

**FOUNDATION PERFORMANCE
ASSOCIATION**

SPECIFICATION AND APPLICATION OF VOID SPACES BELOW CONCRETE FOUNDATIONS

FPA-SC-11-1

November 12, 2014

Specification and Application of Void Spaces Below Concrete Foundations

- Document no: FPA-SC-11-1
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- Presented to : Foundation Performance Association
- Presented on: 12 November 2014

Why are we
here?



Why revise this paper?

- November 11, 2007 – Publication of first paper
- New Void Form products in the market

Types of Void Forms

- Degradable
- Non-Degradable
- Collapsible
- Non-Collapsible

Degradable Void Forms



Degradable Void Forms

Degradable Void Forms are fabricated from materials that degrade quickly, such as corrugated paper and molded paper. Use them where there is an adequate supply of water in the environment to degrade the Void Form material before the soil expands.

Place plastic sheeting only above these Void Forms.

The construction of foundations with Degradable Void Forms requires that these Void Forms be protected from moisture during storage and until concrete is poured.

Non-Degradable Void Forms



Non-Degradable Void Forms

This type of Void Form is fabricated from materials that do not degrade quickly, such as plastic, metal, Styrofoam, and wood.

The design of foundations with non-degradable Void Forms must acknowledge that these Void Forms will remain in place for a long time.

Collapsible Void Forms

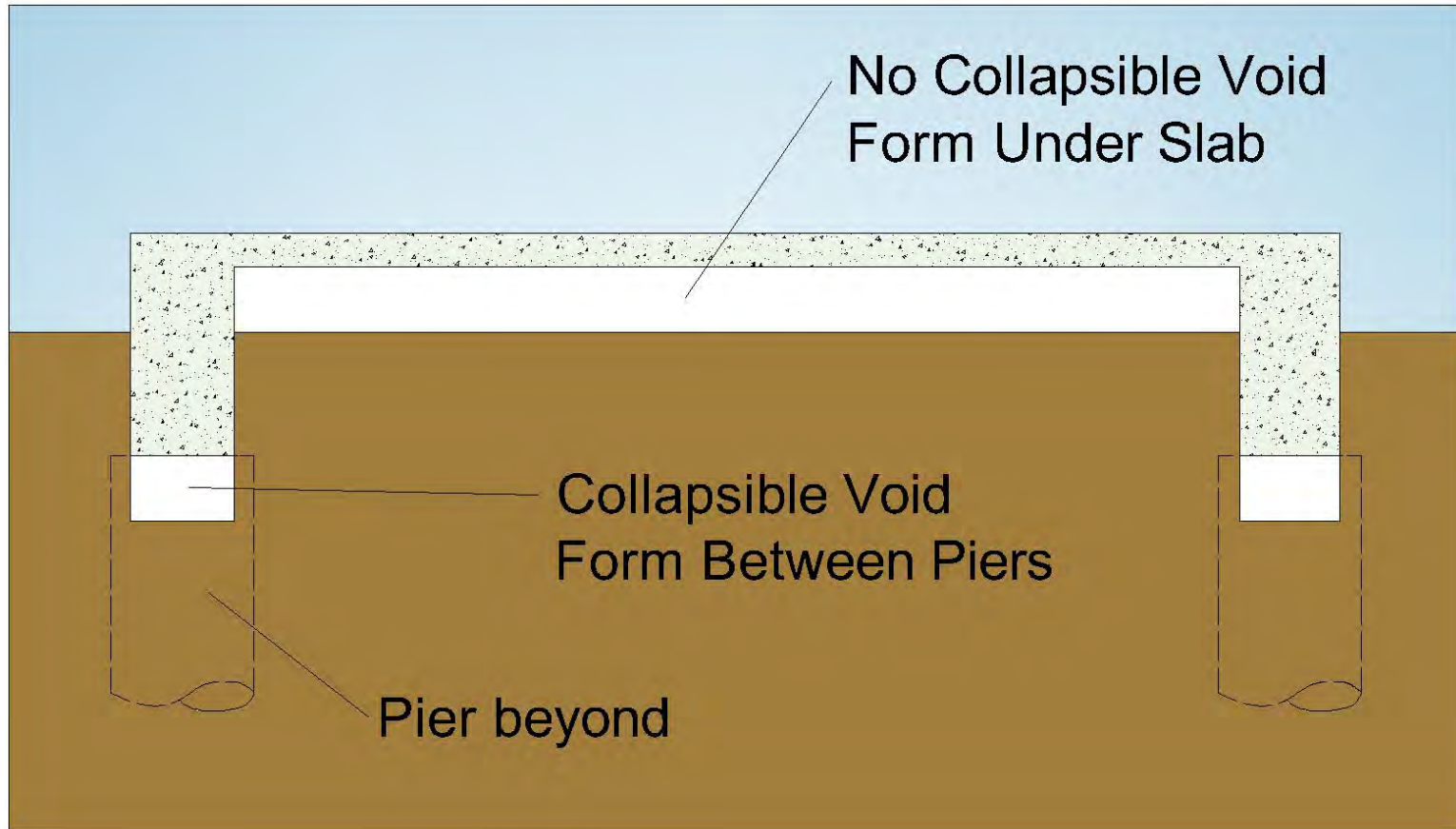


Collapsible Void Forms

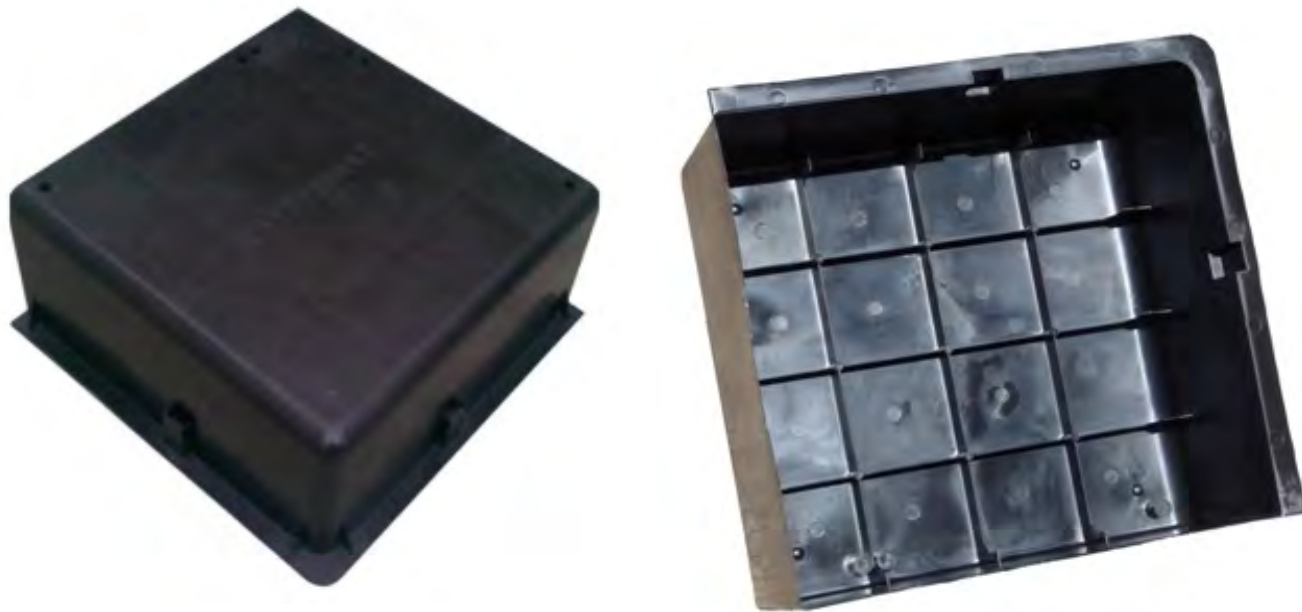
Example: Use Void Forms that are strong enough to support the loads during placement of the concrete foundation.

These Void Forms must be too weak to resist expanding soil loads which are large enough to lift the final foundation and superstructure.

Collapsible Void Forms



Non-Collapsible Void Forms

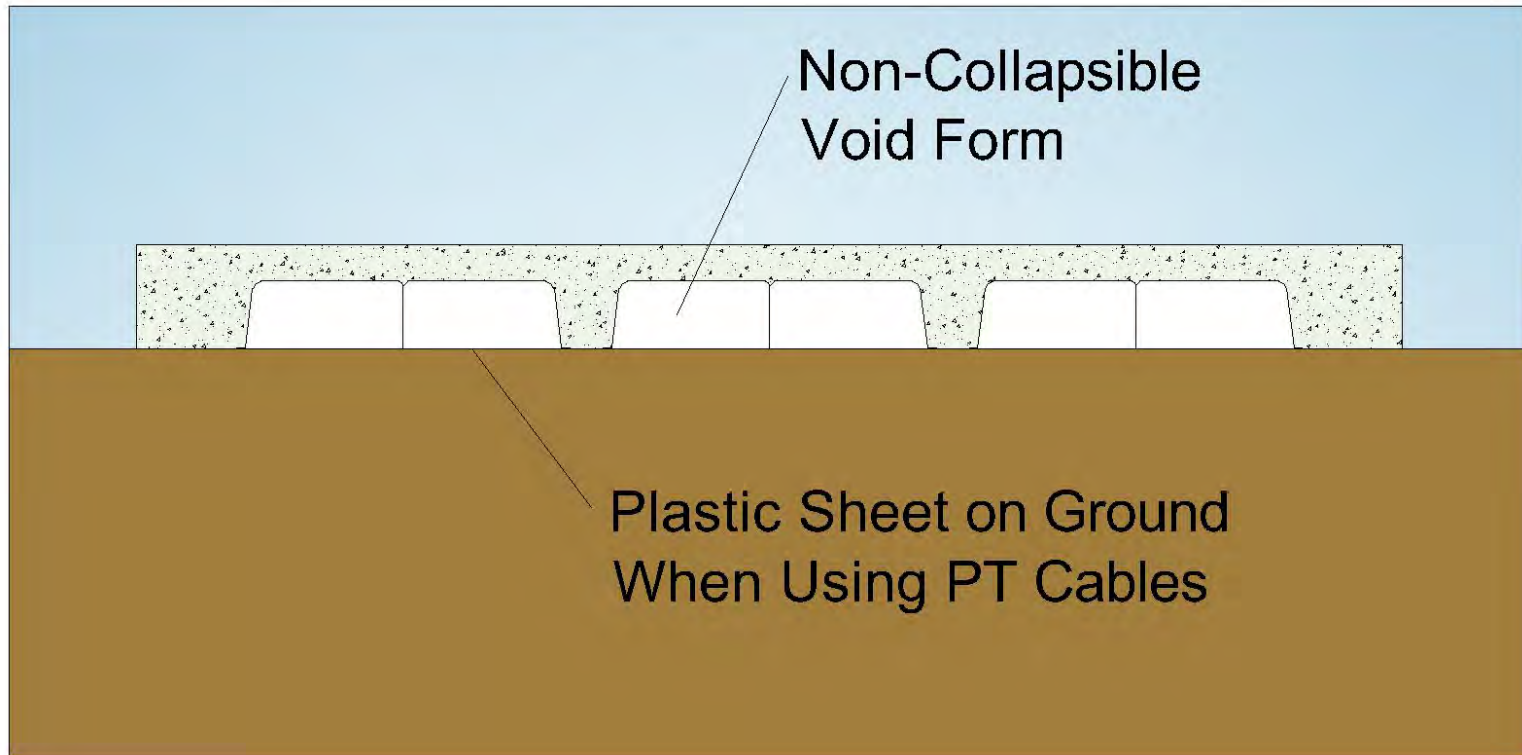


Non-Collapsible Void Forms

Example: Use where the strength of the foundation is high enough to resist the uplift forces of soil expansion acting on the forms.

Do not use these Void Forms under Slab Areas that have long spans between stiffening beams and with thin unreinforced slab elements.

Non-Collapsible Void Forms



Void Form Materials

- Corrugated Paper
- Expanded Metal
- Metal Sheet
- Molded Plastic
- Molded Paper
- Styrofoam
- Wood
- Other?

Corrugated Paper



Corrugated Paper Fabrication



Corrugated Paper Fabrication



Corrugated Paper Fabrication



Corrugated Paper Fabrication



Corrugated Paper Fabrication



Expanded Metal



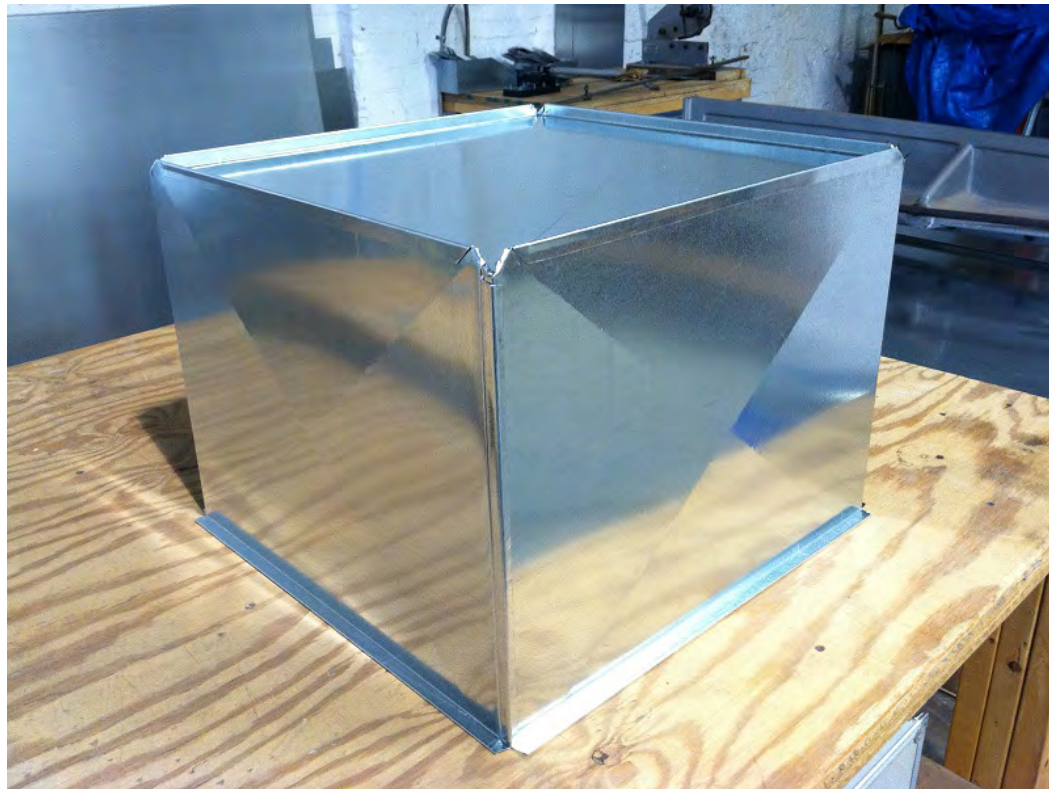
Expanded Metal



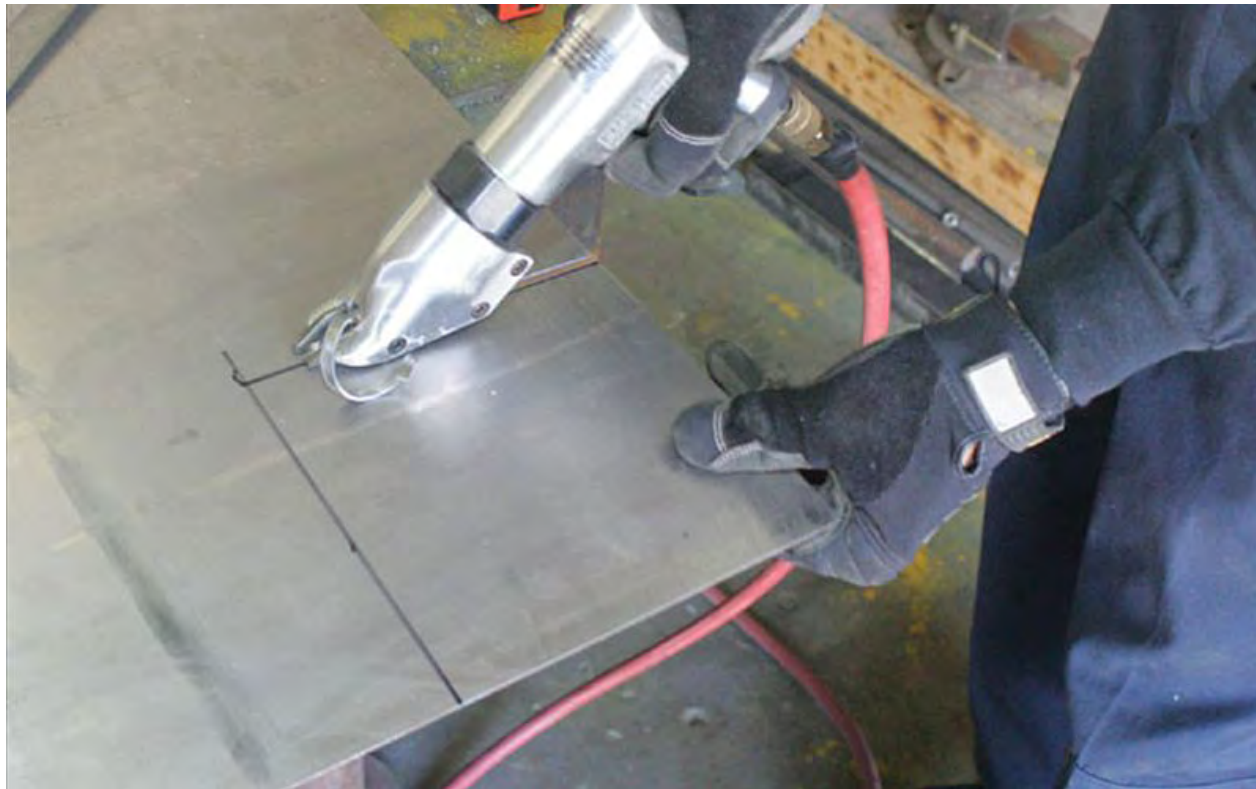
Expanded Metal Fabrication



Metal Sheet



Metal Sheet Fabrication



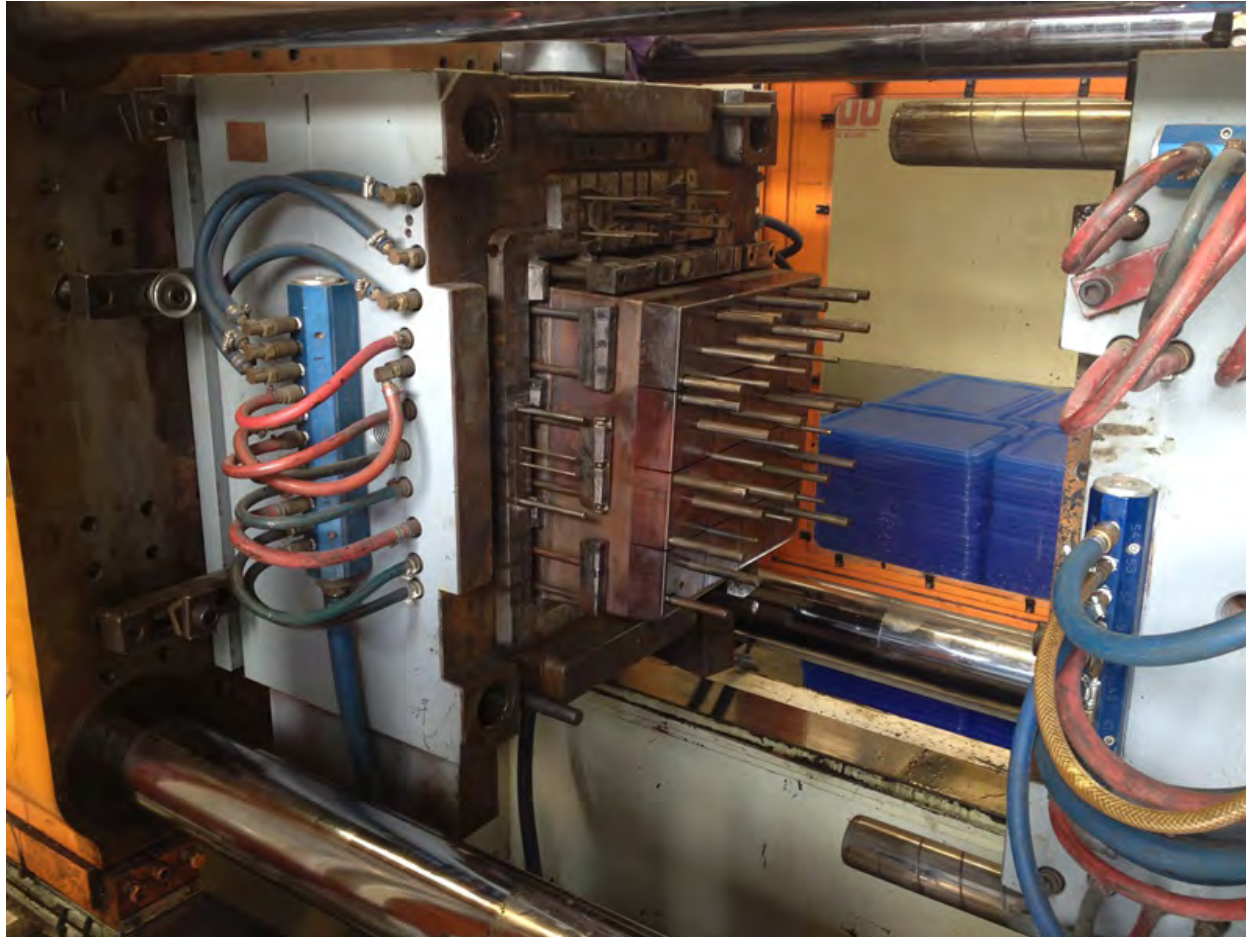
Molded Plastic



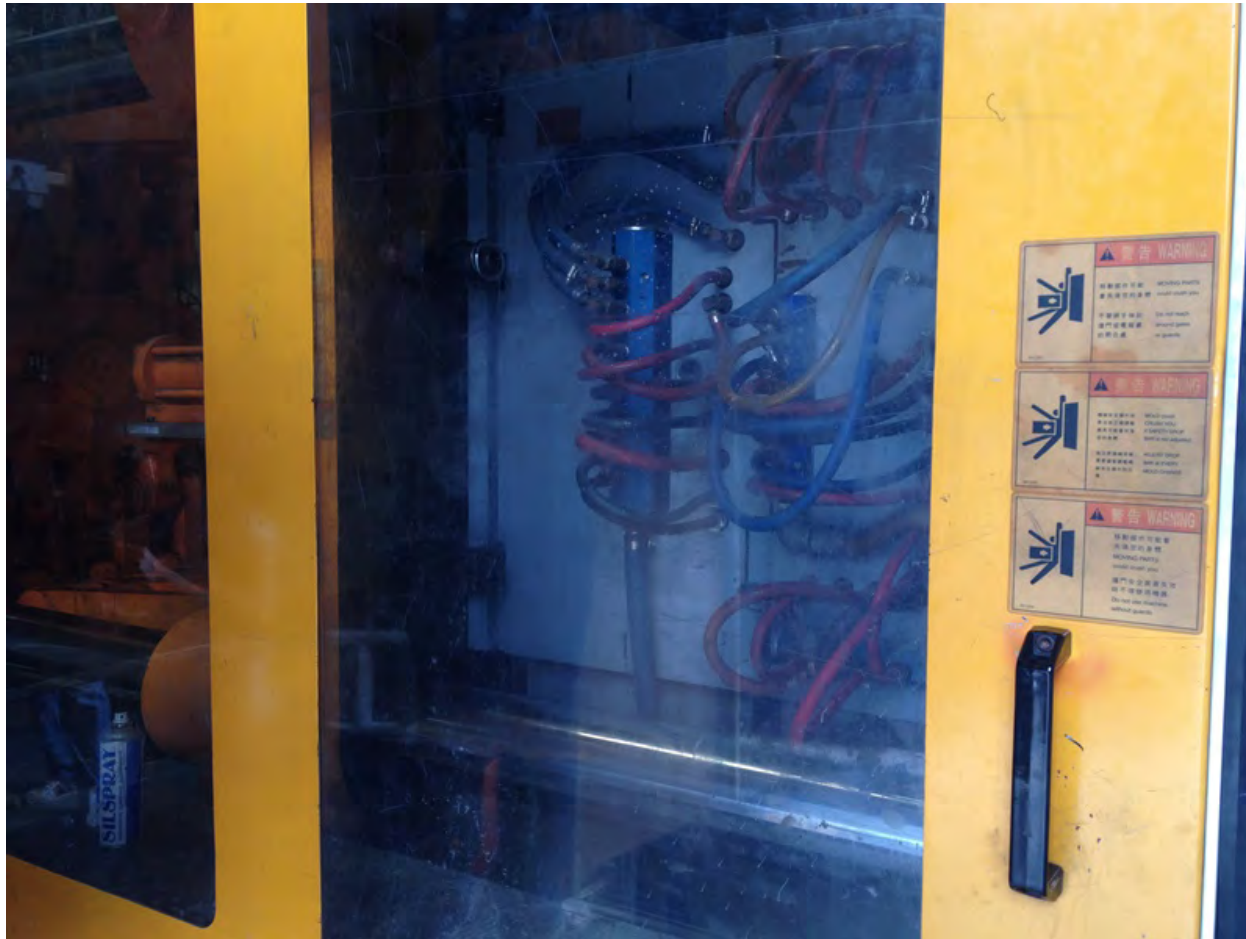
Molded Plastic Fabrication



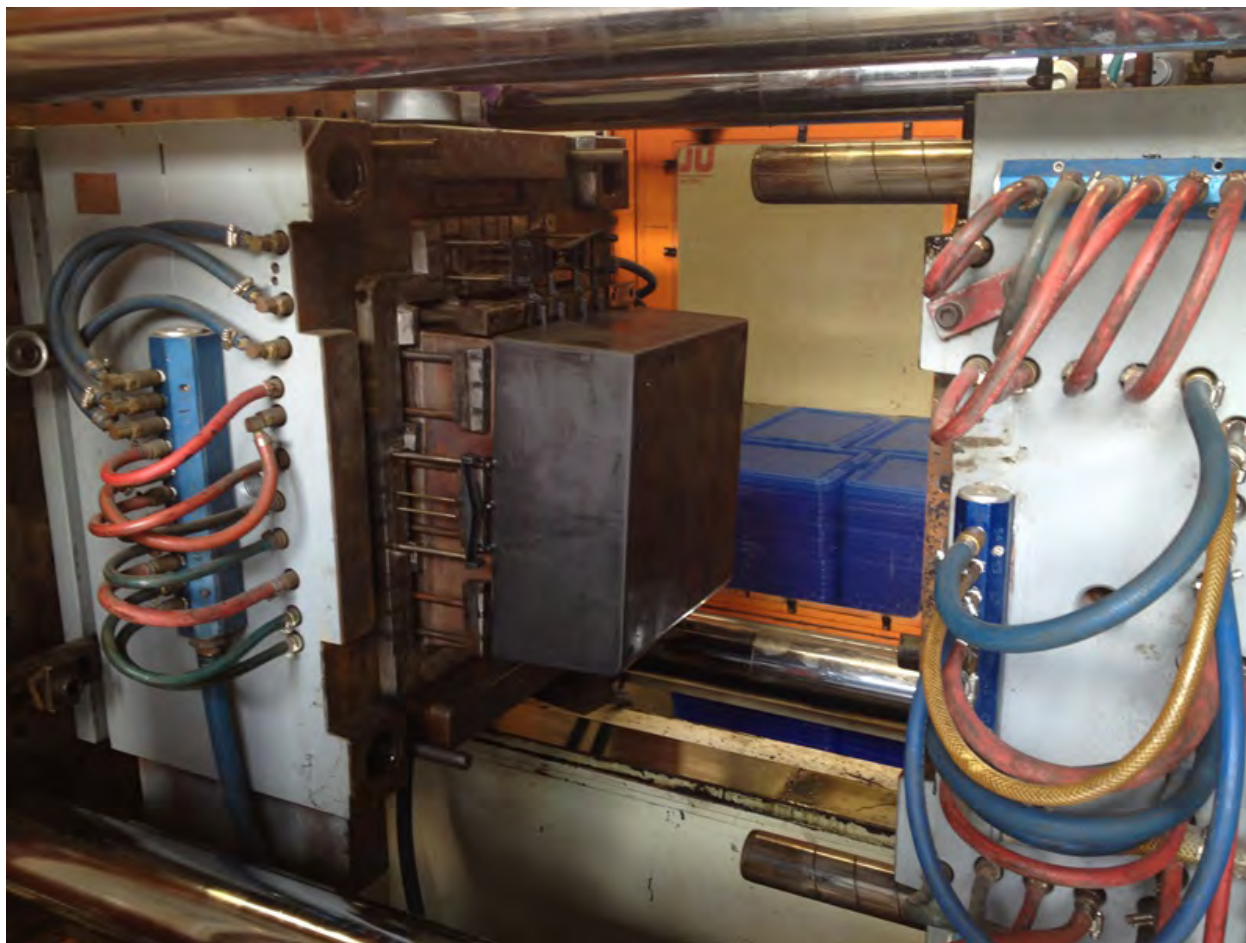
Molded Plastic Fabrication



Molded Plastic Fabrication



Molded Plastic Fabrication



Molded Plastic Fabrication



Molded Paper



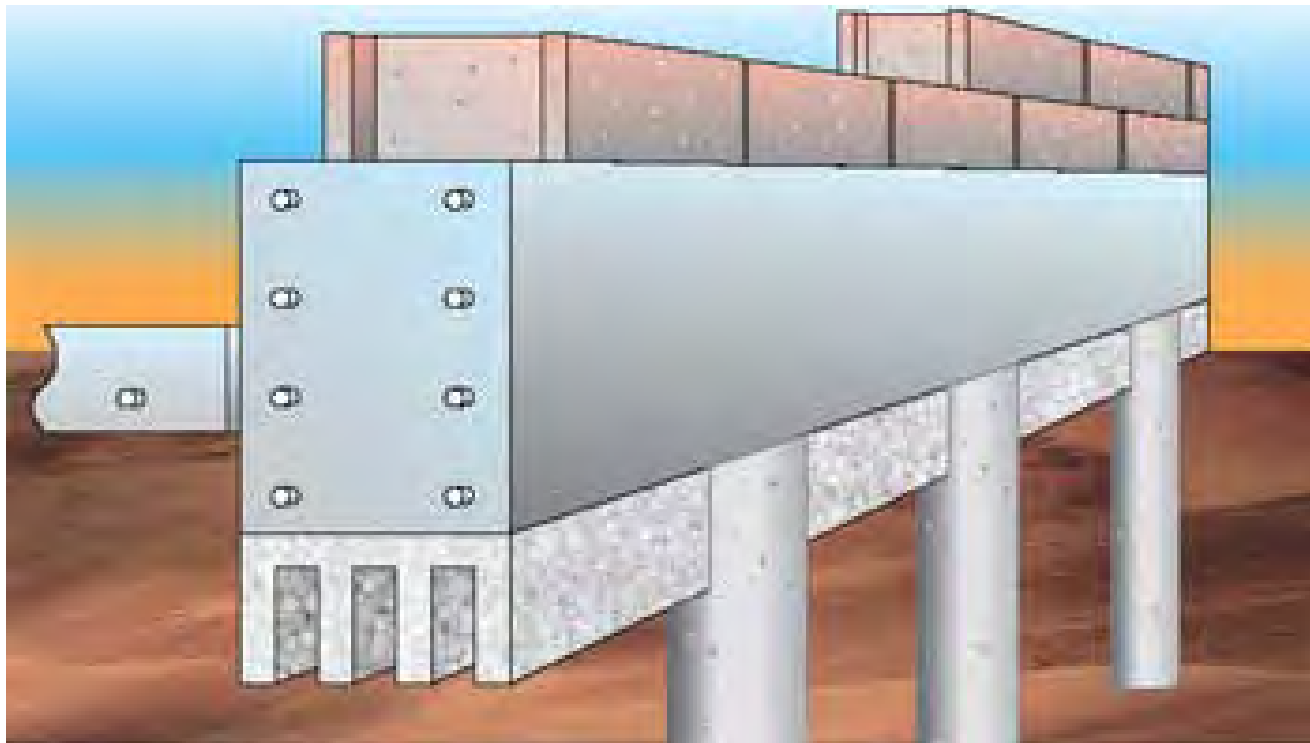
Molded Paper Fabrication



Styrofoam



Styrofoam



Styrofoam



Styrofoam



Styrofoam Fabrication



Wood



Wood



Wood



Wood Fabrication



Other?

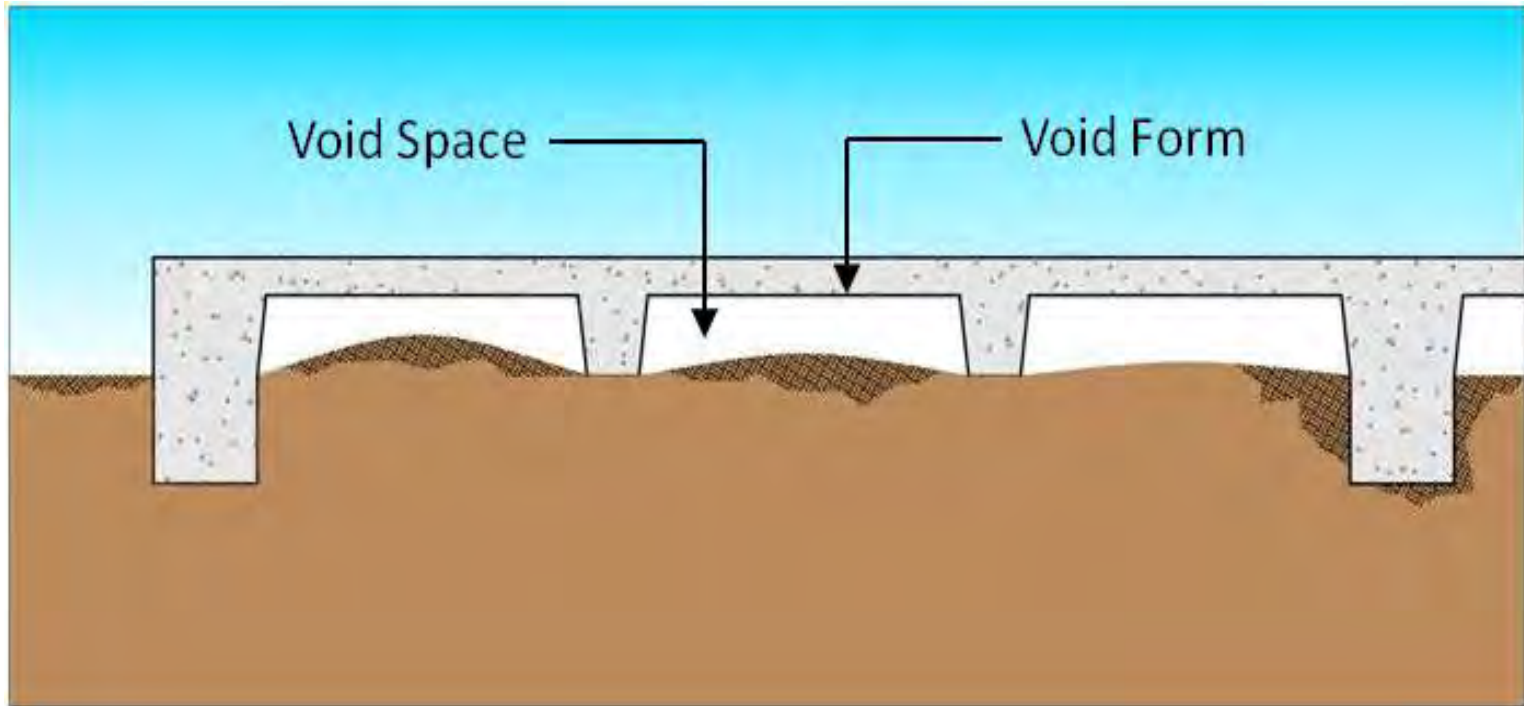


Why Use Void Space Forms?

Void Space Forms Can:

- Absorb expanding soil volume
- Create more stable slab
- Reduce amount of concrete
- Reduce soil excavation

Example of Void Space Foundation



Foundation Performance Failures Where Void Forms Were Not Used

Performance Failure of Non-Void Space Foundation



Performance Failure of Non-Void Space Foundation



Performance Failure of Non-Void Space Foundation



Performance Failure of Non-Void Space Foundation



Performance Failure of Non-Void Space Foundation



Performance Failure of Non-Void Space Foundation



Performance Failure of Non-Void Space Foundation



Performance Failure of Non-Void Space Foundation



Significant Changes In This Revision

- Void Space System Types
- Design of Void Space Systems
- Specifications for Void Space Materials
- Handling and Installation of Void Space Systems

Examples of Changes

Glossary

- 23 terms now vs 13 terms before
- New Definitions:
 - “Isolated Foundation”
 - “Isolated Slab”
 - “Deep Support Systems”
 - “Degrade”
 - “Grade Beams”
 - “Void Forms”

Isolated Foundation

Isolated Foundation utilizes Void Spaces that separate the Slab Area and Grade Beams from the surface soil.

It is supported by a Deep Support System.

Isolated Slab

Isolated Slab is the Slab Area that utilizes Void Spaces that separate the Slab Area from the surface soil.

It is designed to span between Grade Beams resting on finished grade or Deep Support Systems.

Deep Support Systems

Deep Support Systems, alternatively known as Deep Foundations, are deep components such as drilled piers, driven piles, and helical piles that extend an adequate depth below the movement zone of the Expansive Soil and support Foundations.

Degrade

Degrade is the term used to describe physical breakdown and loss of shape and strength of Corrugated Paper Void Forms after concrete has been placed and set.

Grade Beams

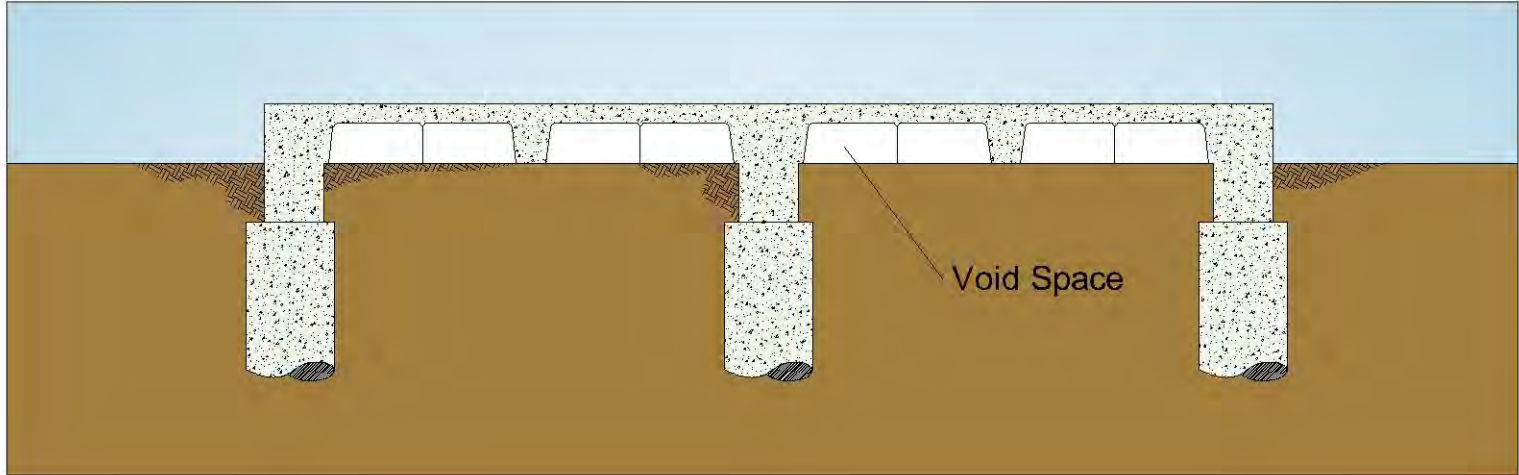
Structural beams in the foundation that extend from top of slab to bottom of foundation, and that either rest directly on the soil, or are fully or partially isolated from the soil by Void Forms.

See following three examples:

Grade Beams Example 1

An Isolated Slab with monolithically poured stiffening Grade Beams bearing directly on the soil and supported by a Deep Support System.

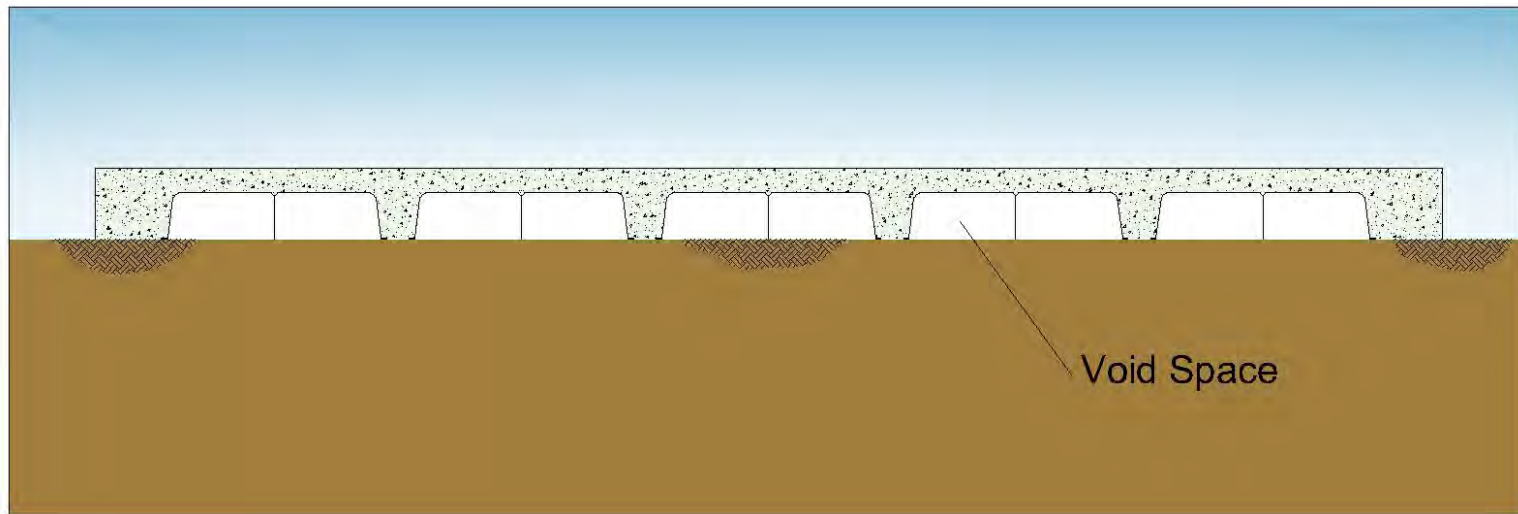
Grade Beams Example 1



Grade Beams Example 2

An Isolated Slab with monolithically poured stiffening Grade Beams bearing directly on the soil and *not* supported by a Deep Support System.

Grade Beams Example 2

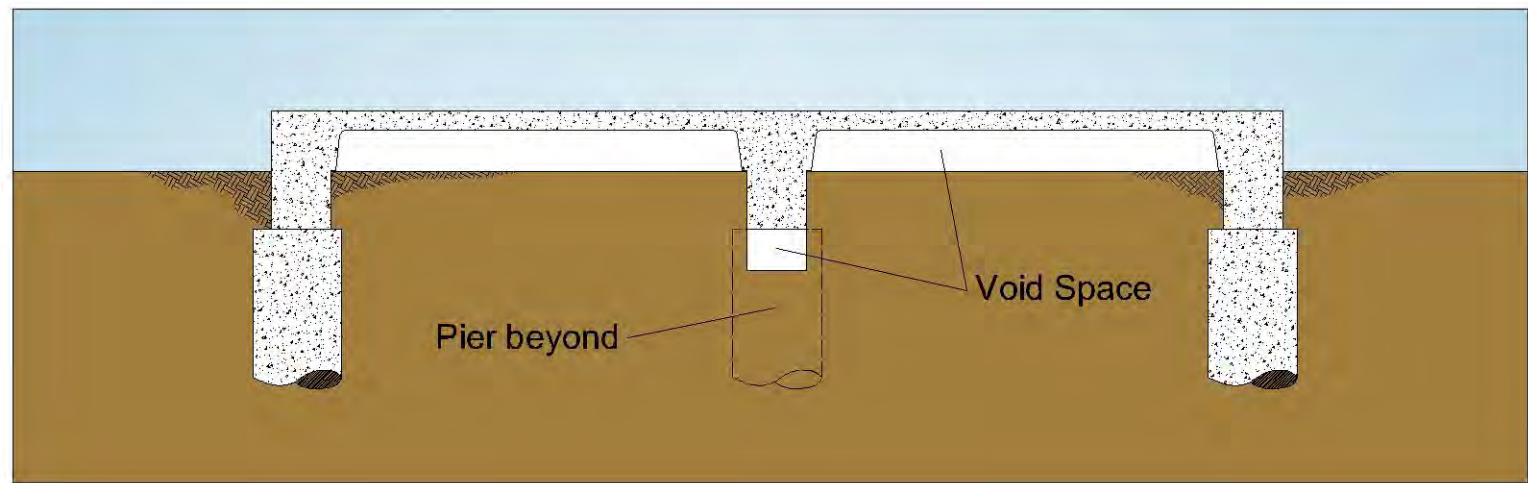


Grade Beams Example 3

An Isolated Slab with monolithically poured stiffening Grade Beams not bearing directly on the soil and supported by a Deep Support System.

The Grade Beams and the Slab Area are isolated from contact with the soil by use of a Void Space System.

Grade Beams Example 3



Void Forms

Void Forms are sacrificial formwork elements designed to provide Void Space between Expansive Soil and the Foundation, while providing a temporary support formwork for the weight of concrete until it has reached a specified strength.

1.0 Introduction

Added section titled “Considerations for the Use of Void Forms”.

2.0 Void Space System Types

Discusses the use of Degradable, Collapsible, and Non-Collapsible types of Void Forms.

3.0 Design of Void Space Systems

The following Tables have been expanded to include new Void Space Systems materials:

- Table 3.1-1 “Use of Void Space Systems Under Slab Areas”
- Table 3.1-2 “Use of Void Space Systems Under Grade Beams”
- Table 3.5-1 “Forms Around the Tops of the Piers”

4.0 Specifications for Void Space Materials

Specifications have been added for:

- Non-Collapsible Void Form use under both Grade Beam and Slab Area
- Plastic Void Forms

Void Forms In Action

Rising Oaks Apartments Oakland, California



Rising Oaks Apartments Oakland, California

- 18,000 sq ft foundation
- 38 units
- Replaced 30 ft deep concrete piers and grade beams
- Void Forms saved \$3.00 USD per sq ft

Goddard School San Ramon, California



Goddard School San Ramon, California



Goddard School San Ramon, California

- 9,000 sq ft foundation
- Replaced 2 ft of soil removal, replacement with non-expansive fill, and lime treatment of remaining soil
- Void Forms saved \$3.00 USD per sq ft

Custom Private Home Honolulu, Hawaii



Custom Private Home Honolulu, Hawaii

- 5,000 sq ft foundation
- Replaced 6 ft of soil removal and replacement with non-expansive fill
- Void Forms saved \$40,000 USD in soil remediation

Franciscan Vistas Multi-Family Retirement Homes, Honolulu, Hawaii



Franciscan Vistas Multi-Family Retirement Homes, Honolulu, Hawaii

- 10 units
- 140,000 sq ft of foundations
- Replaced 5 ft of soil removal and replacement with non-expansive fill
- Void Forms saved \$4.00 USD per sq ft

Marriott Hotel Honolulu, Hawaii



Marriott Hotel Honolulu, Hawaii

- 38,000 sq ft footprint, 120,000 sq ft supported
- 3-story concrete block, steel frame, and wood construction
- Replaced 225 drilled concrete piers, each 70 ft deep
- Void Forms saved \$1,100,000 USD

Q & A