

Commentary on Standard Specifications for Tolerances for Concrete Construction and Materials (ACI 117-90)

Reported by ACI Committee 117

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This report is a commentary on the Standard Specifications for Tolerances for Concrete Construction and Materials. It is intended to be used with ACI 117 for clarity of interpretation and insight into the intent of the committee regarding the application of the tolerances set forth therein.

Keywords: bending (reinforcing steels); building codes; **concrete construction**; concrete piles; concretes; floors; formwork (construction); masonry; mass concrete; piers; precast concrete; prestressed concrete; reinforcing steels, **specifications**; splicing; **standards**; **tolerances (mechanics)**.

INTRODUCTION

This commentary pertains to "Standard Specifications for Tolerances for Concrete Construction and Materials (ACI-117)." The purpose of the report is to provide graphic and written interpretations for the specification and its application.

No structure is exactly level, plumb, straight, and true. Fortunately, such perfection is not necessary. Tolerances are a means to establish permissible variation in dimension and location, giving both the designer and the contractor parameters within which the work is to be performed. They are the means by which the designer conveys to the contractor the performance expectations upon which the design is based or the use of the project requires. Such specified tolerances should reflect design assumptions and project needs, being neither overly restrictive nor lenient. Necessity rather than desirability should be the basis of selecting tolerances.

As the title "Standard Specifications for Tolerances for Concrete Construction and Materials (ACI 117)" implies,

ACI Committee Reports, Guides, Standard Practices, and Commentaries are intended for guidance in planning, designing, executing, or inspecting construction and in preparing specifications. Reference to this document shall not be made in the Project Documents. If items found in these documents are desired to be a part of the Project Documents, they shall be phrased in mandatory language and incorporated in the Project Documents.

the tolerances given are standard or usual tolerances that apply to various types and uses of concrete construction. They are based upon normal needs and common construction techniques and practices. Specific tolerances at variance with the standard values can cause both increases and decreases in the cost of construction.

The required degree of accuracy of performance depends on the interrelationship of several factors:

Structural strength and function requirements

The structure must be safe and strong, reflecting the design assumptions, and accurate enough in size and shape to do the job for which it was designed and constructed.

Esthetics

The structure must satisfy the appearance needs or wishes of the owner and the designer.

Economic feasibility

The specified degree of accuracy has a direct impact on the cost of production and the construction method. In general, the higher degree of accuracy required, the higher the cost of obtaining it.

Relationship of all components

The required degree of accuracy of individual parts can be influenced by adjacent units and materials, joint and connection details, and the possibility of the accumulation of tolerances in critical dimensions.

*Chairman during initial development of this document
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Construction techniques

The feasibility of a tolerance depends on available craftsmanship, technology, and materials.

Properties of materials

The specified degree of accuracy for shrinkage and prestressed camber should recognize the degree of difficulty of predetermining deflection due to shrinkage and prestressed camber.

Compatibility

Designers are cautioned to use finish and architectural details that are compatible with the type and anticipated method of construction. Finish and architectural details used should be compatible with the concrete tolerances which are achievable.

Job conditions

Unique job situations and conditions must be considered. The designer must specify and clearly identify those items that require either closer or more lenient tolerances as the needs of the project dictate.

Measurement

Mutually agreed-upon control points and bench marks must be provided as reference points for measurements to establish the degree of accuracy of items produced and for verifying the tolerances of the items produced. Control points and bench marks should be established and maintained in an undisturbed condition until final completion and acceptance of the project.

Project document references

ACI Specification documents—The following American Concrete Institute documents provide mandatory requirements for concrete construction and may be referenced in the Project Documents:

ACI 117	Standard Specifications for Tolerances for Concrete Construction and Materials
ACI 301	Specifications for Structural Concrete for Buildings
ACI 531.1	Specification for Concrete Masonry Construction

ACI informative documents—ACI Committee Reports, Guides, Standard Practices, and Commentaries are intended for guidance in designing, planning, executing, or inspecting construction, and in preparing plans and specifications. Reference to these Reports, Guides, and Standard Practices should not be included in the Project Documents. If the Architect/Engineer desires to include items found in these ACI documents in the Project Documents, they should be rephrased in mandatory language and incorporated into the Project Documents.

The documents of the following American Concrete Institute Committees cover practice, procedures, and state-of-the-art guidance for the categories of construction as listed.

General building	ACI 302, 303, 304, 318, 347
Special structures	ACI 307, 313, 316, 325, 332, 334, 344, 345, 349, 350, 357, 358
Precast construction	ACI 347
Masonry construction	ACI 531
Materials	ACI 211, 223, 302, 304, 315, 318, 531, 543

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SECTION 1—GENERAL REQUIREMENTS

1.3—Definitions

Bowing—See Fig. 1.3.1.

Flatness—See Fig. 1.3.2.

Lateral alignment—See Fig. 1.3.3.

Level alignment—See Fig. 1.3.4.

Relative alignment—See Fig. 1.3.5.

Vertical alignment—See Fig. 1.3.6.

Warping—See Fig. 1.3.7.

Level alignment, lateral alignment, and vertical alignment are used to establish a tolerance envelope within which permissible variations can occur. Relative alignment, in addition to designating allowable relative displacements of elements, is used to determine the rate of change of adjacent points (slope tolerance) occurring within the tolerance envelope. In this fashion the slope and smoothness of surfaces and lines within a tolerance envelope are controlled. Abrupt

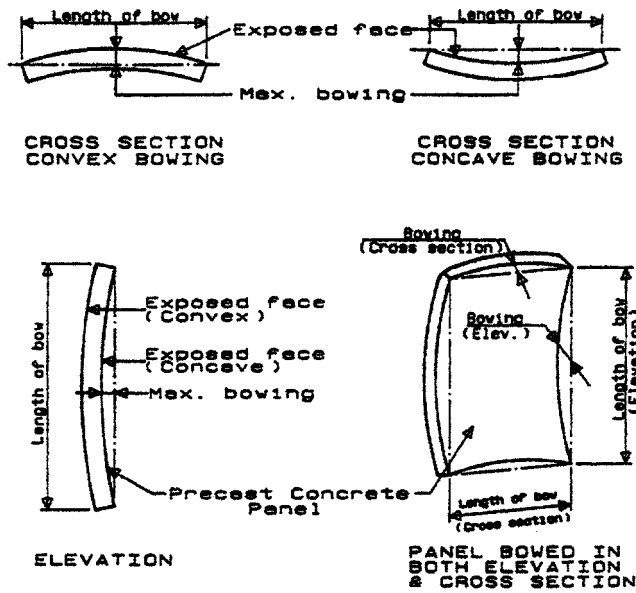


Fig. 1.3.1—Bowling

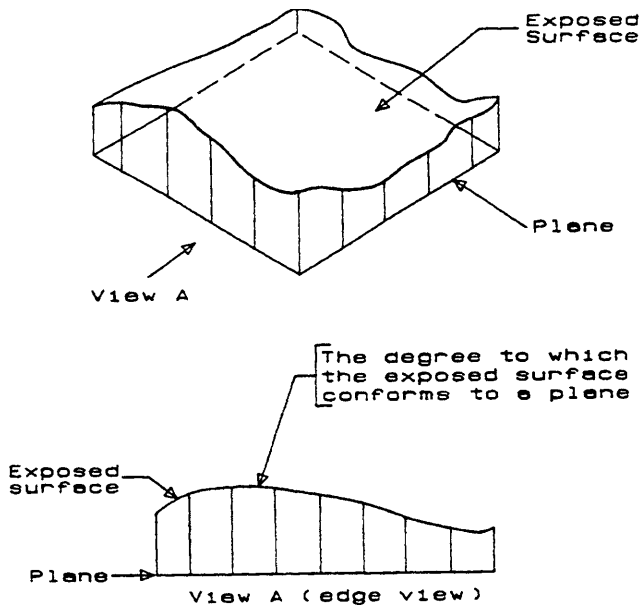


Fig. 1.3.2—Flatness

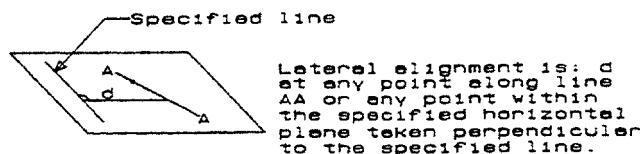


Fig. 1.3.3—Lateral alignment

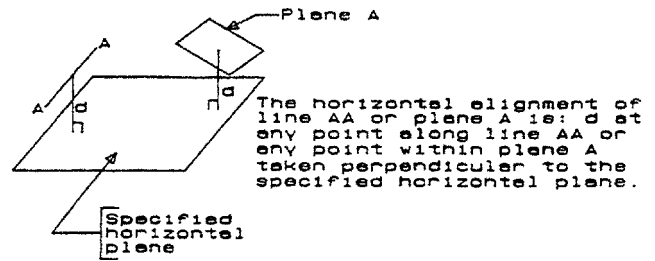


Fig. 1.3.4—Level alignment

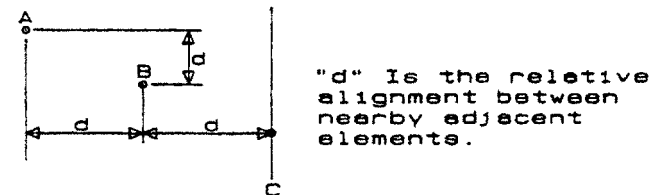
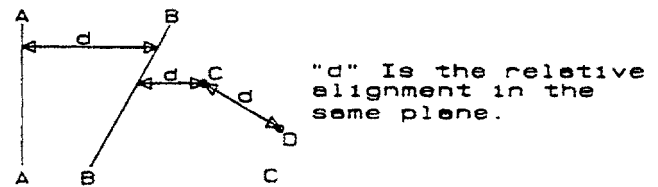


Fig. 1.3.5—Relative alignment

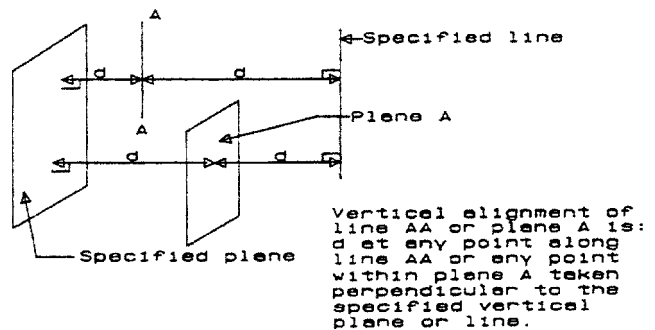


Fig. 1.3.6—Vertical alignment

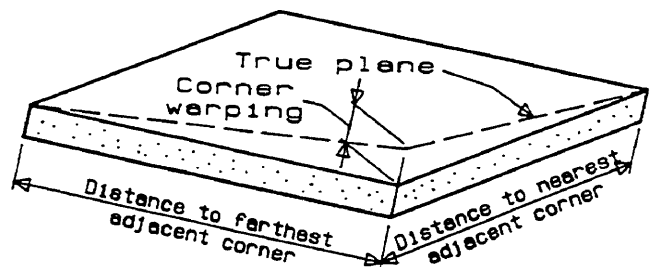


Fig. 1.3.7—Warping

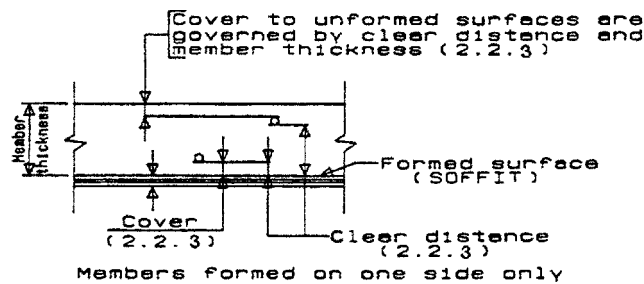


Fig. 2.2.2(a)—Reinforcement placement

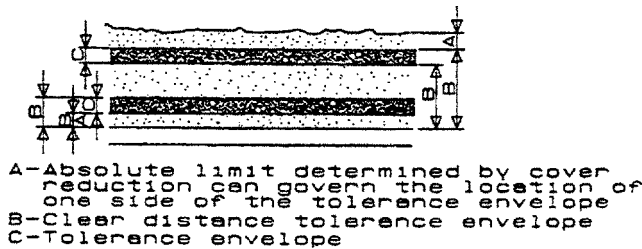


Fig. 2.2.2(b) and 2.2.3(b)—Reinforcement placement

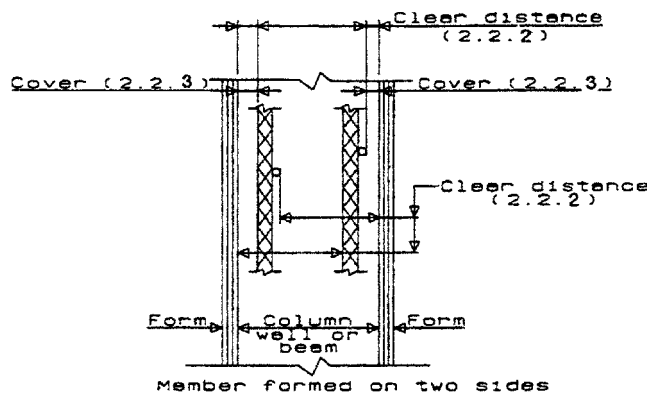


Fig. 2.2.3(a)—Reinforcement placement

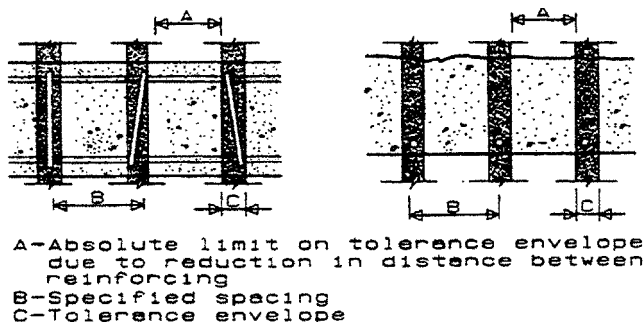


Fig. 2.2.4 and 2.2.5—Reinforcement placement

changes, offsets, sawtoothing, sloping, etc., of lines and surfaces properly located within a tolerance envelope may be objectionable when exposed to view. The acceptable relative alignment of points on a surface or line is determined by using a slope tolerance.

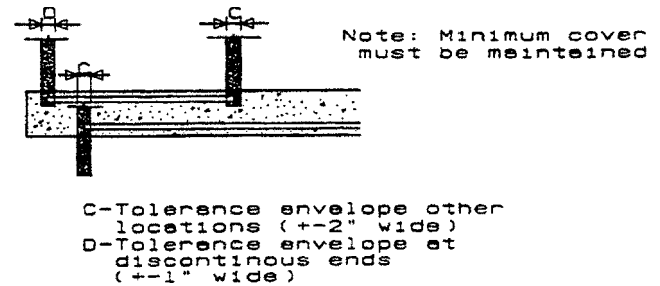


Fig. 2.2.7—Reinforcement placement, longitudinal location

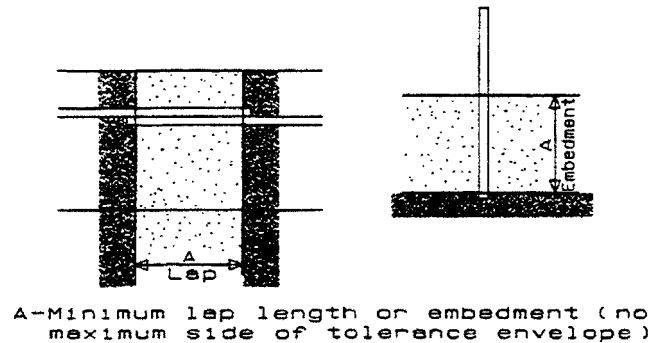


Fig. 2.2.8—Reinforcement placement, embedment and laps

SECTION 2—MATERIALS

2.2—Reinforcement

In the absence of specific design details shown or specified on the contract documents, CRSI MSP-I, Appendix D, should be followed by estimators, detailers, and placers.

2.2.2 and 2.2.3 The tolerance for placing reinforcing steel is predicated upon measurements of the formed surfaces for quality control during construction and from the resulting surfaces for forensic analysis. It consists of an envelope with an absolute limitation on one side of the envelope determined by the limit on the reduction in cover. See Fig. 2.2.2(a), 2.2.2(b), 2.2.3(a), and 2.2.3(b).

2.2.4 and 2.2.5 The spacing tolerance of reinforcing consists of an envelope with an absolute limitation on one side of the envelope determined by the limit on the reduction in distance between reinforcement. In addition, the allowable tolerance on spacing shall not cause a reduction in the specified number of reinforcing bars utilized. See Fig. 2.2.4 and 2.2.5.

2.2.6 The vertical deviation tolerance should be considered in establishing minimum prestressing tendon covers, particularly in applications exposed to deicer chemicals or salt water environments where use of additional cover is recommended to compensate for placing tolerances. Slab behavior is relatively insensitive to horizontal location of tendons.

2.2.7 and 2.2.8 The tolerance for the location of the ends of reinforcing steel is determined by these provisions. See Fig. 2.2.7 and 2.2.8.