

Specification for Tolerances for Precast Concrete

An ACI Standard

Reported by ACI Innovation Task Group 7



American Concrete Institute®

Specification for Tolerances for Precast Concrete

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This Reference Specification provides standard tolerances for precast concrete construction. It covers dimensional tolerances for precast concrete members used in building construction, and it covers erection tolerances for these members. This document is intended to be adopted by reference in Contract Documents. The Specifier supplements the provisions of this Reference Specification as needed by specifying project-specific requirements in Contract Documents.

Keywords: alignment; construction; erection tolerances; precast concrete; prestressed concrete; product tolerances; reinforcement; specification.

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SECTION 1—GENERAL REQUIREMENTS

1.1—Scope

1.1.1 Work specified—This Specification designates standard tolerances for structural and architectural precast concrete members. Tolerances are provided for individual members and their erection. The indicated tolerances govern unless otherwise specified.

1.1.2 Work not specified—Interface tolerances between precast concrete members and cast-in-place concrete construction are specified in ACI 117.

1.1.3 Units—Values in this specification are stated in SI units. A companion specification in inch-pound units is also available.

1.2—Requirements

1.2.1 Accumulation of tolerances—Tolerances are not cumulative. Accumulations of individual tolerances on a single item shall not be used to increase an established tolerance. Individual tolerances are unique to their specific application and shall not be combined with other tolerances to form a tolerance envelope. The most restrictive tolerance controls.

1.2.2 Sign definition—Plus (+) tolerance increases the dimension or elevation to which it applies. Minus (−) tolerance decreases the dimension or elevation to which it applies.

1.2.3 Exceeding tolerances—If the product and erection tolerances in this document are exceeded, the member or the modified assembly shall be accepted if the following conditions are met:

- (a) The Licensed Design Professional determines that the structural requirements have been satisfied.
- (b) The Owner or Architect accepts the appearance of exposed surfaces.

1.3—Definitions

Architect/Engineer—the architect, engineer, architectural firm, or engineering firm developing Contract Documents or administering the Work under Contract Documents, or both.

bearing width overhang—distance from the side of precast concrete member to side of bearing media, that is, pad or shim, measured perpendicular to the direction of the span, as shown in Fig. 1.1.

blockout—opening through the member for conduit, piping, ductwork, connections, or structural framing.

bowing—the deviation of the edge or surface of a planar wall member, in the out-of-plane direction, from a line passing through any two corners of the member, as shown in Fig. 1.2.

camber—deviation of the bottom of the member from a line between the bottom ends of that member due to the effects of the prestress force.

Contract Documents—a set of documents supplied by Owner to Contractor as the basis for construction; these documents contain contract forms, contract conditions, specifications, drawings, addenda, and contract changes.

control surface, primary—the member surface deemed to be critical to the fit and function of interfacing members or to the appearance of the completed project.

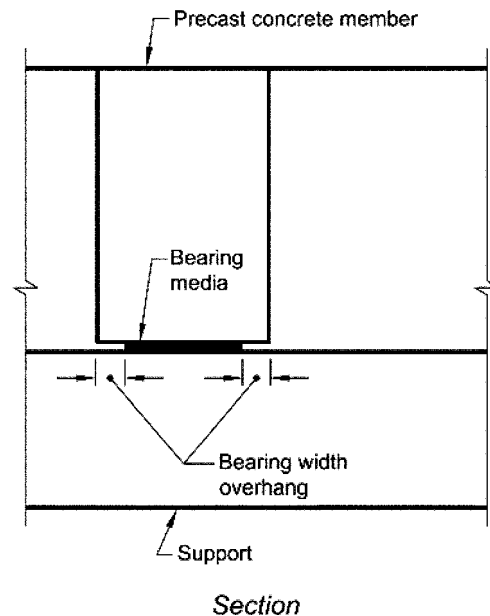
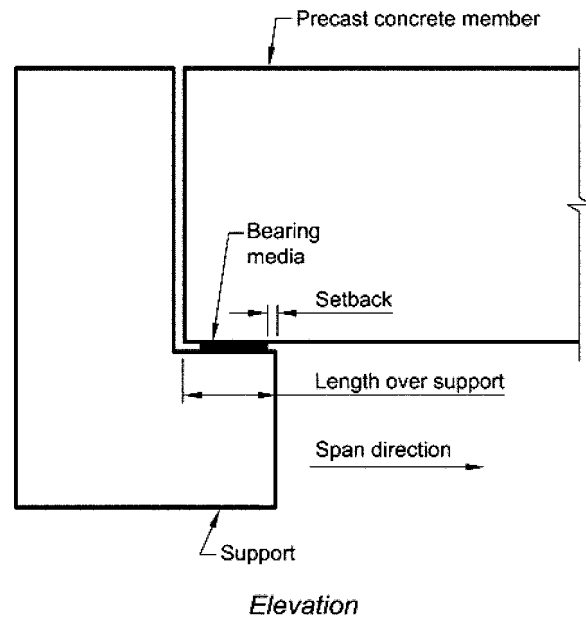


Fig. 1.1—Length over support and bearing width overhang.

cover—the least distance between the surface of embedded reinforcement and the surface of the concrete.

deviation—distance from an established reference point, line, or surface measured perpendicular to the line or surface of the member.

deviation from plane—distance between a point on a reference plane and the corresponding point on the actual surface of the member.

deviation, horizontal—distance from an established point, line, or surface measured perpendicular to a vertical line through the point of interest.

deviation, vertical—distance from an established point, line, or surface measured perpendicular to a horizontal line through the point of interest.

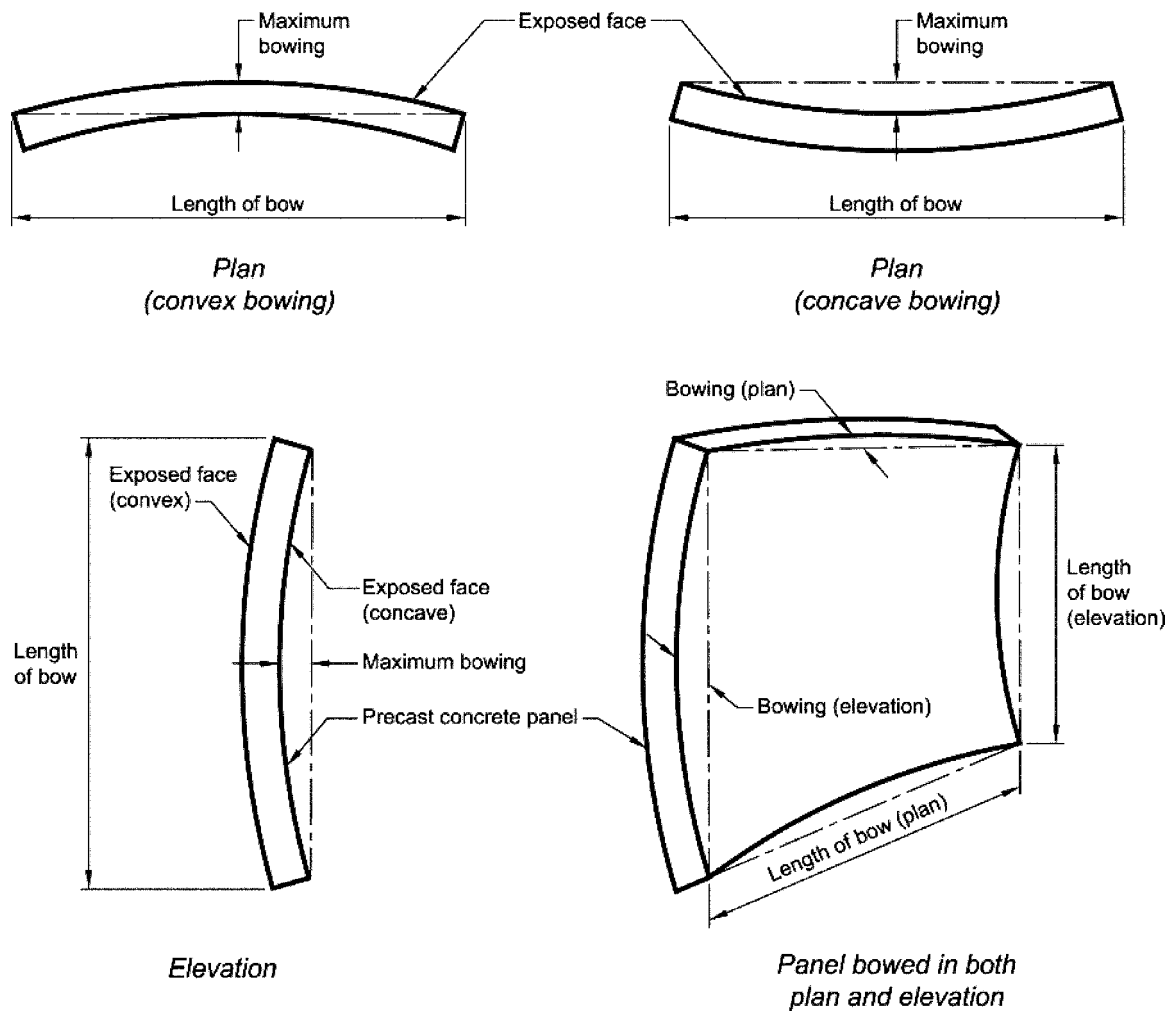


Fig. 1.2—Panel bowing.

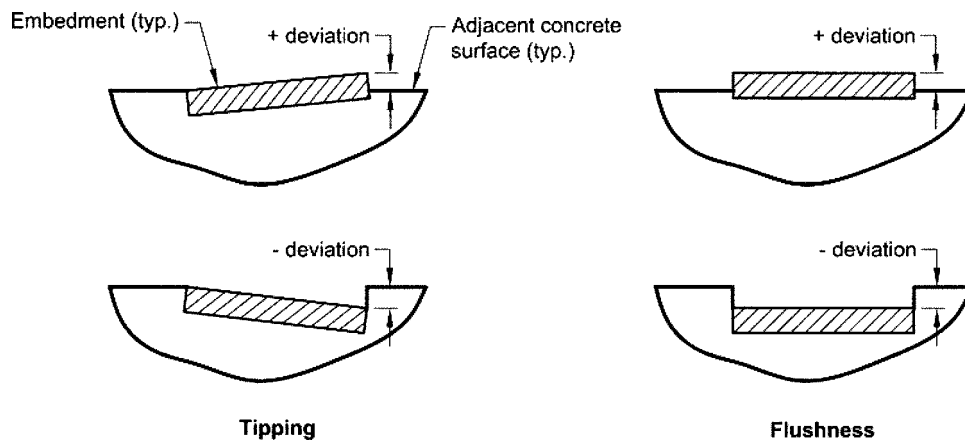


Fig. 1.3—Tipping and flushness.

embedment—item embedded in the concrete to transmit applied loads to the structure.

exposed—intended by the Contract Documents to be visible during normal occupancy.

flushness—deviation of the embedment surface from the surrounding adjacent concrete surface, as shown in Fig. 1.3.

insert—an embedment that uses a threaded device or strap anchor to connect the member to the surrounding structure or other work.

length over support—length of precast member over the support measured in the direction of the span, as shown in Fig. 1.1.

Licensed Design Professional—an individual who is licensed to practice structural design as defined by the

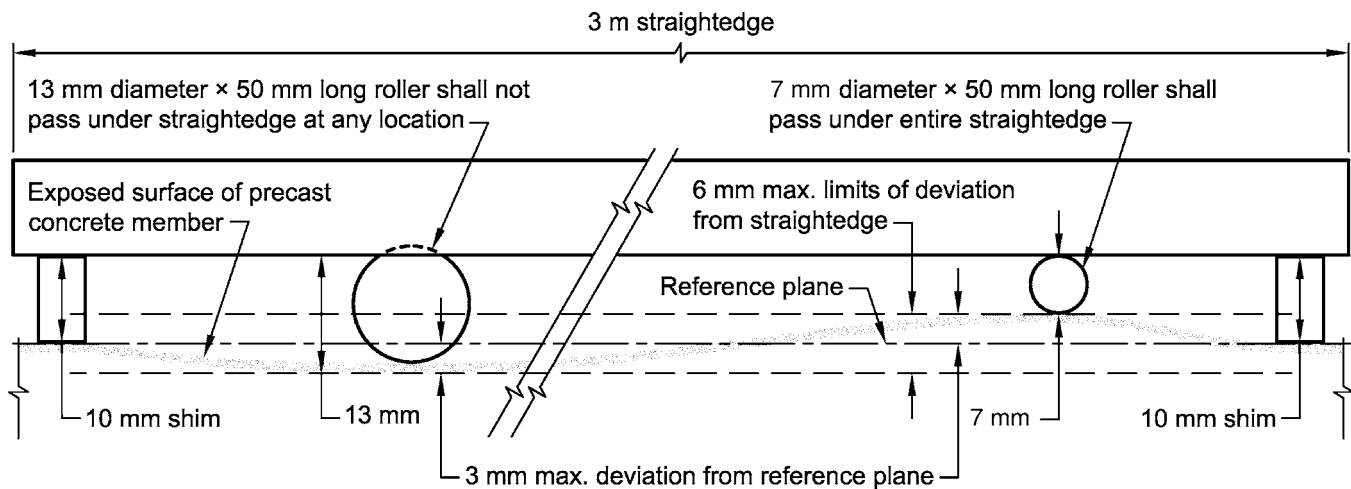


Fig. 1.4—Roughness.

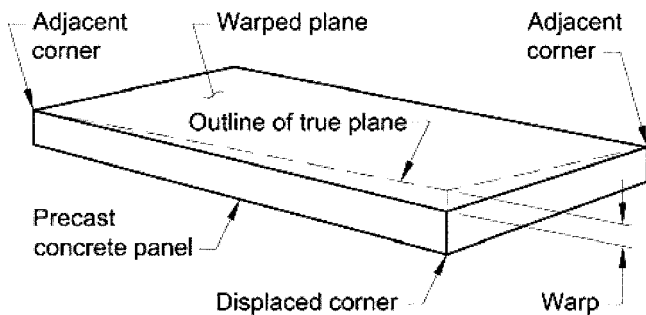


Fig. 1.5—Panel warping.

statutory requirements of the professional licensing laws of the state or jurisdiction in which the project is to be constructed and who is in responsible charge of the structural design.

opening, finished—an opening through a member that will be visible and requires additional finishing to the as-cast concrete surfaces and edges.

opening, rough—opening through a member that accepts a frame for a window, door, louver, hatch, or similar device.

Owner—the corporation, association, partnership, individual, public body, or authority for whom the Work is constructed.

pretopped—a manufactured precast concrete member that does not require a field-placed concrete topping.

Project Drawings—graphic presentation of project requirements.

product, nonstructural architectural—precast concrete member that is visually exposed in the finished Work; does not support any horizontal structural members; and is not part of the lateral force-resisting system.

product, structural—precast concrete member that is part of the structural framing system and is designed to resist imposed loads in addition to self-weight.

roughness—the variation in the deviation of an exposed surface from a local reference plane, as shown in Fig. 1.4.

setback—distance from edge of support to the bearing media, that is, pad or shim, as shown in Fig. 1.1.

spandrel—precast concrete members that are less than a story in height, have a height to web thickness ratio of 3 or greater, and span horizontally between supports.

spanning member—a horizontal member supported at or near the ends.

specified—required by the Contract Documents.

sweep—deviation of a longitudinal edge, of a horizontal or vertical member, from a line through the ends of that edge.

tipping—the deviation from plane of one or both edges of an embedment, as shown in Fig. 1.3.

tolerance—the permitted deviation from a specified dimension, location, line, or plane.

unarmored edge—the corner, in section view, of a concrete support member unprotected by a steel embedment.

warping—deviation of a planar surface due to displacement of one corner in relation to any two adjacent corners, as shown in Fig. 1.5.

Work—the entire construction or separately identifiable parts thereof required to be furnished under Contract Documents.

wythe—the concrete layer of an insulated wall panel, between a panel face and the nearest surface of the sandwiched insulation, measured perpendicular to the face of the panel.

1.4—Referenced standards

Standards of ACI referred to in this Specification are listed with serial designation including year of adoption or revision.

American Concrete Institute

117-06 Specifications for Tolerances for Concrete Construction and Materials and Commentary

This publication may be obtained from this organization:

American Concrete Institute
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SECTION 2—STRUCTURAL PRODUCT TOLERANCES

2.1—Scope

This section provides tolerances for precast structural products specified in the Contract Documents.

2.2—Tolerances

Unless otherwise specified, structural products shall comply with tolerances listed in Table 2.1. The filled circles in Table 2.1 indicate which tolerances are applicable to each product type. Each tolerance category is assigned a number in Table 2.1, and those numbers are used in Fig. 2.1 through 2.12 to illustrate the different categories of tolerances.

Table 2.1—Product tolerances for structural members

Product tolerance	Product type											
	Single tee (Fig. 2.1)	Double tee (Fig. 2.2)	HC slab (Fig. 2.3)	Joist (Fig. 2.4)	Beam and spandrel (Fig. 2.5)	Column (Fig. 2.6)	Ribbed wall panel (Fig. 2.7)	Flat wall panel (Fig. 2.8)	HC wall panel (Fig. 2.9)	Step unit (Fig. 2.10)	Stadium riser (Fig. 2.11)	Room module (Fig. 2.12)
1. Deviation from specified length												
±10 mm												•
±13 mm			•			•	•	•	•	•	•	
±20 mm					•							
±25 mm	•	•		•								
<i>a. Balcony extension</i>												
±6 mm												•
2. Deviation from specified width												
±6 mm	•	•	•	•	•	•	•	•	•		•	
±10 mm										•		
±6 mm (single module)												•
±13 mm (double module)												•
<i>a. Closure panel between units</i>												
+0 mm, -13 mm												•
3. Deviation from specified ledge width												
±6 mm					•							
4. Deviation from specified tread width												
±3 mm											•	
±6 mm										•		
5. Deviation from specified depth												
±6 mm	•	•	•	•	•	•	•	•	•	•	•	
6. Deviation from specified ledge depth												
±6 mm					•							
7. Deviation from specified riser depth												
±3 mm											•	
±5 mm										•		
8. Deviation from specified flange thickness*												
+6 mm, -3 mm	•	•		•			•				•	
±6 mm					•							
Not less than 85% of the specified flange thickness			•						•			
9. Deviation from specified wythe thickness												
±10 mm								•				
10. Deviation from specified web thickness*												
±3 mm		•		•			•				•	
±6 mm	•				•							
Not less than 85% of the specified web thickness			•						•			
11. Deviation from specified wall thickness												
+6 mm, -0 mm												

Table 2.1—Product tolerances for structural members (cont.)

Product tolerance	Product type											
	Single tee (Fig. 2.1)	Double tee (Fig. 2.2)	HC slab (Fig. 2.3)	Joist (Fig. 2.4)	Beam and spandrel (Fig. 2.5)	Column (Fig. 2.6)	Ribbed wall panel (Fig. 2.7)	Flat wall panel (Fig. 2.8)	HC wall panel (Fig. 2.9)	Step unit (Fig. 2.10)	Stadium riser (Fig. 2.11)	Room module (Fig. 2.12)
12. Deviation from specified slab thickness												
±6 mm												•
13. Deviation from specified distance between stems												
±3 mm							•					
±6 mm		•										
14. Deviation from specified distance between centerline of stem and edge of flange												
±3 mm							•					
±6 mm	•	•										
15. Deviation from specified squareness or skew across the width of an end												
±10 mm per m, ±6 mm maximum											•	
±10 mm per m, ±10 mm maximum						•						
±10 mm per m, ±13 mm maximum	•	•			•		•	•		•		
±20 mm per m, ±13 mm maximum				•								
±6 mm												•
±13 mm			•						•			
16. Deviation from specified squareness or skew across the thickness or depth or height of an end												
±3 mm												•
±10 mm per m							•	•	•			
±10 mm per m, ±6 mm maximum											•	
±10 mm per m, ±10 mm maximum						•						
±10 mm per m, ±13 mm maximum			•		•							
±20 mm per m, ±13 mm maximum				•								
±13 mm										•		
<i>a. Depth ≤ 600 mm</i>												
±6 mm	•	•										
<i>b. Depth > 600 mm</i>												
±10 mm per m, ±13 mm maximum	•	•										
17. Deviation from specified location of a haunch, corbel, or ledge bearing surface												
<i>a. From end of member</i>												
±6 mm						•	•	•				
<i>b. Distance between bearing surfaces</i>												
±6 mm							•	•				
18. Deviation from plane (warping)												
5 mm per m							•	•	•			
±6 mm										•	•	
19. Deviation from plane of a haunch, corbel, or ledge bearing surface												
±10 mm per m, ±10 mm maximum						•						
±7 mm per m, ±6 mm maximum							•	•				
20. Deviation from plane of a tread surface												
+3 mm, -0 mm										•	•	
21. Deviation of a local exposed surface from reference plane (roughness), as shown in Fig. 1.4												
6 mm per 3 m	•	•	•	•	•	•	•	•	•	•	•	•
22. Deviation from plane (bowing)												
length/360 maximum							•	•	•			
23. Deviation from specified location of a blockout (any direction)												
±25 mm	•	•			•		•	•	•		•	
±50 mm			•									

Table 2.1—Product tolerances for structural members (cont.)

Product tolerance	Product type											
	Single tee (Fig. 2.1)	Double tee (Fig. 2.2)	HC slab (Fig. 2.3)	Joist (Fig. 2.4)	Beam and spandrel (Fig. 2.5)	Column (Fig. 2.6)	Ribbed wall panel (Fig. 2.7)	Flat wall panel (Fig. 2.8)	HC wall panel (Fig. 2.9)	Step unit (Fig. 2.10)	Stadium riser (Fig. 2.11)	Room module (Fig. 2.12)
<i>a. Sleeve breakout</i>												
±25 mm	•	•										
<i>b. Skew of a sleeve breakout</i>												
±13 mm	•	•										
<i>c. Rotation (where breakout is visible). Distance is measured at perimeter</i>												
2 degrees, ±6 mm maximum												•
24. Deviation from specified size of a breakout												
±13 mm	•	•	•		•		•	•	•		•	
25. Deviation from specified location of an exposed breakout, rough opening, or finished opening												
±25 mm					•		•	•				
26. Deviation from specified size of a rough opening												
±3 mm												•
±25 mm					•		•	•				
27. Deviation from specified size of a finished opening												
±13 mm					•		•	•				
28. Deviation from specified horizontal line or plane (sweep)												
±10 mm			•						•			
±3 mm per 3 m, ±13 mm maximum						•						
±3 mm per 6 m, ±10 mm maximum								•				
±6 mm per 12 m, ±10 mm maximum											•	
<12 m, ±6 mm	•	•			•		•					
<12 m, ±10 mm				•								
>12 m, ±10 mm							•					
12 m to 18 m, ±10 mm	•	•										
12 m to 18 m, ±13 mm					•							
12 m to 18 m, ±16 mm				•								
>18 m, ±13 mm	•	•										
>18 m, ±16 mm					•							
>18 m, ±20 mm				•								
29. Deviation from plane of concrete surface between embedments												
−6 mm, +0 mm							•	•				
30. Deviation from specified location of an insert (any direction)												
±10 mm										•		•
±13 mm	•	•		•	•	•	•	•			•	
31. Deviation from specified location of a bearing plate												
±13 mm	•	•		•	•						•	
32. Deviation from specified location of an embedment (any direction)												
±13 mm												•
±25 mm	•	•		•	•	•	•	•	•	•	•	
±25 mm, ±50 mm			•									
<i>a. Rotation (where embedment visible). Distance is measured at perimeter</i>												
2 degrees, ±6 mm maximum												•
<i>b. Depth of recess</i>												
+6 mm, −3 mm												•
33. Deviation from plane of an embedment (tipping and flushness)												
±3 mm												
±6 mm	•	•	•	•	•	•	•	•	•	•	•	•

Table 2.1—Product tolerances for structural members (cont.)

Product tolerance	Product type											
	Single tee (Fig. 2.1)	Double tee (Fig. 2.2)	HC slab (Fig. 2.3)	Joist (Fig. 2.4)	Beam and spandrel (Fig. 2.5)	Column (Fig. 2.6)	Ribbed wall panel (Fig. 2.7)	Flat wall panel (Fig. 2.8)	HC wall panel (Fig. 2.9)	Step unit (Fig. 2.10)	Stadium riser (Fig. 2.11)	Room module (Fig. 2.12)
34. Deviation from plane of a bearing plate (tipping and flushness)												
±3 mm	•	•		•	•						•	
35. Deviation from specified position of reinforcement												
±6 mm (individual strand)	•	•		•	•	•	•	•			•	
±6 mm (C.G. of group)			•						•			
±13 mm (bundled strands)	•	•		•	•	•						
<i>a. Perpendicular to plane of member</i>												
±6 mm								•				
±13 mm			•						•			
<i>b. Parallel to plane of member</i>												
±20 mm			•						•			
±25 mm								•				
<i>c. Cover</i>												
±6 mm												•
36. Deviation from specified design camber[†]												
±6 mm per 3 m, ±20 mm maximum	•	•		•								
±3 mm per 3 m, ±20 mm maximum					•							
±6 mm per 3 m, ±13 mm maximum											•	
37. Deviation from specified location of a stirrup												
<i>a. Projection</i>												
±6 mm, −13 mm				•	•							
<i>b. Longitudinal spacing at ends within a distance equal to the depth of the member</i>												
±25 mm				•	•							
<i>c. Longitudinal spacing</i>												
±50 mm				•	•							
38. Deviation from specified location of flashing reglet												
±6 mm							•	•				
39. Deviation from specified location of a rustication or architectural feature												
±3 mm								•				
40. Deviation from specified size of a rustication or architectural feature												
±3 mm								•				
41. Deviation from specified location of an electrical box or any accessory of another trade												
±25 mm												•

*See Fig. 2.13 for determination of the flange and web thicknesses. The specified flange and web thicknesses are provided by the hollowcore producer's standard cross section.

[†]Specified design camber from prestressed concrete design calculations.

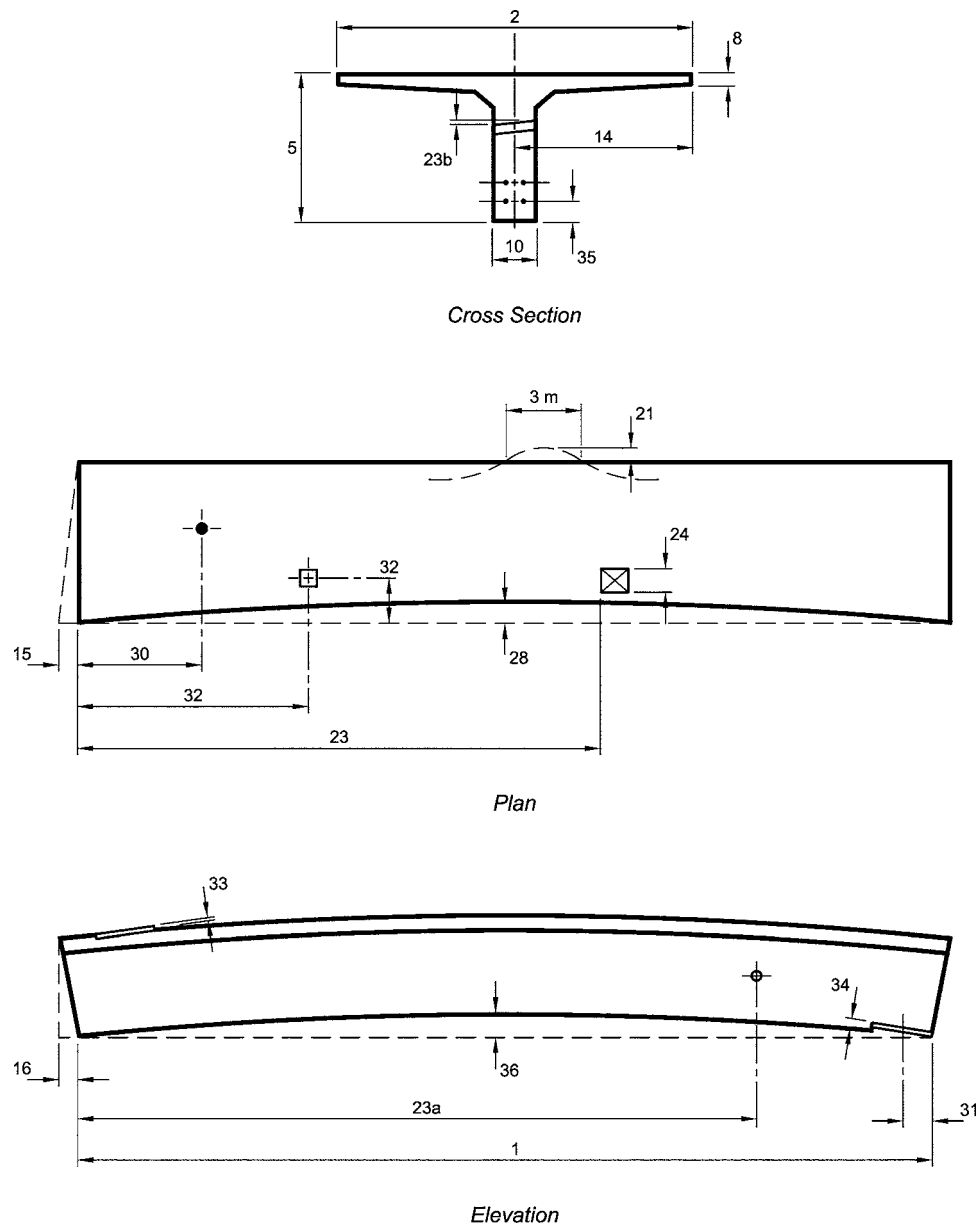


Fig. 2.1—Product deviation: single tee.

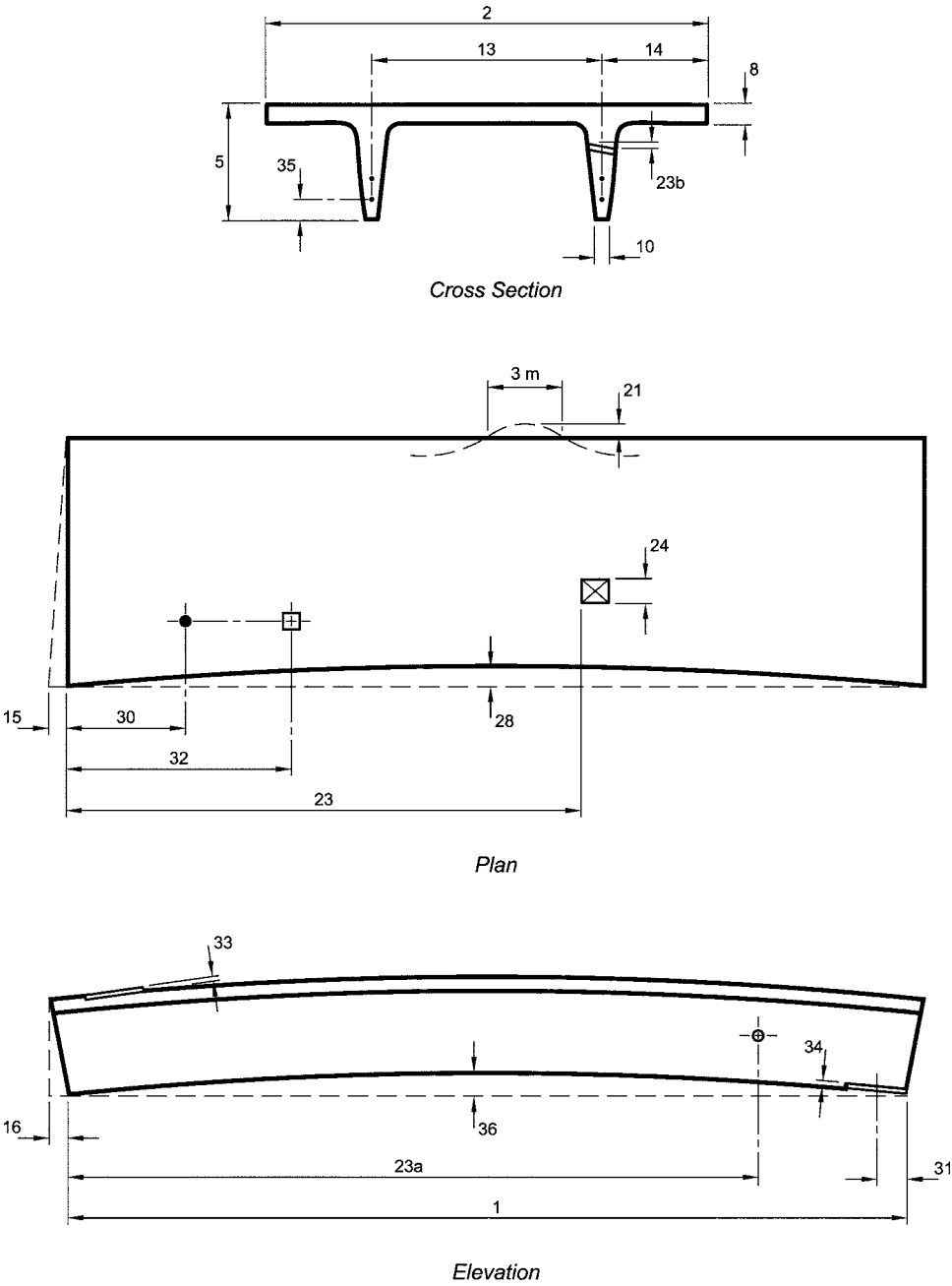


Fig. 2.2—Product deviation: double tee.

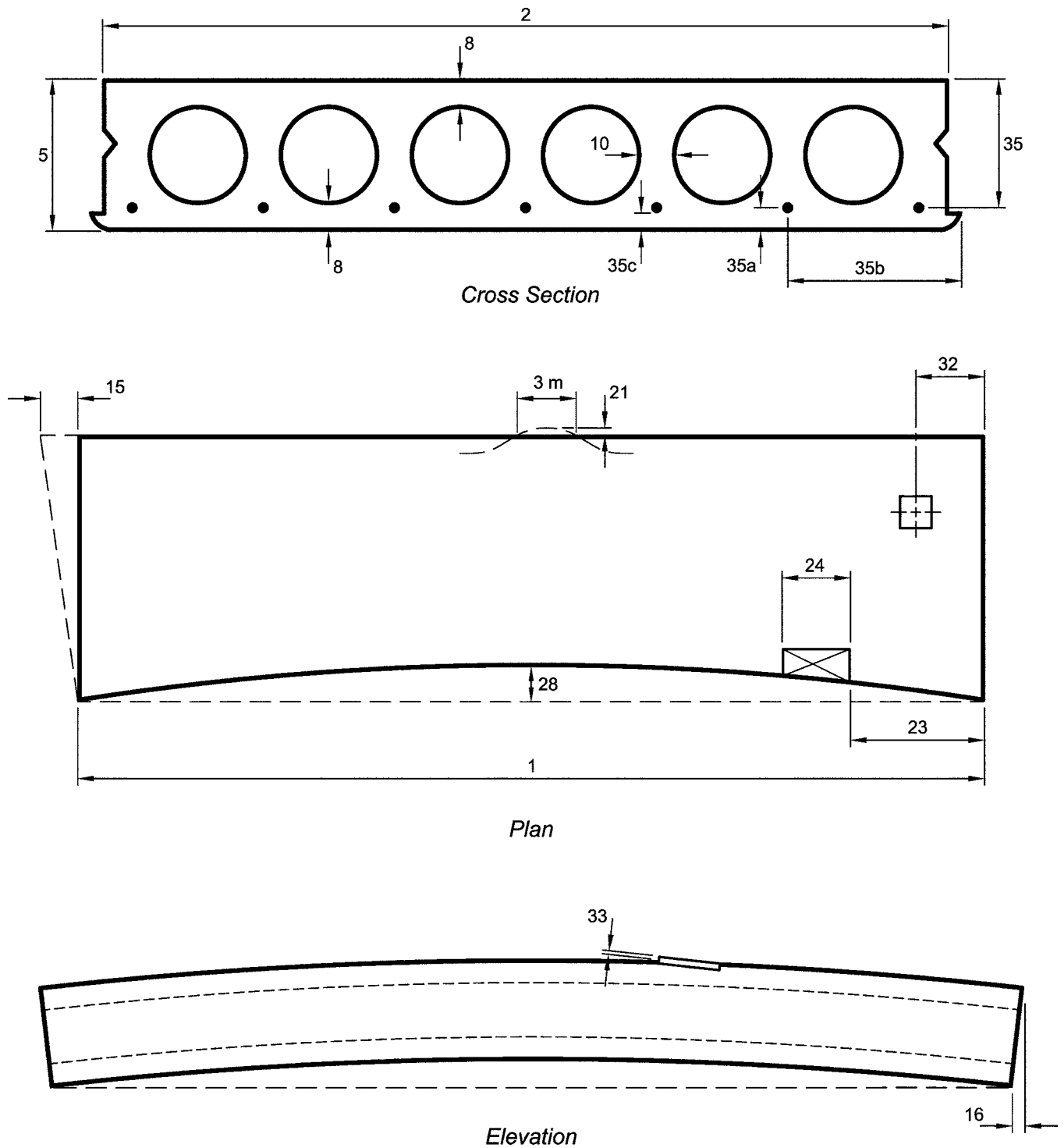


Fig. 2.3—Product deviation: hollow core slab.