A PCI Standard

PCI 135-24

SPECIFICATION FOR TOLERANCES

of Precast Concrete

Precast/Prestressed Concrete Institute

Substantial effort has been made to ensure that all data and information in this standard are accurate. However, PCI cannot accept responsibility for any errors or oversights in the use of materials or in the preparation of engineering plans. This standard is intended for use by professional personnel competent to evaluate the significance and limitations of its contents and able to accept responsibility for the application of the material it contains. Special conditions on a project may require more specific evaluation and practical engineering judgement.

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Foreword

Precast concrete building systems depend on a system of realistic and consistent tolerances to meet the objectives of providing acceptable stability, appearance, durability, and ease of erection.

Reflecting over 65 years of precast concrete industry experience, this standard defines the essential tolerance system for each phase of the building project: design, production, erection, and performance.

PCI has designed this standard to complement and support the PCI quality control manuals: *Manual for Quality Control for Plants and Production of Structural Precast and Prestressed Concrete Products* (MNL 116); *Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products* (MNL 117); *Erector's Manual: Standards and Guidelines for the Erection of Precast Concrete Products* (MNL 127); and *Manual for Quality Control for Plants and Production of Glass Fiber Reinforced Concrete Products* (MNL 130).

Preface

This standard was developed following the protocols required by the *PCI Group Operations Manual*. The provisions were first generated and balloted by the PCI Tolerance Committee, then reviewed by the PCI Quality Activities Council (QAC). A review by the PCI Technical Activities Council (TAC) followed. The document was then submitted to the PCI Standards Committee, where additional review and balloting took place. The membership of that committee is balanced according to the rules of American National Standards Institute (ANSI) accreditation. In addition, a public review period was provided and public comments were resolved through the PCI Standards Committee. The entire process is a consensus process involving PCI members, nonmembers of PCI, and the general public.

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Chapter 1—General

1.1 Scope. This standard specifies tolerances for the design, manufacture, and installation of precast concrete components and fabricated embeds. For the purpose of this standard, “precast concrete component” shall mean an individual plant-cast concrete member reinforced with any combination of nonprestressed reinforcement or prestressed strand. “Embed” shall refer to any item cast within the precast concrete component, such as a fabricated assembly or proprietary connector.

1.2 Definitions.

Architect—Person or organization professionally qualified and duly licensed to perform architectural services.

Architectural precast concrete component—A component characterized by a higher standard of appearance uniformity with respect to surface details, color, and texture than structural precast concrete components.

Bowing—An overall out-of-plane condition in which two opposite edges of a component, such as a panel, fall in the same plane and the portion of the panel between the edges is out of plane.

Camber—(1) Out-of-plane translation of a point within the span of a prestressed component that occurs due to the net bending resulting from an eccentric prestressing force (not including dimensional inaccuracies); (2) a built-in curvature.

Clearance—Distance between two precast concrete components or between a precast concrete component and another material.

Clear cover—The clear distance between the surface of the reinforcement and the reference surface.

Concealed surface—Surface not visible during normal use of the component.

Connection—An embed used to attach precast concrete components to each other or to the structure. Connection design must account for the cumulative effects of all allowed tolerance variations.

Contract documents—The owner–contractor agreement. The agreement shall include, but is not limited to, contract forms, drawings, specifications, and addenda as required for the basis of construction.

Deviation—Departure from an established reference point, line, plane, or surface measured in a direction that is perpendicular to the reference line, plane, or surface.

Draft—Taper given to features of a mold or form to allow the precast concrete component to be removed from the mold or form without damage.

Embed—Any element cast within the precast concrete component, such as a fabricated assembly or proprietary connector.

Erection hardware—Loose hardware necessary for the installation of the precast concrete components.

Erection drawings—Graphic diagrams of precast concrete components and their connecting hardware developed from information in the contract documents and used for erection and field assembly.

Erector—Company contracted to erect the precast concrete components at the site.

Flushness—The offset relationship of an embedded plate or insert to the surrounding concrete surface.

Hardware—Items used to connect precast concrete components or attach or accommodate adjacent materials or equipment.

Manufacturer—Company that manufactures precast concrete components.

Owner—The public body, authority, corporation, association, firm, or person for whom the structure is designed and constructed.

Plumb—In a vertical line.

Precast concrete—Plant-cast, prefabricated concrete components reinforced with any type of nonprestressed or prestressed reinforcement, or both.

Precast, nonprestressed concrete—Plant-cast, prefabricated concrete component reinforced with any type of reinforcement that is not prestressed.

Precast, prestressed concrete—Plant-cast, prefabricated concrete components reinforced with prestressed reinforcement, which may be pretensioned reinforcement, post-tensioned reinforcement, or both.

Pretopped system—A construction approach in which precast concrete components create the final surface, reducing the need for cast-in-place concrete topping.

Primary control surface—A surface or feature on a precast concrete component where the dimensional location is specifically set and controlled in the erection process.

Reference surface—Surface from which tolerance is measured.

Smoothness—Absence of local irregularity or roughness.

Specialty structural engineer (SSE)—Licensed professional engineer delegated to perform the design of a portion of the structure.

Structural engineer of record (SER)—Structural engineer who is legally responsible to seal the structural contract documents for a building project and provide the structural design criteria to the specialty structural engineer.

Structural precast concrete component—Precast concrete component not defined as being an architectural precast concrete component.

Sweep—Deviation of a longitudinal edge of a horizontal or vertical component from a straight line through the ends of that edge.

Tipping—Offset relationship of one edge of an embedded plate to the planned surface, or the offset between two edges of the same embed.

Tolerance— Allowable deviation from specified requirements such as dimensions, location, and alignment.

Tolerances, component—Allowable deviations in dimensions relating to individual precast concrete components.

Tolerances, erection—Allowable deviations in dimensions of a component's placement in the completed structure.

Tolerances, interfacing—Allowable deviations in dimensions associated with other materials or systems in contact with, or in close proximity to, precast concrete components.

Warping—Twisting of a component that results in overall out-of-plane curvature of surfaces characterized by all edges being nonparallel.

1.3 Notation. The following notation shall be used in the application of evaluating tolerances specified herein:

(+) = plus; increase in the dimension

(–) = minus; decrease in the dimension

1.4 Referenced standards.

Referenced documents identified by an asterisk (*) are not consensus standards; rather, they are documents developed within the precast concrete industry that represent acceptable procedures for design and construction to the extent referred to in the specified section.

American Concrete Institute (ACI)

ACI 117/117R-2010 (2015)	Specification for Tolerances for Concrete Construction and Materials and Commentary

American Institute of Steel Construction (AISC)

AISC 325-17	Steel Construction Manual, 15th ed.
ANSI/AISC 360-16	Specification for Structural Steel Buildings

American Iron and Steel Institute (AISI)

AISI S100-16	North American Specification for the Design of Cold-Formed Steel Structural Members
AISI S240-15	North American Standard for Cold-Formed Steel Structural Framing

American Railway Engineering and Maintenance-of-Way Association (AREMA)

2022 Manual for Railway Engineering—Chapter 30: Ties

American Welding Society (AWS)

AWS D1.1/D1.1M:2015	Structural Welding Code—Steel
AWS D1.3/D1.3M:2018	Structural Welding Code—Sheet Steel
AWS D1.4/D1.4M:2018	Structural Welding Code—Steel Reinforcing Bars
AWS D1.6/D1.6M 2017	Structural Welding Code—Stainless Steel

ASTM International

ASTM C67/C67M-21	Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
ASTM C1289-22	Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM C1433-20e1	Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers

International Accreditation Service (IAS)

*AC157 2017	Accreditation Criteria (AC) for Fabricator Inspection Programs for Reinforced and Precast/Prestressed Concrete

International Code Council

IBC 2021	International Building Code (IBC)
ICC 500	2020 ICC/NSSA Standard for the Design and Construction of Storm Shelters

International Organization for Standardization (ISO)

ISO 4898:2018 Rigid Cellular Plastics—Thermal Insulation Products for Buildings Specifications

Precast/Prestressed Concrete Institute

*MNL 116-21 Manual for Quality Control for Plants and Production of Structural Precast Concrete Products

*MNL 117-13 Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products

*MNL 120-17 PCI Design Handbook: Precast and Prestressed Concrete

*MNL 127-99 Erector's Manual: Standards and Guidelines for the Erection of Precast Concrete Products

*MNL 130-09 Manual for Quality Control for Plants and Production of Glass Fiber Reinforced Concrete Products

Chapter 2—Project Responsibilities and Requirements

2.1 General.

2.1.1 Tolerances in this standard shall govern except where the requirements of the contract documents are more stringent.

2.2 Responsibilities. This section defines who is responsible for compliance with this standard.

2.2.1 The architect or structural engineer of record (SER), or the licensed design professional in responsible charge, shall clearly specify the tolerance requirements for precast concrete components as either architectural or structural in the contract documents. Contract documents shall include exceptions to this standard and additional tolerances not included in this standard.

2.2.2 The SER shall specify and clearly communicate required tolerances for precast concrete components, joints, or connections that require additional tolerances to prevent load transfer.

2.2.3 The specialty structural engineer (SSE) shall determine when tolerances are cumulative and shall account for the effect of tolerances in the design of precast concrete components, their connections, and the performance of the structure.

2.2.4 The precast concrete manufacturer shall be certified in the appropriate group and category of the PCI Plant Certification Program, or in accordance with AC157 by the International Accreditation Service, and shall comply with the requirements of this standard.

2.2.5 The precast concrete erector shall be responsible for maintaining tolerances during erection.

2.3. Requirements.

2.3.1 Tolerances shall not be combined to increase the tolerances for an individual precast concrete component or increase tolerances of the structural system.

2.3.2 Tolerances shall be used as criteria for acceptance, not as limits for rejection. If specified tolerances are met, the product shall be accepted. Deviations from listed tolerances shall be allowed when (a) and (b) are met:

(a) The SER or SSE has determined that the tolerances are acceptable and structural requirements have been satisfied.

(b) The architect or owner has determined that the appearance, as related to joints and clearances of exposed surfaces, is acceptable.

2.3.2.1 Drafts at panel edges, recesses, or feature strips shall be included in determining the dimensional tolerance as it relates to the controlling surface.

2.3.2.2 Excessive camber variations of prestressed bridge components shall not be a sole reason for rejection for AASHTO sections.

2.3.3 Erection activities that would cause a precast concrete component to be out of tolerance shall not be made without coordination among the architect, SER or SSE, the precast concrete producer, the erector, and other affected trades.

Chapter 3—Fabricated Embed and Erection Hardware Tolerances

3.1 General. Fabricated embeds, their components, and erection hardware shall conform to tolerances listed in Section 3.3 prior to being installed.

3.2 Requirements.

3.2.1 Weld tolerances and inspection requirements shall be in accordance with one of the following:

(a) AWS D1.1/D1.1M—Structural Welding Code—Steel

(b) AWS D1.4/D1.4M—Structural Welding Code—Steel Reinforcing Bars

(c) AWS D1.6/D1.6M—Structural Welding Code—Stainless Steel

3.3 Tolerances.

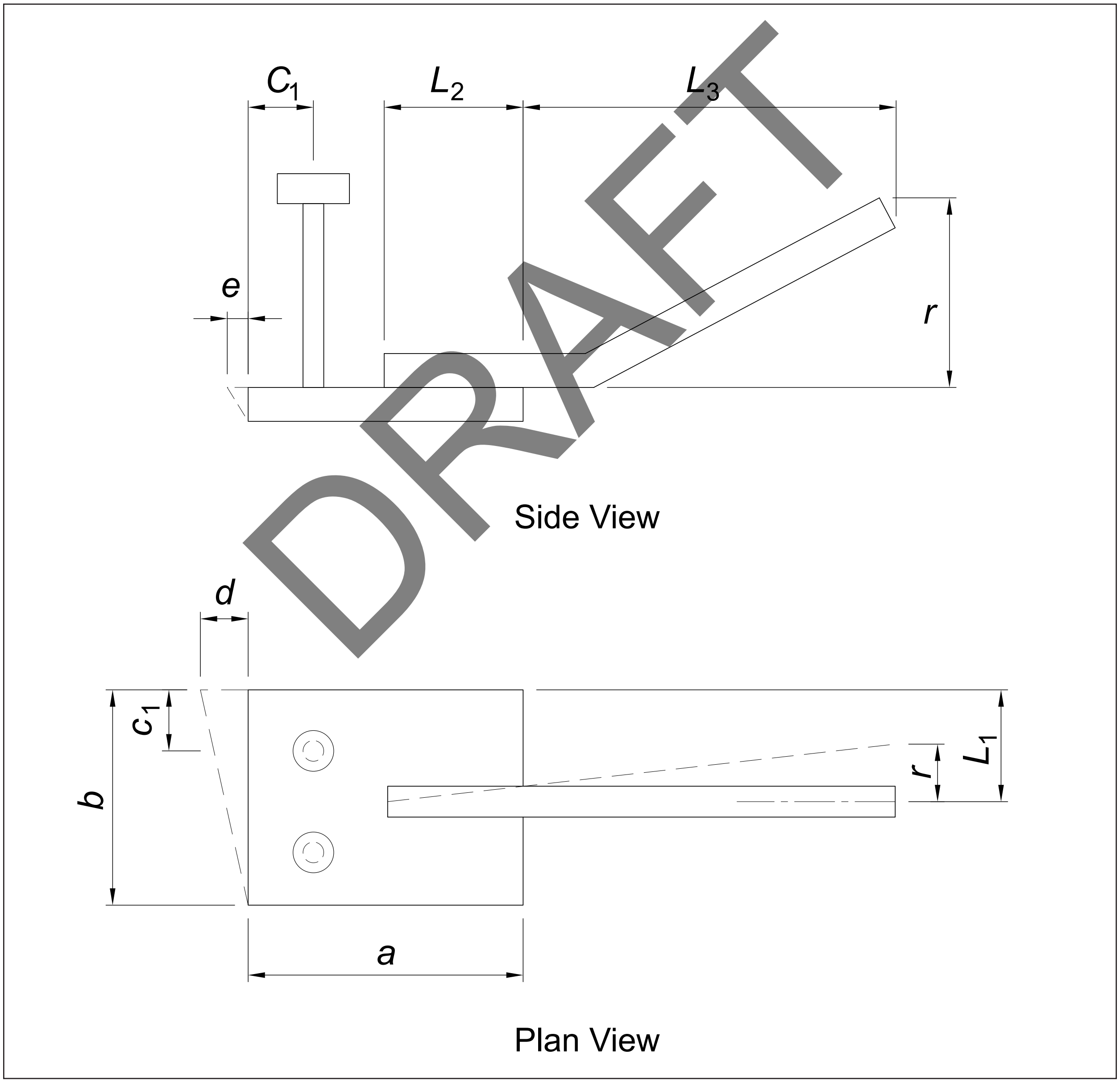

Figure 3.3.1. Fabricated embed plate.

3.3.1 Tolerances for the fabricated embed plate (Fig. 3.3.1) shall be:

a = Overall length of plate:

Plate length ≤6 in. (≤ 152 mm).. . . . . ±⅛ in. (±3 mm)

Plate length >6 in. (>152 mm) . . . . ±¼ in. (±6 mm)

b = Overall width of plate:

Plate width ≤6 in. (≤152 mm) . . . . ±⅛ in. (±3 mm)

Plate width >6 in. (>152 mm) . . . . ±¼ in. (±6 mm)

c_1 = Location of headed stud anchor or deformed bar anchor . . . . ±¼ in. (±6 mm)

d = Variation from squareness at edge of plate . . . . ±¼ in. (±6 mm)

e = Variation from squareness in thickness at edge of plate . . . . ±⅛ in. (±3 mm)

L_1 = Location of add-on steel from edge of plate . . . . ±¼ in. (±6 mm)

L_2 = Lap of add-on steel on plate . . . . +½ in., –¼ in. (+13 mm, –6 mm)

L_3 = Length of reinforcing bar extending beyond plate . . . . +½ in., –¼ in. (+13 mm, –6 mm)

r = Reinforcing bar bend . . . . ±½ in. (±13 mm) = Skew of reinforcing bar placement . . . . ±5 degrees, maximum skew 1 in. (25 mm)

S = Skew of reinforcing bar placement. . . . . ±5 degrees, maximum skew 1 in. (25 mm)

Note: Warping tolerance of final fabricated embed plate shall not exceed tolerances in AISI S100-16 and AISI S240-15.

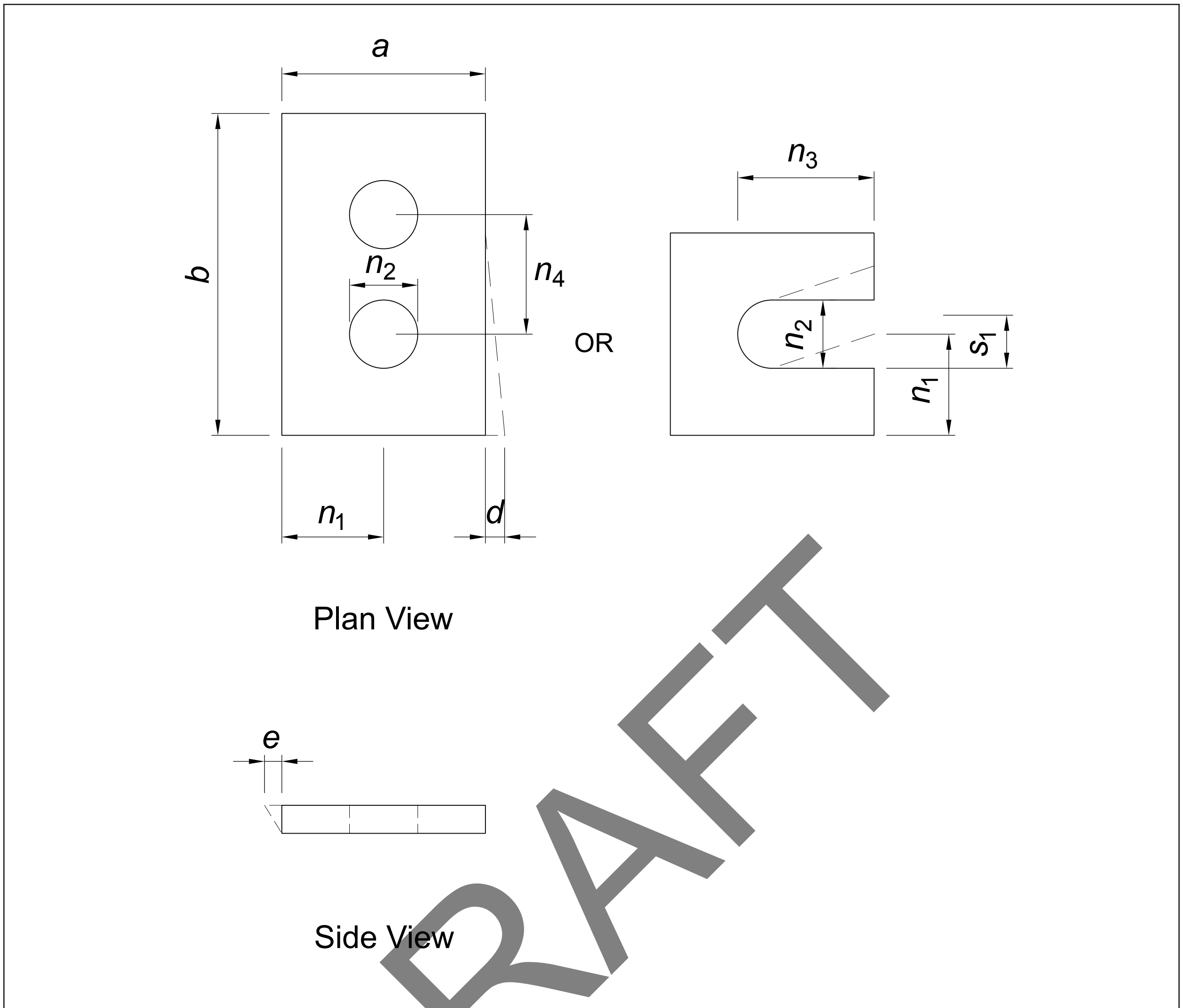

Figure 3.3.2. Fabricated loose plate with void.

3.3.2 Tolerances for the fabricated loose plate with void (Fig. 3.3.2) shall be:

a = Overall length of plate . . . . ±¼ in. (±6 mm)

b = Overall width of plate . . . . ±¼ in. (±6 mm)

d = Variation from squareness at edge of plate . . . . ±¼ in. (±6 mm)

e = Variation from squareness in thickness at edge of plate . . . . ±⅛ in. (±3 mm)

n_1 = Location of hole centerline from edge of plate. . . . . ±¼ in. (±6 mm)

n_2 = Diameter of hole or width of slot in plate shall be in accordance with AISC 325, except where design requires oversized holes or slots for performance. Slot edges shall be parallel.

n_3 = Length of slot in plate. . . . . ±¼ in. (±6 mm)

n_4 = Distance between holes . . . . ±¼ in. (±6 mm)

s_1 = Skew of slot . . . . +⅛ in., –0 in. (+3 mm, –0 mm)

Chapter 4—Production Tolerances

4.1 General. Precast concrete components shall conform to the tolerance requirements of Section 4.2 for architectural precast concrete components, Section 4.3 for structural precast concrete components, or Section 4.4 for glass-fiber-reinforced concrete (GFRC) panels.

4.1.1 Refer to Section 2.3 when tolerances are exceeded.

4.1.2 Precast concrete components or structures requiring special tolerances shall conform to requirements of this chapter and Chapter 5, as appropriate.

4.2 Architectural precast concrete component production tolerances. Architectural precast concrete components shall conform to production tolerances listed in Sections 4.2.1 through 4.2.5.

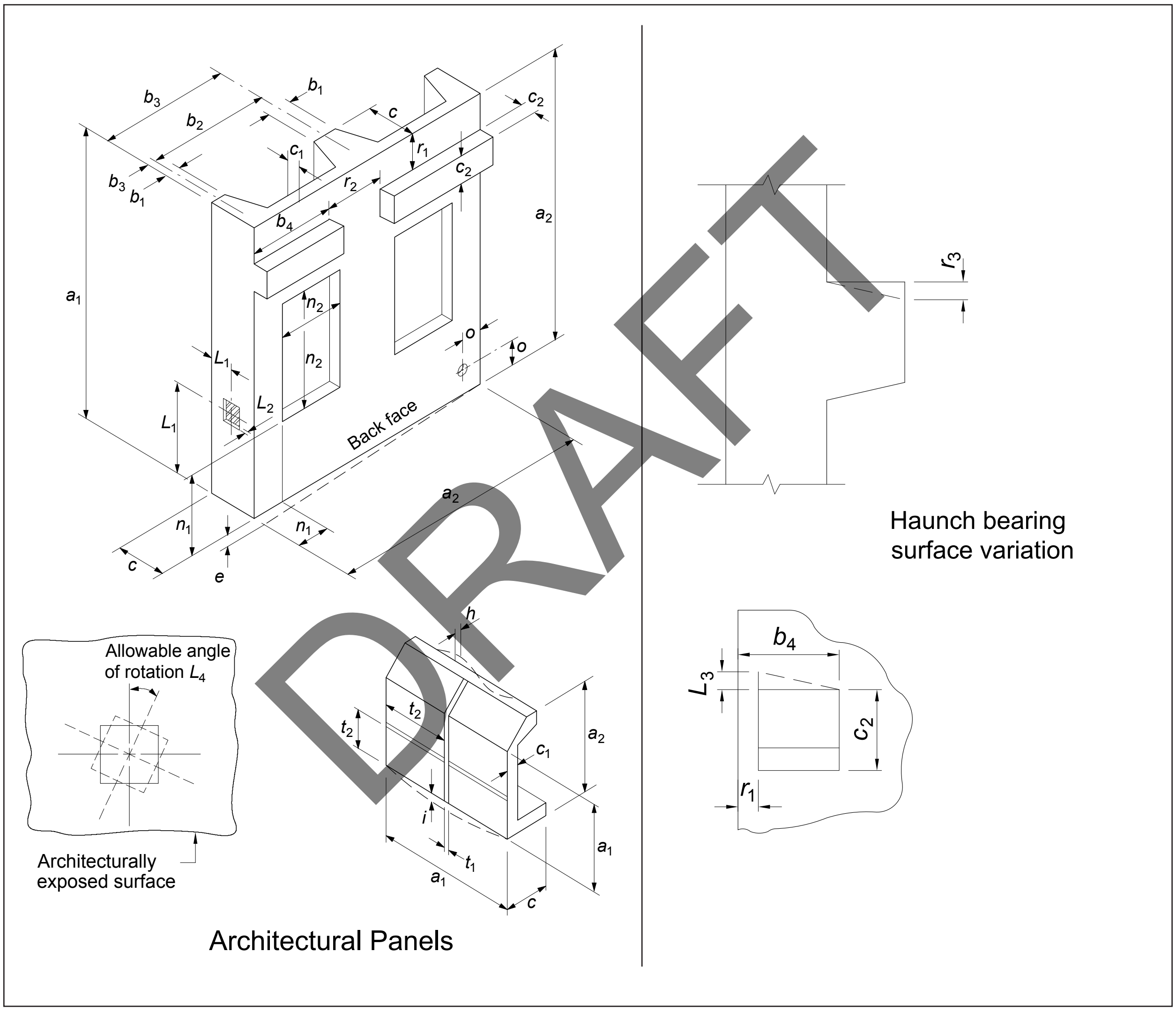

Figure 4.2.1. Architectural precast concrete component.

4.2.1 Production tolerances for architectural precast concrete components (Fig. 4.21) shall be: Length or width tolerance increments shall be based on the minimum length and are not proportional.

a_1 = Overall height and width of unit measured at the face exposed to view:

- ≤10 ft (≤3 m) . . . . . ±⅛ in. (±3 mm)
- >10 to 20 ft (>3 to 6 m) . . . . . +⅛ in., –3⁄16 in. (+3 mm, –5mm)
- >20 to 40 ft (>6 to 12 m) . . . . . ±¼ in. (±6 mm)
- >40 to 50 ft (>12 to 15 m) . . . . . ±5⁄16 in. (±8 mm)
- >50 ft (>15 m) . . . . . ±⅜ in. (±10 mm)

a_2^* = Overall height and width of unit measured at the face not exposed to view:

- ≤10 ft (≤3 m) . . . . . ±¼ in. (±6 mm)
- >10 to 20 ft (>3 to 6 m) . . . . . +¼ in., –⅝ in. (+6 mm, –16 mm)
- >20 to 40 ft (>6 to 12 m) . . . . . ±⅜ in. (±10 mm)
- >40 ft (>12 m) . . . . . ±½ in. (±13 mm)

b_1 = Rib width . . . . . ±⅛ in. (±3 mm)

b_2 = Distance between rib centerlines . . . . . ±⅛ in. (±3 mm)

b_3 = Distance from rib centerline to edge . . . . . ±⅛ in. (±3 mm)

b_4 = Width of haunch . . . . . ±¼ in. (±6 mm)

c = Total thickness . . . . . +¼ in., –⅛ in. (+6 mm, –3 mm)

c_1 = Panel thickness . . . . . +¼ in., –⅛ in. (+6 mm, –3 mm)

c_2 = Dimensions of haunches . . . . . ±¼ in. (±6 mm)

e = Variation† from square or designated skew
. . . . . ±⅛ in. per 6 ft; ±½ in. maximum (±3 mm per 2 m; ±13 mm maximum)

h = Local smoothness, exposed surfaces . . . . . ¼ in. per 10 ft (6 mm per 3 m)

i = Bowing, (Fig. C1.2.1) . . . . . ±length in./360; 1 in. maximum

n_1 = Location of opening within panel . . . . . ±¼ in. (±6 mm)

n_2 = Length and width of blockouts and openings within one unit . . . . . ±¼ in. (±6 mm)

r_1 = Location of bearing surface from end of component . . . . . ±¼ in. (±6 mm)

r_2 = Distance between haunches . . . . . ±¼ in. (±6 mm)

r_3 = Variation from specified haunch bearing surface slope
. . . . . ±⅛ in. per 12 in.; ±⅜ in. maximum (±3 mm per 0.3 m; ±10 mm maximum)

Additional tolerances not shown (NS) in Fig. 4.2.1:

NS_1 = Local smoothness, concealed surfaces . . . . ½ in. per 10 ft (13 mm per 3 m)

NS_3 = Bearing surface deviation from specified plane . . . .±⅛ in. (±3 mm)

NS_4 = Difference in relative position of adjacent haunch bearing surfaces from specified relative position . . . .±¼ in. (±6 mm)

NS_5 = Location and dimensions of blockouts hidden from view and used for HVAC and utility penetrations . . . .±¾ in. (±19 mm)

NSj_2 = Warping . . . . 1⁄16 in. per 1 ft (1.5 mm per 0.3 m) from the nearest adjacent corner

Position tolerances for cast-in items:

L_1 = Weld plates . . . . ±1 in. (±25 mm)

L_2 = Tipping and flushness of plates . . . .±¼ in. (±6 mm)

L_4 = Allowable rotation of plate, channel inserts, electrical boxes . . . . 2 degrees; ¼ in. (6 mm) maximum measured at the perimeter of the insert

o = Position of sleeve . . . .±½ in. (±13 mm)

t_1 = Dimensions of architectural features and rustications . . . .±⅛ in. (±3 mm)

t_2 = Location of rustication joints . . . .±⅛ in. (±3 mm)

Position tolerances for cast-in items not shown (NS) in Fig 4.2.1:

NS_6 = Reinforcing steel bar and welded-wire reinforcement:

Where position has structural implications or affects concrete cover . . . .±¼ in. (±6 mm)

Otherwise . . . .±½ in. (±13 mm)

NS_7 = Reinforcing steel bar extending out of component . . . .±½ in. (±13 mm)

NS_8 = Location of strand:

Perpendicular to panel . . . .±¼ in. (±6 mm)

Parallel to panel . . . . ±1 in. (±25 mm)

NS_9 = Location of flashing reglets . . . .±¼ in. (±6 mm)

NS_{10} = Location of flashing reglets at edge of panel . . . .±⅛ in. (±3 mm)

NS_{11} = Location of reglets for glazing gaskets . . . .±⅛ in. (±3 mm)

NS_{12} = Location of window washer track or buttons . . . .±⅛ in. (±3 mm)

NS_{13} = Electrical outlets, hose bibs, etc. . . . .±½ in. (±13 mm)

NS_{14} = Inserts . . . .±½ in. (±13 mm)

NS_{15}= Lifting anchors (as-cast plan dimension) . . . . ±3 in. (±75 mm)

*Unless joint width and fit-up requirements demand more-stringent tolerance.
†Applies to both the panel and major openings in the panel. Tolerances apply to the difference of the two diagonal measurements.

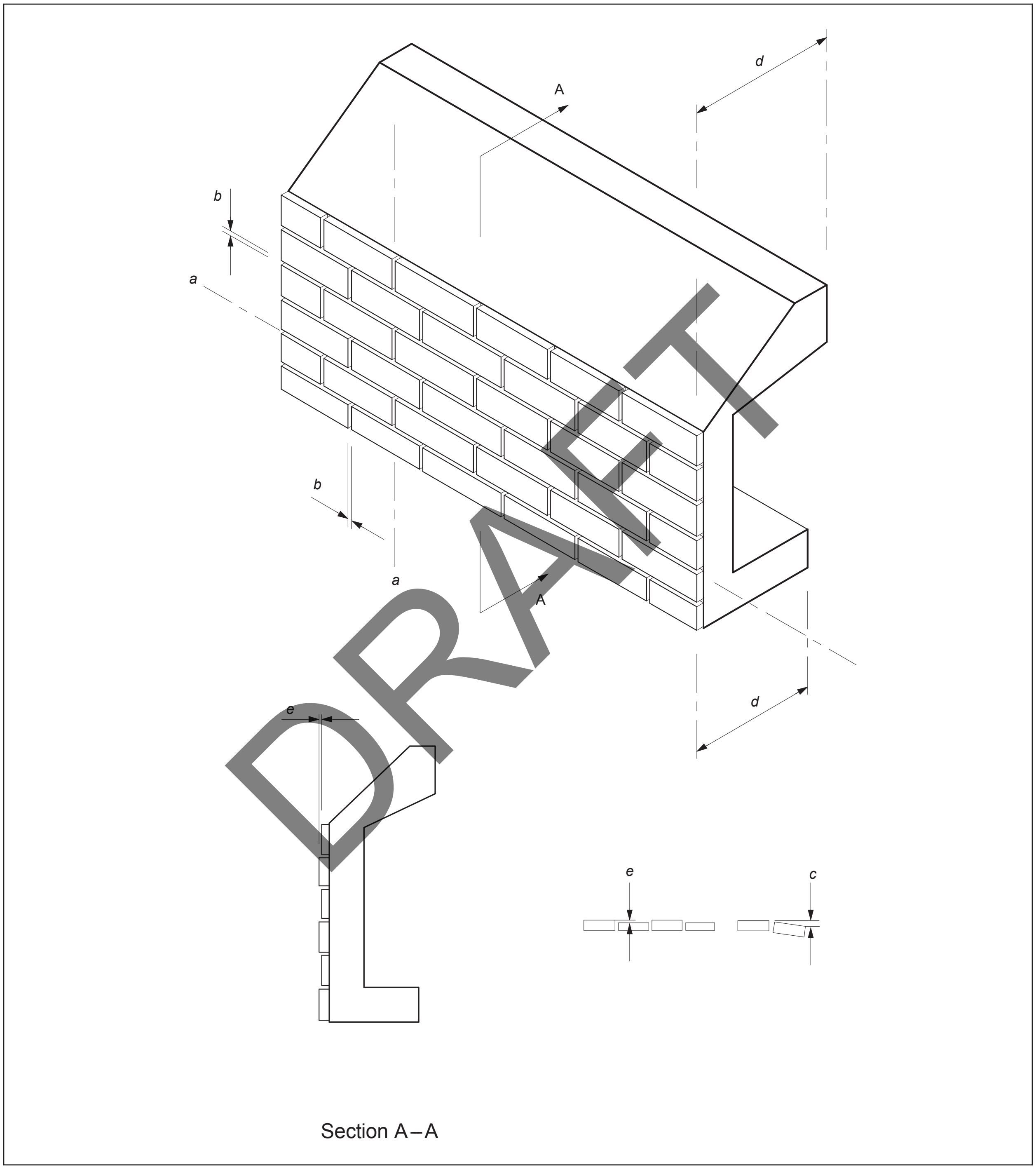

Figure 4.2.2 Brick-faced architectural precast concrete component.

4.2.2 Production tolerances for brick-faced architectural precast concrete components (Fig. 4.2.2) shall be:

a = Alignment of mortar joints:

Jog in alignment . . . . ±1/8 in. (±3 mm)

Alignment with panel centerline . . . . ±1/8 in. (±3 mm)

b = Variation in width of exposed mortar joints . . . .±1/8 in., (±3 mm)

c = Tipping of individual bricks from the panel plane of exposed brick surface joint . . . .+1/16, –1/4 in. (+2mm, –6 mm) ≤ depth of formliner

d = Exposed brick surface parallel to primary control surface of panel . . . .+1/4 in., –1/8 in. (+6 mm, –3 mm)

e = Individual brick step in face from panel plane of exposed brick surface . . . . +1/16 in., –1/4 in. (+1.5 mm, –6 mm) ≤ depth of formliner joint

Notes:
Tolerances from Section 4.2.1 shall be used for additional tolerances not shown in Fig. 4.2.2.
Dimensional tolerances of terra-cotta and thin brick used in formliners shall be in accordance with ASTM C67.

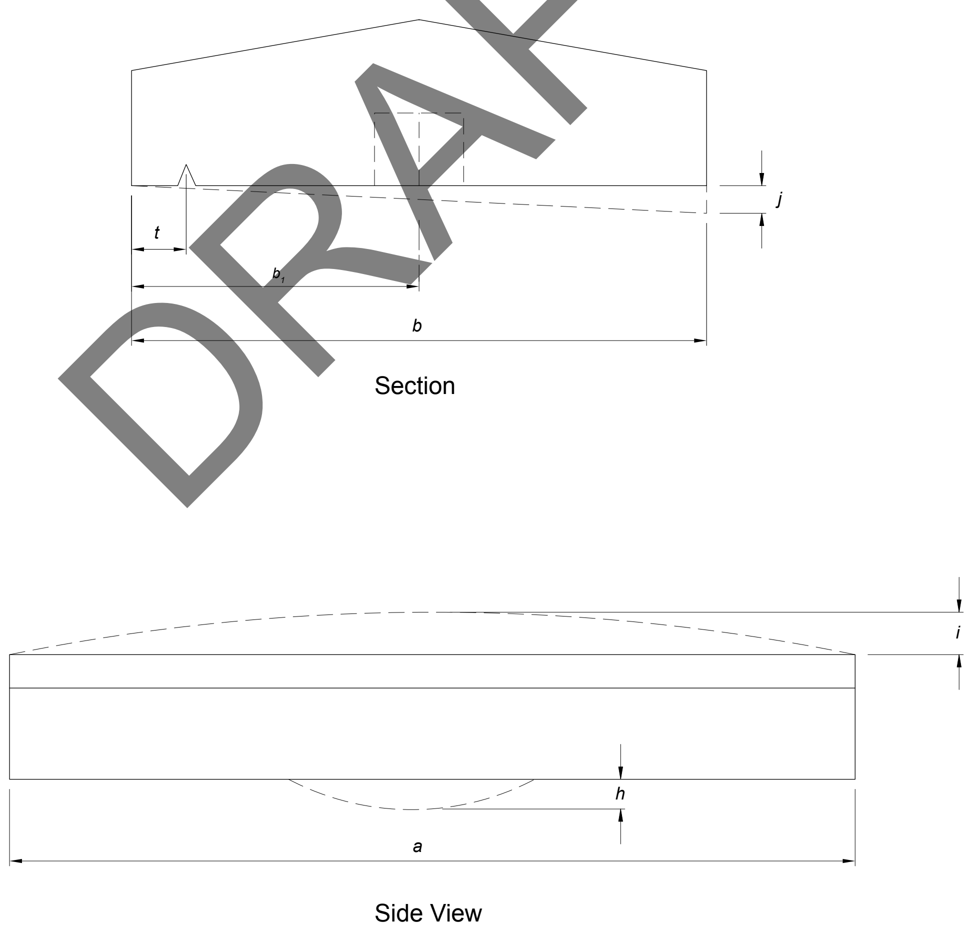

Figure 4.2.3. Sills, lintels, copings, cornices, quoins, and medallions.

4.2.3 Production tolerances for sills, lintels, copings, cornices, quoins, and medallions (Fig. 4.2.3) shall be:

a = Length . . . . ±⅛ in. (±3 mm)

b = Overall width of units measured at face exposed to view . . . . ±⅛ in. (±3 mm)

b_1 = Location of inserts and appurtenances:

On formed surfaces . . . . ±⅛ in. (±3 mm)

On unformed surfaces . . . . ±⅜ in. (±10 mm)

c = Maximum height. . . . . ±⅛ in. (±3 mm)

c_1 = Minimum height . . . . ±⅛ in. (±3 mm)

h = Local smoothness . . . . ⅛ in. per 5 ft (3 mm per 1.6 m)

i = Bowing, (Fig. C1.2.1) . . . . ±length in./360; ±¼ in. maximum

j = Warping, measured per 1 ft (0.3 m) of distance from nearest adjacent corner
. . . . ±1/16 in. (±1.5 mm)

t = Size and location of rustications and architectural features . . . . ±1/16 in. (±1.5 mm)

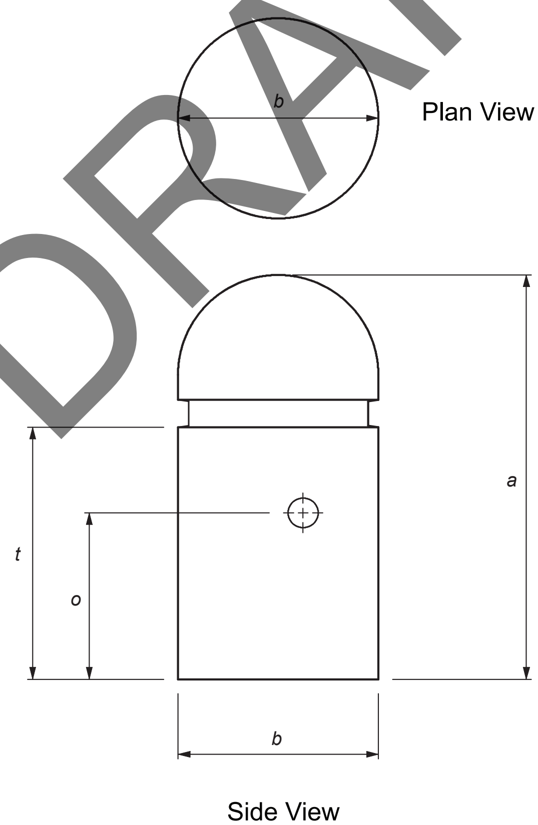

Figure 4.2.4. Bollard, bench, and planter.

4.2.4 Production tolerances for bollards, benches, and planters (Fig. 4.2.4) shall be:

a = Height or length . . . . ±¼ in. (±6 mm)

b = Width or diameter. . . . . ±¼ in. (±6 mm)

o = Location of inserts and appurtenances:

Formed surfaces . . . . ±¼ in. (±6 mm)

Unformed surfaces. . . . . ±¼ in. (±6 mm)

t = Size and location of rustications and architectural features . . . . ±¼ in. (±6 mm)

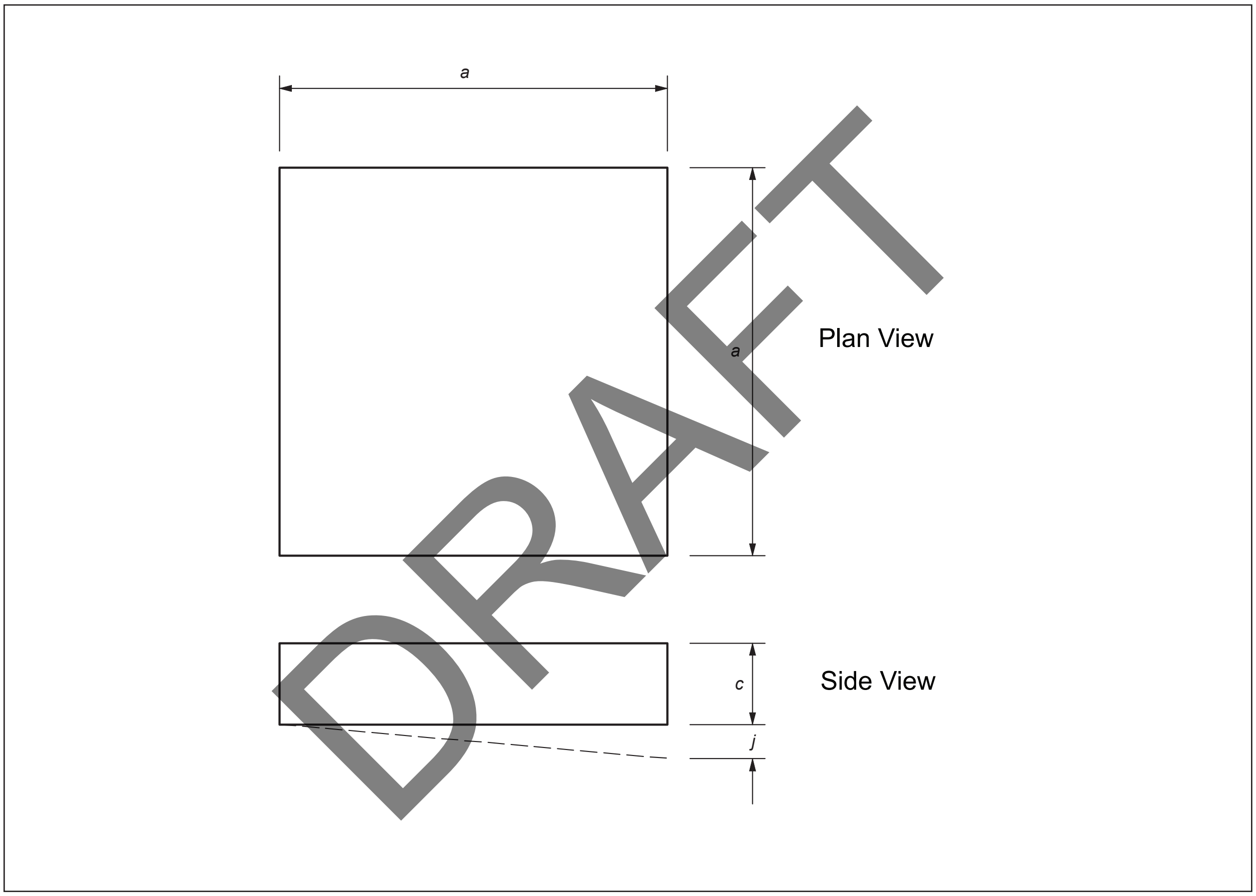

Figure 4.2.5. Paver.

4.2.5 Production tolerances for precast concrete pavers (Fig. 4.2.5) shall be:

a = Length or width . . . . ±1⁄16 in. (±1.5 mm)

c = Thickness . . . . ±1⁄16 in. (±1.5 mm)

j = Warping measured per 1 ft (0.3 m) of distance from nearest adjacent corner . . . ±1⁄32 in. (±0.75 mm)

4.3 Structural precast concrete production tolerances. Structural precast concrete components shall conform to production tolerances listed in Sections 4.3.1 through 4.3.24.

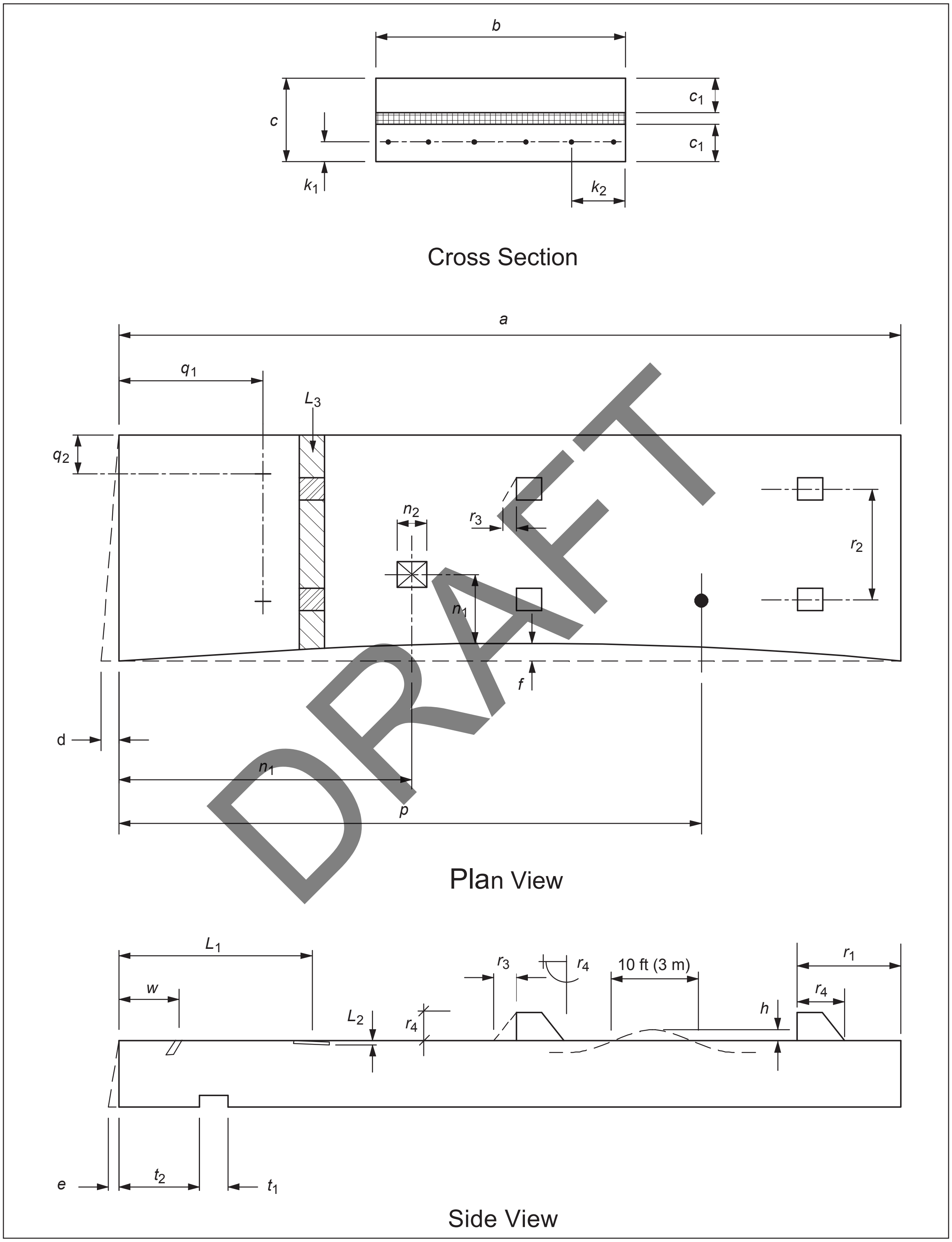

Figure 4.3.1. Solid or insulated flat structural wall panel.

4.3.1 Production tolerances for solid or insulated flat structural precast concrete wall panels (Fig. 4.3.1) shall be:

a = Length .... ±½ in. (±13 mm)

b = Width (overall) .... ±¼ in. (±6 mm)

c = Depth (overall) .... ±¼ in. (±6 mm)

c_1 = Wythe thickness .... ±⅜ in. (±10 mm)

c_2 = Insulation thickness shall conform with ASTM C1289 or ISO 4898

c_3 = Gap between sheets of insulations .... +⅜ in., –0 in. (+9 mm, –0 mm)

d = Variation from specified plan view end squareness or skew
...... ±⅛ in. per 12 in. width; ±½ in. maximum (±3 mm per 300 mm width; ±13 mm maximum)

e = Variation from specified side view end squareness or skew
.... ±⅛ in. per 12 in. (±3 mm per 300 mm)

f = Sweep, for component length:

Component length ≤20 ft (≤6 m) .... ⅛ in. (3 mm)

Component length >20 ft ≤ 40 ft (6 m to ≤ 12 m) .... ¼ in. (6 mm)

Component length >40 ft (>12 m) .... ±⅜ in. (±10 mm) maximum

h = Local smoothness of any surface .... ¼ in. per 10 ft (6 mm per 3 m)

k_1 = Location of reinforcement perpendicular to plane of panel .... ±¼ in. (±6 mm)

k_2 = Location of reinforcement parallel to plane of panel .... ±1 in. (±25 mm)

L_1 = Location of embedment .... ±1 in. (±25 mm)

L_2 = Tipping and flushness of embedment .... ±¼ in. (±6 mm)

n_1 = Location of blockout .... ±1 in. (±25 mm)

n_2 = Size of blockouts .... ±½ in. (±13 mm)

p = Location of inserts for structural connections .... ±½ in. (±13 mm)

q_1 = Location of handling device parallel to length of panel .... ±6 in. (±150 mm)

q_2 = Location of handling device transverse to length of panel .... ±1 in. (±25 mm)

r_1 = Location of haunch bearing elevation from end of panel .... ±¼ in. (±6 mm)

r_2 = Transverse distance between haunches .... ±¼ in. (±6 mm)

r_3 = Variation from specified haunch bearing surface slope
.... ±⅛ in. per 18 in.; ±¼ in. maximum (±3 mm per 0.45 m; ±6 mm maximum)

r_4 = Vertical height or length of haunch . . . . ±¼ in. (±6 mm)

t_1 = Size of architectural feature . . . . ±⅛ in. (±3 mm)

t_2 = Location of architectural feature. . . . . ±⅛ in. (±3 mm)

w = Location of flashing reglet . . . . ±¼ in. (±6 mm)

Additional tolerances not shown (NS) in Fig. 4.3.1:

NSc_4 = Insulation to the panel length. . . . . –¼ in. (–6 mm)

NSc_5 = Insulation along the panel width . . . . +0 in., –¼ in. (+0 mm, –6 mm)

NSi = Bowing . . . . ±Length (in.)/360 (Length(0.3 m)/360); 1 in. (25 mm) maximum

NSi_1 = Differential bowing between panels of the same design and length . . . . ½ in. (13 mm)

NSj_2 = Warping . . . . 1⁄16 in. per 1 ft (1.5 mm per 0.3 m) from the nearest adjacent corner

NSL_3 = Concrete surface between embedments to receive continuous ledger, relative to plane of embedments . . . . +0 in., –¼ in. (+0 mm, –6 mm)

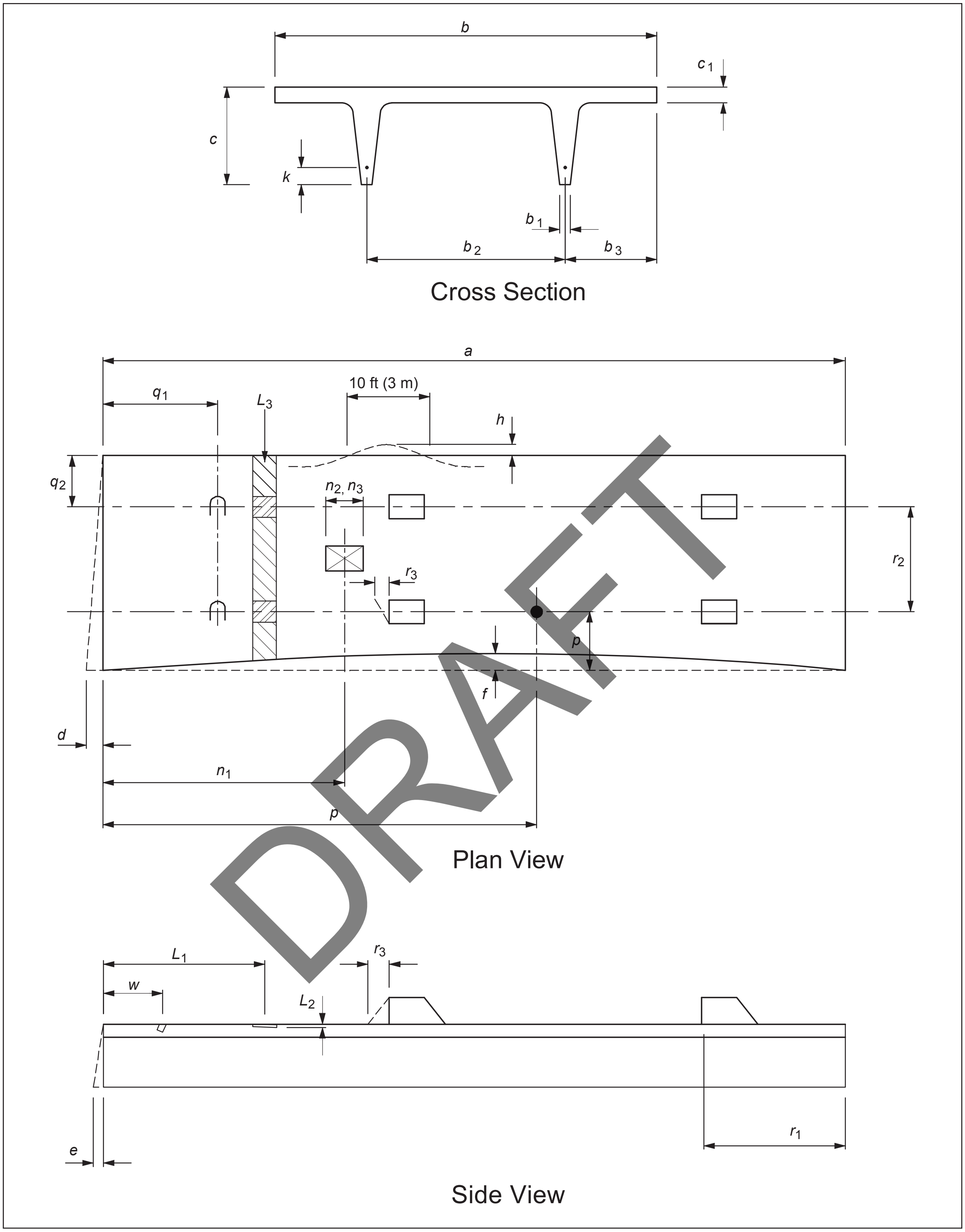

Figure 4.3.2. Ribbed structural wall panel.

4.3.2 Production tolerances for ribbed structural precast concrete wall panels (Fig. 4.3.2) shall be:

a = Length . . . . ±½ in. (±13 mm)

b = Width (overall). . . . . ±¼ in. (±6 mm)

b_1 = Stem width . . . . ±⅛ in. (±3 mm)

b_2 = Distance between stems . . . . ±⅛ in. (±3 mm)

b_3 = Centerline of stem to edge of top flange . . . . ±⅛ in. (±3 mm)

c = Depth (overall) . . . . ±¼ in. (±6 mm)

c_1 = Flange depth . . . . +¼ in., –⅛ in. (+6 mm, –3 mm)

d = Variation from specified plan view end squareness or skew
. . . . . . ±⅛ in. per 12 in. width; ±½ in. maximum (±3 mm per 300 mm width; ±13 mm maximum)

e = Variation from specified side view end squareness or skew
. . . . ±⅛ in. per 12 in. (±3 mm per 300 mm)

f = Sweep, for component length:

Component length ≤20 ft (≤6 m). . . . . ⅛ in. (3 mm)

Component length >20 to 40 ft (>6 to 12 m) . . . . ¼ in. (6 mm)

Component length >40 ft (>12 m) . . . . ⅜ in. (10 mm) maximum

h = Local smoothness of any surface . . . . ¼ in. per 10 ft (6 mm per 3 m)

k = Location of strand . . . . ±¼ in. (±6 mm)

L_1 = Location of embedment . . . . ±1 in. (±25 mm)

L_2 = Tipping and flushness of embedment . . . . ±¼ in. (±6 mm)

L_3 = Concrete surface between embedments to receive continuous ledger, relative to plane of embedments . . . . +0 in., –¼ in. (+0 mm, –6 mm)

n_1 = Location of blockout. . . . . ±1 in. (±25 mm)

n_2 = Size of rough opening . . . . ±1 in. (±25 mm)

n_3 = Size of finished opening . . . . ±½ in. (±13 mm)

p = Location of inserts for structural connections . . . . ±½ in. (±13 mm)

q_1 = Location of handling device parallel to length of panel . . . . ±6 in. (±150 mm)

q_2 = Location of handling device transverse to length of panel. . . . . ±1 in. (±25 mm)

r_1 = Location of haunch bearing elevation from end of panel . . . . ±¼ in. (±6 mm)

r_2 = Transverse distance between haunches . . . . ±¼ in. (±6 mm)

r_3 = Variation from specified haunch bearing surface slope
. . . . ±⅛ in. per 18 in.; ±¼ in. maximum (±3 mm per 450 mm; ±6 mm maximum)

r_4 = Vertical height or length of haunch. . . . .±¼ in. (±6 mm)

w = Location of flashing reglet . . . .±¼ in. (±6 mm)

Additional tolerances not shown (NS) in Fig. 4.3.2:

NSi = Bowing . . . .±Length (in.)/360; (Length(0.3 m)/360); 1 in. (25 mm) maximum

NSj_1 = Differential bowing between panels of the same design and length . . . . ½ in. (13 mm)

NSj_2 = Warping . . . . 1⁄16 in. per 1 ft (1.5 mm per 0.3 m) from the nearest adjacent corner

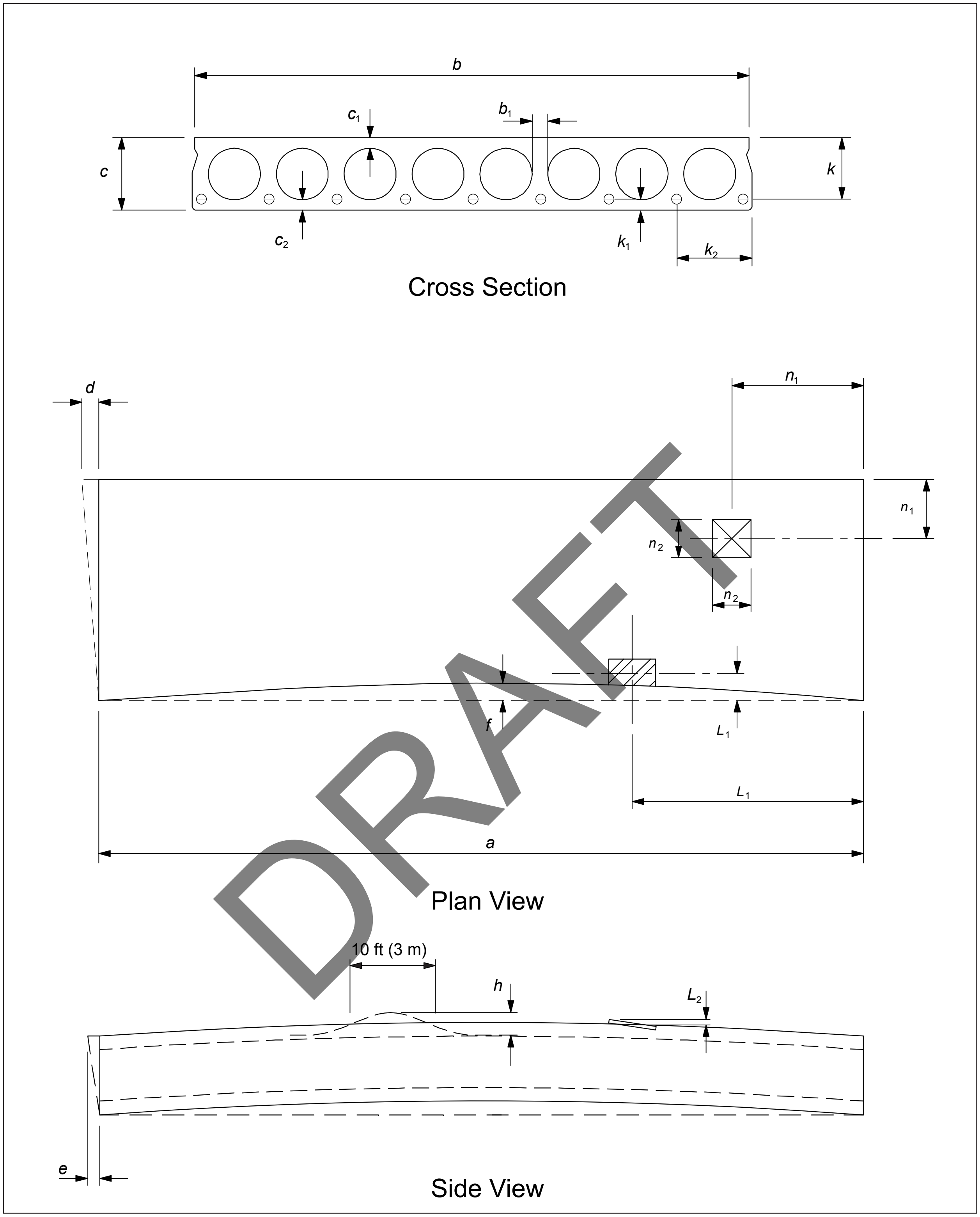

Figure 4.3.3. Hollow-core wall panel.

4.3.3 Production tolerances for precast concrete hollow-core wall panels (Fig. 4.3.3) shall be:

a = Length . . . . ±½ in. (±13 mm)

b = Width (overall) . . . . ±¼ in. (±6 mm)

b_1 = Web width

$b_{1, nominal}$ = The total web width defined by the sum of the actual measured values of b_1 shall not be less than 85% of the sum of the nominal web widths.

c = Depth (overall) . . . . ±¼ in. (±6 mm)

c_1 = Top flange depth

$c_{1, nominal} \times b_{nominal}$ = Top flange area defined by the actual measured values of average $c_1 \times b$ shall not be less than 85% of the nominal area calculated.

c_2 = Bottom flange depth

$c_{2, nominal} \times b_{nominal}$ = Bottom flange area defined by the actual measured values of average $c_2 \times b$ shall not be less than 85% the nominal area calculated.

d = Variation from specified plan view end squareness or skew . . . . ±½ in. (±13 mm)

e = Variation from specified side view end squareness or skew . . . . ±⅛ in. per 12 in. (±3 mm per 300 mm)

f = Sweep, for component length:

Component length ≤20 ft (≤6 m). . . . . ⅛ in. (3 mm)

Component length >20 to 40 ft (>6 to 12 m) . . . . ¼ in. (6 mm)

Component length >40 ft (>12 m) . . . . ±⅜ in. (±10 mm) maximum

h = Local smoothness of any surface . . . . ¼ in. per 10 ft (6 mm per 3 m)

k = Center of gravity of strand group (all strands) . . . . ±¼ in. (±6 mm)

k_1 = Location of any individual strand perpendicular to plane of panel . . . . ±½ in. (±13 mm)

Minimum clear cover . . . . ¾ in. (19 mm)

k_2 = Location of strand parallel to plane of panel . . . . ±¾ in. (±19 mm)

Minimum clear cover . . . . ¾ in. (19 mm)

L_1* = Location of embedment . . . . ±1 in. (±25 mm)

L_2 = Tipping and flushness of embedment . . . . ±¼ in. (±6 mm)

n_1 = Location of blockout. . . . . ±1 in. (±25 mm)

n_2 = Size of blockout . . . . ±½ in. (±13 mm)

Additional tolerances not shown (NS) in Fig. 4.3.3:

NSi = Bowing . . . . ±Length (in.)/360; (Length(0.3 m)/360); 1 in. (25 mm) maximum

NSi_1 = Differential bowing between panels of the same design and length . . . . ½ in. (13 mm)

NSi_2 = Warping . . . . ¹⁄₁₆ in. per 1 ft (1.5 mm per 0.3 m) from the nearest adjacent corner

*Some hollow-core production systems do not permit the incorporation of embedments. Contact local producers for suitable alternate details if embedments are not practical.

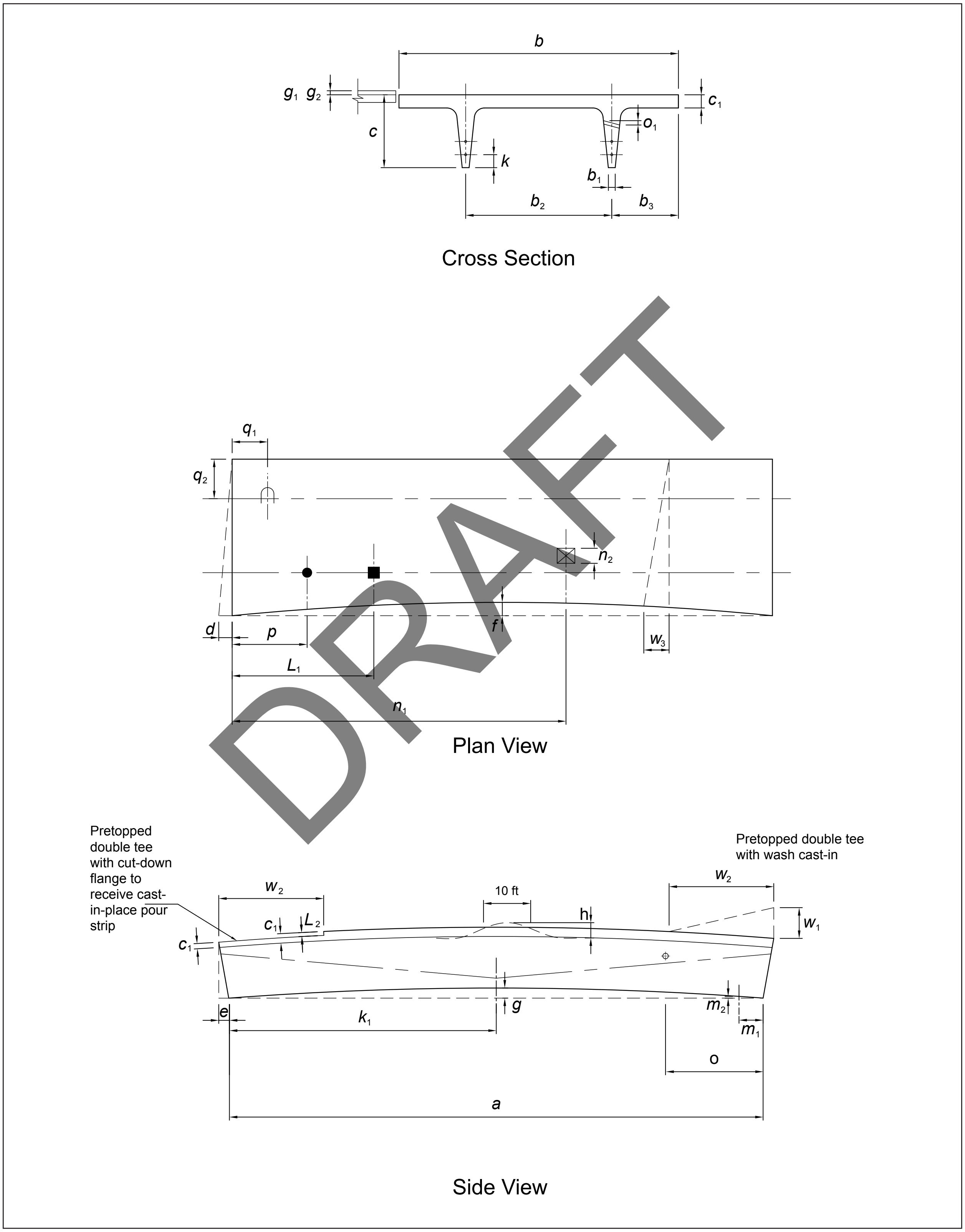

Figure 4.3.4. Double tees (untopped and pretopped).

4.3.4 Production tolerances for precast concrete double tees (Fig. 4.3.4) shall be:

a = Length . . . . ±1 in. (±25 mm)

b = Width (overall). . . . . ±¼ in. (±6 mm)

b_1 = Stem width . . . . ±⅛ in. (±3 mm)

b_2 = Distance between stems . . . . ±¼ in. (±6 mm)

b_3 = Centerline of stem to edge of top flange . . . . ±¼ in. (±6 mm)

c = Depth (overall) . . . . ±¼ in. (±6 mm)

c_1 = Flange thickness. . . . . +¼ in., –⅛ in. (+6 mm, –3 mm)

d = Variation from specified plan view end squareness or skew
. . . . . . ±⅛ in. per 12 in. width; ±½ in. maximum (±3 mm per 300 mm width; ±13 mm maximum)

e = Variation from specified elevation end squareness or skew:

Depth ≤24 in. (≤600 mm) . . . . ±¼ in. (±6 mm)

Depth >24 in. (>600 mm)
. . . . ±⅛ in. per 12 in.; ±½ in. maximum (±3 mm per 300 mm; ±13 mm maximum)

f = Sweep, for component length:

Component length ≤40 ft (≤12 m). . . . . ¼ in. (6 mm)

Component length >40 to 60 ft (>12 to 18 m) . . . . ⅜ in. (10 mm)

Component length >60 ft (>18 m) . . . . ½ in. (13 mm)

g = Camber variation from design camber
. . . . ±¼ in. per 10 ft; ±¾ in. maximum (±6 mm per 3 m; ±19 mm maximum)

g_1 = Differential camber between adjacent untopped components of the same design to receive topping . . . . ±¼ in. per 10 ft; ±¾ in. maximum (±6 mm per 3 m; ±19 mm maximum)

g_2 = Differential camber between adjacent pretopped components of the same design
. . . . ±⅛ in. per 10 ft; ±⅜ in. maximum (±3 mm per 3 m; ±10 mm maximum)

h = Local smoothness of any surface . . . . ¼ in. per 10 ft (6 mm per 3 m)

k = Location of strand:

Individual . . . . ±¼ in. (±6 mm)

Bundled . . . . ±½ in. (±13 mm)

k_1 = Location of harp points for harped strands from design location . . . . ±20 in. (±508 mm)

L_1 = Location of embedment . . . . ±1 in. (±25 mm)

L_2 = Tipping and flushness of embedment . . . . ±¼ in. (±6 mm)

m_1 = Location of bearing assembly . . . . ±½ in. (±13 mm)

m_2 = Tipping and flushness of bearing assembly . . . . ±⅛ in. (±3 mm)

n_1 = Location of blockout . . . . ±1 in. (±25 mm)

n_2 = Size of blockouts . . . . ±½ in. (±13 mm)

o = Location of sleeves cast in stems, in both horizontal and vertical plane . . . . ±1 in. (±25 mm)

o_1* = Skew of sleeve ends, vertical or horizontal, end to end . . . . ±½ in. (±13 mm)

p = Location of inserts for structural connections . . . . ±½ in. (±13 mm)

q_1 = Location of handling device parallel to length of component . . . . ±6 in. (±150 mm)

q_2 = Location of handling device transverse to length of component . . . . ±1 in. (±25 mm)

w_1 = Variation in surface at wash height of wash . . . . ±¼ in. (±6 mm)

w_2 = Production line of wash, longitudinal and transverse . . . . ±½ in. (±13 mm)

w_3 = Transverse skew of wash . . . . ±½ in. (±13 mm)

*If skew tolerance of sleeves cast in stems is important for the function or another reason, it should be treated as a special project tolerance.

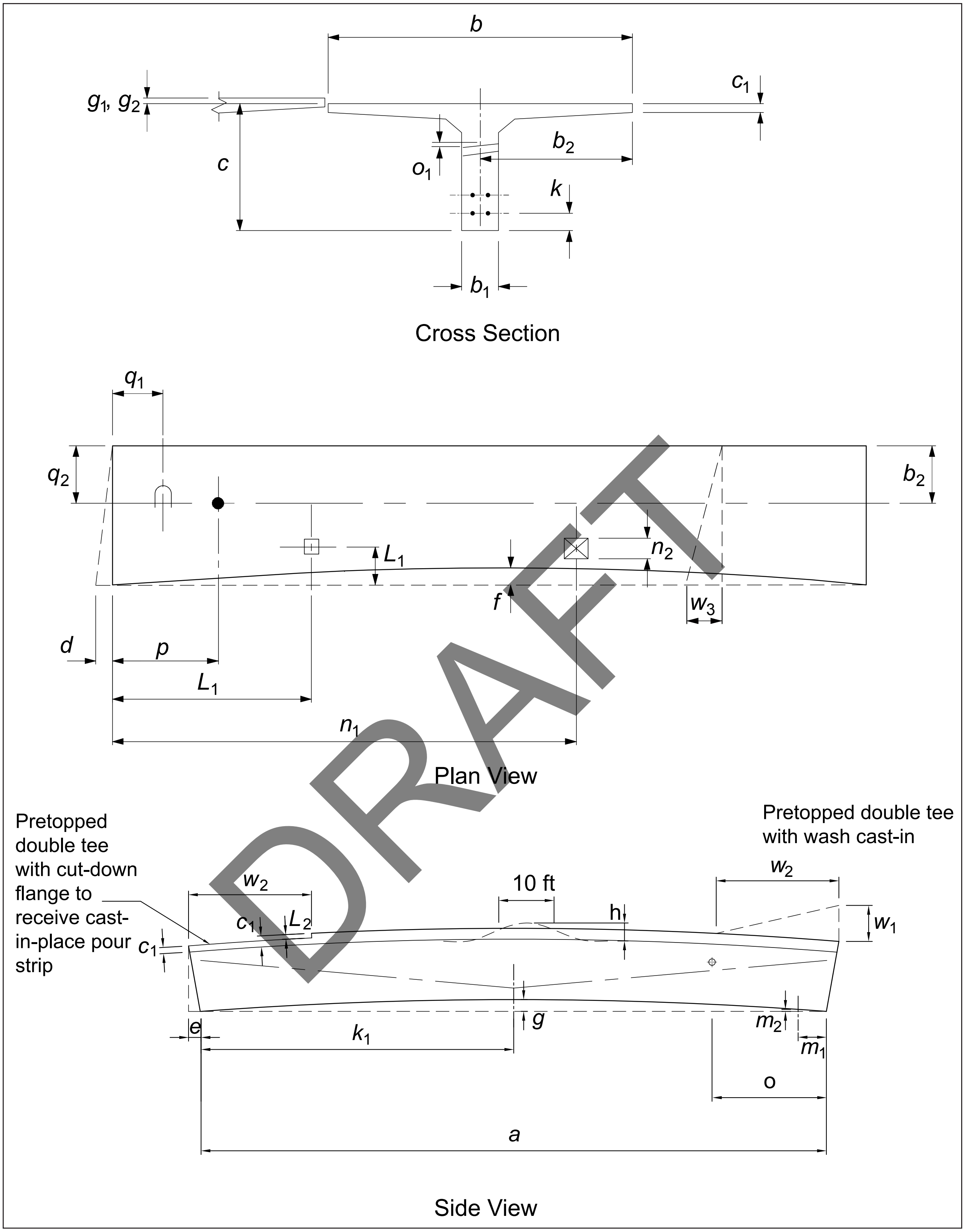

Figure 4.3.5. Single tees (untopped and pretopped).

4.3.5 Production tolerances for precast concrete single tees (Fig. 4.3.5) shall be:

a = Length . . . . . ±1 in. (±25 mm)

b = Width (overall) . . . . . ±¼ in. (±6 mm)

b_1 = Stem width . . . . . ±¼ in. (±6 mm)

b_2 = Centerline of stem to edge of top flange . . . . . ±¼ in. (±6 mm)

c = Depth (overall) . . . . . ±¼ in. (±6 mm)

c_1 = Flange thickness . . . . . +¼ in., –⅛ in. (+6 mm, –3 mm)

d = Variation from specified plan view end squareness or skew
. . . . . . ±⅛ in. per 12 in. width; ±½ in. maximum (±3 mm per 300 mm width; ±13 mm maximum)

e = Variation from specified elevation end squareness or skew:

Depth ≤24 in. (≤600 mm) . . . . . ±¼ in. (±6 mm)

Depth >24 in. (>600 mm)
. . . . . ±⅛ in. per 12 in.; ±½ in. maximum (±3 mm per 300 mm; ±13 mm maximum)

f = Sweep, for component length:

Component length ≤40 ft (≤12 m) . . . . . ¼ in. (6 mm)

Component length >40 to 60 ft (>12 to 18 m) . . . . . ⅜ in. (10 mm)

Component length >60 ft (18 m) . . . . . ½ in. (13 mm)

g = Camber variation from design camber
. . . . . ±¼ in. per 10 ft; ±¾ in. components (±6 mm per 3 m; ±19 mm maximum)

g_1 = Differential camber between adjacent untopped components of the same design to receive topping
. . . . . ¼ in. per 10 ft; ±¾ in. maximum (6 mm per 3 m; ±19 mm maximum)

g_2 = Differential camber between adjacent pretopped components of the same design
. . . . . ⅛ in. per 10 ft; ±⅜ in. maximum (3 mm per 3 m; ±10 mm maximum)

h = Local smoothness of any surface . . . . . ¼ in. per 10 ft (6 mm per 3 m)

k = Location of strand:

Individual . . . . . ±¼ in. (±6 mm)

Bundled . . . . . ±½ in. (±13 mm)

k_1 = Location of harp points for harped strands from design location . . . . . ±20 in. (±508 mm)

L_1 = Location of embedment . . . . . ±1 in. (±25 mm)

L_2 = Tipping and flushness of embedment . . . . . ±¼ in. (±6 mm)

m_1 = Location of bearing assembly . . . . . ±½ in. (±13 mm)

m_2 = Tipping and flushness of bearing assembly . . . . ±⅛ in. (±3 mm)

n_1 = Location of blockout. . . . . ±1 in. (±25 mm)

n_2 = Size of blockouts . . . . ±½ in. (±13 mm)

o = Location of sleeves cast in stems, in both horizontal and vertical planes . . . . ±1 in. (±25 mm)

o_1* = Skew of sleeve ends, vertical or horizontal, end to end. . . . . ±½ in. (±13 mm)

p = Location of inserts for structural connections . . . . ±½ in. (±13 mm)

q_1 = Location of handling device parallel to length of component . . . . ±6 in. (±150 mm)

q_2 = Location of handling device transverse to length of component . . . . ±1 in. (±25 mm)

w_1 = Variation in surface at wash height of wash . . . . ±¼ in. (±6 mm)

w_2 = Production line of wash: Longitudinal and transverse . . . . ±½ in. (±13 mm)

w_3 = Erection line of wash alignment . . . . 1 in. (±25 mm)

*If skew tolerance of sleeves cast in stems is important for the function or another reason, it should be treated as a special project tolerance.

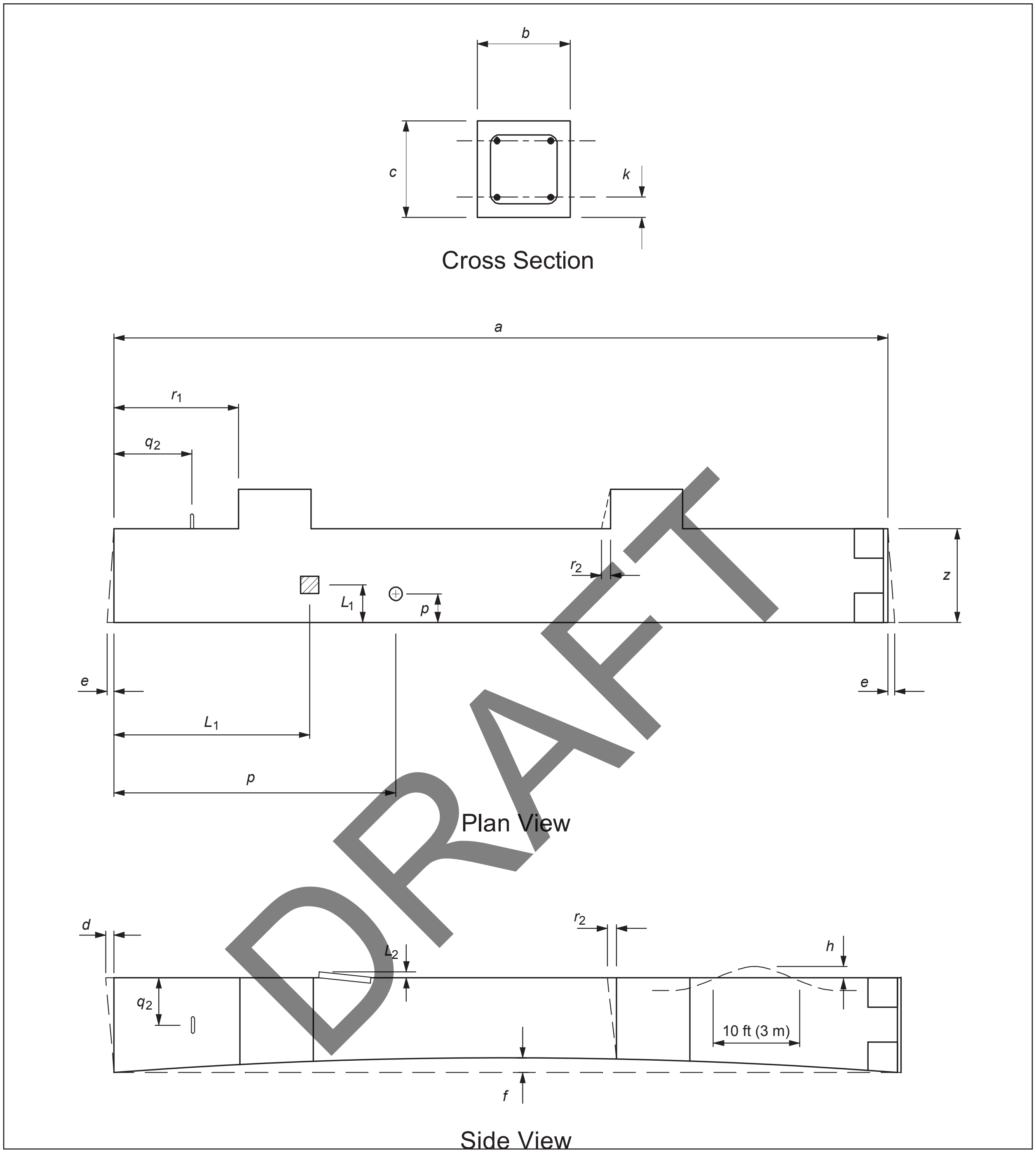

Figure 4.3.6. Column.

4.3.6 Production tolerances for precast concrete columns (Fig. 4.3.6) shall be:

a = Length . . . . ±½ in. (±13 mm)

b = Width . . . . ±¼ in. (±6 mm)

c = Depth . . . . ±¼ in. (±6 mm)

d = Variation from specified top end squareness or skew
. . . . ±⅛ in. per 12 in; ±⅜ in. maximum (±3 mm per 300 mm; ±10 mm maximum)

e = Variation from specified bottom end squareness or skew
. . . . ±⅛ in. per 12 in.; ±⅜ in. maximum (±3 mm per 300 mm; ±10 mm maximum)

f = Sweep, for component length:

Component length up to 20 ft (up to 6 m) . . . . ¼ in. (6 mm)

Component length >20 to 40 ft (>6 to 12 m) . . . . ⅜ in. (10 mm)

Component length >40 ft (>12 m) . . . . ½ in. (13 mm)

h = Local smoothness of any surface . . . . ¼ in. per 10 ft (6 mm per 3 m)

k = Location of strand . . . . ±¼ in. (±6 mm)

L_1 = Location of embedment . . . . ±1 in. (±25 mm)

L_2 = Tipping and flushness of embedment . . . . ±¼ in. (±6 mm)

p = Location of inserts for structural connections . . . . ±½ in. (±13 mm)

q_1 = Location of handling device parallel to length of component . . . . ±6 in. (±150 mm)

q_2 = Location of handling device transverse to length of component . . . . ±1 in. (±25 mm)

r_1 = Location of haunch bearing elevation from end . . . . ±¼ in. (±6 mm)

r_2 = Distance between haunches . . . . ±¼ in. (±6 mm)

r_3 = Variation from specified haunch bearing surface slope
. . . . ±⅛ in. per 12 in.; ±⅜ in. maximum (±3 mm per 300 mm; ±10 mm maximum)

r_4 = Vertical height or length of haunch . . . . ±¼ in. (±6 mm)

z = Base plate overall dimensions . . . . ±¼ in. (±6 mm)

Additional tolerances not shown (NS) in Fig. 4.3.6:

NSs_1 = Longitudinal spacing of stirrups . . . . ±2 in. (±50 mm)

NSs_2 = Longitudinal spacing of stirrups within distance *c* from component ends, where *c* is equal to the height of the component, or as specified by the specialty structural engineer
. . . . ±1 in. (±25 mm)

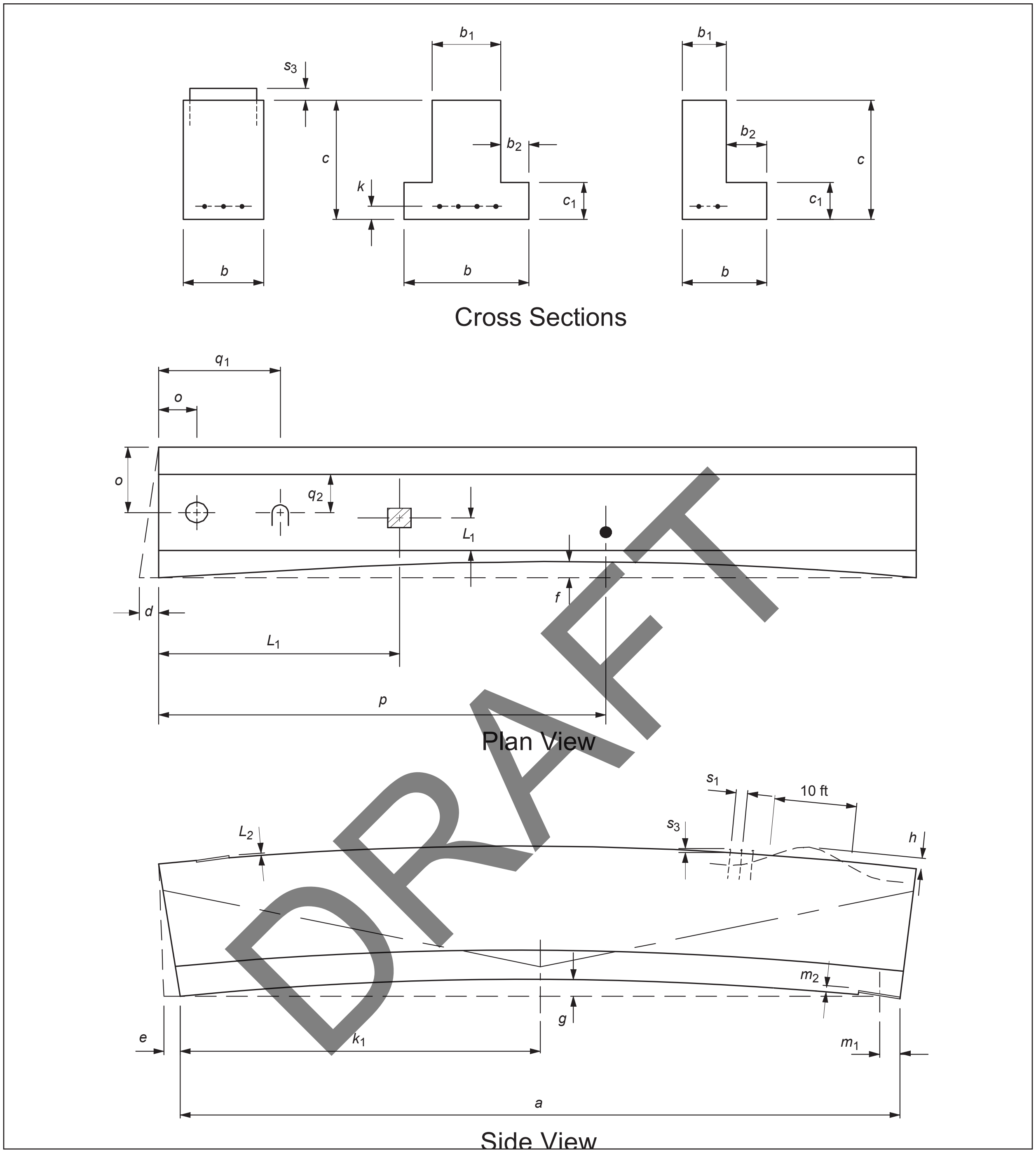

Figure 4.3.7. Beams and spandrel beams.

4.3.7 Production tolerances for precast concrete beams and spandrels (Fig. 4.3.7) shall be:

a = Length . . . . ±¾ in. (±19 mm)

b = Width (overall). . . . . ±¼ in. (±6 mm)

b_1 = Stem width . . . . ±¼ in. (±6 mm)

b_2 = Ledge width . . . . ±¼ in. (±6 mm)

c = Depth (overall) . . . . . ±¼ in. (±6 mm)

c_1 = Ledge depth . . . . . ±¼ in. (±6 mm)

d = Variation from specified plan view end squareness or skew
. . . . . . ±⅛ in. per 12 in. width; ±½ in. maximum (±3 mm per 300 mm width; ±13 mm maximum)

e = Variation from specified elevation end squareness or skew
. . . . . . ±⅛ in. per 12 in. depth; ±½ in. maximum (±3 mm per 300 mm depth; ±13 mm maximum)

f = Sweep, for component length:

Component length ≤40 ft (≤12 m). . . . . . ¼ in. (6 mm)

Component length >40 to 60 ft (>12 to 18 m) . . . . . . ½ in. (13 mm)

Component length >60 ft (>18 m) . . . . . . ⅝ in. (16 mm)

g = Camber variation from design camber
. . . . . . ±⅛ in. per 10 ft; ±¾ in. maximum (±3 mm per 3 m; ±19 mm maximum)

h = Local smoothness of any surface . . . . . . ¼ in. per 10 ft (6 mm per 3 m)

k = Location of strand:

Individual . . . . . . ±¼ in. (±6 mm)

Bundled . . . . . . ±½ in. (±13 mm)

k_1 = Location of harp points for harped strands from design location for component length:

Component length ≤30 ft (≤9 m). . . . . . ±6 in. (±150 mm)

Component length >30 ft (>9 m) . . . . . . ±12 in. (±300 mm)

L_1 = Location of embedment . . . . . . ±1 in. (±25 mm)

L_2 = Tipping and flushness of embedment . . . . . . ±¼ in. (±6 mm)

m_1 = Location of bearing assembly . . . . . . ±½ in. (±13 mm)

m_2 = Tipping and flushness of bearing assembly . . . . . . ±⅛ in. (±3 mm)

o = Location of sleeves cast in stems, in both horizontal and vertical planes . . . . . . ±1 in. (±25 mm)

p = Location of inserts for structural connections . . . . . . ±½ in. (±13 mm)

q_1 = Location of handling device parallel to length of component . . . . . . ±12 in. (±300 mm)

q_2 = Location of handling device transverse to length of component . . . . . . ±½ in. (±13 mm)

s_1 = Longitudinal spacing of stirrups . . . . . . ±2 in. (±50 mm)

s_3 = Stirrup projection from beam surface. . . . . . +¼ in., –½ in. (+6 mm, –13 mm)

Additional tolerance not shown (NS) in Fig. 4.3.7:

NSs_2 = Longitudinal spacing of stirrups within distance *c* from component ends, where *c* is equal to the height of the component, or as specified by the specialty structural engineer . . . . ±1 in. (±25 mm)

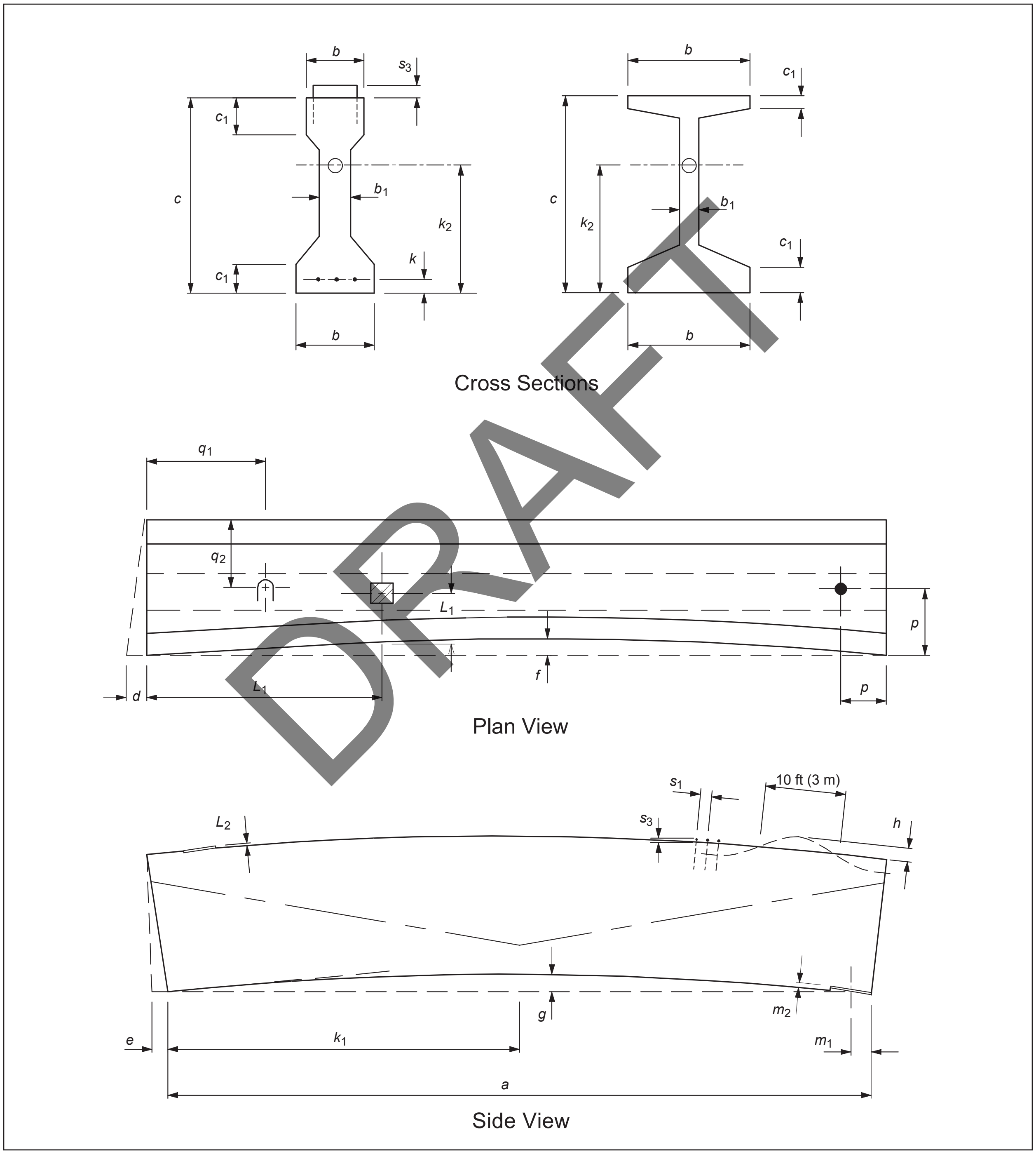

Figure 4.3.8. I-beam girder or bulb-tee girder.

4.3.8 Production tolerances for precast concrete I-beam girders or bulb-tee girders (Fig. 4.3.8) shall be:

a = Length . . . . ±¼ in. per 25 ft length; (±6 mm per 7.5 m length)

b = Width (overall). . . . . +⅛ in., –¼ in. (+10 mm, –6 mm)

b_1 = Web width. . . . . +⅛ in., –¼ in. (+10 mm, –6 mm)

c = Depth (overall) . . . . +½ in., –¼ in. (+13 mm, –6 mm)

c_1 = Flange depth . . . . ±¼ in. (±6 mm)

d = Variation from specified plan view end squareness or skew
. . . . . . ±⅛ in. per 12 in. width; ±½ in. maximum (±3 mm per 300 mm width; ±13 mm maximum)

e = Variation from specified elevation end squareness or skew
. . . . . . ±3/16 in. per 12 in. depth; ±1 in. maximum (±5 mm per 300 mm depth; ±25 mm maximum)

*f** = Sweep . . . . ¼ in. per 10 ft length (6 mm per 3 m length)

*g** = Camber variation from predicted camber . . . . ±¼ in. per 10 ft (±6 mm per 3 m)

h = Local smoothness of any surface . . . . ¼ in. per 10 ft (6 mm per 3 m)

k† = Location of strand

Individual . . . . ±¼ in. (±6 mm)

Bundled . . . . ±½ in. (±13 mm)

k_1 = Location of harp points for harped strands from design location . . . . ±20 in. (±510 mm)

k_2 = Location of post-tensioning duct . . . . ±¼ in. (±6 mm)

L_1 = Location of embedment . . . . ±1 in. (±25 mm)

L_2 = Tipping and flushness of embedment . . . . ±¼ in. (±6 mm)

m_1 = Location of bearing assembly . . . . ±⅝ in. (±16 mm)

m_2 = Tipping and flushness of bearing assembly. . . . . ±⅛ in. (±3 mm)

p = Location of inserts for structural connections . . . . ±½ in. (±13 mm)

q_1 = Location of handling device parallel to length of component . . . . ±6 in. (±150 mm)

q_2 = Location of handling device transverse to length of component. . . . . ±1 in. (±25 mm)

s_1 = Longitudinal spacing of stirrups. . . . . ±2 in. (±50 mm)

s_3 = Stirrup projection from beam surface. . . . . +¼ in., –½ in. (+6 mm, –13 mm)

Additional tolerances not shown (NS) in Fig. 4.3.8:

NSs_2 = Longitudinal spacing of stirrups within distance *c* from component ends, where *c* is equal to the height of the component, or as specified by the specialty structural engineer
. . . . ±1 in. (±25 mm)

*Sweep and camber measurements outside of the stated tolerances shall not be the sole reason for rejection of the product, subject to engineering evaluation.
†The location of harped strand at the end of the beam shall be controlled to ±½ in. (±13 mm) providing that calculations show that such a variation will not result in unacceptable stresses at any design load condition.

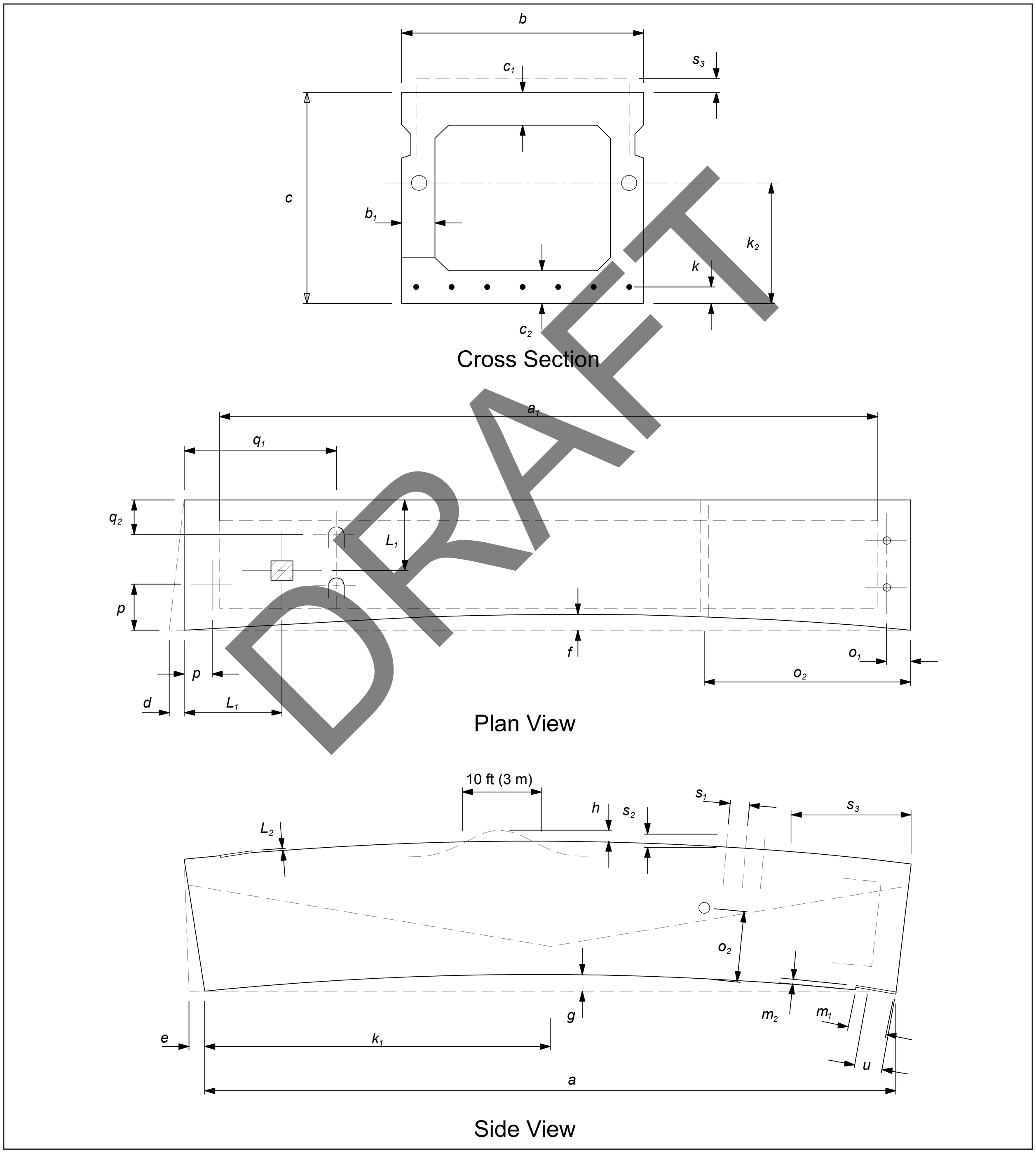

Figure 4.3.9. Box beam.

4.3.9 Production tolerances for precast concrete box beams (Fig. 4.3.9) shall be:

a = Length . . . . ±¾ in. (±19 mm)

a_1 = Length of void form . . . . +1 in., –6 in. (+25 mm, –150 mm)

b = Width (overall). . . . . ±¼ in. (±6 mm)

b_1 = Web width. . . . . ±⅜ in. (±10 mm)

c = Depth (overall) . . . . ±¼ in. (±6 mm)

c_1 = Top flange depth. . . . . ±½ in. (±13 mm)

c_2 = Bottom flange depth. . . . . +½ in., –⅛ in. (+13 mm, –3mm)

d = Variation from specified plan view end squareness or skew
. . . . . . ±⅛ in. per 12 in. width; ±½ in. maximum (±3 mm per 300 mm width; ±13 mm maximum)

e = Variation from specified elevation end squareness or skew . . . . ±½ in. (±13 mm)

f = Sweep, for component length:

Component length ≤40 ft (≤12 m). . . . . ¼ in. (6 mm)

Component length >40 to 60 ft (>12 to 18 m) . . . . ⅜ in. (10 mm)

Component length >60 ft (>18 m) . . . . ½ in. (13 mm)

g = Camber variation from design camber
. . . . ±⅛ in. per 10 ft; ±½ in. maximum (±3 mm per 3 m; ±13 mm maximum)

g_1 = Differential camber between adjacent components of the same design
. . . . ±¼ in. per 10 ft; ±¾ in. maximum (±6 mm per 3 m; ±19 mm maximum)

h = Local smoothness of any surface . . . . ¼ in. per 10 ft (6 mm per 3 m)

k * = Location of strand (individual and bundled). . . . . ±¼ in. (±6 mm)

k_1 = Location of harp points for harped strands from design location . . . . ±20 in. (±508 mm)

k_2 = Location of post-tensioning duct . . . . ±¼ in. (±6 mm)

L_1 = Location of embedment . . . . ±1 in. (±25 mm)

L_2 = Tipping and flushness of embedment . . . . ±¼ in. (±6 mm)

m_1 = Location of bearing assembly . . . . ±⅝ in. (±16 mm)

m_2 = Tipping and flushness of beam seat bearing surface . . . . ±⅛ in. (±3 mm)

o_1 = Location of sleeve at connection to support . . . . ±⅝ in. (±16 mm)

o_2 = Location of tie-rod sleeve:

Horizontal . . . . ±½ in. (±13 mm)

Vertical . . . . ±⅜ in. (±10 mm)

p = Location of inserts for structural connections . . . . ±½ in. (±13 mm)

q_1 = Location of handling device parallel to length of component . . . . ±6 in. (±150 mm)

q_2 = Location of handling device transverse to length of component . . . . ±1 in. (±25 mm)

Additional tolerances not shown (NS) in Fig. 4.3.9:

NSs_1 = Longitudinal spacing of stirrups. . . . . ±1 in. (±25 mm)

NSs_2 = Longitudinal spacing of stirrups within distance c from component ends, where c is equal to the height of the component, or as specified by the specialty structural engineer . . . . ±1 in. (±25 mm)

NSs_3 = Stirrup projection from beam surface . . . . +¼ in., –½ in. (+6 mm, –13 mm)

NSu = Location of void relative to design center location . . . . ±½ in. (±13 mm)
From end of beam . . . . +3 in., –1 in. (+75 mm, –25 mm)

*The location of harped strand at the end of the beam shall be controlled to ±½ in. (±13 mm) providing that calculations show that the variation will not result in unacceptable stress at any design load.

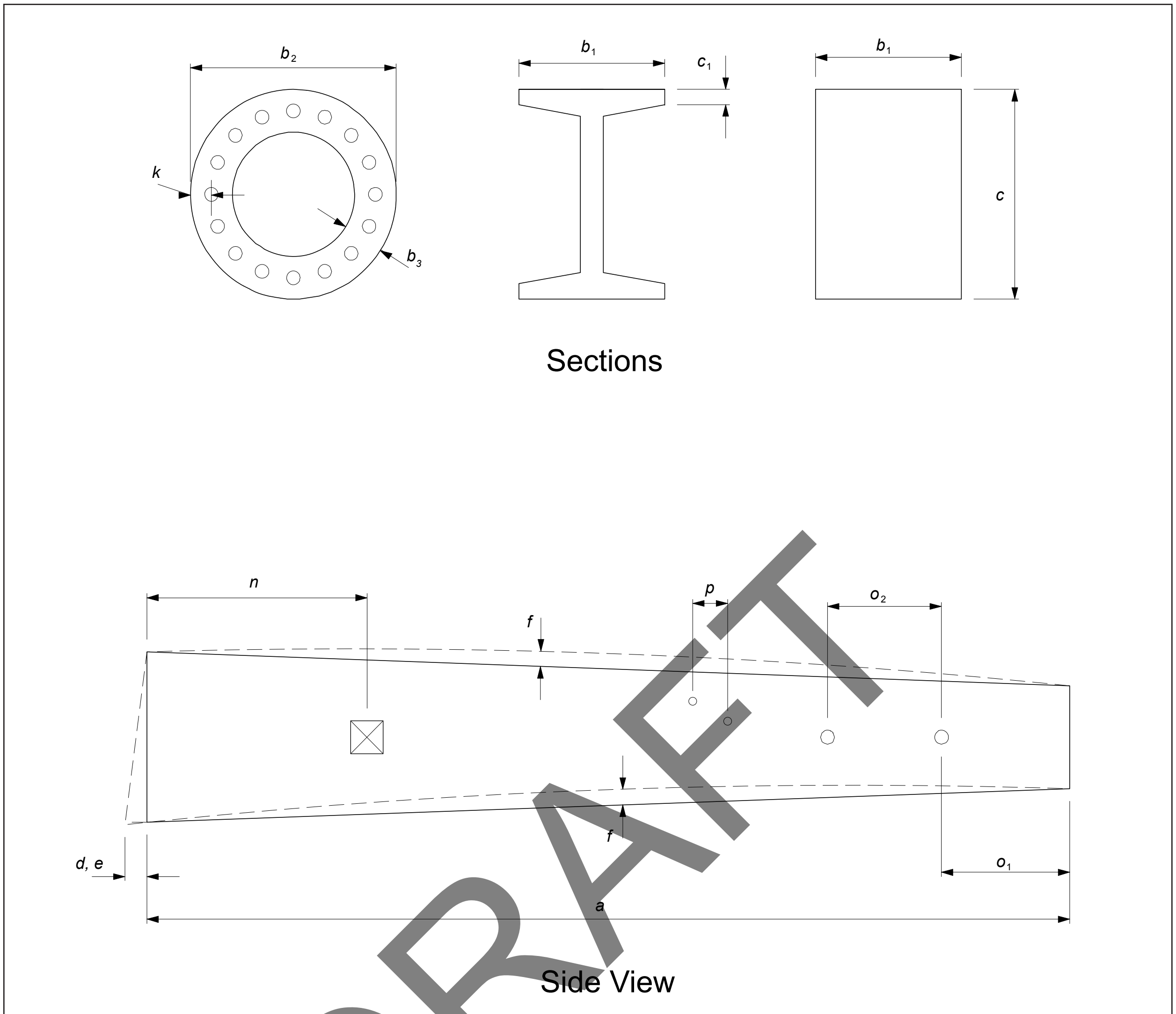

Figure 4.3.10. Poles.

4.3.10 Production tolerances for precast concrete poles (Fig. 4.3.10) shall be:

a = Length . . . . greater of ±⅛ in. per 10 ft *or* ±2 in. (±3 mm per 3 m *or* ±50 mm)

b_1 = Width, static cast poles:

≤24 in. (≤600 mm) . . . . ±⅜ in. (±10 mm)

<24 to 36 in. (600 to 900 mm) . . . . ±½ in. (±13 mm)

>36 in. (>900 mm) . . . . ±⅝ in. (±16 mm)

b_2 = Diameter, spun poles . . . . ±¼ in. (±6 mm)

b_3 = Wall thickness. . . . . greater of ±¼ in. (±6 mm) *or* +20%, –10% of nominal thickness

c = Depth, static cast poles:

<24 in. (<600 mm) . . . . ±⅜ in. (±10 mm)

<24 to 36 in. (600 to 900 mm) . . . . . ±½ in. (±13 mm)

>36 in. (>900 mm) . . . . . ±⅝ in. (±16 mm)

c_1 = Flange thickness. . . . . . ±¼ in. (±6 mm)

d = Variation from specified plan view end squareness or skew:

Top . . . . . ±¼ in. (±6 mm)

Bottom . . . . . ±1 in. (±25 mm)

e = Variation from specified elevation end squareness or skew:

Top . . . . . ±¼ in. (±6 mm)

Bottom . . . . . ±1 in. (±25 mm)

f = Sweep. . . . . . greater of ¼ in. per 10 ft *or* ½ in. (6 mm per 3 m *or* 13mm)

k = Location of strand . . . . . ±¼ in. (±6 mm)

n = Location of blockout. . . . . . ±1 in. (±25 mm)

o_1 = Location of sleeve . . . . . ±1 in. (±25 mm)

o_2 = Location of sleeve for matching hardware pattern. . . . . . ±⅛ in. (±3 mm)

p = Location of insert for matching hardware pattern . . . . . ±⅛ in. (±3 mm)

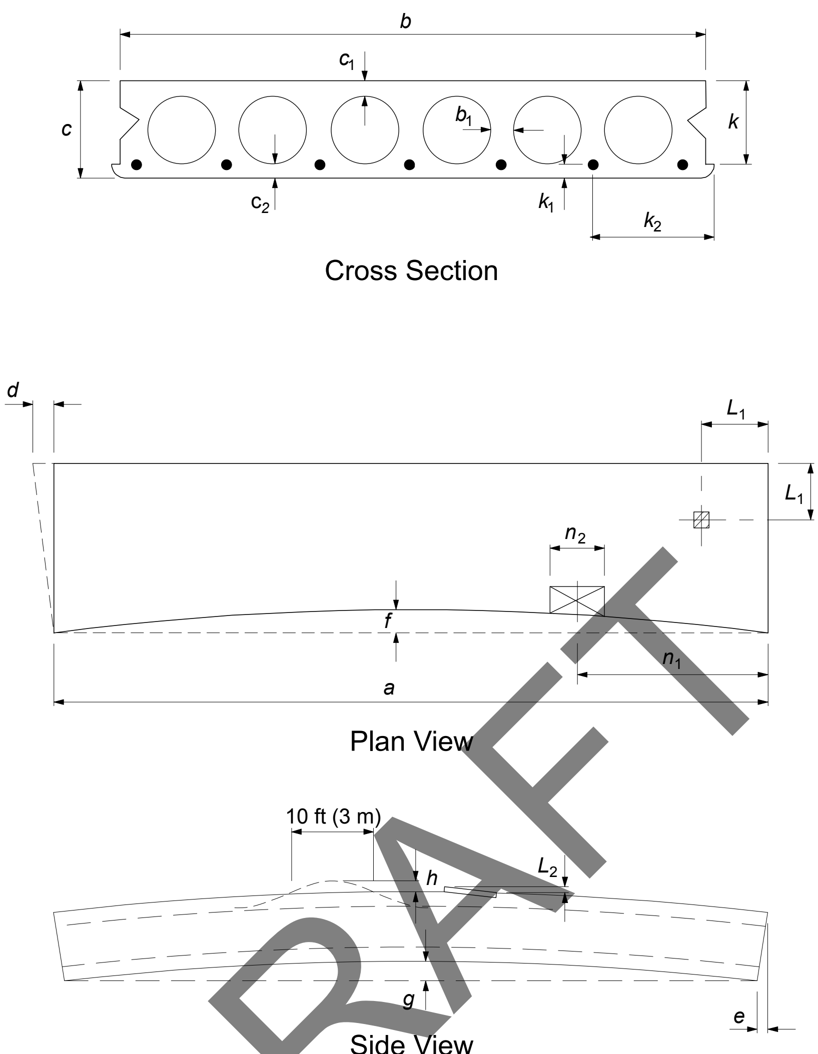

Figure 4.3.11. Hollow-core slab.

4.3.11 Production tolerances for precast concrete hollow-core slabs (Fig. 4.3.11) shall be:

a = Length . . . . ±½ in. (±13 mm)

b = Width (overall). . . . . ±¼ in. (±6 mm)

b_1 = Web width

$b_{1,\ nominal}$ = The total web width defined by the sum of the actual measured values of b_1 shall not be less than 85% of the sum of the nominal web widths.

c = Depth (overall) . . . . ±¼ in. (±6 mm)

c_1 = Top flange depth

$c_{1,\ nominal} \times b_{nominal}$ = Top flange area defined by the actual measured values of average $c_1 \times b$ shall not be less than 85% of the nominal area calculated.

c_2 = Bottom flange depth

$c_{2,\text{ nominal}} \times b_{\text{nominal}}$ = Bottom flange area defined by the actual measured values of average $c_2 \times b$ shall not be less than 85% of the nominal area calculated.

d = Variation from specified plan view end squareness or skew . . . . ±½ in. (±13 mm)

e = Variation from specified elevation end squareness or skew
. . . . ±⅛ in. per 12 in.; ±½ in. maximum (±3 mm per 300 mm; ±13 mm maximum)

f = Sweep. . . . . ±⅜ in. (±10 mm)

g = Camber variation from design camber
. . . . ±⅛ in. per 10 ft; ±¾ in. maximum (±3 mm per 3 m; ±19 mm maximum)

h = Local smoothness of any surface . . . . ¼ in. per 10 ft (6 mm per 3 m)

k = Center of gravity of strand group . . . . ±¼ in. (±6 mm)

k_1 = Location of strand perpendicular to plane of panel . . . . ±½ in. (±13 mm)

Minimum cover. . . . . ¾ in. (19 mm)

k_2 = Location of strand parallel to plane of panel . . . . ±¾ in. (±19 mm)

Minimum cover. . . . . ¾ in. (19 mm)

L_1 = Location of embedment . . . . ±2 in. (±50 mm)

L_2 = Tipping and flushness of embedment . . . . ±¼ in. (±6 mm)

n_1 = Location of blockout. . . . . ±2 in. (±50 mm)

n_2 = Size of blockout . . . . ±½ in. (±13 mm)

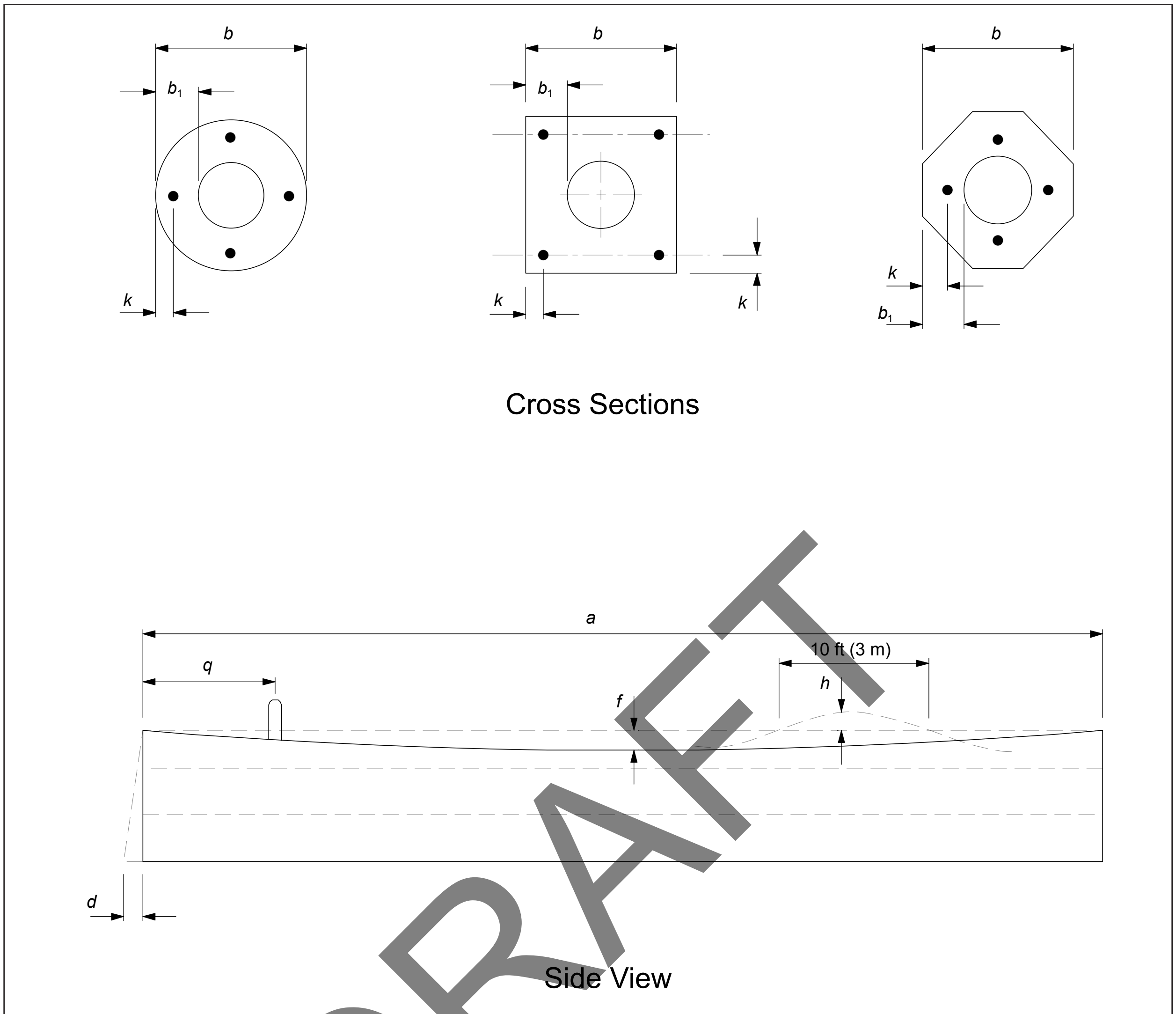

Figure 4.3.12. Piles (hollow and solid).

4.3.12 Production tolerances for precast concrete piles (Fig. 4.3.12) shall be:

a = Length . . . . ±1 in. (±25 mm)

b = Width or diameter. . . . . ±⅜ in. (±10 mm)

b_1 = Wall thickness. . . . . +½ in., –¼ in. (+13 mm, –6 mm)

c = Depth . . . . ±⅜ in. (±10 mm)

d = Variation from specified plan view end squareness or skew . . . . ±¼ in. per 12 in.; ±½ in. maximum (±6 mm per 300 mm; ±13 mm maximum)

f = Sweep. . . . . ±⅛ in. per 10 ft (±3 mm per 3 m)

h = Local smoothness of any surface . . . . ¼ in. per 10 ft (6 mm per 3 m)

k = Location of strand . . . . ±¼ in. (±6 mm)

q = Location of handling device . . . . ±6 in. (±150 mm)

Additional tolerances not shown (NS) in Fig. 4.3.12:

NSs = Longitudinal spacing of stirrups or spiral reinforcement . . . . ±¾ in. (±19 mm)

NSz = Location of driving tip . . . . ±½ in. (±13 mm)

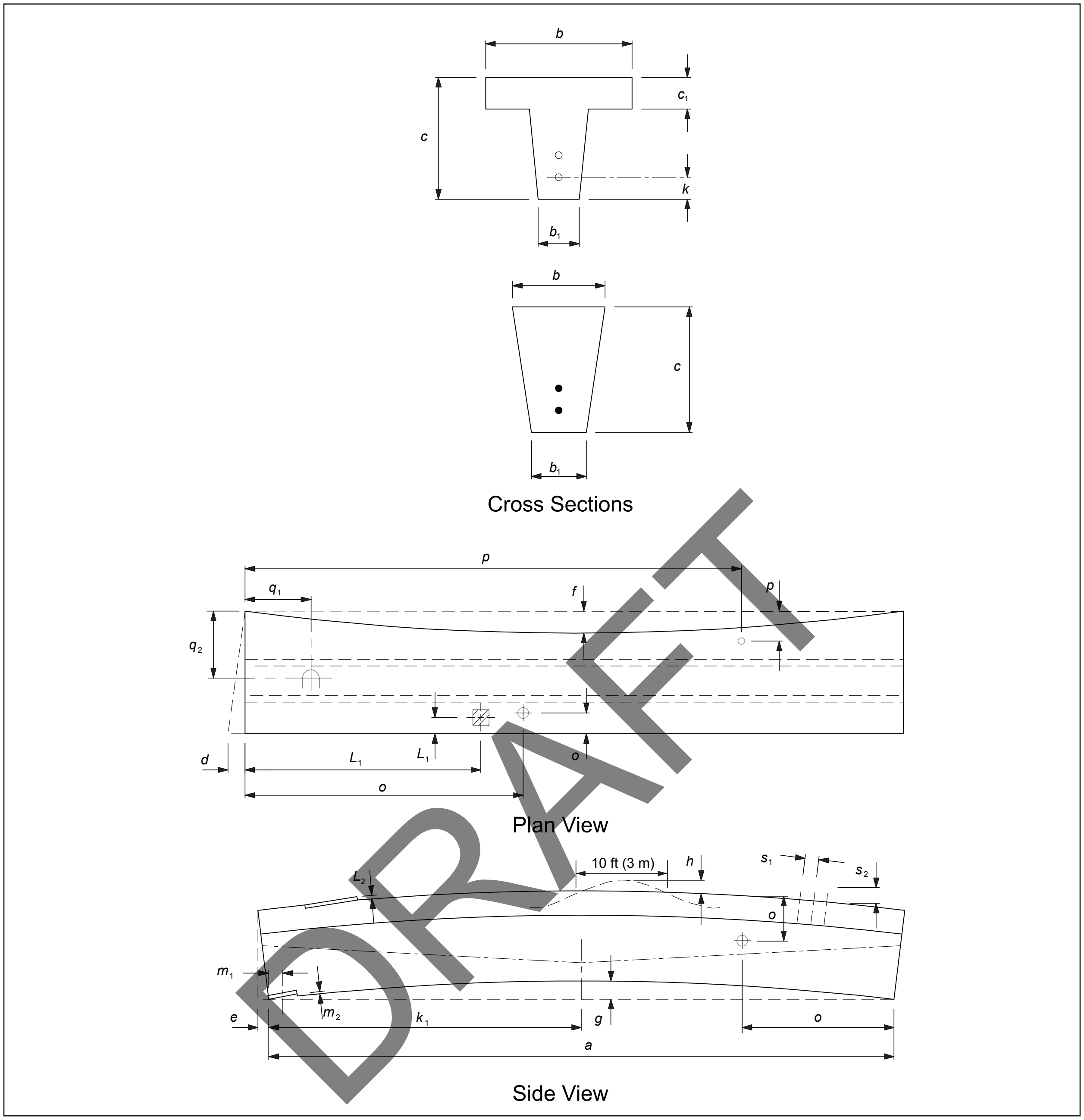

Figure 4.3.13. Tee joist and keystone joist.

4.3.13 Production tolerances for tee joists and keystone joists (Fig. 4.3.13) shall be:

a = Length . . . . ±1 in. (±25 mm)

b = Width (overall). . . . . ±¼ in. (±6 mm)

b_1 = Stem width . . . . ±⅛ in. (±3 mm)

c = Depth (overall) . . . . ±¼ in. (±6 mm)

c_1 = Flange thickness. . . . . +¼ in., –⅛ in. (+6 mm, –3 mm)

d = Variation from specified plan view end squareness or skew
. . . . . . ±¼ in. per 12 in. width; ±½ in. maximum (±6 mm per 300 mm width; ±13 mm maximum)

e = Variation from specified elevation end squareness or skew
. . . . . ±¼ in. per 12 in. height; ±½ in. maximum (±6 mm per 300 mm height; ±13 mm maximum)

f = Sweep, for component length:

Component length ≤40 ft (≤12 m). . . . . ⅜ in. (10 mm)

Component length >40 to 60 ft (>12 to 18 m) . . . . ⅝ in. (16 mm)

Component length >60 ft (>18 m) . . . . ¾ in. (19 mm)

g = Camber variation from design camber
. . . . ±¼ in. per 10 ft; ¾ in. maximum (±6 mm per 3 m; 19 mm maximum)

h = Local smoothness of any surface . . . . ¼ in. per 10 ft (6 mm per 3 m)

k = Location of strand:

Individual . . . . ±¼ in. (±6 mm)

Bundled . . . . ±½ in. (±13 mm)

k_1 = Location of harp points for harped strands from design location . . . . ±20 in. (±510 mm)

L_1 = Location of embedment . . . . ±1 in. (±25 mm)

L_2 = Tipping and flushness of embedment . . . . ±¼ in. (±6 mm)

m_1 = Location of bearing assembly . . . . ±½ in. (±13 mm)

m_2 = Tipping and flushness of bearing assembly . . . . ±⅛ in. (±3 mm)

o = Location of sleeves cast in stem, in both horizontal and vertical planes . . . . ±1 in. (±25 mm)

p = Location of insert for structural connections . . . . ±½ in. (±13 mm)

q_1 = Location of handling device parallel to length of component . . . . ±6 in. (±150 mm)

q_2 = Location of handling device transverse to length of component . . . . ±1 in. (±25 mm)

s_1 = Longitudinal spacing of stirrups . . . . ±2 in. (±50 mm)

s_2 = Stirrup projection from beam surface. . . . . +¼ in., –½ in. (+6 mm, –13 mm)

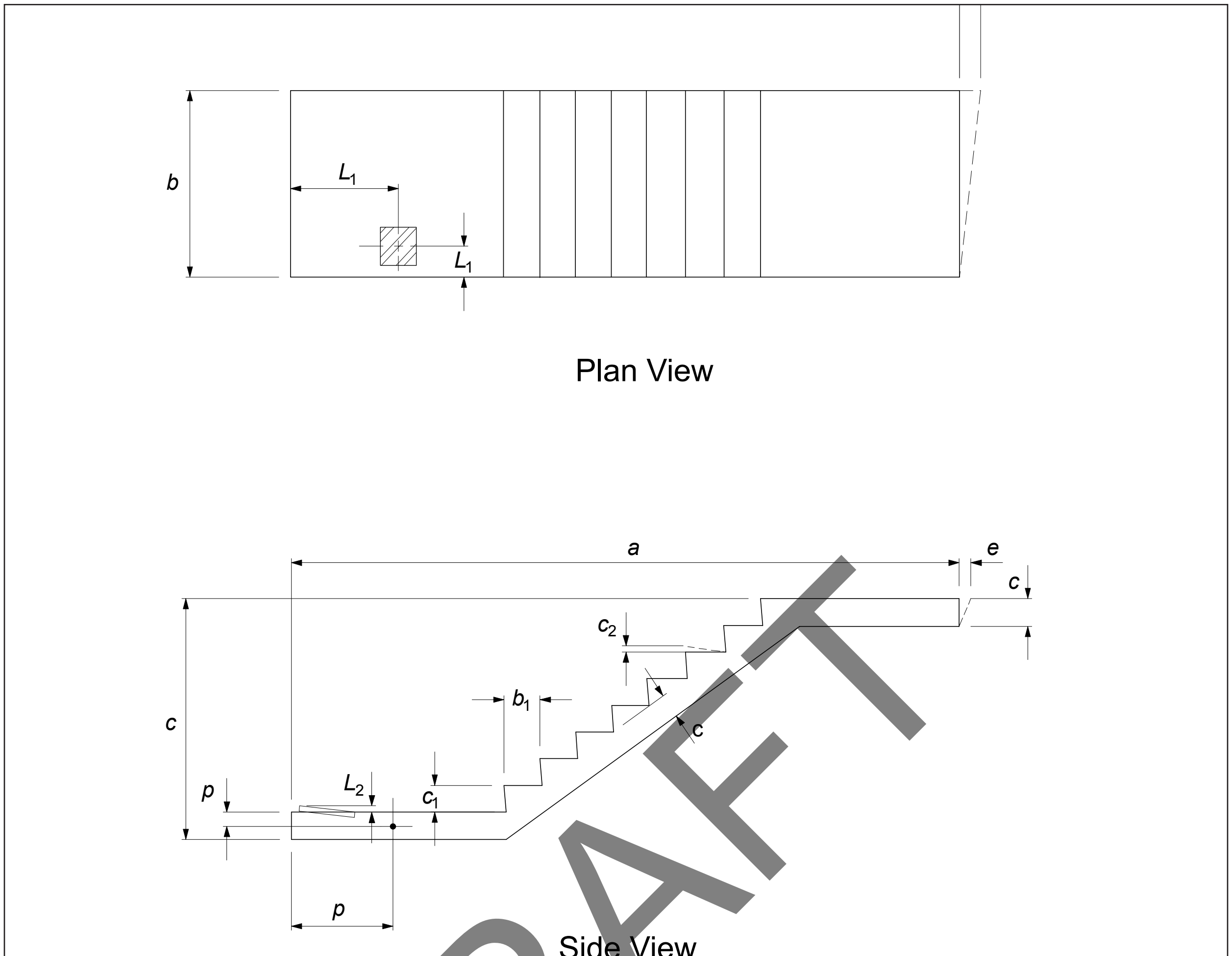

Figure 4.3.14. Stair unit.

4.3.14 Production tolerances for precast concrete stair units (Fig. 4.3.14) shall be:

a = Length . . . . ±½ in. (±13 mm)

b = Width (overall). . . . . ±⅜ in. (±10 mm)

b_1 = Individual tread width (not cumulative). . . . . ±¼ in. (±6 mm)

c = Depth (overall) . . . . ±¼ in. (±6 mm)

c_1 = Individual riser depth (not cumulative) . . . . ±3/16 in. (±5 mm)

c_2 = Riser variation from specified plane . . . . ±⅛ in. (±3 mm)

d = Variation from specified view plan end squareness or skew
. . . . . . ±⅛ in. per 12 in. width; ±½ in. maximum (±3 mm per 300 mm width; ±13 mm maximum)

e = Variation from specified elevation end squareness or skew . . . . ±¼ in. (±6 mm)

L_1 = Location of embedment . . . . ±1 in. (±25 mm)

L_2 = Tipping and flushness of embedment . . . . ±⅛ in. (±3 mm)

p = Location of inserts for structural connections . . . . ±3⁄8 in. (±10 mm)

Additional tolerances not shown (NS) in Fig. 4.3.14:

NSc_3 = Differential height between adjacent risers . . . . ±1⁄4 in. (±6 mm)

NSj = Warp (Fig. C1.2.3) . . . . ±1⁄4 in. (±6 mm)

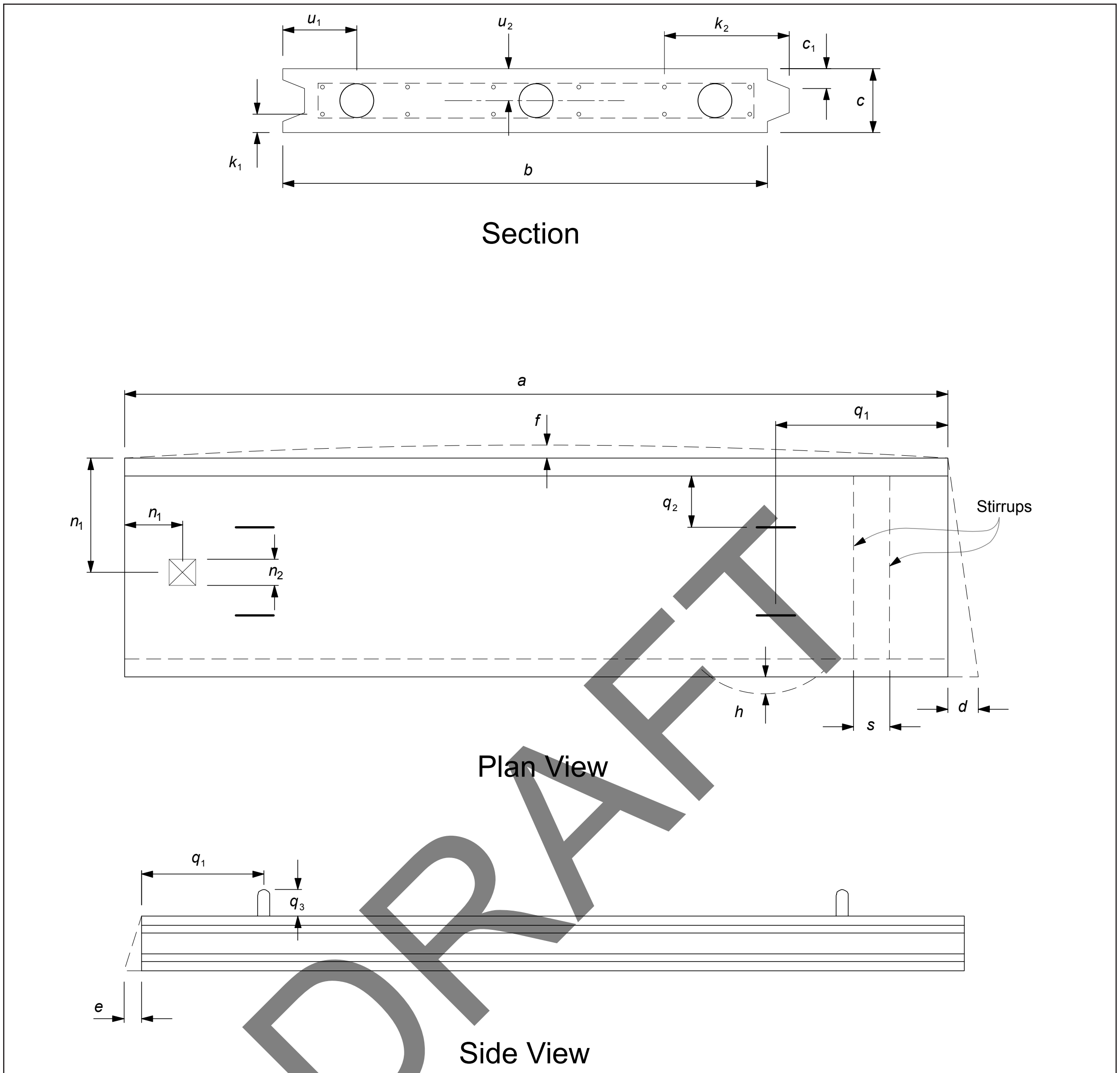

Figure 4.3.15. Sheet piling.

4.3.15 Production tolerances for precast concrete sheet piling (Fig. 4.3.15) shall be:

a = Length . . . . ±1 in. (±25 mm)

b = Width . . . .±3⁄8 in. (±10 mm)

c = Depth . . . .±¼ in. (±6 mm)

c_1 = Flange depth . . . .±½ in. (±13 mm)

d = Variation from specified plan view end squareness or skew
. . . . ±¼ in. per 10 ft; ±½ in. maximum (±6 mm per 3 m; ±13 mm maximum)

e = Variation from specified elevation end squareness or skew . . . .±¼ in. (±6 mm)

f = Sweep. . . . . ±⅛ in. per 10 ft (±3 mm per 3 m)

h = Local smoothness of any surface . . . . ¼ in. per 10 ft (6 mm per 3 m)

k_1 = Location of strand perpendicular to plane of panel . . . . ±¼ in. (±6 mm)

k_2 = Location of strand parallel to plane of panel . . . . ±1 in. (±25 mm)

n_1 = Location of blockout. . . . . ±1 in. (±25 mm)

n_2 = Size of blockout . . . . ±½ in. (±13mm)

q_1 = Location of handling device parallel to length of component . . . . ±6 in. (±150 mm)

q_2 = Location of handling device transverse to length of component . . . .±½ in. (±13 mm)

s = Longitudinal spacing of stirrups . . . .±¾ in. (±19 mm)

u_1 = Transverse location of voids. . . . .±½ in. (±13 mm)

u_2 = Vertical location of voids . . . .±¼ in. (±6 mm)

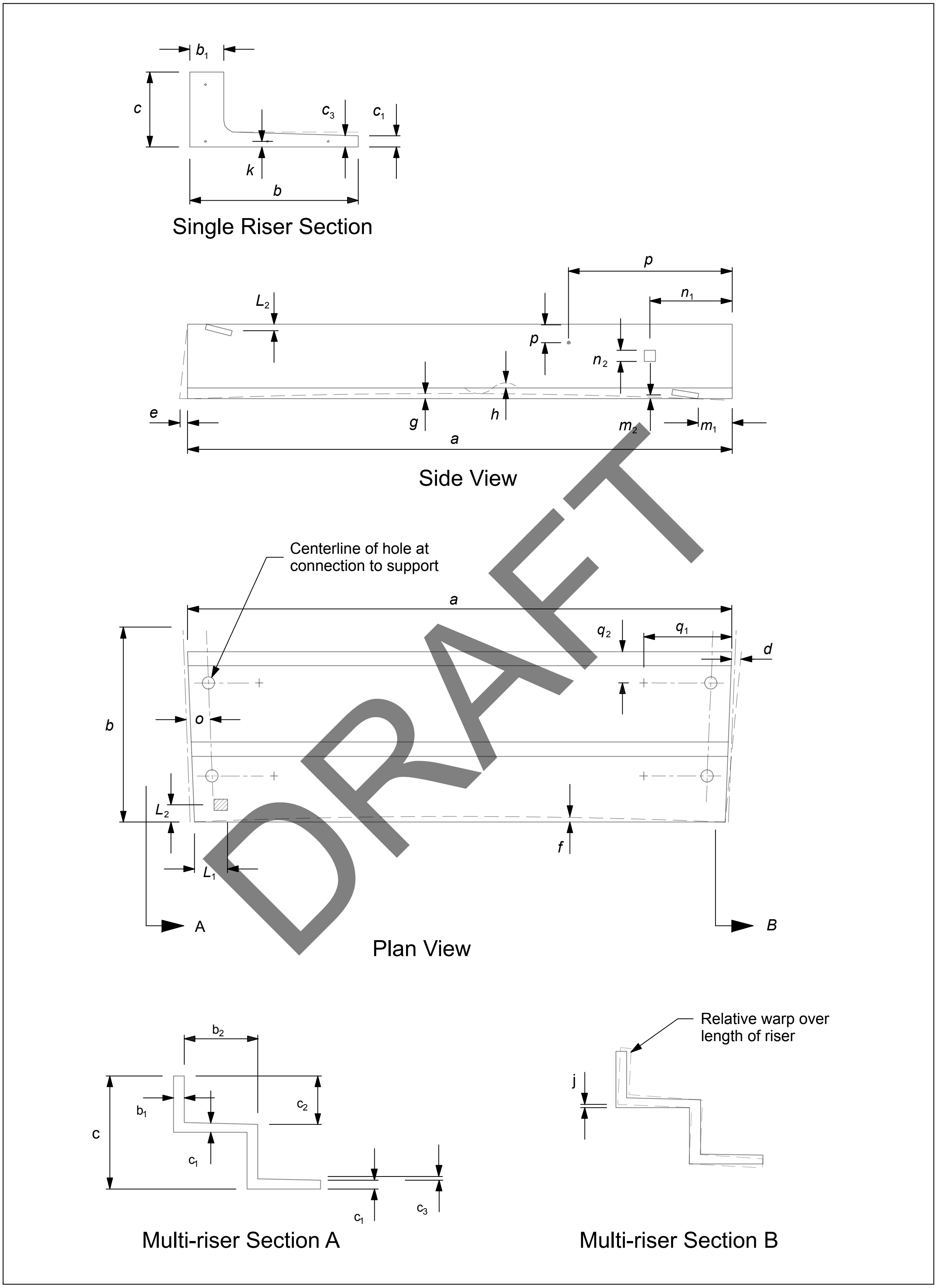

Figure 4.3.16. Stadium riser.

4.3.16 Production tolerances for precast concrete stadium risers (Fig. 4.3.16) shall be:

a = Length ±½ in. (±13 mm)

b = Width (overall) ±¼ in. (±6 mm)

b_1 = Stem width ±⅛ in. (±3 mm)

b_2 = Individual tread width (not cumulative) ±⅛ in. (±3 mm)

c = Depth (overall) ±¼ in. (±6 mm)

c_1 = Flange thickness +¼ in., –⅛ in. (+6 mm, –3 mm)

c_2 = Individual riser depth (not cumulative) ±⅛ in. (±3 mm)

c_3 = Riser variation from specified plane +⅛ in., –0 in. (+3 mm, –0 mm)

d = Variation from specified plan view end squareness or skew ±⅛ in. per 12 in. width; ±¼ in. maximum, (±3 mm per 300 mm width; ±6 mm maximum)

e = Variation from specified elevation end squareness or skew ±¼ in. per 12 in. height; ±½ in. maximum (±6 mm per 300 mm height; ±13 mm maximum)

f = Sweep, for component length:

Component length ≤40 ft (≤12 m) ... ¼ in. (6 mm)

Component length >40 ft (>12 m) ⅜ in. (10 mm) maximum

g = Camber variation from design camber ±¼ in. per 10 ft; ±½ in. maximum (±6 mm per 3 m; 13 mm maximum)

h = Local smoothness of any surface ¼ in. per 10 ft (6 mm per 3 m)

j = Warp ±¼ in. (±6 mm)

k = Location of strand ±¼ in. (±6 mm)

L_1 = Location of embedment ±1 in. (±25 mm)

L_2 = Tipping and flushness of embedment ±¼ in. (±6 mm)

m_1 = Location of bearing assembly ±½ in. (±13 mm)

m_2 = Tipping and flushness of bearing assembly ±⅛ in. (3 mm)

n_1 = Location of blockout ±1 in. (±25 mm)

n_2 = Size of blockout ±1 in. (±25 mm)

o = Location of sleeves at connection to support ±½ in. (±13 mm)

p = Location of inserts ±½ in. (±13 mm)

q_1 = Location of handling device parallel to length of component ±6 in. (±150 mm)

q_2 = Location of handling device transverse to length of component . . . . ±1 in. (±25 mm)

Additional tolerance not shown (NS) in Fig. 4.3.16:

NSg_1 = Differential camber between adjacent components of the same design and length . . . . ±¼ in. per 10 ft; ±½ in. maximum; (±6 mm per 3 m, 13 mm maximum)

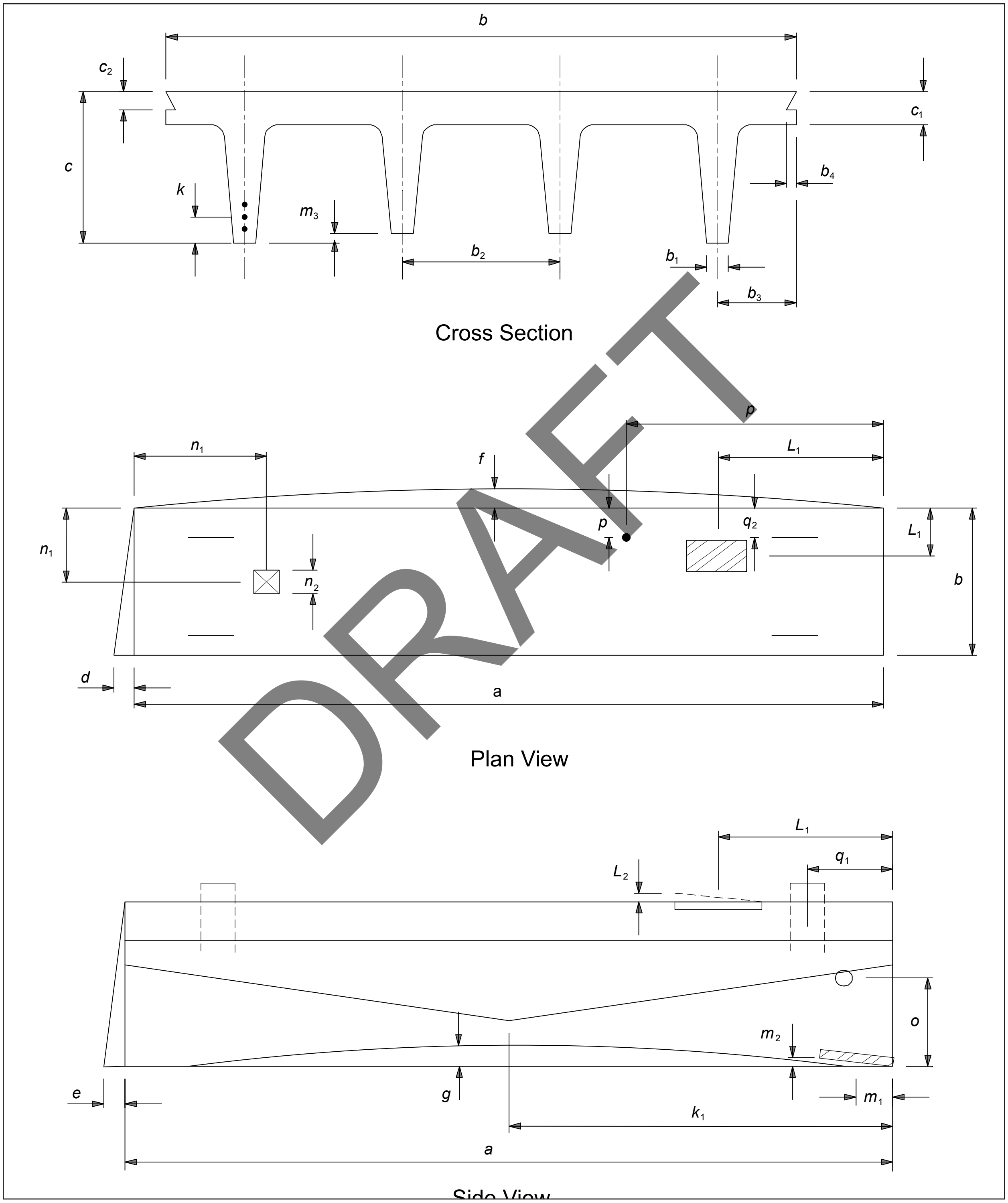

Figure 4.3.17. Multi-stemmed bridge unit.

4.3.17 Production tolerances for multi-stemmed bridge units (Fig. 4.3.17) shall be:

a = Length ... ±¾ in. (±19 mm)

b = Width (overall) ... ±¼ in. (±6 mm)

b_1 = Stem width ... ±¼ in. (±6 mm)

b_2 = Distance between stems ... ±⅛ in. (±3 mm)

b_3 = Centerline of stem to edge of top flange ... ±¼ in. (±6 mm)

b_4 = Shear key depth ... ±¼ in. (±6 mm)

c = Depth (overall) ... ±¼ in. (±6 mm)

c_1 = Flange thickness ... +¼ in., –⅛ in. (+6 mm, –3 mm)

c_2 = Shear key height ... ±¼ in. (±6 mm)

d = Variation from specified plan view end squareness or skew ... ±¾ in. (±19 mm)

e = Variation from specified elevation end squareness or skew ... ±¾ in. (±19 mm)

f = Sweep, for component length:

Component length ≤40 ft (≤12 m) ... ¼ in. (6 mm)

Component length >40 to 60 ft (>12 to 18 m) ... ⅜ in. (10 mm)

Component length >60 ft (>18 m) ... ½ in. (13 mm)

g = Camber variation from design
... ±¼ in. per 10 ft; ¾ in. maximum (±6 mm per 3 m; 19 mm maximum)

g_1 = Differential camber between units of the same design and length
... ¼ in. per 10 ft; ¾ in. maximum (6 mm per 3 m; 19 mm maximum)

k = Location of strand:

Individual ... ±¼ in. (±6 mm)

Bundled ... ±½ in. (±13 mm)

k_1 = Location of harp points for harped strands from design location ... ±6 in (±150 mm)

L_1 = Location of embedment ... ±1 in. (±25 mm)

L_2 = Tipping and flushness of embedment ... ±¼ in. (±6 mm)

m_1 = Location of bearing assembly ... ±½ in. (±13 mm)

m_2 = Tipping and flushness of bearing assembly ... ±⅛ in. (±3 mm)

m_3 = Differential elevation of bearing surface between stems ... ±1/16 in. (±2 mm)

n_1 = Location of blockout. . . . . ±1 in. (±25 mm)

n_2 = Size of blockout . . . . ±1 in. (±25 mm)

o = Location of sleeves cast in stems, in both horizontal and vertical planes . . . . ±½ in. (±13 mm)

p = Location of inserts for structural connections . . . . ±½ in. (±13 mm)

q_1 = Location of handling device parallel to length of component . . . . ±6 in. (±150 mm)

q_2 = Handling device location transverse to length of component . . . . ±1 in. (±25 mm)

Additional tolerance not shown (NS) in Fig. 4.3.17 :

NSs = Longitudinal spacing of stirrups. . . . . ±1 in. (±25 mm)

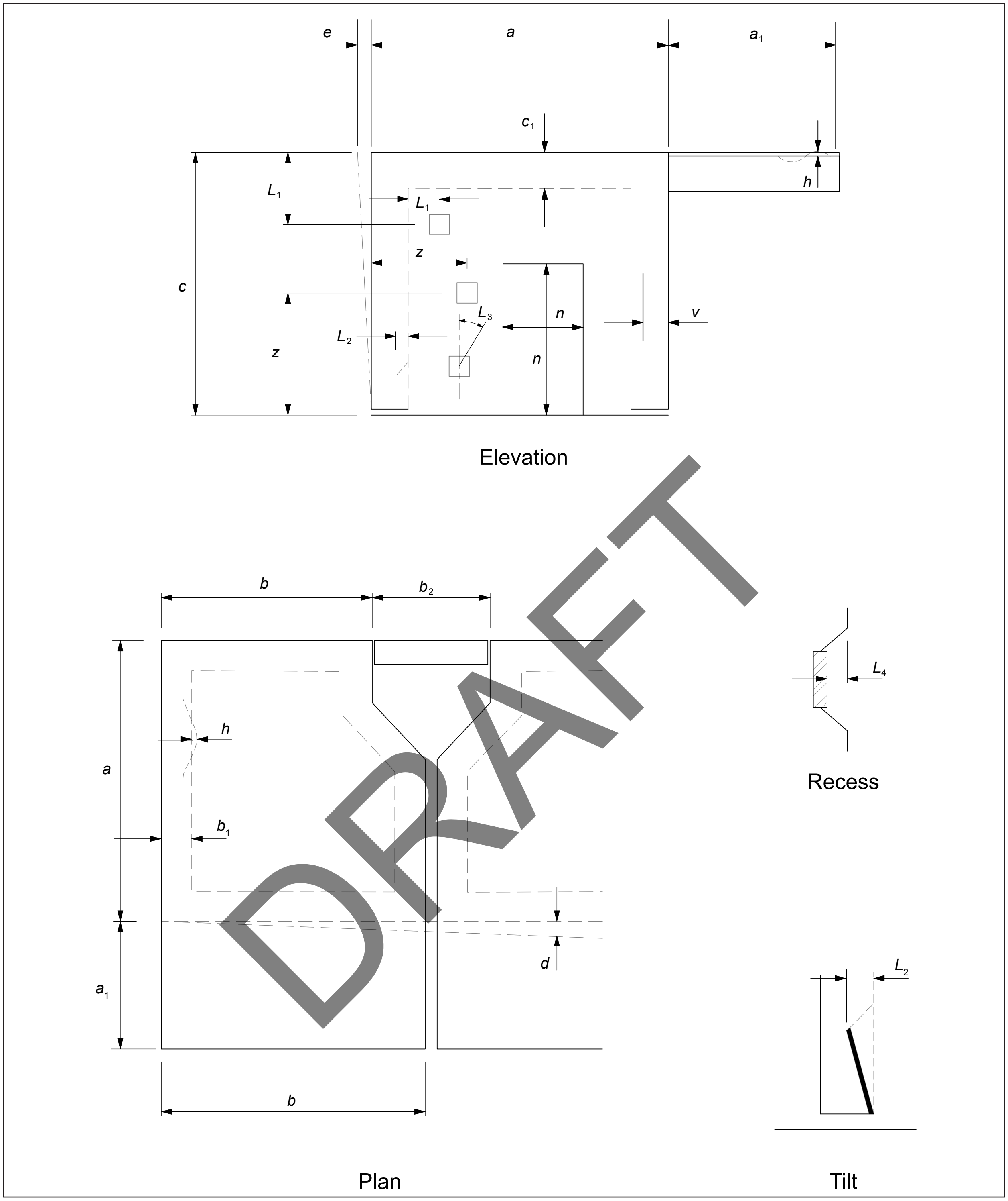

Figure 4.3.18. Modular room unit.

4.3.18 Production for precast concrete modular room units (Fig. 4.3.18) shall be:

a = Length . . . . ±⅜ in. (±10 mm)

a_1 = Length of balcony extension . . . . ±¼ in. (±6 mm)

b = Width (overall):

Single unit . . . ±¼ in. (±6 mm)

Multiple units . . . ±½ in. (±13 mm)

b_1 = Wall thickness . . . +¼ in., –0 in. (+6 mm, –0 mm)

b_2 = Width of the opening for the closure panel . . . +0 in., –½ in. (+0 mm, –13 mm)

c = Depth (overall) . . . ±¼ in. (±6 mm)

c_1 = Slab thickness . . . ±¼ in. (±6 mm)

d = Variation from specified plan view end squareness or skew . . . ±¼ in. (±6 mm)

e = Variation from specified elevation end squareness or skew . . . ±⅛ in. (±3 mm)

h = Local smoothness of any surface . . . ¼ in. per 10 ft (6 mm per 3 m)

L_1 = Location of embedment . . . ±½ in. (±13 mm)

L_2 = Tipping and flushness of embedment . . . ±⅛ in. (±3 mm)

L_3 = Angular rotation of embedment or blockout
. . . ¼ in. (6 mm) maximum measured at perimeter of embedment or blockout

L_4 = Depth of recess to embedment . . . +¼ in., –⅛ in. (+6 mm, –3mm)

n = Size of blockout for door or window . . . ±⅛ in. (±3 mm)

z = Location of electrical boxes . . . ±1 in. (±25 mm)

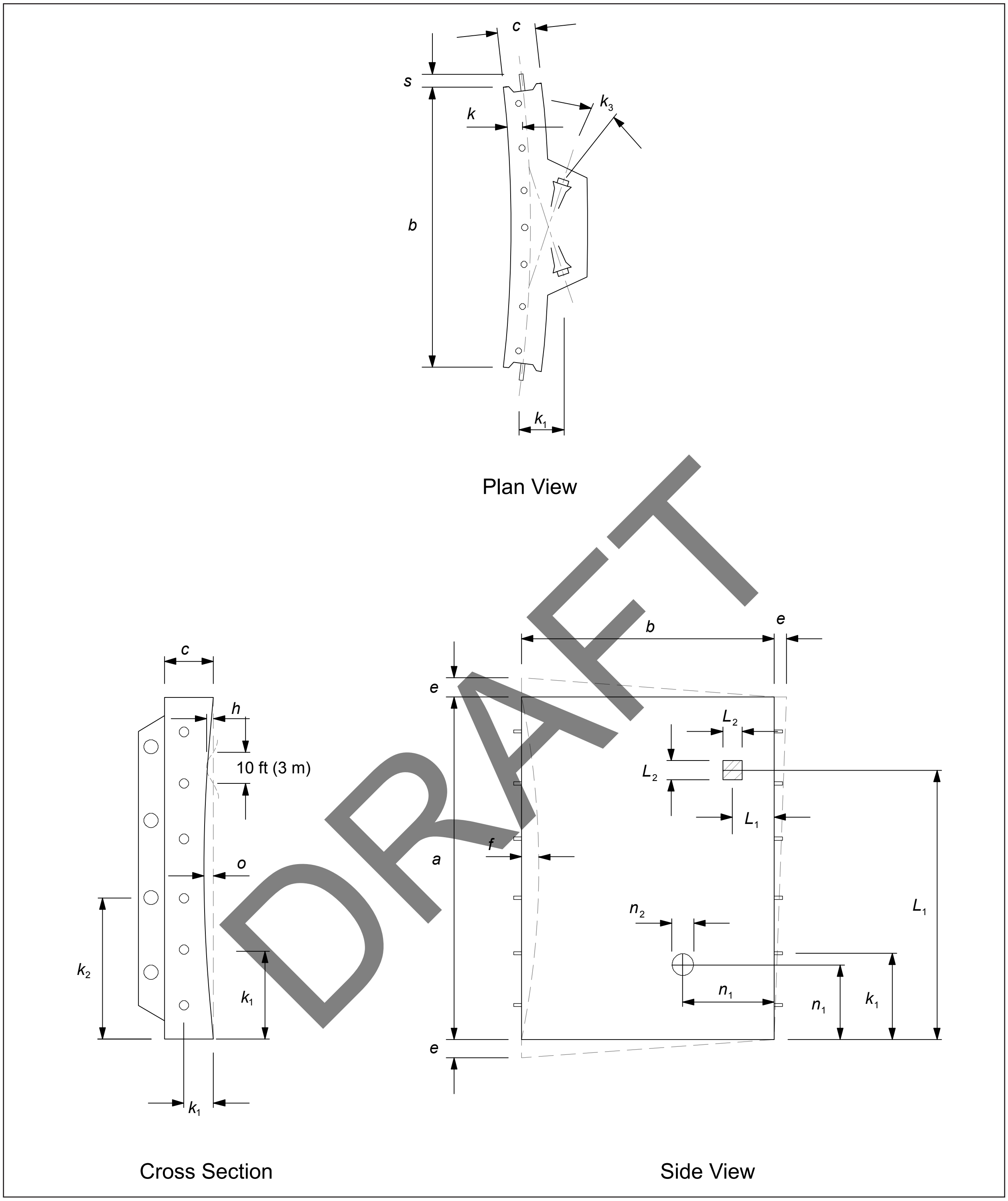

Figure 4.3.19. Panel for storage tank.

4.3.19 Production tolerances for precast concrete panels for storage tanks (Fig. 4.3.19) shall be:

a = Length . . . . ±¼ in. (±6 mm)

b = Width (overall). . . . . ±¼ in. (±6 mm)

c = Depth (overall) . . . . +¼ in., –⅛ in. (+6 mm, –3 mm)

e = Variation from specified elevation end squareness or skew
. . . . ±⅛ in. per 6 ft length; ±¼ in. maximum (±3 mm per 1.8 m length; ±6 mm maximum)

f = Sweep. . . . . ±⅜ in. (±10 mm)

h = Local smoothness:

Horizontal surface . . . . ⅛ in. per 10 ft (3 mm per 3 m)

Vertical surface . . . . ¼ in. per 10 ft (6 mm per 3 m)

i = Bowing, (Fig. C1.2.1) . . . . ±Length (in.)/360; (Length(0.3 m)/360); 1 in. (25 mm) maximum

i_1 = Differential bowing between adjacent panels of the same design . . . . ⅜ in. (10 mm)

k = Location of strand . . . . ±¼ in. (±6 mm)

k_1 = Location of post-tensioning duct . . . . ±⅛ in. (±3 mm)

k_2 = Location of post-tensioning anchor . . . . ±¼ in. (±6 mm)

k_3 = Angular rotation of post-tensioning anchor from specified alignment . . . . ±5 degrees

L_1 = Location of embedment . . . . ±¾ in. (±19 mm)

L_2 = Size of embedment . . . . ±⅛ in. (±3 mm)

n_1 = Location of blockout. . . . . ±¾ in. (±19 mm)

n_2 = Size of blockouts . . . . ±¼ in. (±6 mm)

s = Projection of post-tensioning duct . . . . ±½ in. (±13 mm)

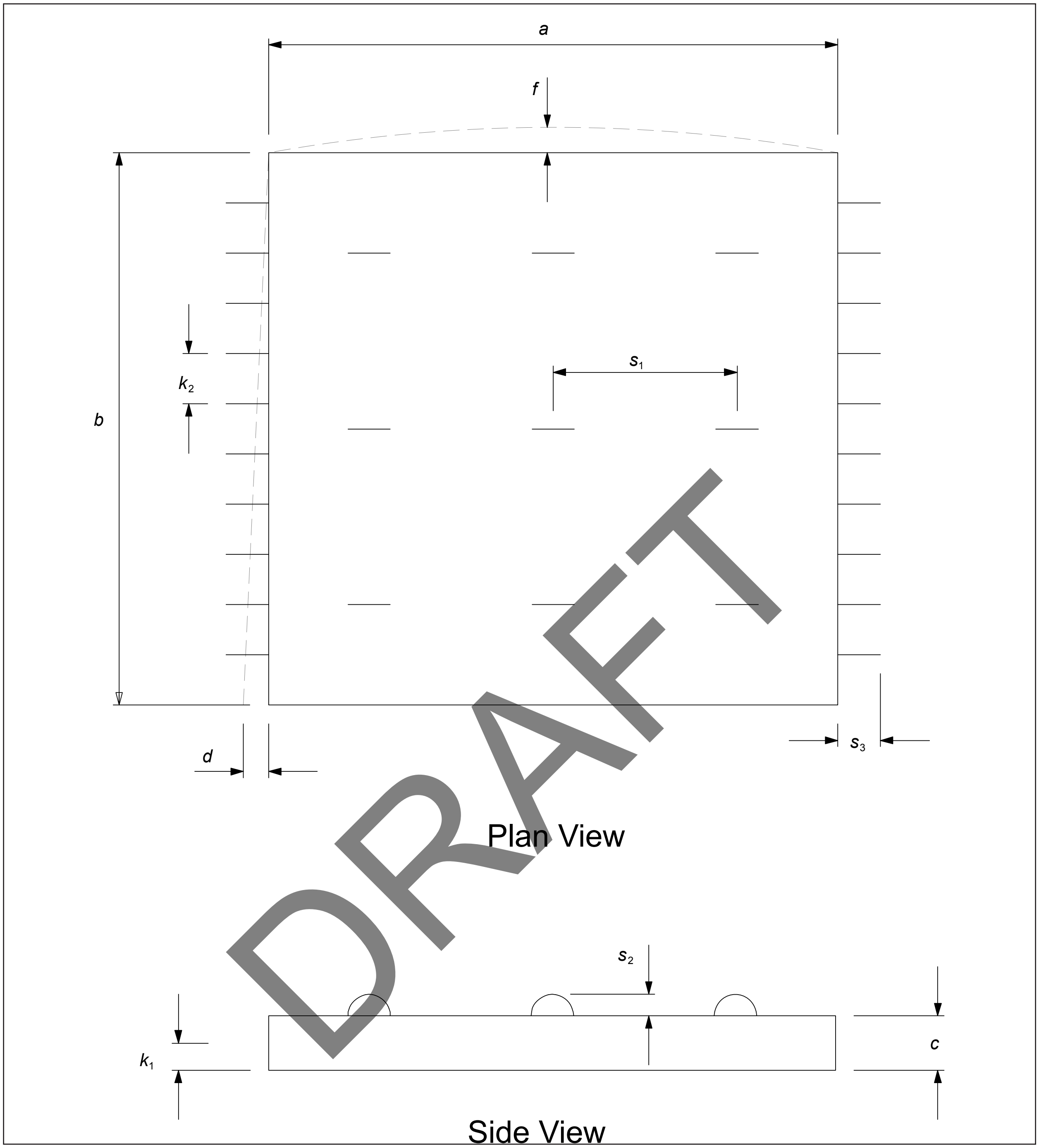

Figure 4.3.20. Bridge deck unit.

4.3.20 Production tolerances for precast concrete bridge deck units (Fig. 4.3.20) shall be:

a = Length . . . . ±¼ in. (±6 mm)

b = Width . . . . ±¼ in. (±6 mm)

c = Depth . . . . +¼ in., –⅛ in. (+6 mm, –3 mm)

d = Variation from specified plan view end squareness or skew . . . . ±¼ in. (±6 mm)

f = Sweep . . . . ±⅛ in. (±3 mm)

k_1 = Location of strand perpendicular to plane of panel . . . . ±⅛ in. (±3 mm)

k_2 = Location of strand parallel to plane of panel . . . . ±¼ in. (±6 mm)

s_1 = Longitudinal spacing of stirrups . . . . ±1 in. (±25 mm)

s_2 = Stirrup projection from surface . . . . ±½ in. (±13 mm)

s_3 = Strand projection from end . . . . ±½ in. (±13 mm)

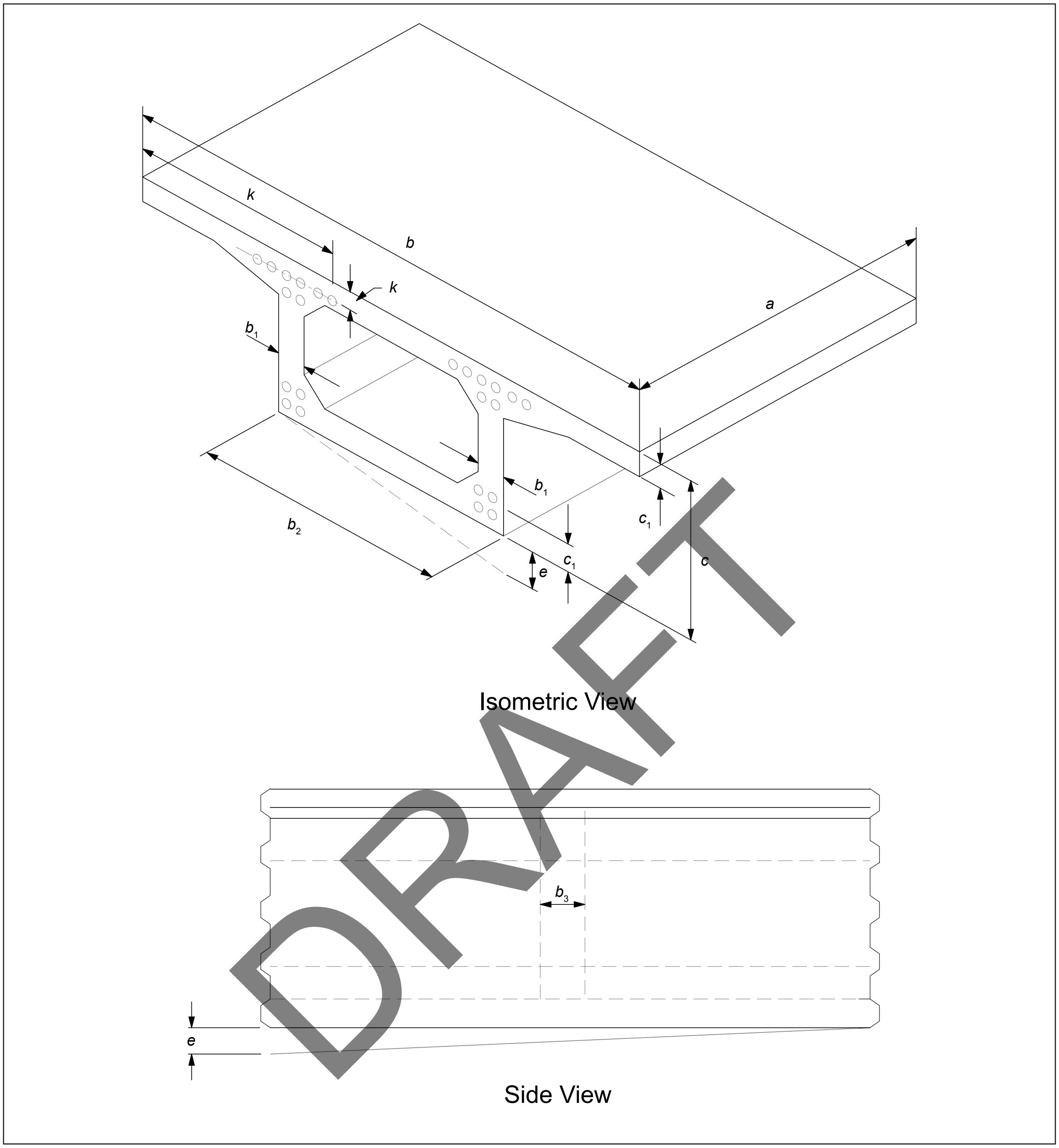

Figure 4.3.21. Segmental box girder.

4.3.21 Production tolerances for precast concrete segmental box girders (Fig. 4.3.21) shall be:

a = Length . . ±⅛ in. per 12 in. length; ±1 in. maximum (±3 mm per 1 meter length; ±25 mm maximum)

b = Width (overall)
. . . . . . ±1/16 in. per 12 in. length; ±¾in. maximum (±2mm per 300 mm length; ±19mm maximum)

b_1 = Web width. . . . . ±⅜ in. (±10 mm)

b_2 = Bottom flange width
. . . . . ±1/16 in. per 12 in. length; ±½ in. maximum (±2 mm per 1 meter length; ±13 mm maximum)

b_3 = Diaphragm thickness . . . . ±½ in. (±13 mm)

c = Depth (overall) . . . . ±¼ in. (±6 mm)

c_1 = Depth of top and bottom slabs . . . . ±⅜ in. (±10 mm)

e = Grade of form edge and soffit (vertical curve and superelevation) . . . . ±⅛ in. per 10 ft (±3 mm per 3 m)

k = Location of post-tensioning duct . . . . ±⅛ in. (±3 mm)

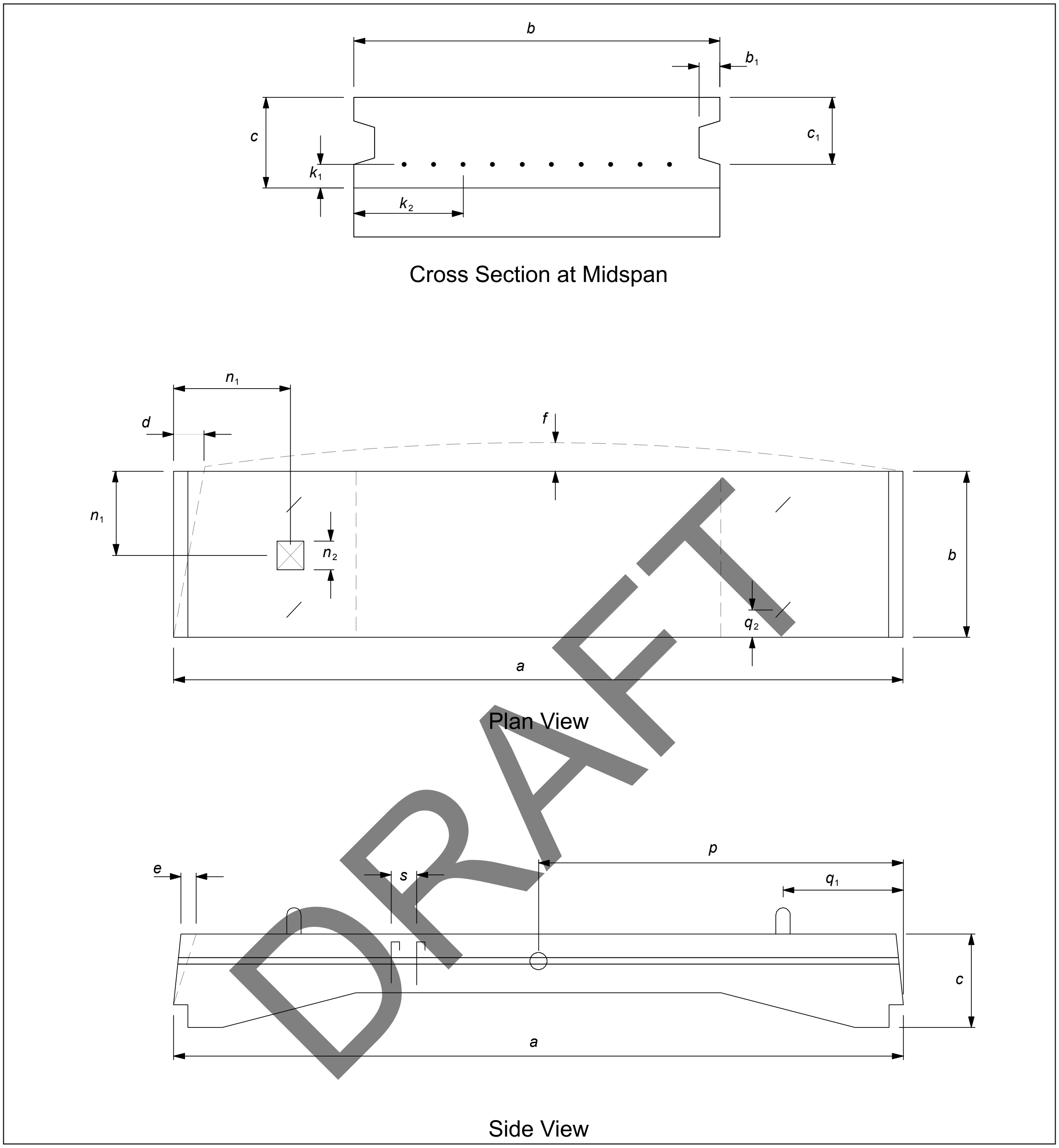

Figure 4.3.22. Pier deck unit.

4.3.22 Production tolerances for precast concrete pier deck units (Fig. 4.3.22) shall be:

a = Length . . . . ±½ in. (±13 mm)

b = Width . . . . ±¼ in. (±6 mm)

b_1 = Shear key depth . . . . ±¼ in (±6 mm)

c = Depth . . . . ±¼ in. (±6 mm)

c_1 = Shear key height . . . . ±¼ in. (±6 mm)

d = Variation from specified plan view end squareness or skew . . . . ±½ in. (±13 mm)

e = Variation from specified elevation end squareness or skew . . . . ±½ in. (±13 mm)

f = Sweep. . . . . ±⅛ in. per 10 ft (±3 mm per 3 m)

g = Differential camber between units of the same design and length. . . . ¼ in. per 10 ft (6 mm per 3 m)

k_1 = Location of strand perpendicular to plane of panel . . . . ±¼ in. (±6 mm)

k_2 = Location of strand parallel to plane of panel . . . . ±1 in. (±25 mm)

n_1 = Location of blockout. . . . . ±1 in. (±25 mm)

n_2 = Size of blockouts . . . . ±1 in. (±25 mm)

p = Location of inserts . . . . ±1 in. (±25 mm)

q_1 = Location of handling device parallel to length of component . . . . ±6 in. (±150 mm)

q_2 = Location of handling device transverse to length of component . . . . ±1 in. (±25 mm)

s = Longitudinal spacing of stirrups . . . . ±1 in. (±25 mm)

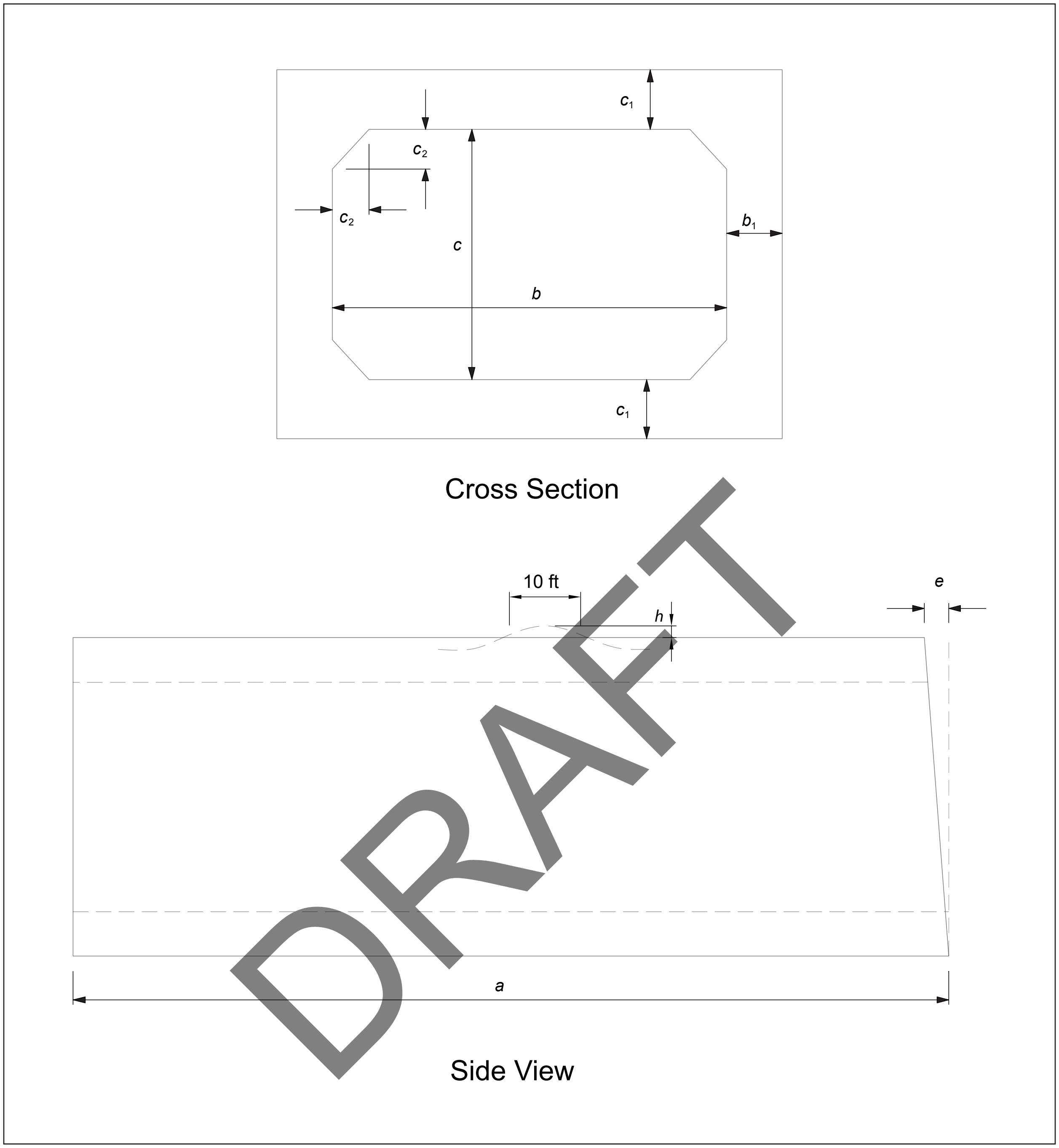

Figure 4.3.23. Box culvert.

4.3.23 Production tolerances for precast concrete box culverts (Fig. 4.3.23) shall be:

a = Length . . . . +1 in., –½ in. (+25 mm, –13 mm)

b = Span:

≤48 in. (≤1200 mm). . . . . ±½ in. (±13 mm)

>48 in. to 96 in. (>1200 mm to 2400 mm) . . . . ±¾ in. (±19 mm)

>96 in. (>2400 m) . . . . ±1 in. (±25 mm)

b_1 = Thickness of walls . . . . +1 in., –$\frac{3}{16}$ in. (+25 mm, –5 mm)

c = Rise:

≤48 in. (≤1200 mm). . . . . ±½ in. (±13 mm)

>48 in. to 96 in. (>1200 mm to 2400 mm) . . . . ±¾ in. (±19 mm)

>96 in. (>2400 mm) . . . . ±1 in. (±25 mm)

c_1 = Slab thickness . . . . +1 in., –$\frac{3}{16}$ in. (+25 mm, –5 mm)

c_2 = Chamfer dimension . . . . ±¼ in. (±6 mm)

e = Variation in length of opposite surfaces:

Per 12 in. (300 mm) of internal span . . . . ±⅛ in. (±3 mm)

Span ≤84 in. (≤2100 mm) . . . . ±⅝ in. (±16 mm)

Span >84 in. (>2100 mm) . . . . ±¾ in. (±19 mm)

h = Local smoothness of any surface . . . . ¼ in. per 10 ft (6 mm per 3 m)

ASTM C1433-20e1 *Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers* shall be used for reinforcement placement tolerances.

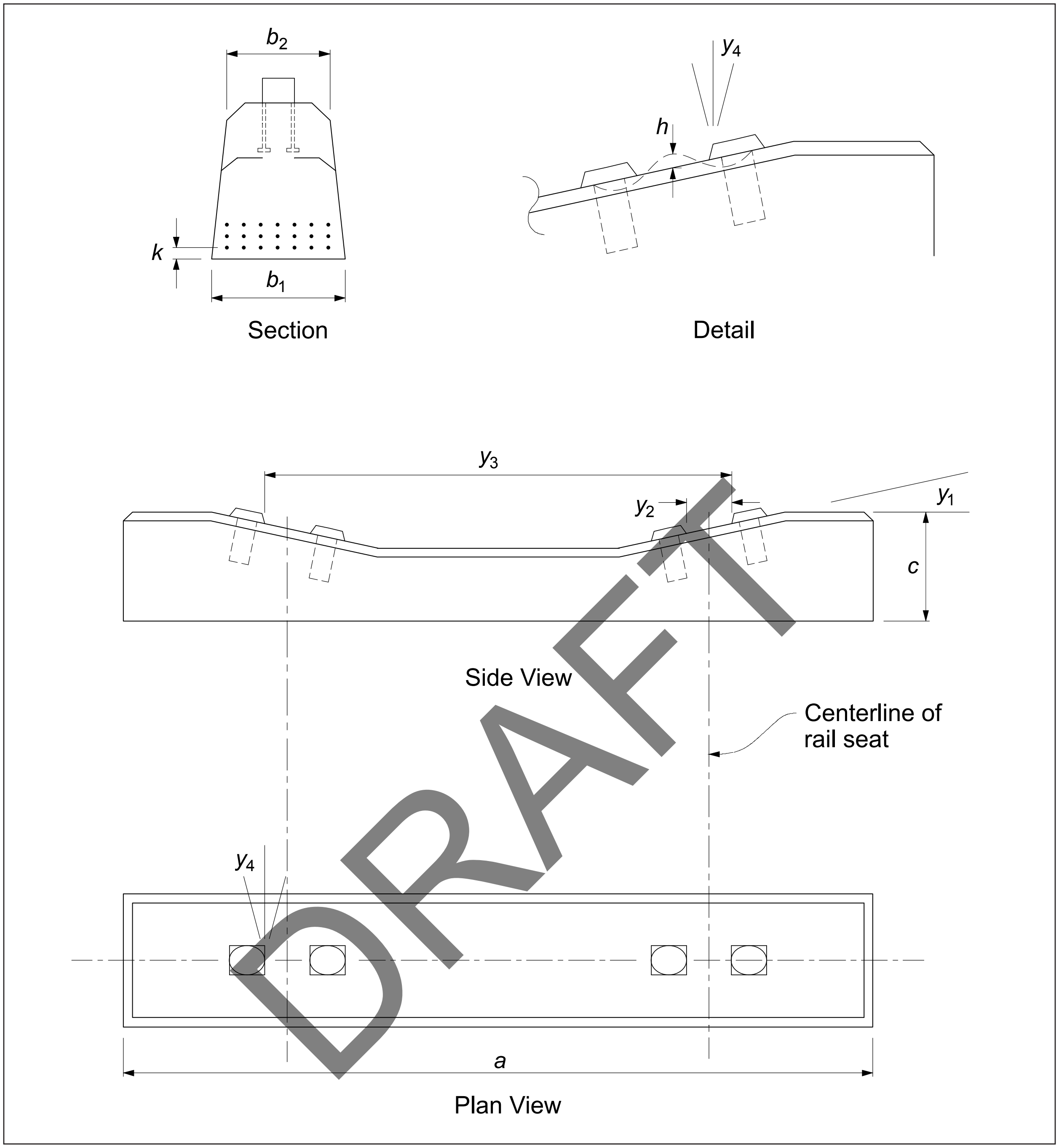

Figure 4.3.24. Railroad tie.

4.3.24 Production tolerances for precast concrete railroad ties (Fig. 4.3.24) shall be:

a = Length . . . . ±¼ in. up to 108 in. length (±6 mm up to 2700 mm length)

b_1 = Width at bottom . . . . ±⅛ in. (±3 mm)

b_2 = Width at top . . . . ±⅛ in. (±3 mm)

c = Depth . . . . ±3⁄16 in. up to 10 in. depth (±5 mm up to 250 mm depth)

h = Local smoothness . . . . . . 1⁄32 in. per 6 in.^{2} area of rail seat (1 mm per 3870 mm^2 area of rail seat)

k = Location of strand or wire . . . . ±⅛ in. (±3 mm)

y_1 = Rail seat slope . . . . ±5 degrees

y_2 = Spacing between adjacent inserts for rail attachment
. . . .+1⁄16 in., –0 in. up to 7 in. spacing (+2 mm, –0 mm up to 180 mm spacing)

y_3* = Spacing between inserts for setting track gauge
. . . .±0.08 in. up to 70 in. spacing (±2 mm up to 1800 mm spacing)

y_4 = Shoulder tilt, vertical or horizontal . . . . ±2 degrees

*The spacing of shoulder inserts shall be verified by the fastener manufacturer.
Note: Chapter 30 of the AREMA *Manual for Railway Engineering* shall be used in cases where the railroad ties exceed the dimensions listed herein.

4.4 Glass-fiber-reinforced concrete. GFRC panels shall conform to production tolerances listed in Section 4.4.1. GFRC panel frame turns shall be fabricated within the tolerances listed in Section 4.4.2.

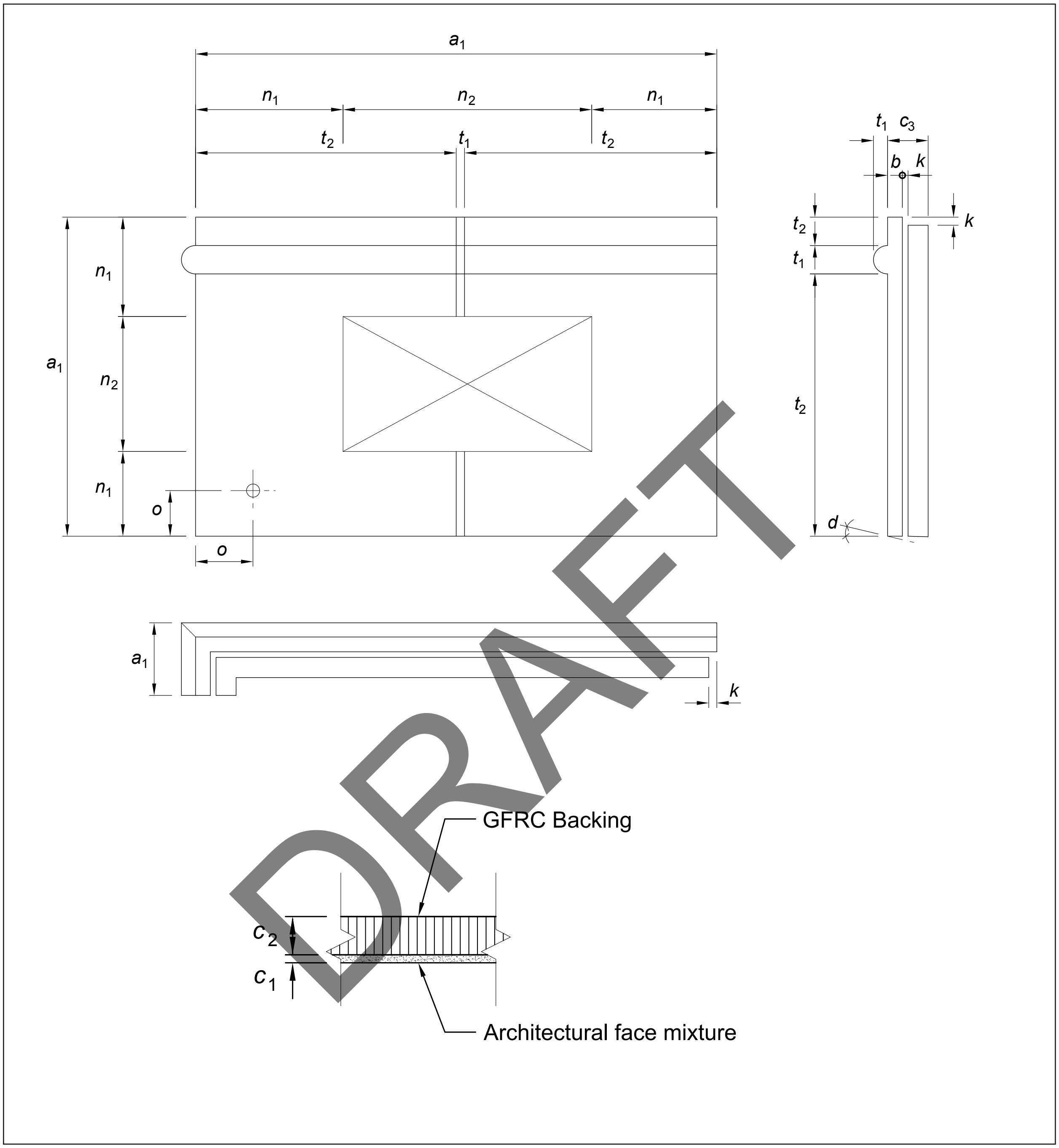

Figure 4.4.1. Glass-fiber-reinforced concrete (GFRC) panel.

4.4.1 Production tolerances for glass-fiber-reinforced concrete (GFRC) panels shall be:

a_1 = Overall height and width of unit measured at the face exposed to view:

≤10 ft (≤3 m) . . . . $\pm\frac{1}{8}$ in. (±3 mm)

>10 to 20 ft (>3 to 6 m). . . . . $\pm\frac{3}{16}$ in. (±5 mm)

>20 ft (>6 m) . . . . ±¼ in. (±6 mm)

Edge return . . . . +½ in., –0 in. (+13 mm, -0 mm)

c_1 = Architectural face mixture thickness . . . . +⅛ in., –0 in. (+3 mm, –0 mm)

c_2 = Glass-fiber-reinforced concrete backing thickness . . . . +¼ in., –0 in. (+6 mm, –0 mm)

c_3 = Depth from face of skin to back of panel frame of integral rib
. . . . +⅜ in., –¼ in., (+10 mm, –6 mm)

d = Angular variation of plane of side mold
. . . . The greater of ±1/32 in. per 3 in. (1 mm per 75 mm) depth *or* ±1/16 in. (±2 mm)

e = Variation from square or designated skew
. . . . greater of ±⅛ in. per 6 ft (±3 mm per 2 m) *or* ±¼ in. (±6 mm) total

h = Local smoothness, exposed surfaces . . . . ¼ in. per 10 ft (6 mm per 3 m)

i = Bowing . . . . Shall not exceed L (in.)/240

j = Warping (Fig. C.1.2.3)
Maximum permissible warpage of one corner out of the plane of the other three shall be 1/16 in. per 1 ft (2 mm per 0.3 m) of distance from the nearest adjacent corner.

k = Location of panel frame . . . . ±¼ in. (±6 mm)

n_1 = Location of window opening within panel . . . . ±¼ in. (±6 mm)

n_2 = Length and width of blockouts and openings within one unit . . . . ±¼ in. (±6 mm)

o = Location of sleeves, hose bibs, electrical boxes, and other nonstructural embeds
. . . . ±⅜ in. (±10 mm)

p = Location of connection devices . . . . ±½ in. (±13 mm)

q_2 = Location of handling devices . . . . ±3 in. (±75 mm)

r_1 = Location of bearing devices . . . . ±¼ in. (±6 mm)

t_1 = Dimensions of architectural features and rustication joints . . . . ±⅛ in. (±3 mm)

t_2 = Location of architectural features and rustication joints . . . . ±⅛ in. (±3 mm)

w_1 = Location of flashing reglets . . . . ±¼ in. (±6 mm)

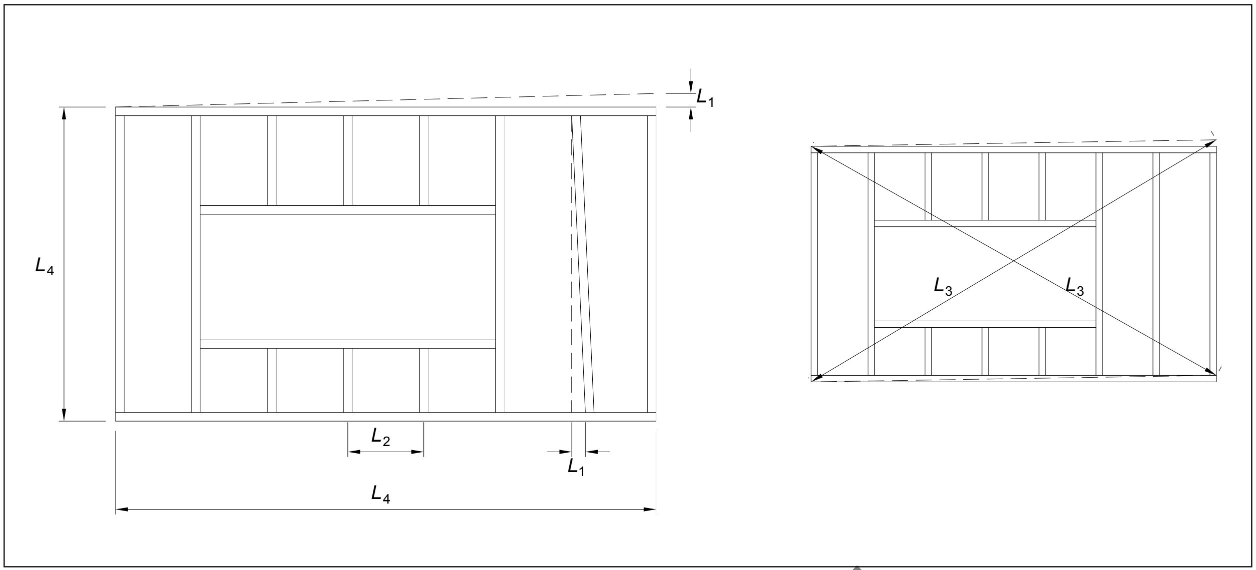

Figure 4.4.2. Glass-fiber-reinforced concrete (GFRC) panel frame.

4.4.2 Production tolerances for glass-fiber-reinforced concrete (GFRC) panel frames shall be:

L_1 = Vertical and horizontal alignment . . . . ¼ in. per 10 ft (6 mm per 3 m)

L_2 = Spacing of framing components . . . . ±⅜ in. (±10 mm)

L_3 = Squareness of frame . . . . ±⅜ in. (±10 mm)

L_4 = Overall size of frame . . . . ±⅜ in. (±10 mm)

Chapter 5—Erection Tolerances

5.1 General. Erection tolerances for precast concrete components shall conform to the tolerance requirements of Section 5.3, unless more stringent tolerances are listed within the contract documents. Connection and bearing tolerances shall conform to Section 5.4.

5.1.1 Tolerance discrepancies found during erection or after placement shall be resolved in accordance with Sections 2.2.2 and 2.2.3.

5.2 Requirements.

5.2.1 Prior to the start of erection, (a) through (c) shall be completed:

(a) Benchmarks shall be clearly marked, accessible, and remain undisturbed until completion of the project.

(b) The primary control surface shall be identified.

(c) The location of interfacing materials shall be verified.

5.2.2 Tolerances between the precast concrete component and items (a) through (d) shall be monitored and maintained as applicable:

(a) Adjacent precast concrete component

(b) Cast-in-place concrete or masonry

(c) Steel construction

(d) Preexisting structures

5.3 Erection tolerances for precast concrete components. Unless more-stringent tolerances are listed within the contract documents, precast concrete components shall conform to erection tolerances listed in Sections 5.3.1 through 5.3.13.

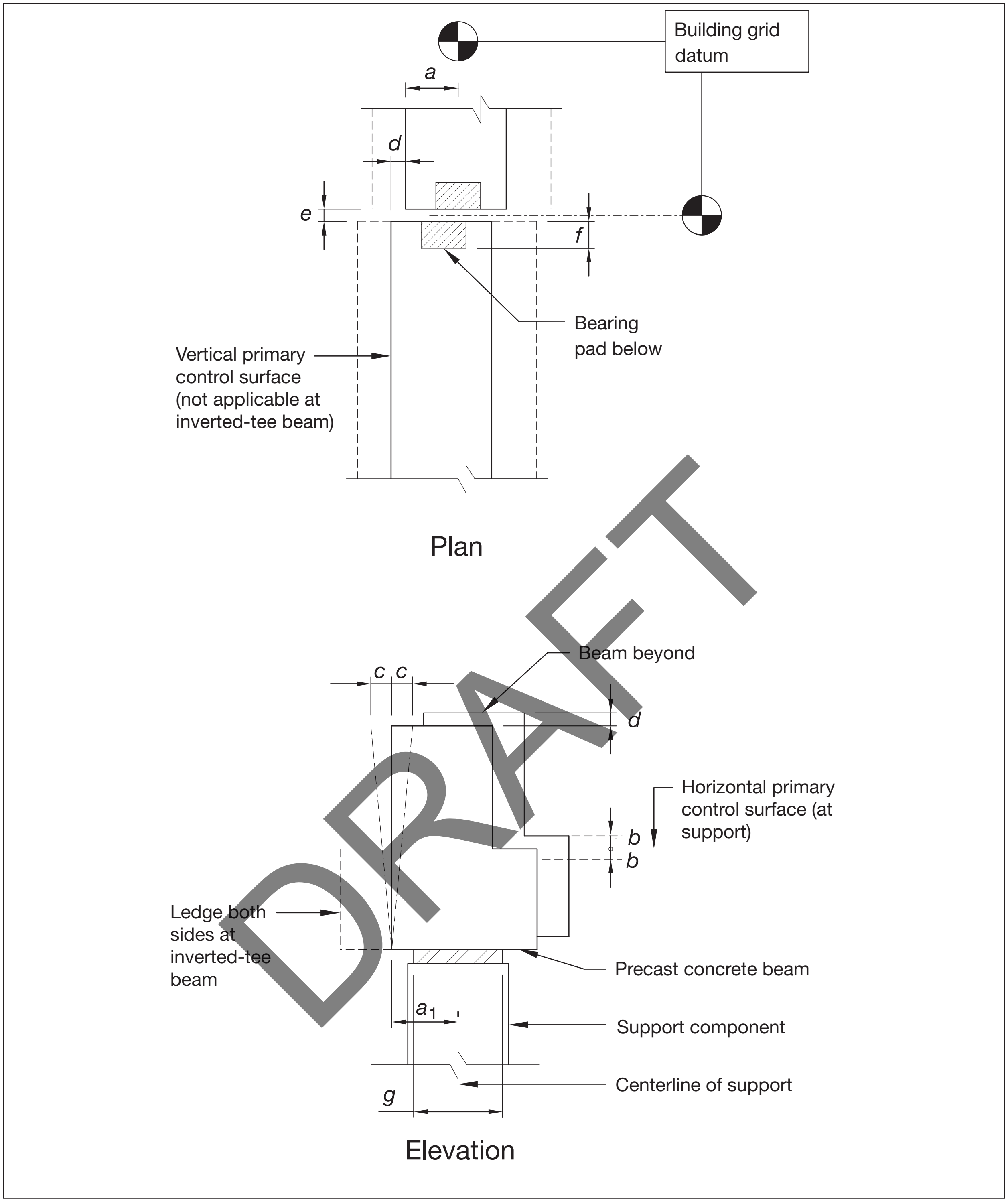

Figure 5.3.1. Beam erection tolerances.

5.3.1 Precast concrete beam erection tolerances (Fig. 5.3.1) shall be:

a = Plan location from building grid datum . . . . ±1 in. (±25 mm)

a_1* = Plan location from centerline of support . . . . ±1 in. (±25 mm)

b = Bearing elevation† from nominal elevation at support:

Maximum low .... ½ in. (13 mm)

Maximum high .... ¼ in. (6 mm)

c = Maximum plumb variation over height of component:

Per 12 in. (300 mm) height .... ⅛ in. (3 mm)

Maximum at rectangular or L beam .... ½ in. (13 mm)

Maximum at inverted tee beam .... ¾ in. (19 mm)

d = Maximum jog in alignment of matching edges:

Architectural exposed edges .... ¼ in. (6 mm)

Visually noncritical edges .... ½ in. (13 mm)

e = Joint width:

Architectural exposed joints .... ±¼ in. (±6 mm)

Hidden joints .... ±¾ in. (±19 mm)

Exposed structural joint, not visually critical .... ±½ in. (13 mm)

f ‡ = Bearing length (span direction) .... ±¾ in. (±19 mm)

g ‡ = Bearing width .... ±½ in. (±13 mm)

Note: Bearing pads adjacent to unarmored faces shall be set back from the face of the support or chamfered face, and from the end of the supported component, a distance >½ in. (13 mm) or the dimension of the chamfered face.

*Where precast concrete components bear on a steel frame, a_1 shall control.
†Or component top elevation where component is part of a frame without bearing ledges.
‡This is a setting tolerance and shall not take precedence over the structural performance requirement set by the architect or structural engineer of record. The nominal bearing dimensions and the allowable variations in the bearing length and width shall be specified by the specialty structural engineer and shown on the erection drawings.

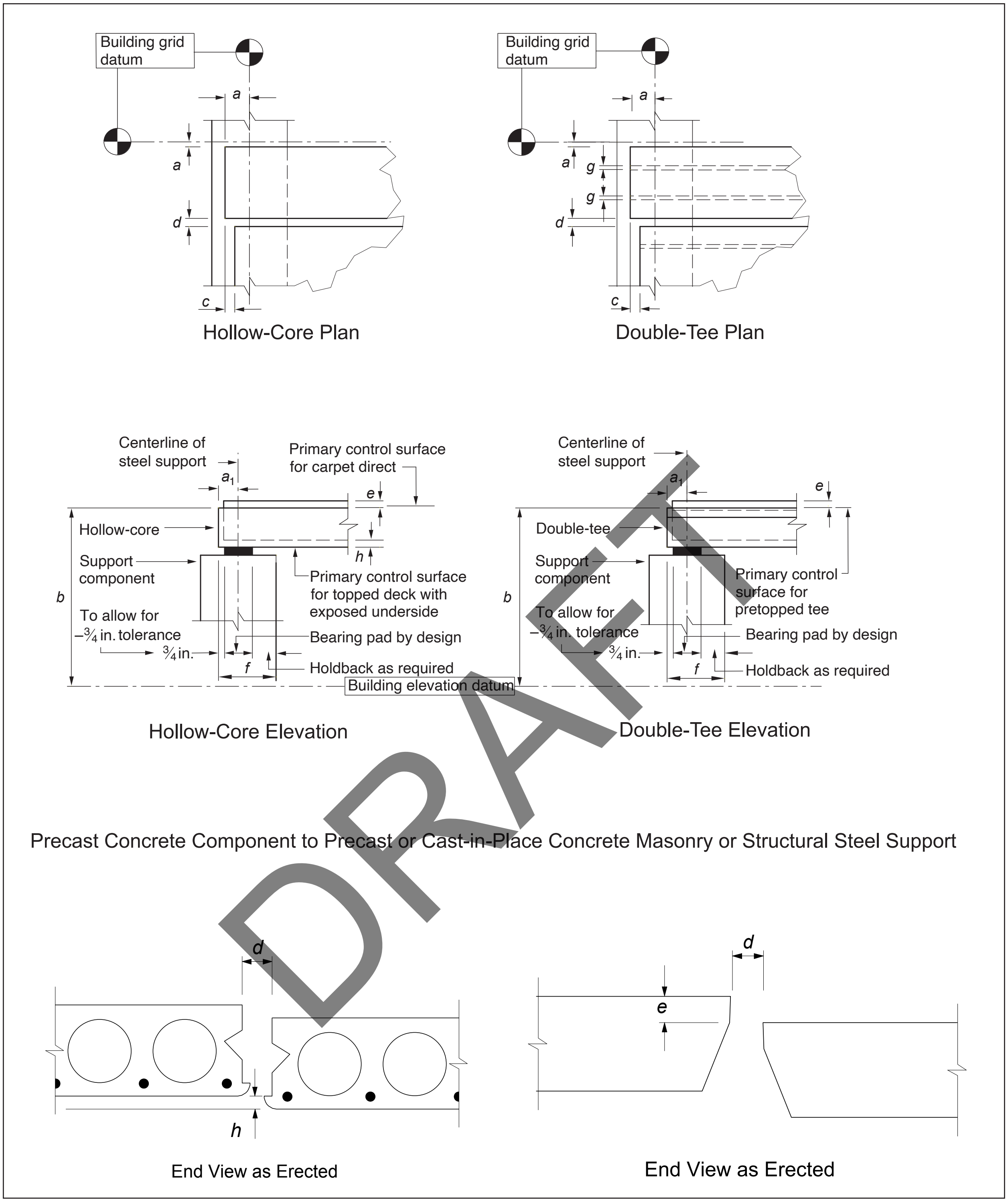

Figure 5.3.2. Floor and roof component erection tolerances.
Note: 1 in. = 25 mm.

5.3.2 Precast concrete floor and roof component erection tolerances (Fig. 5.3.2.) shall be:

a = Plan location from building grid datum . . . . ±1 in. (±25 mm)

a_1* = Plan location from centerline of support . . . . ±1 in. (±25 mm)

b = Top elevation from building elevation datum at component ends:

Covered with topping . . . ±¾ in. (±19 mm)

Pretopped tee/carpet direct hollow core . . . ±¼ in. (±6 mm)

Untopped roof . . . ±¾ in. (±19 mm)

c = Maximum offset in alignment of matching edges (both topped and untopped construction) . . . 1 in. (25 mm)

d = Joint width:

Component ≤40 ft (≤12 m). . . . ±½ in. (±13 mm)

Component >40 to 60 ft (>12 to 18 m) . . . ±¾ in. (±19 mm)

Component >60 ft (>18 m) . . . ±1 in. (±25 mm)

e = Differential top elevation as erected (for units of same design and length):

Field topped . . . ¾ in. (19 mm)

Pretopped tees at driving surfaces . . . ¼ in. (6 mm)

Carpet direct hollow core . . . ¼ in. (6 mm)

Untopped roof . . . ¾ in. (19 mm)

Pretopped double tees (roof subsurface) . . . ¾ in. (19 mm)

f [†] = Bearing length (span direction) . . . ±¾ in. (±19 mm)

g [†] = Bearing width (excluding hollow core) . . . ±½ in. (±13 mm)

h [‡] = Differential bottom elevation of exposed hollow-core slabs . . . ¼ in. (6 mm)

Note: Bearing pads used at unarmored edges shall be set back a minimum of ½ in. (13 mm) from the face of the support or the dimension of the chamfered edge.

*Where precast concrete components bear on a steel frame, a_1 shall control.
[†]The nominal bearing dimensions and the allowable variations in the bearing length and width shall be specified by the specialty structural engineer and shown on the precast concrete erection drawings.
[‡]Dimension *h* shall control only when both tolerances for *h* and *e* apply.

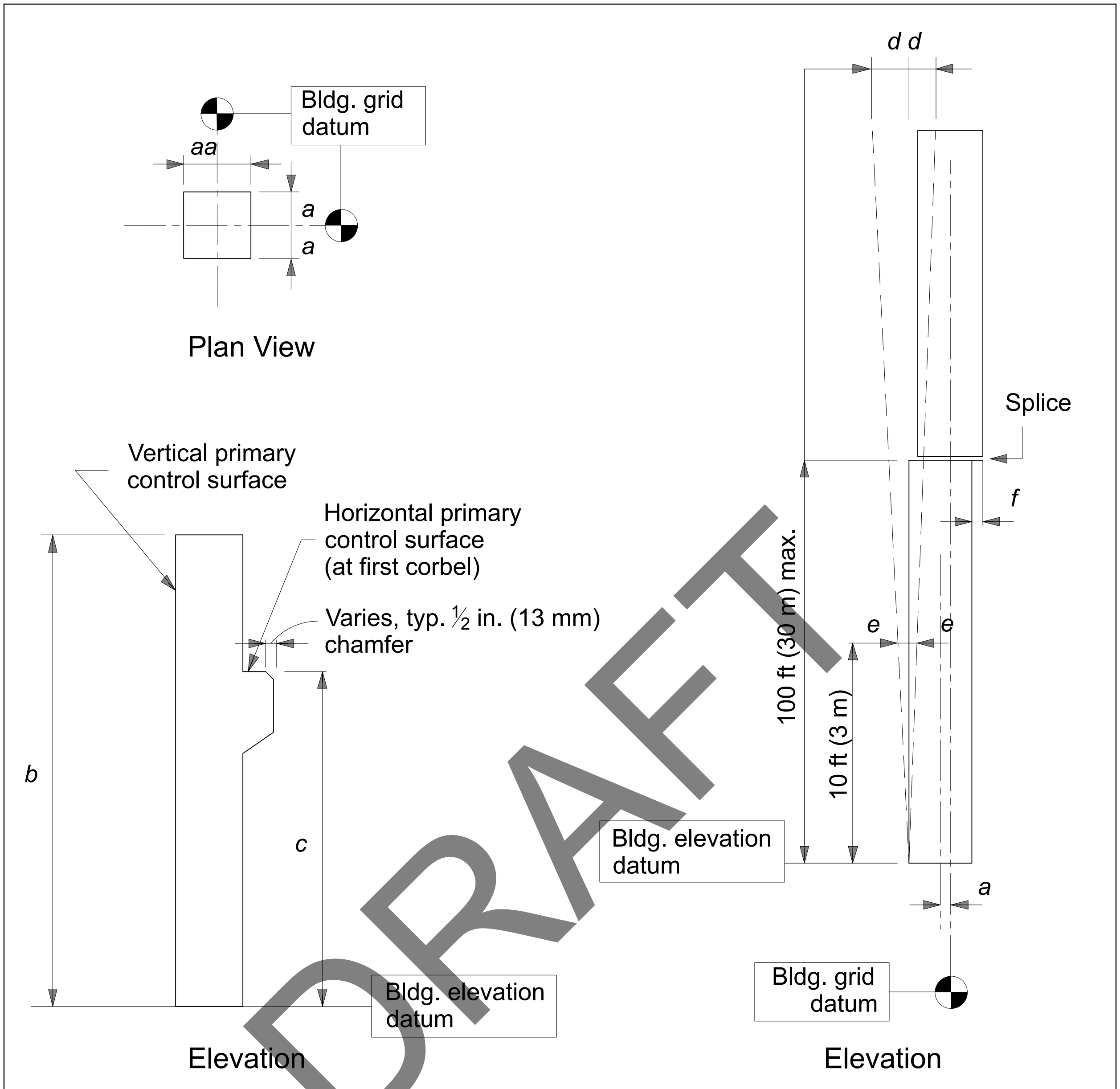

Figure 5.3.3. Column erection tolerances.

5.3.3 Precast concrete column erection tolerances (Fig. 5.3.3) shall be:

a = Plan location from building grid datum:

Structural applications . . . . ±½ in. (±13 mm)

Architectural applications . . . . ±⅜ in. (±10 mm)

b = Top elevation from nominal top elevation:

Maximum low . . . . ½ in. (13 mm)

Maximum high . . . . ¼ in. (6 mm)

c = Bearing haunch elevation from nominal elevation:

Maximum low . . . . ½ in. (13 mm)

Maximum high . . . . ¼ in. (6 mm)

d = Maximum plumb variation over height of component:

Component in structure with height ≤100 ft (≤30 m) . . . . 1 in. (25 mm)

Component in structure with height >100 ft (>30 m) . . . . ⅛ in. per 10 ft; 2 in. maximum (3 mm per 3 m; 50 mm maximum)

e = Plumb in any 10 ft (3 m) of component height . . . . ¼ in. (6 mm)

f = Maximum jog in alignment of matching edges:

Architectural exposed edges . . . . ¼ in. (6 mm)

Visually noncritical edges . . . . ½ in. (13 mm)

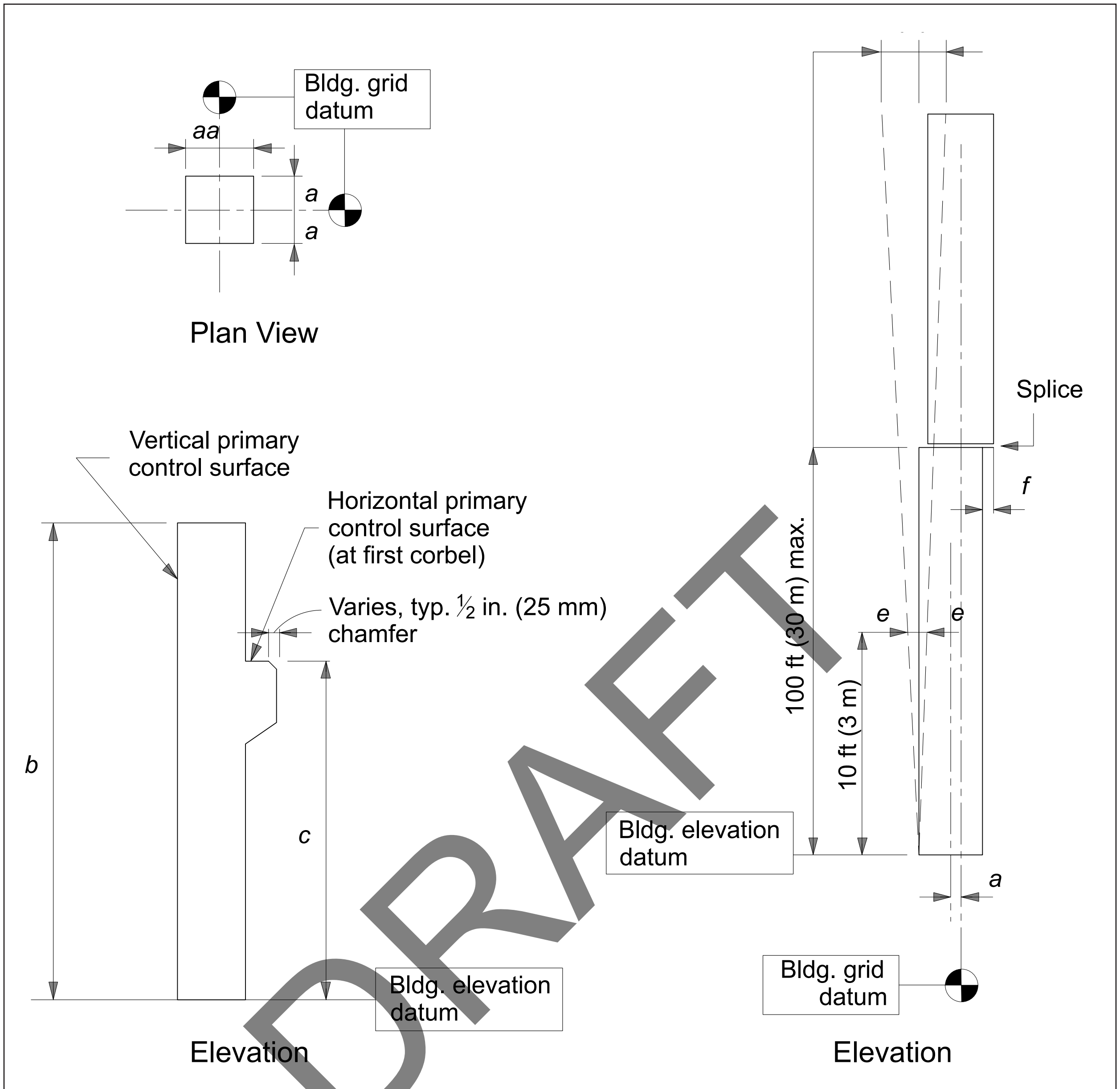

Figure 5.3.4. Architectural wall panel or spandrel erection tolerances.

5.3.4 Architectural precast concrete wall panel or spandrel erection tolerances (Fig. 5.3.4) shall be:

a = Plan location from building grid datum . . . . ±½ in. (±13 mm)

a_1* = Plan location from centerline of support . . . . ±½ in. (±13 mm)

b = Top elevation from nominal top elevation:

Exposed individual panel . . . . ±¼ in. (±6 mm)

Nonexposed individual panel . . . . ±½ in. (±13 mm)

c = Support elevation from nominal elevation:

Maximum low . . . . ½ in. (13 mm)

Maximum high . . . . ¼ in. (6 mm)

d = Maximum plumb variation over height of structure:

Structure height ≤100 ft (≤30 m). . . . . 1 in. (25 mm)

Structure height >100 ft (>30 m)
. . . . ⅛ in. per 10 ft; 2 in. maximum (3 mm per 3 m; 50 mm maximum)

e = Plumb in any 10 ft (3 m) of component height . . . . ¼ in. (6 mm)

f = Maximum jog in alignment of matching edges:

Exposed relative to adjacent panel . . . . ¼ in. (6 mm)

Nonexposed relative to adjacent panel . . . . ½ in. (13 mm)

g = Joint width (governs over joint taper) . . . .±¼ in. (±6 mm)

h = Joint taper over length of panel maximum . . . . ⅜ in. (10 mm)

h_{10} = Joint taper over 10 ft (3 m) length . . . . ¼ in. (6 mm)

i = Maximum jog in alignment of matching faces . . . . ¼ in. (6 mm)

j = Differential bowing or camber as erected between adjacent components of the same design:

Exposed relative to adjacent panel . . . . +¼ in. (+6 mm)

Nonexposed relative to adjacent panel . . . . ±½ in. (±13 mm)

k = Opening height between spandrels . . . . ±¼ in. (±6 mm)

*Where precast concrete components bear on a steel frame, a_1 shall control.

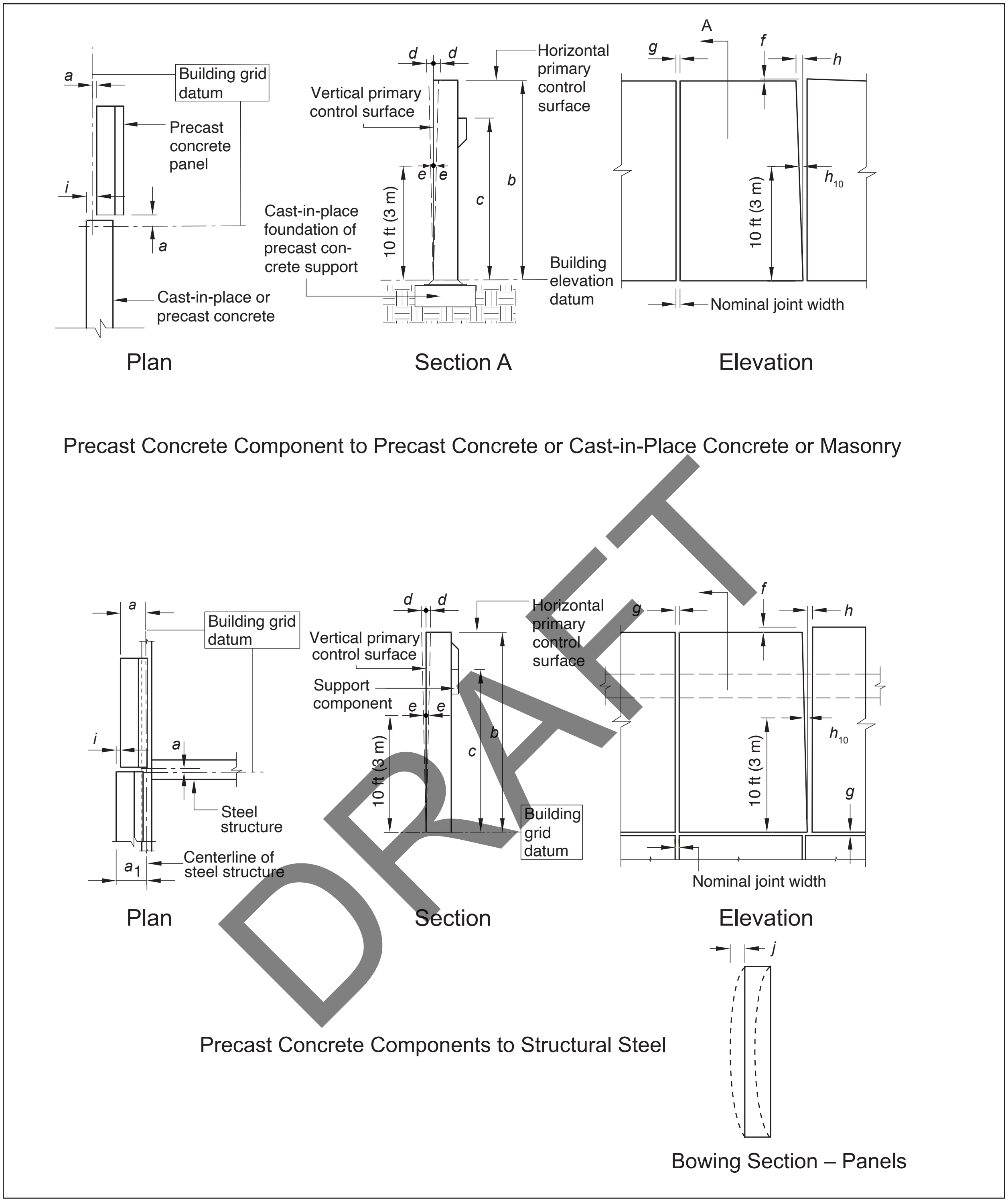

Figure 5.3.5. Structural wall panel erection tolerances.

5.3.5 Precast concrete structural wall panel erection tolerances (Fig. 5.3.5) shall be:

a = Plan location from building grid datum . . . . ±½ in. (±13 mm)

a_1* = Plan location from centerline of support. . . . . ±½ in. (±13 mm)

b = Top elevation from nominal top elevation:

Exposed individual panel . . . ±½ in. (±13 mm)

Nonexposed individual panel . . . ±¾ in. (±19 mm)

Exposed relative to adjacent panel . . . ±½ in. (±13 mm)

Nonexposed relative to adjacent panel . . . ±¾ in. (±19 mm)

c = Support elevation from nominal elevation:

Maximum low . . . ½ in. (13 mm)

Maximum high . . . ¼ in. (6 mm)

d = Maximum plumb variation over height of structure:

Structure ≤100 ft (≤30 m). . . . 1 in. (25 mm)

Structure >100 ft (>30 m)
. . . ⅛ in. per 10 ft; 2 in. maximum (3 mm per 3 m; 50 mm maximum)

e = Plumb in any 10 ft (3 m) of component height . . . ¼ in. (6 mm)

f = Maximum jog in alignment of matching edges . . . ½ in. (13 mm)

g = Joint width (governs over joint taper) . . . ±⅜ in. (±10 mm)

h = Joint taper over length of panel . . . ½ in. (13 mm)

h_{10} = Joint taper over 10 ft (3 m) length . . . ⅜ in. (10 mm)

i = Maximum jog in alignment of matching faces:

Exposed to view . . . ⅜ in. (10 mm)

Not exposed to view . . . ¾ in. (19 mm)

j = Differential bowing or camber as erected between adjacent components of the same design and length . . . ½ in. (13 mm)

*Where precast concrete components bear on a steel frame, a_1 shall control.

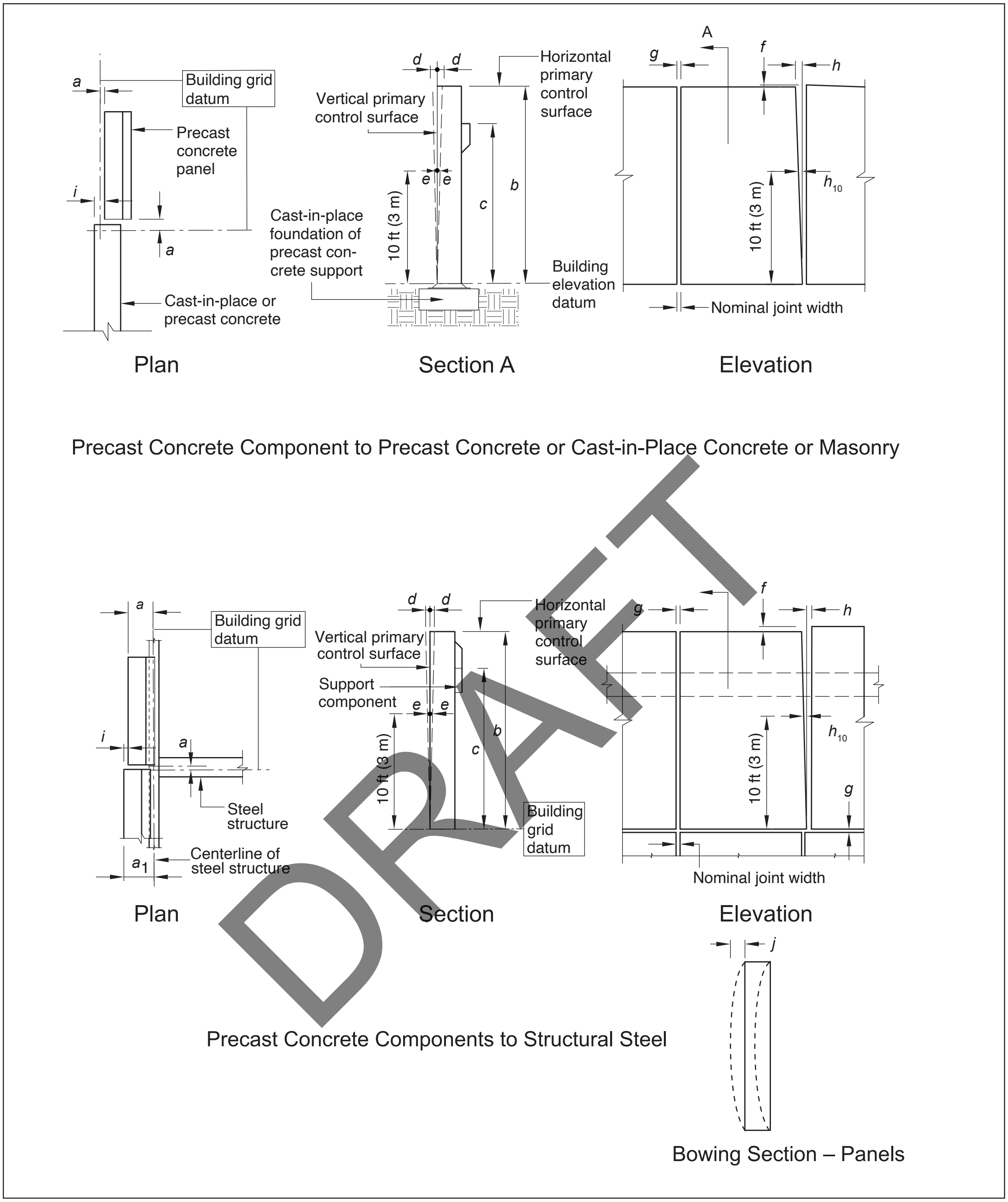

Figure 5.3.6. Single and double stadium riser erection tolerances.

5.3.6 Precast concrete single and double stadium riser erection tolerances (Fig. 5.3.6) shall be:

a = Plan location from building grid line datum . . . . ±1 in. (±25 mm)

b = Plan location from theoretical centerline of support structure . . . . ±1 in. (±25 mm)

*c**= Top elevation from building elevation datum at component's end . . . . ±½ in. (±13 mm)

d = Maximum jog in alignment of matching edges at the horizontal primary control surface . . . . ¼ in. (6 mm)

e = Maximum jog in alignment of matching edges at the vertical primary control surface . . . . ½ in. (13 mm)

f[†] = Bearing in span direction . . . . –1 in. (–25 mm)

g[‡] = Joint width (horizontal) at end of component . . . . ±½ in. (±13 mm)

h[§] = Joint width:

90-degree angle . . . . ±½ in. (±13 mm)

Joint width at skewed ends . . . . ±⅝ in. (±16 mm)

j = Differential camber (at midspan as erected) between adjacent components of the same design and length. . . . . 3⁄16 in. per 10 ft of component length; (5 mm per 3 m of component length)

k = Differential sweep (at midspan as erected) between adjacent components of the same design and length . . . . 3⁄16 in. per 10 ft of component length; ½ in. maximum (5 mm per 3 m of component length;13 mm maximum)

*This datum may be adjusted to accommodate existing field conditions.

[†]Bearing pads adjacent to unarmored faces shall be set back from the face of the support or the chamfered face, and the end of the supported component, a distance not less than ½ in. (13 mm) or the dimension of the chamfered face.

[‡]Joint width shall be ¼ in. (6 mm) minimum.

[§]Joint width shall be ¼ in. (6 mm) minimum.

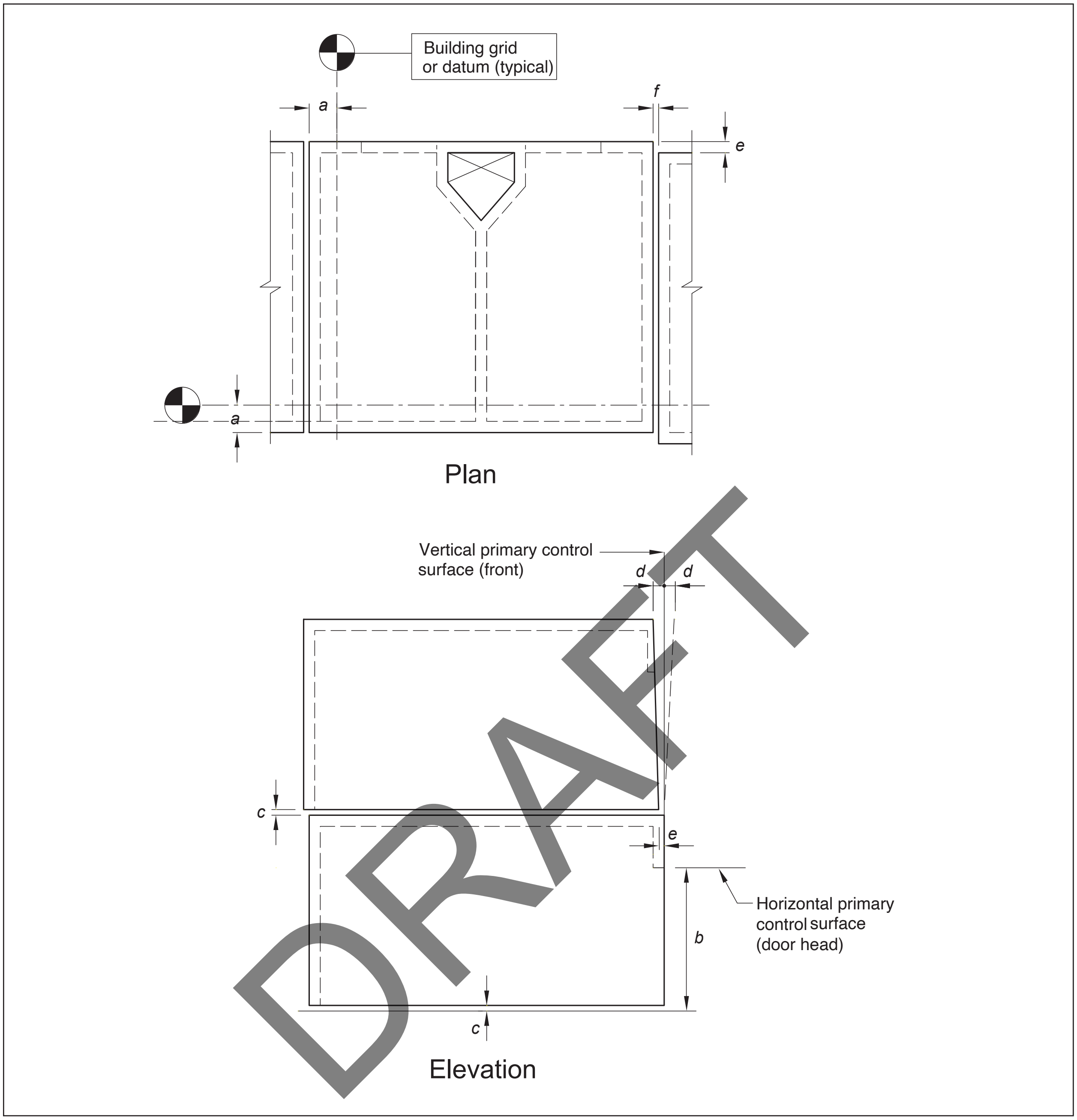

Figure 5.3.7. Room module erection tolerances.

5.3.7 Precast concrete room module erection tolerances (Fig. 5.3.7) shall be:

a = Plan location from building grid line datum . . . . ±½ in. (±13 mm)

b = Vertical control (at primary control surface) from a horizontal datum . . . . ±3⁄8 in. (±9 mm)

c = Actual grout joint . . . . ½ in. (13 mm) minimum

d = Plumb at component height . . . . ¼ in. (6 mm)

e = Maximum jog in alignment of matching edges . . . . ¼ in. (6 mm)

f = Vertical joint width. . . . . ±3⁄8 in. (±9 mm)

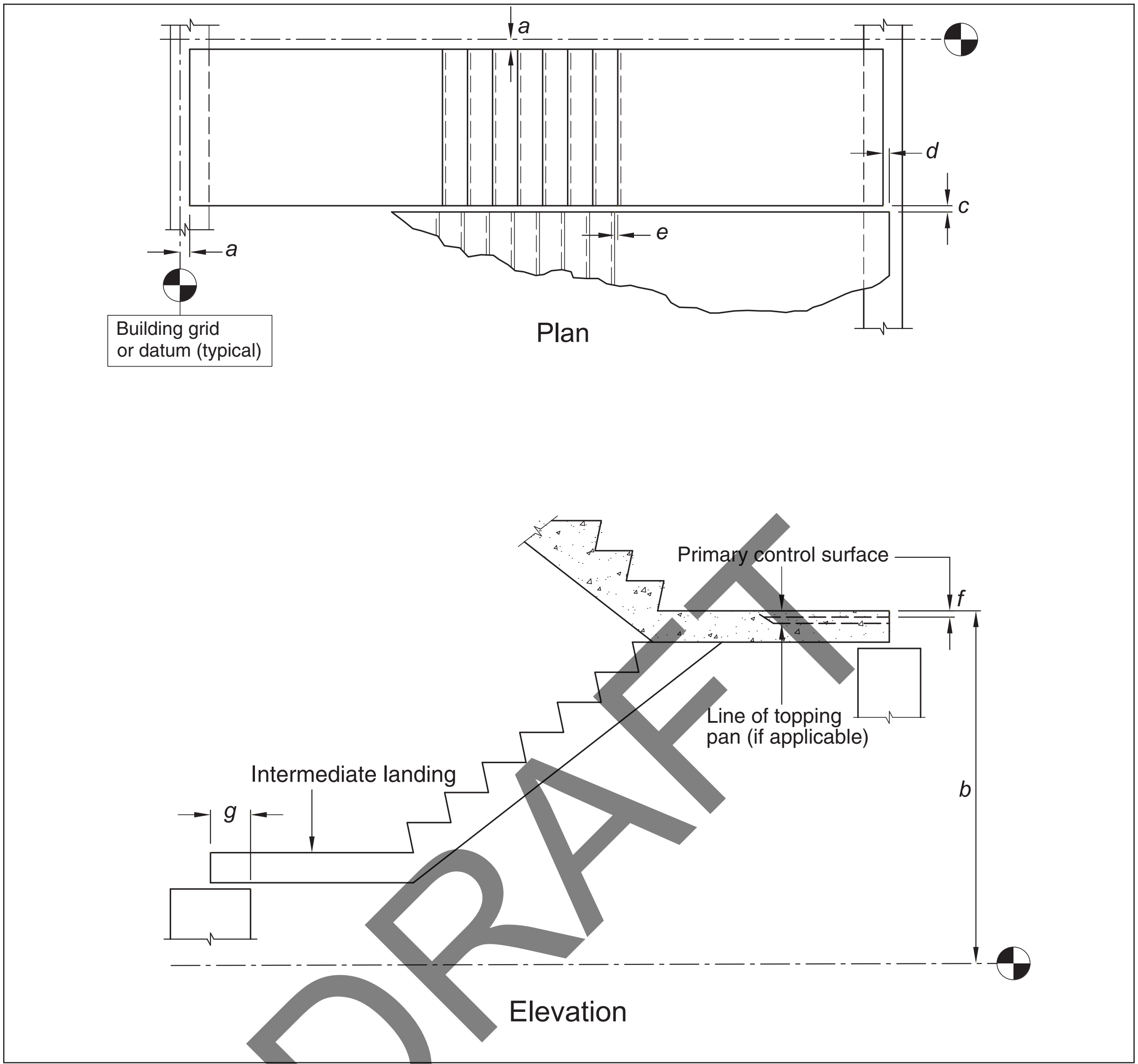

Figure 5.3.8. Stair unit erection tolerances.

5.3.8 Precast concrete stair unit erection tolerances (Fig. 5.3.8) shall be:

a = Plan location from building grid line datum . . . . ±½ in. (±13 mm)

b = Differential elevation as erected . . . . ±⅜ in. (±9 mm)

c = Joint width . . . . ±¾ in. (±19 mm)

d = Maximum jog in alignment of matching edges . . . . 1 in. (25 mm)

*e** = Maximum jog in alignment of matching edges at the primary control surface . . . . . . ⅜ in. (9 mm)

f = Bearing (in span direction) . . . . ±¾ in. (±19 mm)

*At stair units that have pretopped precast concrete landings, the maximum jog between stair units, or from stair unit to finish floor, shall not exceed ¼ in. (6 mm).

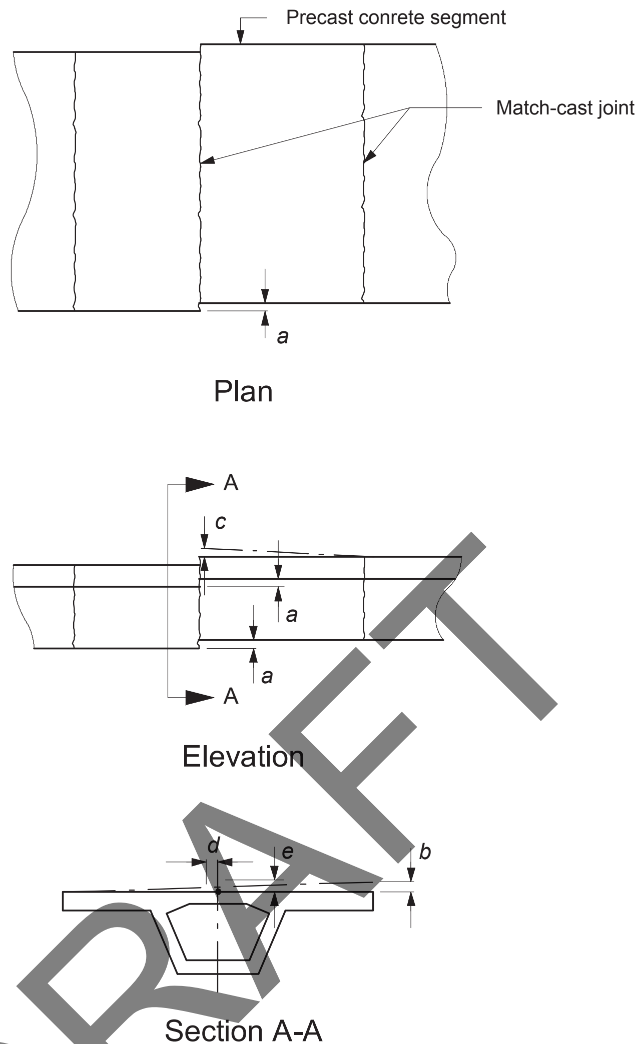

Figure 5.3.9. Segmental bridge component erection tolerances.

5.3.9 Precast concrete segmental bridge component erection tolerances (Fig. 5.3.9) shall be:

a = Maximum differential offset between outside faces of adjacent segments in the erected position . . . . ⅛ in. (3 mm)

b = Deviation from the theoretical transverse cross slope of the roadway . . . . 0.001 rad measured from curb to curb at any point along the span

c = Longitudinal angular deviation from the theoretical slope change between two successive segments . . . . 0.003 rad maximum

d = Deviation from horizontal centerline alignment as required by the contract documents . . . . ±⅛ in. (±3 mm)

e = Deviation from vertical centerline alignment as required by the contract documents . . . . ±⅛ in. (±3 mm)

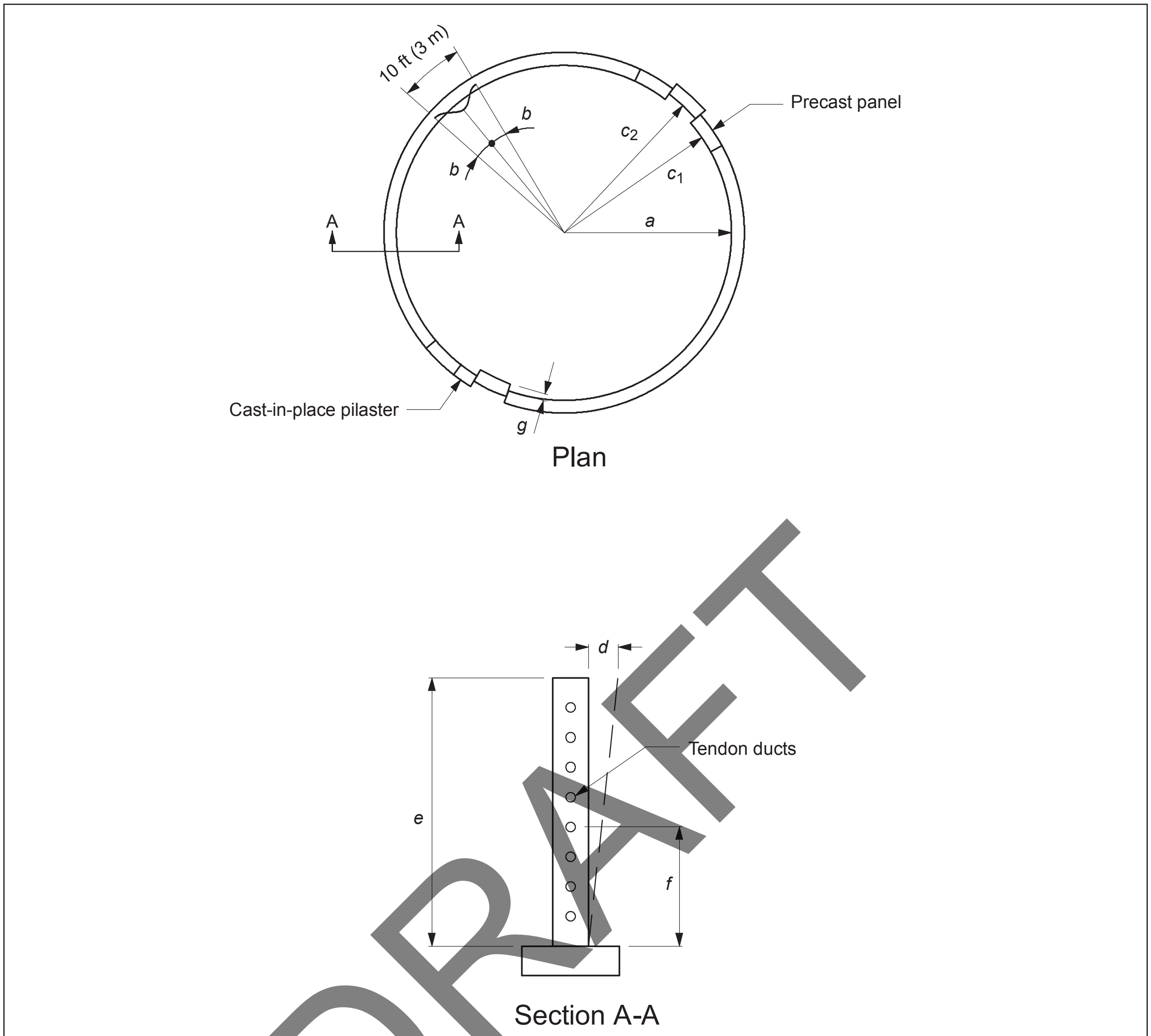

Figure 5.3.10. Circular storage tank erection tolerances.

5.3.10 Precast concrete circular storage tank erection tolerances (Fig. 5.3.10) shall be:

a = Variation from the nominal tank radius
. . . . ±½ in. per 50 ft of radius; ±1 in. maximum (±13 mm per 15 m of radius; ±25 mm maximum)

b = Maximum variation of nominal tank radius along any 10 ft (3 m) of circumference
. . . . ±3/8 in. (±9 mm)

$c_1 - c_2$ = Radial misalignment between adjoining precast concrete panels
. . . . ±¼ in. (6 mm) maximum

c_1 = Radial dimension to panel edge adjacent to location c_2

c_2 = Radial dimension to panel edge adjacent to location c_1

d = Plumb of walls
. . . . . . ¼ in. per 10 ft of vertical height; ¾ in. maximum (6 mm per 3 m of vertical height; 19 mm maximum)

e = Height to top of wall panel . . . . ±½ in. (±13 mm)

f = Height to centerline of post-tensioning ducts or embedded reinforcement to be welded . . . . ±¼ in. (±6 mm)

g = Step in face, interior surface . . . . ±¼ in. (±6 mm)

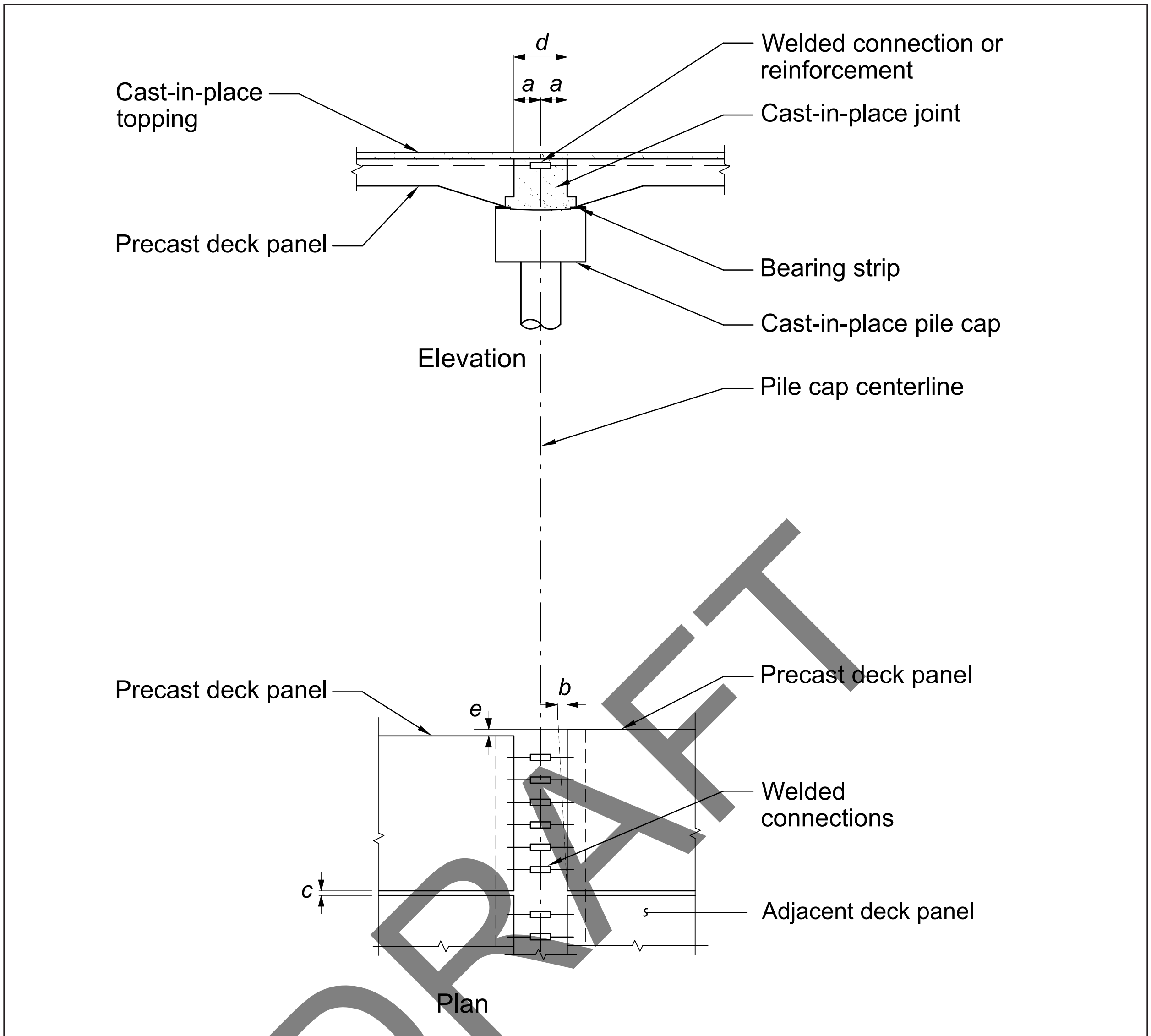

Figure 5.3.11. Pier deck erection tolerances.

5.3.11 Precast concrete pier deck erection tolerances (Fig. 5.3.11) shall be:

a = Variation in placement of panel end relative to centerline of pile cap . . . . ±½ in. (±13 mm)

b = Variation of panel end from a line parallel to centerline of pier cap . . . . ±¼ in. (±6 mm)

c = Variation in width of panel-to-panel grout joint . . . . ±⅛ in. (±3 mm)

d = Variation in width of joint between panels . . . . ±1 in. (±25 mm)

e = Variation in alignment of adjacent panel edges . . . . ±⅛ in. (±3 mm)

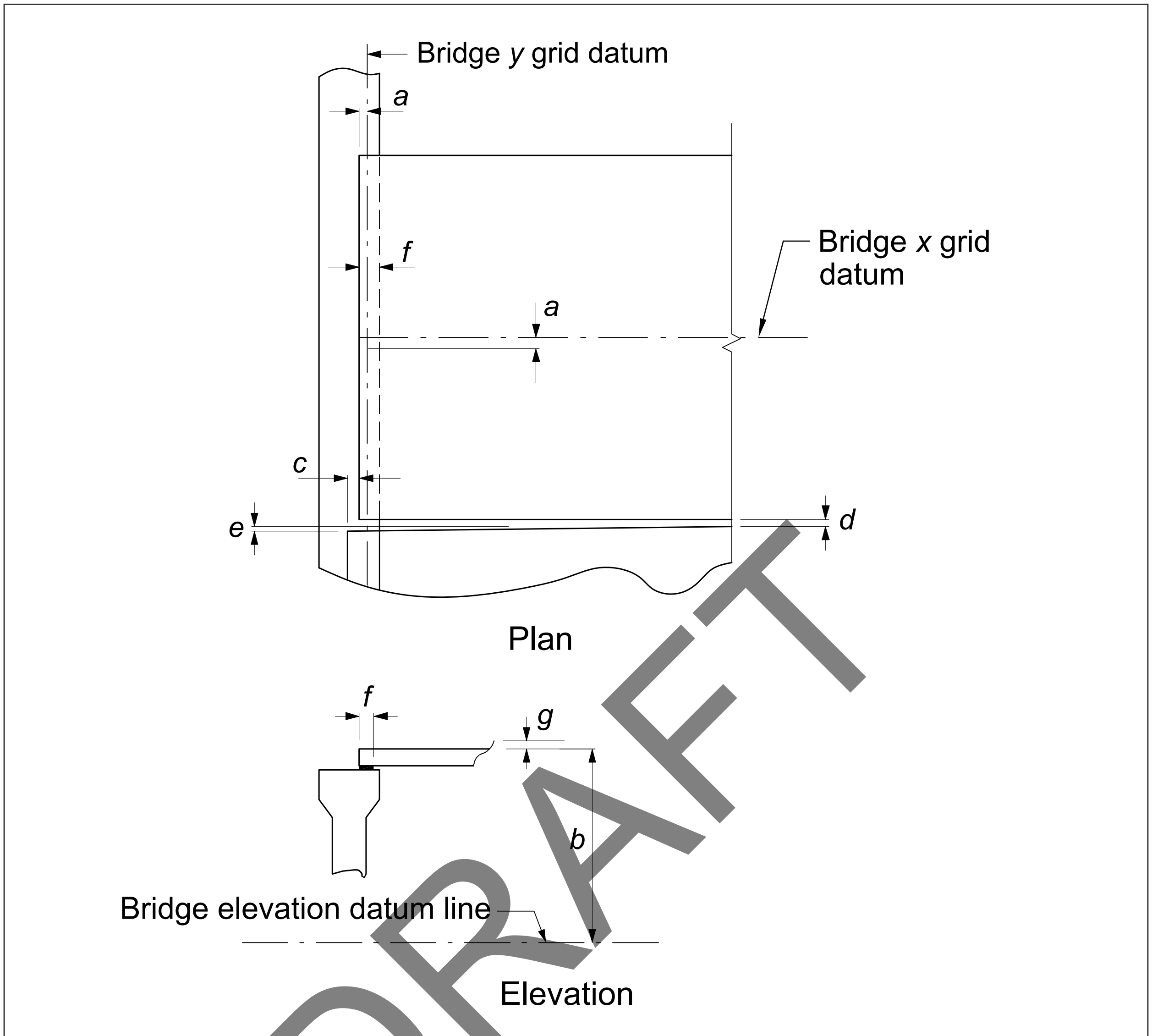

Figure 5.3.12. Bridge deck unit erection tolerances.

5.3.12 Precast concrete bridge deck unit erection tolerances (Fig. 5.3.12) shall be:

a = Plan location from bridge datum . . . . ±1 in. (±25 mm)

b = Top surface elevation from nominal top surface elevation . . . . ±¾ in. (±19 mm)

c = Maximum jog in alignment of matching edges . . . . 1 in. (25 mm)

d = Joint width . . . . ±½ in. (±13 mm)

e = Joint taper . . . . ±¼ in. (±6 mm)

f = Bearing length in the span direction . . . . ±½ in. (±13 mm)

g = Differential elevation between adjacent panels . . . . ¾ in. (19 mm)

Note: These tolerances shall be compared against those specified by the controlling bridge authority. Contract documents shall govern the erection of the project.

5.3.13 Miscellaneous erection tolerances

5.3.13.1 Sills, lintels, copings, cornices, quoins, and medallions (Fig. 4.2.3)

Where one face will be installed in dead wall space of mortar joint:

c_1 = Concealed end . . . . +¼ in., –0 in. (+6 mm, –0 mm)
c_2 = Exposed end . . . . ±⅛ in. (±3 mm)

f = Maximum jog in alignment of matching edges:
Exposed relative to adjacent panel . . . . ¼ in. (6 mm)
Nonexposed relative to adjacent panel . . . . ½ in. (13 mm)

5.4 Glass-Fiber-Reinforced Concrete (GFRC) erection tolerances.

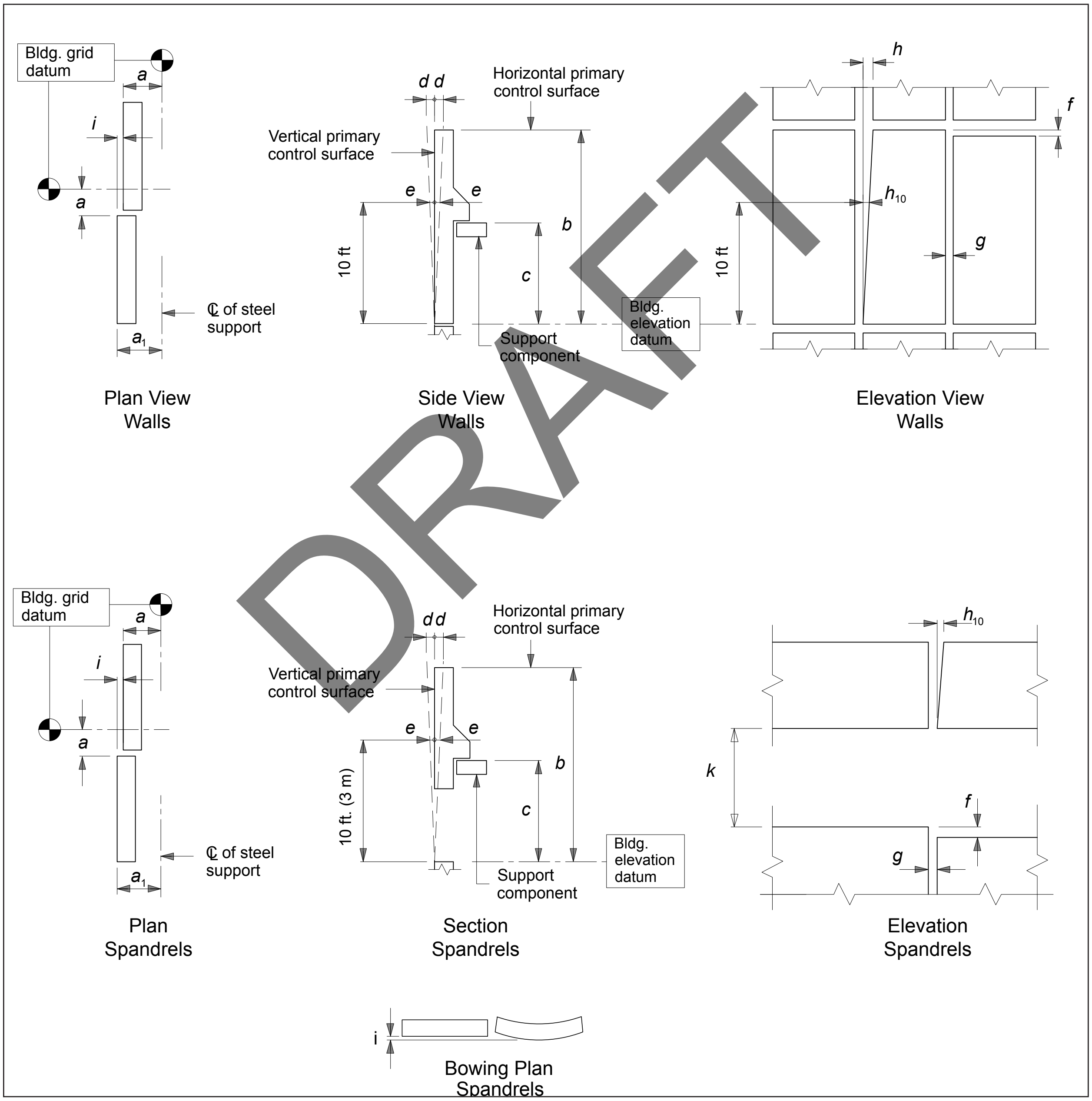

Figure 5.4.1. Glass-fiber-reinforced concrete component erection tolerances.

5.4.1 GFRC wall panel or spandrel panel erection tolerances (Fig. 5.4.1) shall be:

a = Plan location from building grid datum . . . . ±½ in. (±13 mm)

a_1* = Plan location from centerline of support . . . . ±½ in. (±13 mm)

b = Top elevation from nominal top elevation:

Exposed individual panel . . . . ±¼ in. (±6 mm)

Nonexposed individual panel . . . . ±½ in. (±13 mm)

c = Support elevation from nominal elevation:

Maximum low . . . . ½ in. (13 mm)

Maximum high . . . . ¼ in. (6 mm)

d = Maximum plumb variation over height of structure:

Structure height≤100 ft (≤30 m) . . . . 1 in. (25 mm)

Structure height >100 ft (>30 m)
. . . . ⅜ in. per 10 ft; 2 in. maximum (3 mm per 3 m; 50 mm maximum)

e = Plumb in any 10 ft (3 m) of component height . . . . ¼ in. (6mm)

f = Maximum jog in alignment of matching edges:

Exposed relative to adjacent panel . . . . ¼ in. (6 mm)

Nonexposed relative to adjacent panel . . . . ½ in. (13 mm)

g = Joint width (governs over joint taper):

Panel dimensions <20 ft (<6 m) . . . . ±¼ in. (±6 mm)

Panel dimensions ≥20 ft (≥6 m) . . . . ±⅜ in. (±9 mm)

h = Joint taper over length of panel, maximum . . . . ⅜ in. (9 mm)

h_{10} = Joint taper over 10 ft (3 m) length . . . . ¼ in. (6 mm)

i = Maximum jog in alignment of matching faces . . . . ¼ in. (6 mm)

j = Differential bowing or camber as erected between adjacent component of the same design:

Exposed relative to adjacent panel . . . . ¼ in. (6 mm)

Nonexposed relative to adjacent panel . . . . ½ in. (13 mm)

k = Opening height between spandrels . . . . ±½ in. (±13 mm)

*Where GFRC components bear on a steel frame, a_1 shall control.

5.5 Connections and bearing.

5.5.1 General

5.5.1.1 Connections and bearing conditions shall conform to requirements listed in Sections 5.5.2 and 5.5.3.

5.5.1.2 Embed tolerances shall comply with requirements of Chapter 4.

5.5.2 Connections

5.5.2.1 Connections between precast concrete components, or between precast concrete components and other materials, shall be completed as detailed in the precast concrete erection drawings.

5.5.2.2 Where connections cannot be completed as detailed, provisions (a) and (b) shall be met:

(a) The erector shall notify the specialty structural engineer.

(b) The structural engineer of record or specialty structural engineer shall approve the increased tolerances or provide a modified connection detail such that structural requirements have been satisfied.

5.5.3 Bearing. Bearing requirements shall be met in accordance with the precast concrete erection drawings. Specific minimum requirements shall be provided by the specialty structural engineer, as necessary.

Chapter 6—Interfacing Tolerances

6.1 General. Requirements for interfacing tolerances that affect project-defined tolerances shall be communicated as established by Section 2.2.

6.1.1 Deviation from listed tolerances due to other systems within a project shall be allowed when the requirements of Section 2.3 have been satisfied.