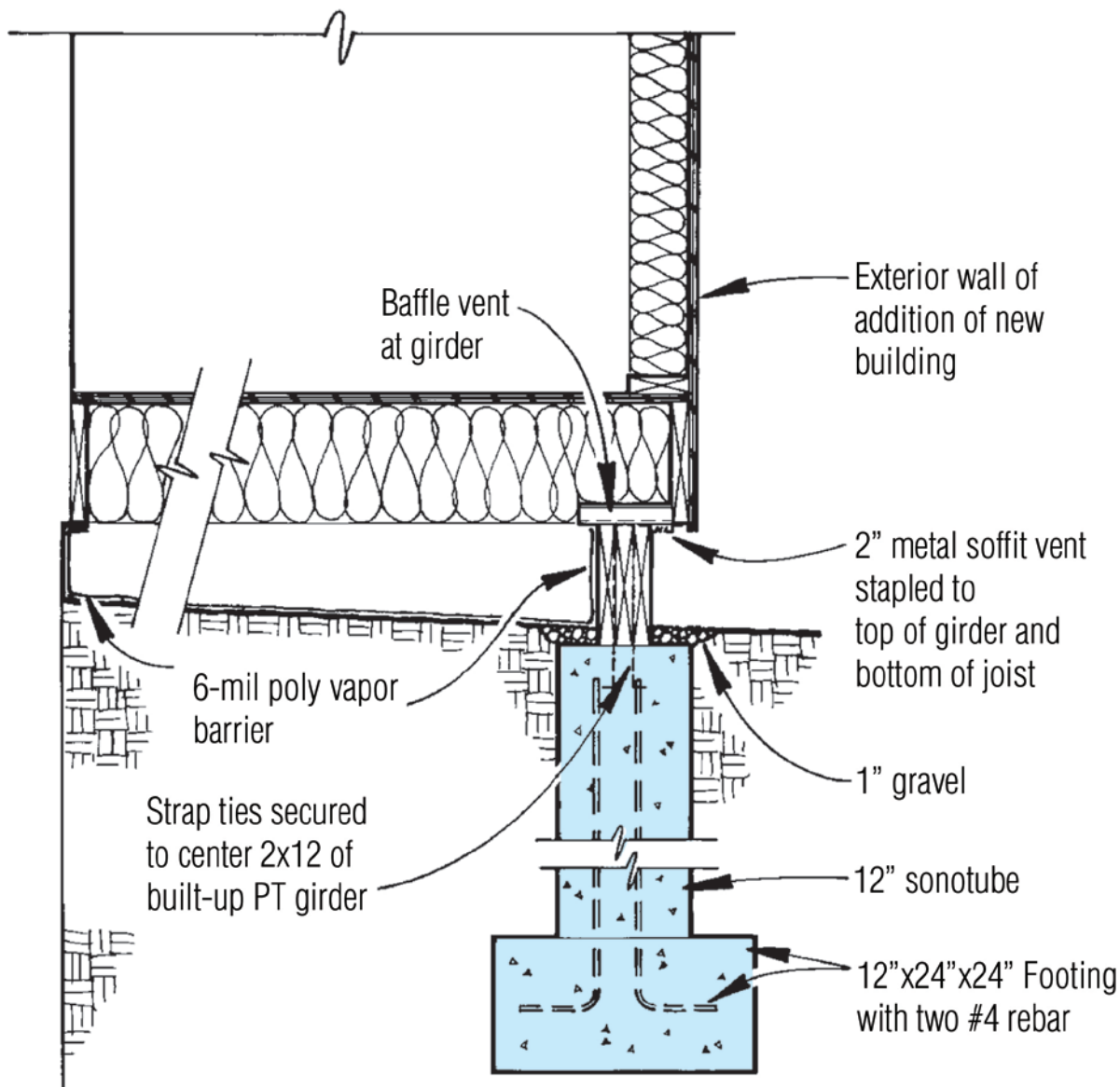
Pier foundations can be as simple as a sonotube foundation for a porch, deck or small addition, or as complex as an engineered pier-and-grade-beam foundation for expansive soils.

### Simple Pier Foundations

#### SIMPLE PIER FOUNDATIONS

Simple pier-and-grade-beam foundations can support decks, porches, pole barns, and small home additions, providing good insulation and ventilation (**below**).

FIGURE: SIMPLE PIER FOUNDATIONS



Sonotubes, placed on pier footings with a pressure-treated grade beam, can be installed easily without disturbing existing utility lines.

## Sizing Piers

For sizing pier diameters for small foundations, the rule of thumb is “1 inch per foot of span.” Thus, a deck that spans 8 ft. will stand comfortably on 8-in.-diameter piers, while a deck that spans 10 ft. requires 10-in.-diameter piers. For spans longer than 12 ft., add a second row of piers and a second girder at the center of the joist span.

For calculating concrete amounts, see Estimating Concrete for Piers.

## Pier Footings

Footings for shallow piers (less than 6 ft. deep) will help prevent the pier from settling. The pier footing should be as thick as the pier’s diameter, with sides that measure twice that much. So an 8-in. pier, for example, should rest on a footing that’s 8 in. thick and 16 in. square, while a 12-in. pier should rest on a footing that’s 12 in. thick and 24 in. square.

## Simple Pier Foundation Details

- Use strap ties to anchor piers to a triple pressure-treated 2-by girder. The ties wrap around the center stick in the built-up girder and lap over the top. (The girder looks better if the ties aren’t exposed on its face.)
- Install a poly vapor barrier over the ground beneath the joists, and run it up and staple it to the inside of the girder. This helps prevent water vapor from building up in the shallow space beneath the joists.
- Additional moisture control can be added by cantilevering joists 2 in. beyond the rim of the girder, and installing a 2-in.-wide standard metal soffit vent on the underside of the overhanging joists.
- Finished grade should slope well away from a pier foundation — about a slope of 4 in. in 10 ft.

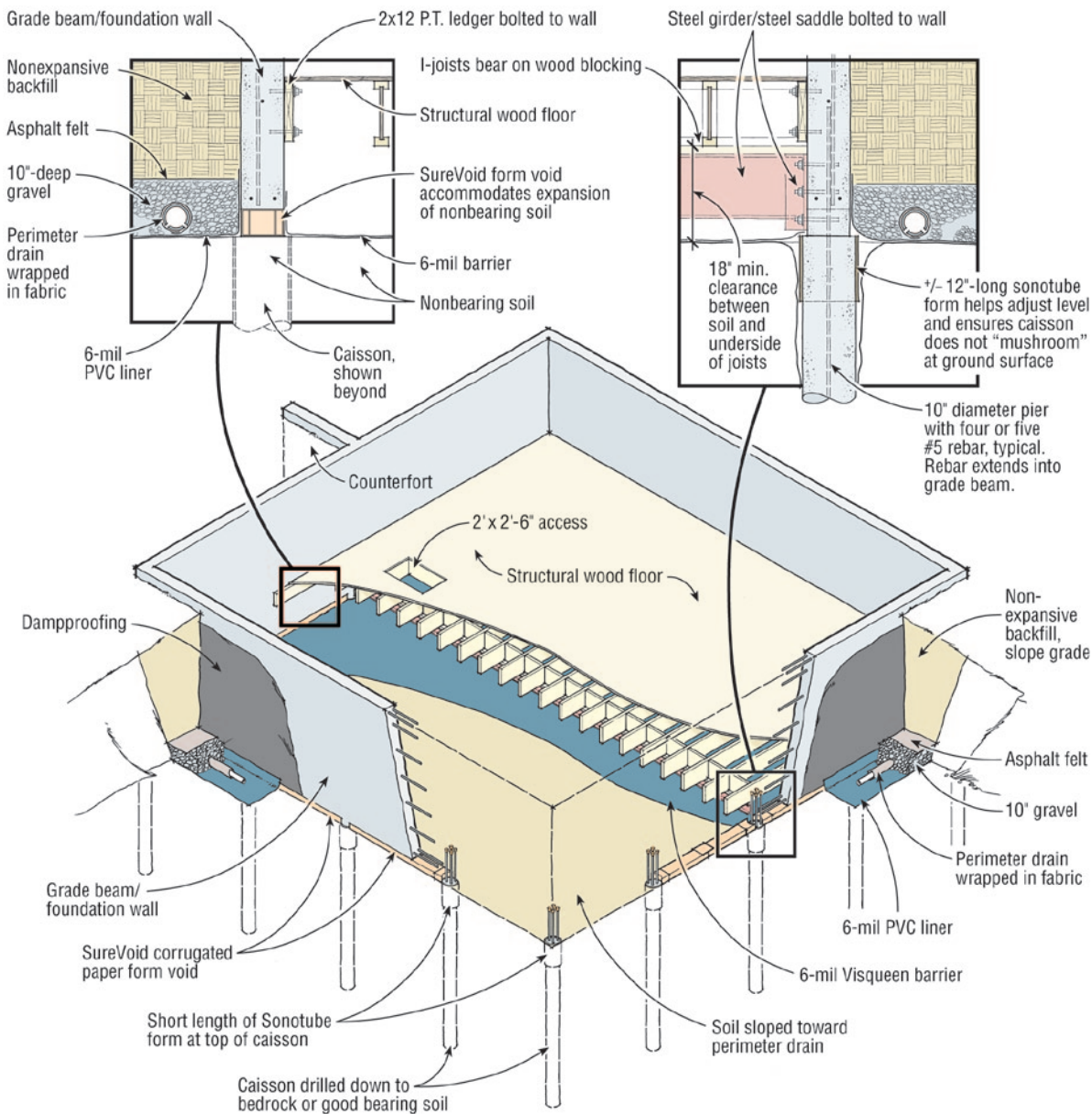
## ENGINEERED PIER FOUNDATIONS

Pier-and-grade-beam foundations work where slopes are too steep for conventional stepped footings, where soils are weak, or where expansive soils would move conventional footings (**Engineered Pier Foundation**, below). Piers can penetrate deep through unstable soils and reach stronger soil or rock, where a combination of end bearing and soil friction against the sides of the pier supports the weight of the house. Grade beams transfer house loads onto the piers.

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FIGURE: ENGINEERED PIER FOUNDATION



Estimating Earth  
Removal

Estimating Earth  
Concrete

## Engineering

A soils engineer and a structural engineer are generally necessary to design this type of foundation and to supervise or inspect construction.

## Pier Dimensions

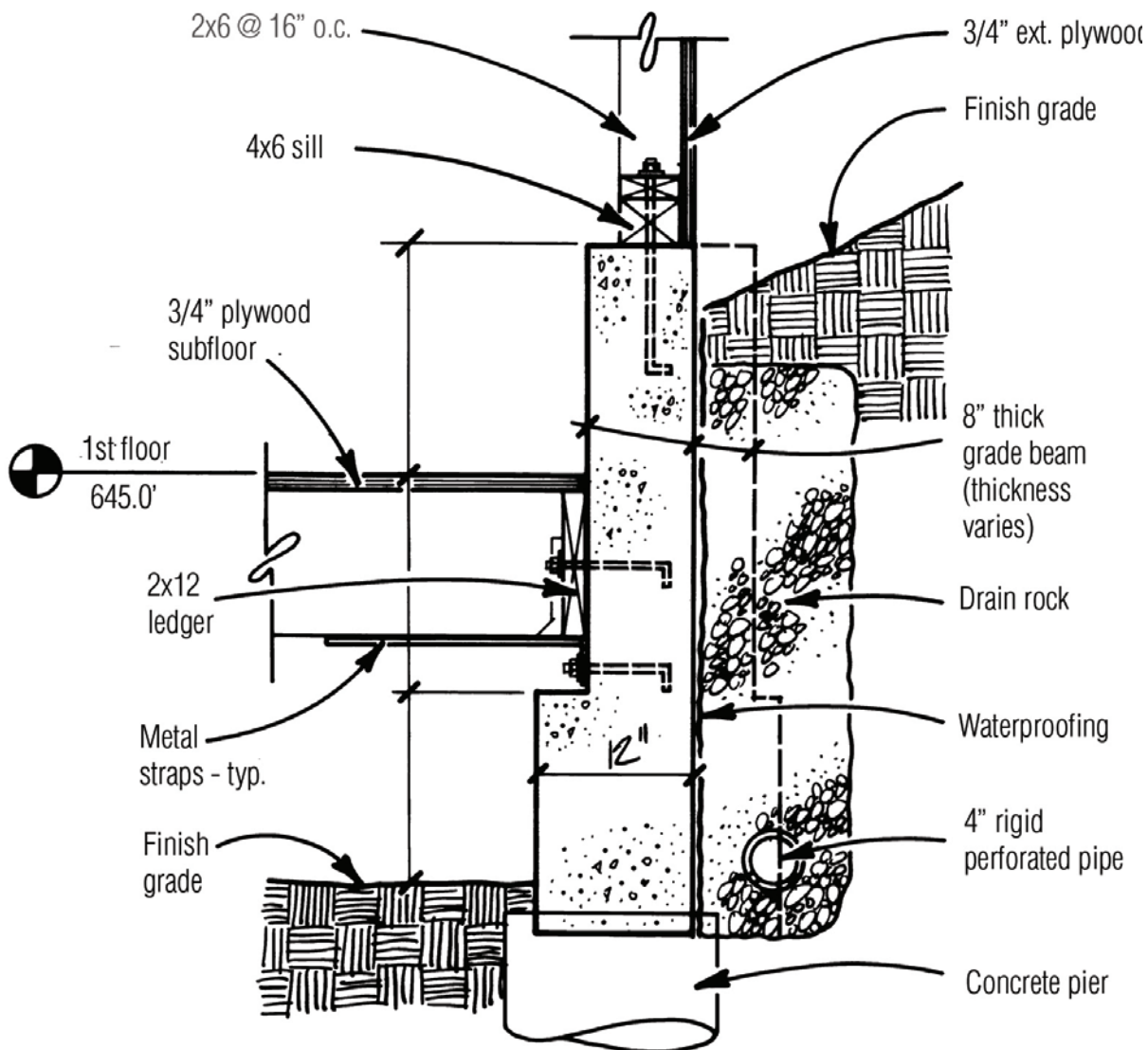
Depth and diameter of piers are calculated based on soil characteristics and building loads. Piers may be anywhere from 5 to 20 ft. deep or deeper, depending on site conditions. Pier diameters are typically 10 to 12 in. Piers are generally spaced from 5- to 12-ft. apart. Of course, in seismic zones, on steep sites, and in areas with extreme soil conditions, piers may need to be much larger and spaced more closely.

## Grade-Beam Dimensions

Beams are generally a minimum of 6 in. wide and 12 in. deep (**Grade-Beam Section**, below), but can be much larger (**Engineered Pier Foundation**, above), depending on loads and spans. A grade-beam may slope to conform to site contours, in which case a pony wall is typically framed over the beam (see **Figure: Full-Height vs. Half-Height Foundation Walls in Stepped Foundation Walls**).

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FIGURE: GRADE-BEAM SECTION



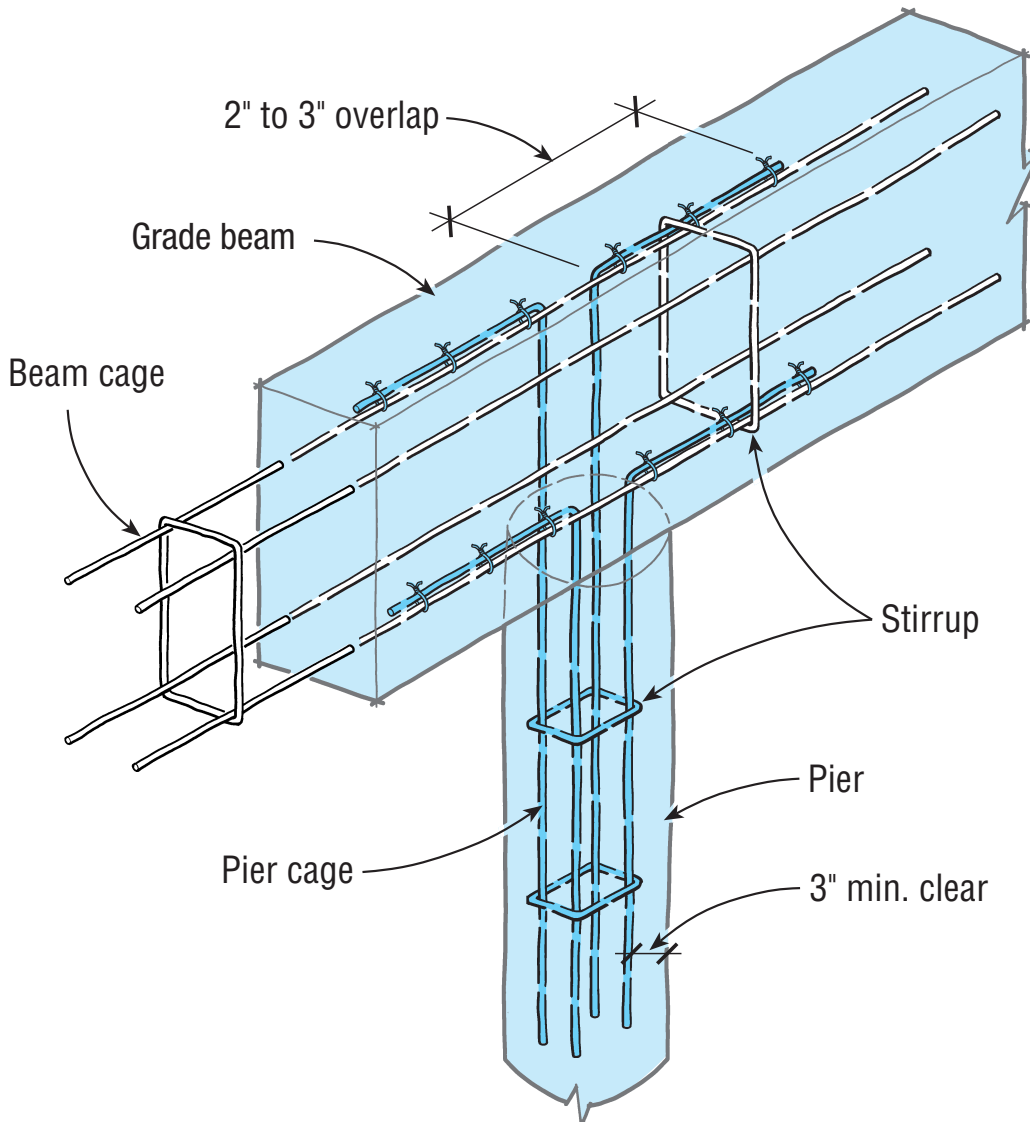
Grade-beams should be centered on piers to transfer house loads directly to the piers. Provide well-draining backfill and perimeter drains to relieve soil pressure on the beam between piers.

## Reinforcement

Reinforcing steel must also be sized and installed in accordance with engineering calculations. Large (12-in.-diameter) piers should have at least four pieces of vertical rebar, creating rebar cages that tie into horizontal rebar in the beams (**below**).

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FIGURE: PIER-TO-GRADE-BEAM



Bend rebar to overlap rebar cages in the piers and the grade beam. Each overlap should be at least 24 bar diameters at splices and spliced tightly with wire.

## Void Forms

If soils are expansive, space must be created under the beams to allow soil to expand without stressing the structure. This is accomplished with cardboard boxes placed at the bottom of the form (**Engineered Pier Foundation**, above). In less extreme cases, expanded foam (not extruded) can be used to form beams; the spaces in the foam will give a little to absorb slight expansions.

## Anchor Bolts

Anchor bolts should be cast into the beams. In places where cripple walls are needed above grade-beams to create a level elevation for floor framing, the spacing between anchor bolts may need to be closer than usual (consult the engineer on this detail). In addition, horizontal anchor bolts may be required to secure the rim joist of floor framing (**Grade-Beam Section**, above).

## Backfill

Grade-beams should be backfilled with a well-compacted granular fill, and perimeter drainage should be installed that drains to daylight (see Drainage).

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