



CONSTRUCTION INDUSTRY INSTITUTE™

ONSITE DESIGN:
WHEN AND HOW MUCH?

Construction Industry Institute

3M	ABB Lummus Global
Abbott Laboratories	ALSTOM Power
Air Products and Chemicals	AMEC
Anheuser-Busch Companies	AZCO
Aramco Services Company	BE&K
BP America	BMW Constructors
CITGO Petroleum Corporation	Baker Concrete Construction
Cargill	Bechtel Group
Celanese	Black & Veatch
ChevronTexaco Corporation	Bovis Lend Lease
Colelectric Partners	Burns & McDonnell
ConocoPhillips	Butler Manufacturing Company
Dofasco	CCC Group
The Dow Chemical Company	CDI Engineering Group
DuPont	CH2M HILL Constructors/IDC
Eastman Chemical Company	CSA Group
ExxonMobil Corporation	Chicago Bridge & Iron Company
General Motors Corporation	Day & Zimmermann International
General Services Administration	Dick Corporation
GlaxoSmithKline	Dillingham Construction Holdings
Intel Corporation	Eichleay Engineers & Constructors
International Paper	Emerson Process Management
Eli Lilly and Company	Fluor Daniel
Marathon Oil Company	Foster Wheeler USA Corporation
NASA	Fru-Con Construction Corporation
Naval Facilities Engineering Command	Graycor
Ontario Power Generation	Hatch
Petrobras	Hilti Corporation
Pfizer	Honeywell International
Praxair	Jacobs
The Procter & Gamble Company	Johnson Controls
Rohm and Haas Company	J. A. Jones
Shell Oil Company	Kellogg Brown & Root
Smithsonian Institution	Kiewit Construction Group
Solutia	Kværner
Southern Company Services	M. A. Mortenson Company
Sunoco	Parsons E&C
Tennessee Valley Authority	Perot Systems Corporation
U.S. Air Force Research Laboratory	Primavera Systems
U.S. Army Corps of Engineers	Rust Constructors
U.S. Department of Commerce/NIST	S&B Engineers and Constructors Ltd.
U.S. Department of Energy	The Shaw Group
U.S. Department of Health and Human Services	Stevens Painton Corporation
U.S. Department of State	Structural Group
U.S. Steel	Technip USA Corporation
Weyerhaeuser Company	Turner Construction Company
	Walbridge Aldinger Company
	Washington Group International
	Williams Group International
	Zachry Construction Corporation
	Zurich North America



Documents

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**Prepared by
The Construction Industry Institute
Evaluating Onsite Design Research Team**

**Research Summary 163-1
March 2003**

Reviewed by CII 23Jun04

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The University of Texas at Austin.

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Printed in the United States of America.

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Executive Summary

The communication interface between design and construction is one of the most critical points of information exchange within a project. When the communication of design information is timely, unambiguous, and easily understood, construction activities are more efficiently performed.

Performing selected design activities on site, to some degree, is a commonly employed technique. However, the use of onsite design varies widely and is a function of project scope, complexity, location, team composition, execution strategy, and many other factors. Important questions such as “When?” and “How much?” should be employed in order for onsite design to influence project performance favorably.

CII created the Evaluating Onsite Design Project Team to address the onsite design issue. The project team found conclusive evidence that onsite design is beneficial and contributes to project success. Projects in the study utilizing onsite design were more constrained by cost, schedule, and technical complexity than projects not using onsite design. Even so, these projects performed as well as those projects not utilizing onsite design in every performance measure category. Furthermore, effective implementation of an onsite design strategy significantly improved 16 of 29 project performance measures.

The project team developed a computer-based decision support tool (CII Implementation Resource 163-2, *Onsite Design Tool for Project Planning*) that permits users to identify specific design activities that should be performed on site to maximize the likelihood that selected performance measures will be met or exceeded. The tool allows users to generate onsite design strategies for the various project phases and for combined or multiple decision criteria. This publication summarizes the study and introduces the tool.

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Introduction

Background

Nearly every project enjoys some level of field design support during construction execution. The split between home office and onsite design, however, varies widely among projects. In some cases, onsite design has been limited to field engineering functions such as formwork design or drawing interpretation. In other cases, it has been expanded to include such initiatives as the relocation of design disciplines to the jobsite. While it is generally agreed that the timely and accurate exchange of information between design and construction is critical to project success, it is often unclear what criteria should determine the appropriate level of onsite design support for a given project. Additionally, it has been unknown how onsite design specifically impacts project cost, schedule, rework, changes, and other measures of project performance. As a result, without a means to provide a quantitative measure, CII members have been unable to compare costs to benefits.

The CII Evaluating Onsite Design Project Team (PT 163) undertook a research initiative to address these issues. Specifically, the project team sought to answer these questions:

- Does onsite design truly yield benefits?
- If so, which performance measures are improved?
- When should onsite design be employed?
- How much onsite design is recommended?
- Does the design executed on site vary by project phase?

Until now, no detailed studies have been undertaken to quantify the benefits of onsite design or to develop decision support tools to aid in the determination of when and how much onsite design is appropriate and beneficial. It has long been suspected that the most

beneficial level of onsite design support is not a constant, unchanging quantity, but varies with project phases and project-specific requirements and conditions.

Research Objectives

The research objectives were defined as follows:

- Determine the type and magnitude of benefits resulting from onsite design with respect to improving the interface between design and construction.
- Quantify and validate the impact of onsite design support with respect to overall project performance measures such as cost, schedule, quality, rework, and change orders.
- Provide a methodology to determine the level of onsite design support that is optimal for project specific conditions and variables.

Scope of Research

The scope of this research included the study of a large number of projects executed by CII members. Data were collected from all market sectors. Additionally, the project database was nearly evenly divided between projects that employed onsite design and those that did not. Each project record included in the database contains a detailed description of the level of onsite design actually deployed as well as retrospective documentation of project performance. The research sought to address the benefits of onsite design both qualitatively and quantitatively.

As part of the research process, the project team identified 50 distinct design activities commonly performed on industrial and commercial type projects. These activities are summarized in Table 1. Such activities may or may not be performed on site. For any given project, the decision to perform an activity on site varied with the specific project requirements and the detailed plan for project execution.