PRECAST CONCRETE FOUNDATIONS
INTRODUCTION

Foundations are used:

• To transfer the loads of structures into the bearing soils they sit upon.
• To resist uplift forces caused by wind.
• To enclose basements and crawlspaces, and to resist lateral earth and hydrostatic pressures.
INTRODUCTION

Types of foundations – residential, light commercial

- Continuous footings
  - Basement
  - Crawlspace
  - Slab on ground

- Thickened slab
INTRODUCTION

Materials used to build foundations

- Masonry (CMUs)
- Cast-in-place concrete
- Wood
- Precast concrete
INTRODUCTION

Masonry

- Built on site, labor intensive
- High site impact (approx. 5-10 days)
- Construction impacted by weather
- Moderate permeability
- f’m = 2,500 psi
OVERVIEW

Cast-in-place concrete

- Formed and cast on site
- High site impact (5-8 days)
- Construction impacted by weather
- Low Permeability
- Monolithically cast = cracks
- \( f'c = 3,500 \text{ psi} \)
OVERVIEW

Wood

• Can be built on site or off site
• Moderate site impact (3-4 days)
• High permeability
• $f'_c = 7,000$ psi, buckling is a concern
OVERVIEW

Precast concrete

• Built off site
• Lowest site impact (0.5-1.0 days)
• Negligible impact by weather
• Panelized = joints for expansion and contraction
• Low permeability
• f’c = 5,000 psi
OVERVIEW

Many precast concrete foundation systems employ thin-wall/thin-shell designs.
CODES AND STANDARDS

Foundations fall under the International Residential Code (IRC)

• Precast concrete foundations entered the IRC in 2003, Chapter 4.
• However, they are not well defined; the IRC lacks direction and details for building officials.
CODES AND STANDARDS

IRC development

• NPCA has submitted code changes to better define the use of precast concrete foundations (IRC 2007 supplementary code cycle).
CODES AND STANDARDS

Precast concrete foundations are pre-engineered systems manufactured in a controlled environment; therefore code submissions are performance-based.
CODES AND STANDARDS

Masonry, cast-in-place and wood are field-built systems whose design must be specified in the code in order for building officials to inspect them; these are prescriptive-based.
Proposed minimum material requirements:

- $f'c = 5,000$ psi @ 28days.
- Rebar must meet ASTM 615, A706, A996 with a minimum cover of 5/8”.
- Panel-to-panel connections shall be Grade II, if bolted.
- Fibers must conform to ASTM C 1116.
- Grout must conform to ASTM C 1107.
CODES AND STANDARDS

Design:

• System design by a P.E.
• Components of the system do not require a PE stamp every time they are used.
• Manufacturers must have third-party inspection and QA program.
CODES AND STANDARDS

Proposed minimum design criteria:

• Total uniform load applied = 5,300 lbs/ft (this correlates with new footing table @ 3-story height).

• Lateral earth pressure = 60 lbs/ft$^2$/ft.

• Accommodate concentrated loads in excess of the uniform loads.
Since precast concrete foundations are pre-engineered, such as a truss or joist, their capacities or limits must be communicated to the purchaser.
CODES AND STANDARDS

Information that must be conveyed to the purchaser:

• Soil bearing capacity (psf).
• Footing design and material.
• Max. allowable uniform load (lbs/ft).
• Concentrated loads and their points of application.
DESIGN

Suggested procedure to design with a precast concrete foundation

• Calculate all live and dead loads from floors, roofs and walls.
• Calculate applicable snow, wind and seismic loads.
• Calculate and determine locations of concentrated loads, such as from floor beams or girders.
DESIGN

Suggested procedure to design with a precast concrete foundation

• Determine soil type and bearing capacity.
• Check to ensure that a precast concrete foundation system can safely support all calculated loads – work with manufacturer.
• Design footing, IRC chapter 4.
• Check for uplift.
INSTALLATION

• Footings should be installed on undisturbed soil.
• Panels are set into place on leveled, compacted crushed stone or cast-in-place continuous footing.
• Joints are sealed in accordance with manufacturers instructions, commonly during panel-to-panel installation.
• Backfill may not commence until walls are braced at top and bottom.
INSTALLATION

Windows and doors are easily included to meet ingress and egress requirements.
ADVANTAGES

Precast concrete foundations:

• Are cast off site in a controlled environment with stringent quality control.

• Are stronger and lighter than most competing materials.
ADVANTAGES

Precast concrete foundations:

- Minimize construction period.
  - Installed quicker
  - Less weather dependency
  - Reduced coordination of trades
- Are leak resistant and have little to no cracking.
ADVANTAGES

Precast concrete foundations:

• Can have a variety of architectural finishes.
• Are environmentally friendly and can qualify for LEED credits.
ADVANTAGES

Precast concrete foundations:

• Reduce the overall costs for builders and homeowners.
• Are the best material choice for residential and light commercial foundations.