

# Specification for Unreinforced Concrete Parking Lots

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*This specification covers minimum requirements for the construction of unreinforced concrete parking lots on grade. Included are requirements for materials, placing, texturing, curing, jointing, and opening to traffic.*

**Keywords:** concrete parking lots; concrete pavements; construction; curing; inspection testing; jointing; pavement; specifications; texturing.

## PREFACE

**P1.** ACI Specification 330.1 is intended to be used by reference or incorporation in its entirety in the project specifications. Individual sections, articles, or paragraphs shall not be copied into the project specifications because taking them out of context may change their meaning.

**P2.** A statement such as the following will serve to make ACI Specification 330.1 a part of the project specifications:

Work on (Project Title) shall conform to all requirements of ACI 330.1 published by the American Concrete Institute, Farmington Hills, Michigan, except as modified by these contract documents.

**P3.** If sections or parts of ACI Specification 330.1 are copied into project specifications or any other document, they shall not be referred to as ACI Specifications because the specification has been altered.

**P4. Units**—The values stated in inch-pounds are to be regarded as the standard. The values in SI units given in parentheses are for information only.

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## SECTION 1—GENERAL

### 1.1—Scope

**1.1.1** This specification covers requirements for the construction of unreinforced concrete parking lots on grade, including attached and integral curbs.

ACI 330.1-03 supersedes ACI 330.1-94 and became effective March 24, 2003.  
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## 1.2—Definitions

**1.2.1** These definitions are to assist in interpreting the provisions of this specification.

**accepted**—accepted by or acceptable to the architect/engineer.

**architect/engineer**—the architect, engineer, architectural firm, engineering firm, or architectural and engineering firm issuing project drawings and project specifications or administering the work under the contract documents.

**cold weather**—a period when for more than three successive days the average daily outdoor temperature drops below 40 °F (5 °C). The average daily temperature is the average of the highest and lowest temperature during the period from midnight to midnight. When temperatures above 50 °F (10 °C) occur during more than half of any 24 h duration, the period shall no longer be regarded as cold weather.

**construction joint**—a joint constructed from two separate placements where the first has undergone final setting before the next placement.

**contraction joint**—formed, sawed, or tooled groove in a concrete structure to create a weakened plane and regulate the location of cracking resulting from the dimensional change of different parts of the structure.

**contractor**—the person, firm, or corporation with whom the owner enters into an agreement for construction of the work.

**contract documents**—documents, including project drawings and project specifications, covering the required work.

**dowel bars**—steel pins, commonly plain round steel bars, that extend into adjoining portions of a concrete construction, as at a joint in a pavement slab, to transfer shear loads.

**free edge**—the edge of pavement abutting an isolation joint or the edge of the pavement against which no concrete is placed.

**hot weather**—any combination of the following conditions that tend to impair the quality of freshly mixed or hardened concrete by accelerating the rate of moisture loss and rate of cement hydration, or otherwise resulting in detrimental results.

- a. high ambient temperature;
- b. high concrete temperature;
- c. low relative humidity;
- d. wind velocity; and
- e. solar radiation.

**isolation joint**—a separation between adjoining parts of a concrete structure, usually a vertical plane, at a designed location such as to interfere least with performance of the structure, yet such as to allow relative movement in three directions and avoid formation of cracks elsewhere in the concrete and through which all or part of the bonded reinforcement is interrupted.

**mild exposure condition**—absence of exposure to freezing and thawing or to deicing agents.

**moderate exposure condition**—exposure to a climate where the concrete will not be in a saturated condition when exposed to freezing and will not be exposed to deicing agents or other aggressive chemicals.

**owner**—the corporation, association, partnership, individual, or public body or authority with whom the contractor enters into an agreement and for whom the work is accomplished.

**panel**—an individual concrete slab bordered by joints or slab edges.

**project drawings**—the drawings that, along with the project specifications, addenda, bulletins, and change orders, constitute the descriptive information for constructing the work required or referred to in the contract documents.

**parking lot**—an area used to park automobiles, trucks, or both.

**pavement (concrete)**—a layer of concrete over areas such as roads, sidewalks, canals, playgrounds, and those used for storage or parking.

**permitted**—permitted by the architect/engineer.

**project specifications**—the written documents that specify requirements for a project in accordance with service parameters and other specific criteria established by the owner.

**reference standards**—standardized mandatory language documents of a technical society, organization, or association, including the building codes of local or state authorities, which are referenced in the contract documents.

**severe exposure condition**—exposure to deicing chemicals or other aggressive agents or where the concrete can become saturated by continual contact with moisture or free water before freezing.

**subbase (also called base)**—a layer in the pavement system between the subgrade and the concrete pavement.

**subgrade**—the soil prepared and compacted to support the pavement system.

**submittal**—documents that are required by the contract documents to be turned in to the architect/engineer for action as described in the contract documents.

**tie bar**—a reinforcing bar, commonly a deformed steel bar intended to transmit tension, compression, or shear through a construction joint.

**tolerances**—as applied to [Section 3.10](#)—plus (+) tolerance increases the amount or dimension to which it applies or raises a level alignment. Minus (−) tolerance decreases the amount or dimension to which it applies or lowers a level alignment. A nonsigned tolerance means + or −. Where only one signed tolerance is specified (+ or −), there is no limit in the other direction.

**unreinforced concrete pavement**—concrete pavement that does not contain distributed deformed steel reinforcing bars or welded wire fabric.

**work**—the entire construction of separately identifiable parts that are required to be furnished under the contract documents.

## 1.3—Reference organizations

### 1.3.1 ACI:

American Concrete Institute  
P.O. Box 9094  
Farmington Hills, MI 48333-9094

### 1.3.2 ASTM:

ASTM International  
100 Barr Harbor Drive  
West Conshohocken, PA 19428

**1.3.3 Federal Specifications**

Business Service Center  
General Services Administration  
7th & D Street SW  
Washington, D.C. 20407

**1.3.4 Referenced standards****1.3.4.1 ACI standards**

- 301-99 Specifications for Structural Concrete  
306.1-90(98) Standard Specification for Cold Weather Concreting  
308.1-98 Standard Specification for Curing Concrete

**1.3.4.2 ASTM standards**

- A 615/ Standard Specification for Deformed and Plain  
A 615M-01a Billet-Steel Bars for Concrete Reinforcement  
C 94/ Standard Specification for Ready-Mixed Concrete  
C 94M-00  
C 150-00 Standard Specification for Portland Cement  
C 309-98a Standard Specification for Liquid Membrane-Forming Compounds  
D 994-98 Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)  
D 1751-99 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)  
D 1752-84 Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction (1996)  
D 3406-95 Standard Specification for Joint Sealant, Hot Applied, Elastomeric Type, for Portland Cement Concrete Pavements (2000)

**1.3.4.3 Federal specifications**

- TT-S-0011543a Sealing Compound: Silicone Rubber Base (6/9/71)  
TT-S-00230 Sealing Compound: Elastomeric Type, Single Component (2/2/70)

**1.4—Submittals**

**1.4.1** Submit drawings and documentation as required in this specification.

**1.4.2** Obtain written acceptance of submittals before using the materials or methods requiring acceptance.

**1.5—Storage and handling**

**1.5.1** Store manufactured construction material in a clean, dry location.

**1.6—Testing and inspection**

**1.6.1** Tests required to document submittals, certify product compliance with this Specification before use in construction, establish concrete mixture proportions, provide acceptability of changes requested by the contractor, or appeal rejection of material found defective by owner's test shall be performed by accredited laboratories using certified personnel.

**1.6.2** The work in progress will be inspected, and materials, equipment, and procedures will be evaluated for quality and acceptability by representatives of the owner or as designated in the contract documents.

**Table 2.1—Required total air content\***

Nominal maximum aggregate size, in. (mm)	Total air content <sup>†</sup> , %		
	Mild exposure	Moderate exposure	Severe exposure
3/8 (10)	4.5	6.0	7.5
1/2 (13)	4.0	5.5	7.0
3/4 (19)	3.5	5.0	6.0
1 (25)	3.0	4.5	6.0
1-1/2 (40)	2.5	4.5	5.5

\*Measured in accordance with ASTM C 138, C 173, and C 231.

<sup>†</sup>Air content tolerance is  $\pm 1.5\%$

**1.6.3** The contractor shall permit and facilitate access of the owner's representatives to the construction sites for the performance of all activities for quality assurance and quality control by these representatives, including inspection and testing required in these specifications.

**1.6.4** Failure to detect defective work or material shall not prevent later rejection if defects are discovered, nor shall it constitute final acceptance by the architect/engineer.

**1.6.5** Concrete shall be tested and inspected in accordance with ASTM C 94. Concrete failing to meet strength requirements shall be remedied in accordance with ASTM C 94, unless otherwise specified.

**1.6.6** Concrete test results shall be distributed to owner, architect/engineer, contractor, and concrete supplier.

**SECTION 2—PRODUCTS****2.1—Concrete**

**2.1.1** Comply with ASTM C 94 and the following requirements.

**2.1.2 Cement type**—Type I cement, unless otherwise specified.

**2.1.3 Strength**—Specified compressive strength shall be 4000 psi (28 MPa) at 28 days, unless otherwise specified.

**2.1.4 Total air content**—Comply with Table 2.1, unless otherwise specified.

**2.1.5 Aggregates**—Nominal maximum aggregate size shall not exceed 1/3 of the specified pavement thickness.

**2.1.6 Slump**—Slump shall not exceed 4 in. (100 mm) for pavements placed by other than slipform equipment or 1-1/2 in. (40 mm) for concrete placed with slipform equipment. Concrete with different slumps may be permitted when accepted.

**2.1.7** Submit documentation describing concrete mixture proportions in accordance with ACI 301.

**2.2—Joint reinforcement**

**2.2.1** When used, comply with ASTM A 615 and 2.2.2 through 2.2.4.

**2.2.2** Dowel bars shall be plain bars.

**2.2.3** Tie bars shall be deformed bars.

**2.2.4** Dowel bars and tie bars shall be the sizes indicated in project drawings.

**2.3—Membrane-forming curing compounds**

**2.3.1** Comply with ASTM C 309, Type 2, Class A.

**2.4—Joint and sealant material**

**2.4.1** For isolation joint materials, comply with ASTM D 994, D 1751, or ASTM D 1752.

**2.4.2** Joint sealing materials shall comply with ASTM D 3406 for hot-applied elastomeric type, TT-S-001543a for silicone rubber type, and TT-S-00230s for single-component elastomeric type.

## **2.5—Forms**

**2.5.1** Forms shall be made of steel or wood or other material capable of supporting concrete and mechanical concrete placing equipment that is sufficiently rigid to maintain the specified tolerances.

**2.5.2** Forms shall be clean and free of dirt, rust, and hardened concrete.

## **SECTION 3—EXECUTION**

### **3.1—Subgrade preparation**

**3.1.1** Prepare subgrade as required in the contract documents.

**3.1.2** Construct subgrade to ensure that the required pavement thickness is obtained in all locations.

**3.1.3** Regrade and recompact subgrade disturbed by concrete delivery vehicles or other construction equipment.

**3.1.4** Do not use sand or loose material to obtain final subgrade elevation.

### **3.2—Subbase**

**3.2.1** Use only when required by contract documents. If used, prepare subbase in accordance with Section 3.1, Subgrade preparation.

### **3.3—Setting forms**

**3.3.1** Set, align, and brace forms so that the pavement will meet the tolerances specified in Section 3.10, Tolerances.

**3.3.2** Apply form release agent to inside face of forms before placing concrete.

**3.3.3** The edge of previously placed concrete may be used as a form. Do not apply form release agent to previously placed concrete, unless prevention of bond between the new and the old concrete is desired.

### **3.4—Placing joint reinforcement**

**3.4.1** Place joint reinforcement at locations indicated on project drawings.

**3.4.2** Support joint reinforcement so that it will not be dislocated by concrete placing operations. Place and align to meet the requirements of Section 3.10, Tolerances.

### **3.5—Batching, mixing, and delivery**

**3.5.1** Comply with ASTM C 94.

### **3.6—Placing and finishing fixed-form pavement**

**3.6.1** Deposit concrete directly from the transporting equipment onto the subgrade.

**3.6.2** Do not place concrete on frozen subgrade or subbase.

**3.6.3** Other methods of conveying the concrete may be used when specified or permitted by the architect/engineer.

**3.6.4** Deposit concrete between the forms to a uniform height.

**3.6.5** Consolidate concrete to remove voids and air pockets. Do not move concrete horizontally with a vibrator.

**3.6.6** Strike off concrete between forms using a form-riding paving machine or vibrating screed. Other strikeoff

devices may be used, such as a highway straightedge or scraping straightedge, when accepted.

**3.6.7** Immediately after strikeoff, and before bleed water appears on the surface, level concrete with a bullfloat.

**3.6.8** Do not use steel trowels or power finishing equipment.

**3.6.9** Finish the pavement to the elevations and thickness specified in the project drawings and meet the requirements of Section 3.10, Tolerances.

### **3.7—Placing and finishing slipform pavement**

**3.7.1** When accepted, slipform equipment may be permitted.

**3.7.2** Deposit and finish concrete in accordance with Section 3.6.

### **3.8—Edging**

**3.8.1** Edge top surface edges to a radius of 1/4 in. (6 mm).

**3.8.2** Do not tool edges if the joint is to be widened to provide a reservoir for joint sealant.

### **3.9—Final surface texture**

**3.9.1** Broom concrete surface with a steel or fiber broom to produce corrugations between 1/16 and 1/8 in. (2 and 3 mm) deep.

**3.9.2** Broom perpendicular to nearest edge of pavement. Broom all areas of a panel in the same direction.

**3.9.3** Use the same type and manufacture of broom for all paved surfaces to provide a consistent appearance.

**3.9.4** Other methods of producing final surface texture may be permitted when specified and accepted.

### **3.10 Tolerances (see 1.2, Definitions—Tolerances)**

**3.10.1** Construct pavement to comply with the following tolerances:

Elevation: 3/4 in. (19 mm)

Thickness: +3/8 in., -1/4 in. (+10 mm, -6 mm)

Surface: In any direction, the gap below a 10 ft (3 m) unlevelled straightedge resting on highspots shall not exceed 1/2 in. (13 mm)

**3.10.2** Joint reinforcement:

Tie bars—alignment of tie bar end relative to line perpendicular to edge of pavement: 1/2 in./ft (13 mm/300 mm) of tie bars

**3.10.3** Dowels:

Lateral alignment and spacing: 1 in. (25 mm)

Vertical alignment: 1/4 in. (6 mm)

Alignment of dowel bar end relative to line perpendicular to edge of pavement: 1/4 in./ft (6 mm/300 mm) of dowel

**3.10.4** Joint spacing (see Table 3.13)

Contraction joint depth ( $d$  = slab thickness): +1/4 in. (6 mm), -0 in.

Joint width: +1/8 in. (3 mm), -0 in.

### **3.11—Curing**

**3.11.1** Apply membrane-forming curing compound to all exposed surfaces at a maximum coverage rate of 200 ft<sup>2</sup>/gal. (5 m<sup>2</sup>/L).

**3.11.2** Apply curing compound immediately after final surface texture has been obtained and water sheen has disappeared.

**3.11.3** Apply curing compound to pavement edges after forms have been removed.

**3.11.4** Alternative curing methods may be used when specified or allowed by ACI 308.1.

### 3.12—Hot- and cold-weather construction

**3.12.1** In hot weather, protect finished concrete with wind-breaks, shading, fog spraying, ponding, or wet covering to prevent cracking at locations other than contraction joints.

**3.12.2** If required, submit detailed procedures for the production, transportation, placement, protection, curing, and temperature monitoring of concrete during hot weather.

**3.12.3** In cold weather, comply with ACI 306.1.

### 3.13—Jointing

**3.13.1** Construct joints at the locations, depths, and with dimensions indicated on the project drawings or accepted drawings submitted by the contractor.

**3.13.2** If jointing requirements are not indicated on the project drawings, the contractor shall submit drawings describing proposed jointing in accordance with [Section 1.4](#), Submittals, and the requirements of 3.13.2.1 through 3.13.2.9. The contractor shall not proceed with work until the jointing requirements are accepted by the architect/engineer.

**3.13.2.1** Indicate locations of contraction joints, construction joints, and isolation joints. Spacing between contraction joints shall conform to Table 3.13.

**3.13.2.2** The larger dimension of a panel shall not exceed 125% of the smaller dimension.

**3.13.2.3** The minimum angle between two intersecting joints shall be 80 degrees, unless otherwise specified or permitted.

**3.13.2.4** Joints shall intersect pavement free edges at 90-degree angles and shall extend straight for a minimum of 1-1/2 ft (0.5 m) from the pavement edge, where possible.

**3.13.2.5** Align joints of adjacent panels.

**3.13.2.6** Align joints in attached curbs with joints in pavement.

**3.13.2.7** Ensure joint depths, widths, and keyway dimensions are as specified.

**3.13.2.8** Minimum contraction joint depth, using a conventional saw, hand tools, or inserts, shall be 1/4 of the pavement thickness. Minimum joint width for saw cutting is 1/8 in. (3 mm). When using an early-entry dry-cut saw, the depth of the cut shall be at least 1 in. (25 mm).

**3.13.2.9** Use isolation joints only where pavement abuts buildings, foundations, existing pavements, manholes, and other fixed objects.

**3.13.3** Construct contraction joints by one of the following methods:

**3.13.3.1** Tool contraction joints in fresh concrete after the concrete has set sufficiently to maintain the formed joint to the specified depth and width.

**3.13.3.2** Insert plastic strips vertically into the fresh concrete. Depress strips into pavement until flush with surface.

**3.13.3.3** Saw-cut concrete after concrete has hardened sufficiently to prevent aggregate being dislodged and soon enough to control pavement cracking. Discontinue sawing

**Table 3.13—Spacing between contraction joints**

Pavement thickness, in. (mm)	Maximum spacing, ft (m)
3-1/2 (90)	8-1/2 (2.5)
4, 4-1/2 (100, 110)	10 (3)
5, 5-1/2 (125, 140)	12-1/2 (4)
6 or greater (150 or greater)	15 (4.5)

joint if a crack precedes the saw-cut. Resume sawing at the next joint location.

**3.13.4** Extend isolation joints through the full depth of the pavement. Fill the entire isolation joint with isolation joint material, unless otherwise required by project drawings or by accepted jointing drawings submitted by the contractor. (See [Section 2.4](#).)

### 3.14—Opening to traffic

**3.14.1** Do not open the pavement to vehicular traffic until the in-place compressive strength is at least 3000 psi (21 MPa) or until the pavement is accepted by the architect/engineer for opening to traffic.

## FOREWORD TO AN ACI SPECIFICATION CHECKLIST

**F1.** This foreword is included for explanatory purposes only; it does not form a part of ACI Specification 330.1.

**F2.** ACI Specification 330.1 may be referenced by the specifier in the project specifications for any building project, together with supplementary requirements for the specific project. Responsibilities for project participants must be defined in the project specifications. The ACI Specification cannot and does not address responsibilities for any project participant other than the contractor.

**F3.** Checklists do not form a part of ACI Specification 330.1. Checklists assist the specifier in selecting and specifying project requirements in the project specifications.

**F4.** Building codes set minimum requirements necessary to protect the public. ACI Specification 330.1 may stipulate requirements more or less restrictive than the minimum. The specifier shall make adjustments to the needs of a particular project by reviewing each of the items in the checklists and including those the specifier selects as mandatory requirements in the project specifications.

**F5.** The mandatory checklist requirements indicate work requirements regarding specific qualities, procedures, materials, and performance criteria that are not defined in the ACI Specification 330.1.

**F6.** The optional checklists identify specifier choices and alternatives. The checklists identify the sections, parts, and articles of the reference specification and the action required or available to the specifier.

**F7. Recommended references**—Documents and publications referred to in the Checklists of ACI Specification 330.1 are listed. These references provide guidance to the specifier and are not considered to be part of ACI Specification 330.1.

### ACI

301-99	Specifications for Structural Concrete
306R-88	Cold Weather Concreting



306.1-90	Standard Specification for Cold Weather Concreting	D 1751-99	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving Structural Construction (Nonextruding and Resilient Bituminous Types)
308-92	Standard Practice for Curing Concrete		
308.1-98	Standard Specification for Curing Concrete	D 1752-84 (1996)	Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM			
A 615/	Standard Specification for Deformed and Plain		
A 615M-01a	Billet-Steel Bars for Concrete Reinforcement	D 3406-95 (2000)	Standard Specification for Joint Sealant, Hot-Applied, Elastomeric Type, for Portland Cement Concrete Pavements
C 94/	Standard Specification for Ready-Mixed Concrete		
C 94M-00			
C 150-00	Standard Specifications for Portland Cement		
C 309-98a	Standard Specification for Liquid Membrane-Forming Compounds	<i>Federal Specifications</i>	
D994-98	Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)	TT-S-0011543a	Sealing Compound: Silicone Rubber Base (6/9/71)
		TT-S-00230	Sealing Compound, Elastomeric Type, Single Component (2/2/70)

## MANDATORY CHECKLIST

Part/article	Notes to the architect/engineer
<b>1.6.1 Testing and inspection</b>	Review for compliance with project specifications. Designate responsibility for "inspection and testing."
<b>3.1 Subgrade preparation</b>	Specify subgrade preparation requirements in appropriate section of contract documents.
<b>3.6.9 Final evaluation</b>	Specify final surface elevations and pavement thicknesses on project drawings.
<b>3.13.1 Jointing</b>	Specify joint locations, depths, and dimensions on project drawings; or
<b>3.13.2 Jointing</b>	Review and accept drawings from the contractor describing joint requirements.
<b>3.14 Opening to traffic</b>	Specify method to determine in-place compressive strength.

## OPTIONAL CHECKLIST

Part/article	Notes to the architect/engineer
<b>1.6.5 Testing and inspection</b>	Specify other than ASTM C 94 for concrete testing, inspection, and remedy for concrete failing to meet strength requirements, when permitted.
<b>2.1.2 Cement type</b>	Identify cement specifications and type when other than ASTM C 150, Type I cement is required. Refer to ASTM C 94.
<b>2.1.3 Strength</b>	Specify strength when other than 4000 psi (28 MPa) compressive strength at 28 days is required.
<b>2.1.4 Total air content</b>	Specify total required air content when other value listed in <b>Table 2.1</b> is required.
<b>2.1.6 Slump</b>	Specify slump other than required in <b>Section 2.1.6</b> .
<b>2.2 Joint reinforcement</b>	Specify dowel and tie bar sizes on project drawings, when required.
<b>3.2 Subbase</b>	Specify the type of subbase in contract documents, when required.
<b>3.4.1 Placing joint reinforcement</b>	Specify joint reinforcement locations on project drawings, when required.
<b>3.9 Final surface texture</b>	Specify other than broom finish, when permitted.
<b>3.11.4 Curing</b>	Specify curing method other than membrane-forming curing compound. Refer to ACI 308.
<b>3.13.4 Filling isolation joints</b>	Specify extent of filling isolation joints other than full depth, when required.
<b>3.14 Opening to traffic</b>	Specify compressive strength other than 3000 psi (21 MPa).

## SUBMITTAL CHECKLIST

Part/article	Notes to the architect/engineer
<b>2.1.7 Concrete mixture proportions</b>	Required, verify all mixture proportions and performance records submitted by the contractor.
<b>3.12 Hot- and cold-weather construction</b>	When required, verify execution plan from the contractor where applicable. Refer to ACI 306R and 305R.
<b>3.13.2 Jointing requirements</b>	When required, verify jointing requirements submitted by the contractor, where applicable.