

Designing Concrete Structures:

Slender Reinforced Concrete Wall
Design—Solid Wall with Out-of-Plane
Loading Due to Wind



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Reported by ACI Committee E702

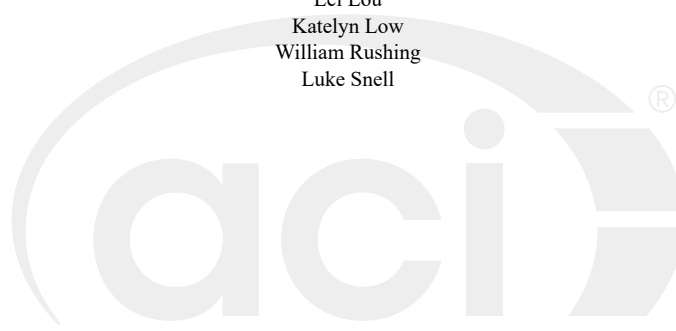
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ACI E702.5-21 Designing Concrete Structures: Slender Reinforced Concrete Wall Design - Solid Wall with Out-of-Plane Loading Due to Wind.

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Example Problem: Slender Reinforced Concrete Wall Design— Solid Wall with Out-of-Plane Loading Due to Wind

Problem Statement

For the given wall, determine the required area of vertical and horizontal reinforcement for out-of-plane bending due to wind and axial loads considering secondary effects using the ACI 318-19 alternative method for out-of-plane slender wall analysis.

Given Information

See Figures 1, 2, and 3 for general layout and dimensions of wall section.

Given Information	Additional Guidance
Applicable design code is ACI 318-19.	Referenced by major building codes (IBC, etc.).
Concrete compressive strength, $f'_c = 4000$ psi.	Common industry value; see project guidelines.
Reinforcement yield strength, $f_y = 60,000$ psi.	Common industry value; ASTM A615, Grade 60.
Panel thickness = 7.25 in.	Excludes reveals or other architectural finishes that may reduce the structural thickness of the panel.
Structure in a low seismic region – SDC A.	Seismic forces do not control design.
Metal deck acts as diaphragm.	Pinned top support for wall – this example does not include additional moments caused by drift of the roof structure.
The wall supports four joists evenly spaced. Each joist has a service level dead load = 2.2 kip; roof live load = 2.3 kip; and 2.5 kip snow load.	Reasonable value for example purposes; determine load path and sum loads to get value.
Wind load perpendicular to the wall is 27 lb/ft ² at strength levels (ASCE 7-16).	Reasonable value for example purposes; determine load path and sum loads to get value.

Designer's Assumptions

- Design wall with pinned base
- Neglect parapet since it is short and will reduce maximum moment
- The wall is fully attached to the roof diaphragm and the foundation for this example (no construction case considered in example)
- Use center-to-center of supports dimension of 34 ft for both moment and shear calculations (simplification, will be conservative for shear calculations)
- Three inch eccentricities are associated with vertical load.
- Exposure classification (ACI 318-19, Sections 11.2 and 19.3.1): F1, S0, W0, C1 (Exterior wall that has exposure to freeze-thaw cycles but little exposure to water; negligible exposure to sulfates; limited contact with water when in service, and limited exposure to water-carrying chlorides. From Table 19.3.2.1, requirement for concrete for this type of exposure class is required to be: minimum f'_c of 3500 psi and minimum w/cm of 0.55.)

Discussion:

In practice, a designer would also need to consider a partially restrained base.

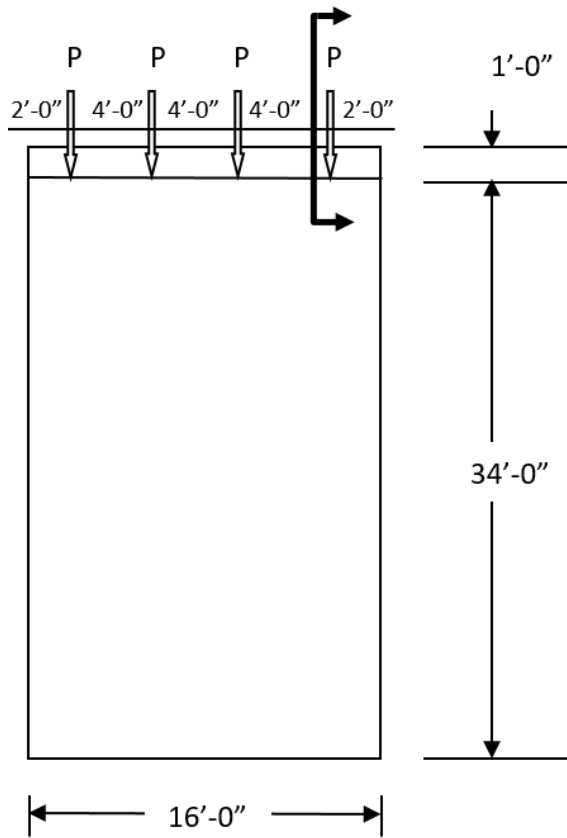


Fig. 1—Elevation.

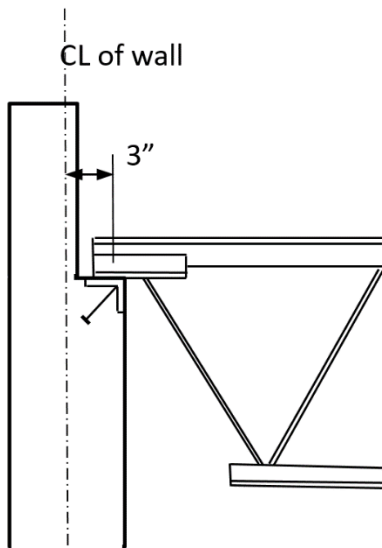


Fig. 2—Joist-to-panel connection.