Guide to Formwork for Concrete

An ACI Standard

Reported by ACI Committee 347

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Objectives of safety, quality, and economy are given priority in these guidelines for formwork. A section on contract documents explains the kind and amount of specification guidance the engineer/architect should provide for the contractor. The remainder of the report advises the formwork engineer/contractor on the best ways to meet the specification requirements safely and economically. Separate chapters deal with design, construction, and materials for formwork. Considerations peculiar to architectural concrete are also outlined in a separate chapter. Other sections are devoted to formwork for bridges, shells, mass concrete, and underground work. The concluding chapter on formwork for special methods of construction includes slipforming, preplaced-aggregate concrete, tremie concrete, precast, and prestressed concrete.

Keywords: anchors; architectural concrete; coatings; concrete construction; falsework; form ties; forms; formwork; foundations; quality control; reshoring; shoring; slipform construction; specifications; tolerances.

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PREFACE

Before the formation of ACI Committee 347 (formerly ACI Committee 622) in 1955, there had been an increase in the use of reinforced concrete for longer spans in structures, multistoried structures, and increased story heights.

The need for a formwork standard and increased knowledge concerning the behavior of formwork was evident from the rising number of failures, sometimes resulting in the loss of life. The first report by the committee, based on a survey of current practices in the United States and Canada, was published in the ACI JOURNAL in June 1957.[1.1] The second committee report was published in the ACI JOURNAL in August 1958.[1.2] This second report was an in-depth review of test reports and design formulas for determining lateral pressure on vertical formwork. The major result of this study and report was the development of a basic formula establishing form pressures to be used in the design of vertical formwork. The first standard was ACI 347-63. Subsequent revisions were ACI 347-68 and ACI 347-78. Two subsequent revisions, ACI 347R-88 and ACI 347R-94, were committee reports because of changes in the ACI policy on the style and format of standards. ACI 347-01 returned the guide to the standardization process.

A major contribution of the committee has been the sponsorship and review of *Formwork for Concrete*[1.3] by M. K. Hurd, first published in 1963 and currently in its sixth edition. Now comprising more than 490 pages, this is the most comprehensive and widely used document on this subject. (The Japan National Council on Concrete has published a Japanese translation.)

The paired values stated in inch-pound and SI units are usually not exact equivalents. Therefore, each system is to be used independently of the other. Combining values from the two systems may result in nonconformance with this document.

CHAPTER 1—INTRODUCTION

1.1—Scope

This guide covers:

- A listing of information to be included in the contract documents;
- Design criteria for horizontal and vertical forces on formwork;
- Design considerations, including safety factors, to be used in determining the capacities of formwork accessories;
- Preparation of formwork drawings;
- Construction and use of formwork, including safety considerations;
- Materials for formwork;
- Formwork for special structures;
- Formwork for special methods of construction; and
- Qualification of personnel for inspection and testing.

This guide is based on the premise that layout, design, and construction of formwork should be the responsibility of the formwork engineer/contractor. This is believed to be fundamental to the achievement of safety and economy of formwork for concrete.

1.2—Definitions

The following definitions will be used in this guide. Many of the terms can also be found in ACI 116R:

backshores—shores placed snugly under a concrete slab or structural member after the original formwork and shores have been removed from a small area at a time, without allowing the slab or member to deflect; thus, the slab or other member does not yet support its own weight or existing construction loads from above.

bugholes—surface air voids: small regular or irregular cavities, usually less than 0.6 in. (15 mm) in diameter, resulting from entrapment of air bubbles in the surface of formed concrete during placement and consolidation. Also called blowholes.

centering—specialized temporary support used in the construction of arches, shells, and space structures where the entire temporary support is lowered (struck or decentered) as a unit to avoid introduction of injurious stresses in any part of the structure.

climbing form—a form that is raised vertically for succeeding lifts of concrete in a given structure.

diagonal bracing—supplementary formwork members designed to resist lateral loads.