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Report on Design and Construction with Insulating Concrete Forms (ICFs)

Reported by ACI Committee 560

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Insulating concrete forms (ICFs) are leave-in-place forms typically produced in block or panel shapes of expanded polystyrene (EPS). They provide additional components, such as insulation and a substrate for interior and exterior finish attachment, for a wall or floor system. The most widely used ICFs are block shapes, which are stacked in an interlocking fashion to create stable formwork for creation of reinforced concrete walls. Due to the variability of these manufactured form systems, this report does not attempt to address every ICF type, but provides a commentary on those systems most prevalent in the market, and insight, as well as additional information, relative to their use in design and construction. The report focuses on ICFs for walls.

Keywords: bracing system; crossties; expanded polystyrene; formwork configurations; formwork materials; insulating concrete forms; polypropylene; polyurethane; screen grid; wall design; wall systems; web.

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CHAPTER 1—INTRODUCTION AND SCOPE

1.1—Introduction

This report is a comprehensive introduction to the design and construction of reinforced concrete structures with insulating concrete forms (ICFs). ICFs are stay-in-place concrete forms that create vertical elements such as walls, columns, and pilasters, and horizontal elements such as floors and roofs. This report focuses on ICFs for walls.

ICFs that result in reinforced concrete walls are of varying dimensions and manufactured in blocks, planks, panels, and other shapes. They are made of plastic foam or a blended combination of other types of material such as cement, foam, and wood fiber. The most common ICFs used for wall construction typically provide two layers of low-absorptive foam plastic insulation held together with a system of crossties. The crossties are also typically configured to allow for direct attachment of internal and external finishes to the ICF. Reinforcing steel can be installed within the hollow portion of the form, followed by concrete placed to create a reinforced concrete wall. Figures 1.1a through 1.1c are examples of ICFs used for wall construction.

There are many manufacturers of ICFs. An ICF manufacturer's form design is proprietary, so each has specific characteristics and limitations. While individual ICFs perform similarly, they are not generally interchangeable. Most major ICF manufacturers have their own proprietary training programs supporting residential and commercial construction. Insulating concrete forms are typically lightweight so they are easy to handle and place. Concrete placement when using ICFs is completed by skilled craft construction crews who are trained and experienced with concrete placement and consolidation per ACI 301.

In spite of their simplicity, ICFs are based on extensive research and continue to evolve with changes in technology. Because there are many proprietary systems, and building codes do not offer general guidance about ICF construction, this report provides background information that is useful for designing and building ICF structures. This report also supplements proprietary information available from individual manufacturers with general information applying to most ICFs. In addition to informing designers and builders, this report is useful to building officials and other professionals who work with ICFs.

Originally evolved in Switzerland near the end of World War II, the earliest versions of ICFs were made from treated wood fibers and portland cement. In the late 1940s and 50s, plastic foams were developed, and by the late 1960s, the concepts of combining plastic foams and ICFs together resulted in the creation of contemporary ICFs. In the 1980s and 90s, numerous companies and products emerged. Growth in the number of ICF manufacturers led to the creation of the Insulating Concrete Form Association (ICFA) in the mid-1990s with a primary goal to advance the industry.

Insulating concrete forms initially entered the residential marketplace through their use in foundations and basements. They expanded into above-grade walls, often in more-expen-

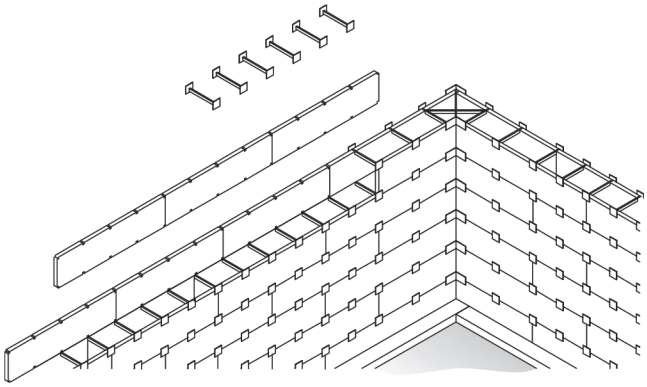

Fig. 1.1a—Panel and tile construct-in-place ICF system.

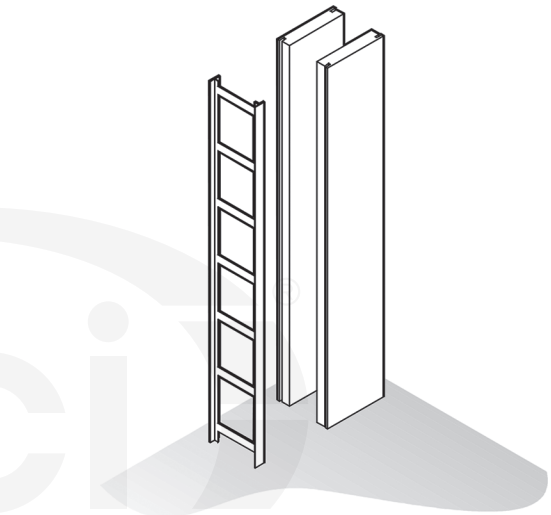

Fig. 1.1b—Vertical ladder and panel ICF system (ladder for interconnection).

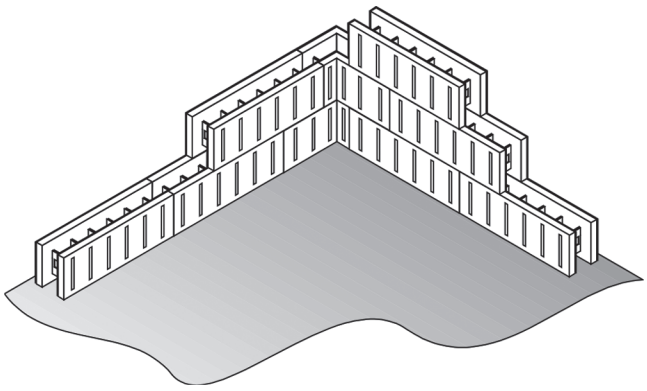

Fig. 1.1c—Block-type ICF system.