Development of ACI 330's Industrial Pavement Guide

330.XR
To TAC

ACI 330.XR

Guide for the Design and Construction of Concrete Site Paving

for Industrial and Trucking Facilities

Reported by ACI Committee 330

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Keywords: insert words that are not found in the CT and are unique to the document.

1

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Tim Cost, PE, FACI

Background – ACI 330 documents and history

- Committee name – Concrete Parking Lots and Site Paving
  - What exactly is “site paving”?
- Formed in the 1980s
  - Mission was to develop a complete, “one-stop” guide for design and construction of concrete parking area pavements (330R)
  - Later, a companion specification
- 330R (Guide for Design and Construction of Concrete Parking Lots)
  - 1992, 2001, 2008
- 330.1 (Specification for Unreinforced Concrete Parking Lots and Site Paving)
  - 1994, 2003, 2014

Background – 330X

American Concrete Institute
Always advancing

- Interested stakeholders approached and joined the committee, 2004-2005
  - Other committees had rejected them ☹
  - Was it “site paving” that seemed to be a fit?
- First committee discussion of developing the industrial pavement document noted in Spring 2005 minutes
- Outline of the proposed document presented, Fall 2005

Publications | Certification | Education | Committees | Events | Cha

Home > Committees > Directory of Committees > A Committee Home

Committee Home

330 - Concrete Parking Lots and Site Paving

Committee Mission: Develop and report information on concrete parking lots and site paving.

Goals: 1) Draft "Guide for the Design and Construction of Concrete Pavements for Industrial and Trucking Facilities"; 2) Revise "Standard Specification for Plain Concrete Parking Lots (ACI 330.1).

Chair: Robert Varner

TAC Contact: Eldon Tipping

Upcoming Open Meetings:
ACI Spring Convention 2015 - 4/15/2015 8:00 AM-4:30 PM - C-2208, Kansas City, MO

Upcoming Convention Sessions:
Heavy Duty Concrete Pavements, Part 1 of 2
ACI Spring Convention 2015 - Kansas City, MO

Heavy Duty Concrete Pavements, Part 2 of 2
ACI Spring Convention 2015 - Kansas City, MO

Active Committee Documents:
- 330.1-14: Specification for Unreinforced Concrete Parking Lots and Site Paving
- 330R-08: Guide for the Design and Construction of Concrete Parking Lots

See all 330 Committee Documents...

Documents Under Development:
- 330.1M-14: Specification for Unreinforced Concrete Parking Lots and Site Paving
- 330.XR: Guide for the Design and Construction of Concrete Site Paving for Industrial and Trucking Facilities

Justification for developing the new Guide

- The original intent of 330R was to provide an easily-used guide for most light-traffic and modest or mixed-traffic parking facilities – broad application and target use
  - Industrial & trucking facility pavements are more complex
- Resources used in developing 330R thickness guidance were valid for truck traffic well beyond target applications
  - Up to 700 ADTT included in design tables
  - But details and construction scenarios common to most parking lots were not really intended for heavy industrial pavements
- No comprehensive resource for industrial apps existed, and new technologies were changing the way these facilities were being designed and built
  - A new Guide document was needed

330R Guide overview

- Focus on common commercial parking lots
- Over-the-road vehicles only, 0 to 700 ADTT*
  - ADTT = average daily truck traffic, as reflected via a counter on the entrance drive (*no more than ½ of design axle loads at any given point)
  - Using axle load distributions for a variety of vehicles
  - 20-year design life, overall reliability of 95%
- Thickness tables covering a broad range of soil support values, concrete strengths, and truck traffic, assuming no load transfer devices at joints
- Use of dowels discussed (for heavier applications) but not emphasized, with alternatives offered
- Use of subbases essentially discouraged except in special cases

330R-08 Thickness table

	MOR, psi:	k = 500 psi/in. (CBR = 50, R = 86) 650	600	550	500	k = 400 psi/in. (CBR = 38, R = 80) 650	600	550	500	k = 300 psi/in. (CBR = 26, R = 67) 650	600	550	500
Traffic Category	A (ADTT =1)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.5
	A (ADTT = 10)	4.0	4.0	4.0	4.5	4.0	4.0	4.5	4.5	4.0	4.5	4.5	4.5
	B (ADTT = 25)	4.0	4.5	4.5	5.0	4.5	4.5	5.0	5.5	4.5	4.5	5.0	5.5
	B (ADTT = 300)	5.0	5.0	5.5	5.5	5.0	5.0	5.5	5.5	5.0	5.5	5.5	6.0
	C (ADTT = 100)	5.0	5.0	5.5	5.5	5.0	5.5	5.5	6.0	5.5	5.5	6.0	6.0
	C (ADTT = 300)	5.0	5.5	5.5	6.0	5.5	5.5	6.0	6.0	5.5	6.0	6.0	6.5
	C (ADTT = 700)	5.5	5.5	6.0	6.0	5.5	5.5	6.0	6.5	5.5	6.0	6.5	6.5
	D (ADTT = 700)	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5

	MOR, psi:	k = 200 psi/in. (CBR = 10, R = 48) 650	600	550	500	k = 100 psi/in. (CBR = 3, R = 18) 650	600	550	500	k = 50 psi/in. (CBR = 2, R = 5) 650	600	550	500
Traffic Category	A (ADTT =1)	4.0	4.0	4.0	4.5	4.0	4.5	4.5	5.0	4.5	5.0	5.0	5.5
	A (ADTT = 10)	4.5	4.5	5.0	5.0	4.5	5.0	5.0	5.5	5.0	5.5	5.5	6.0
	B (ADTT = 25)	5.0	5.0	5.5	6.0	5.5	5.5	6.0	6.0	6.0	6.0	6.5	7.0
	B (ADTT = 300)	5.5	5.5	6.0	6.5	6.0	6.0	6.5	7.0	6.5	7.0	7.0	7.5
	C (ADTT = 100)	5.5	6.0	6.0	6.5	6.0	6.5	6.5	7.0	6.5	7.0	7.5	7.5
	C (ADTT = 300)	6.0	6.0	6.5	6.5	6.5	6.5	7.0	7.5	7.0	7.5	7.5	8.0
	C (ADTT = 700)	6.0	6.5	6.5	7.0	6.5	7.0	7.0	7.5	7.0	7.5	8.0	8.5
	D (ADTT = 700)	7.0	7.0	7.0	7.0	8.0	8.0	8.0	8.0	9.0	9.0	9.0	9.0

Factors that distinguish industrial & trucking facility pavements

- Design traffic may include lift trucks, other extreme axle load vehicles, as well as over-the-road vehicles
  - Also point loads (dolly stands and wheels, product storage)
- Frequent severe loads need higher subgrade support values and non-eroding subgrade/subbase materials
  - Subbses are more the rule than the exception
- Joint stability (load transfer devices) an important integral part of design & construction details
- Usually somewhat higher performance concrete mixtures
- Larger pavement areas & different placement methods

New technologies and trends that needed to be addressed

- Increasing % of industrial and trucking pavements placed using laser screeds, higher concrete slumps, different finishing methods
- New load transfer technologies
- Trends toward higher non-standard wheel & point loads
- Broader range of options for subgrade improvement and subbase design to enhance performance

OVERVIEW and HIGHLIGHTS of the (DRAFT) “330X” DOCUMENT

NOTE: The document is still in a DRAFT in review and subject to revision!

General distinctions relative to 330R

- Design assumes 100% of traffic in the "design lane"
- Pavement designed for all loads, including OTR trucks, lift trucks, static and/or concentrated (point) loads, and other non-traditional vehicle wheel/track configurations
- Non-eroding subgrade / subbase combinations with higher minimum support values than for typical parking lots
- More stringent requirements: joint spacing, detailing, sealing
- Focus on joint stability design – control of pumping and subgrade erosion in combination with joint load transfer
  - Specific guidance on load transfer device (dowels) design
- More concrete mixture design info, focus on durability, low shrinkage, optimum properties based on placement equipment
- More detailed construction guidance, various placement methods and equipment options, covering operational factors that impact pavement quality, influences of the environment

CONTENTS

CHAPTER 1 – GENERAL
- 1.1 – Introduction
- 1.2 – Scope
- 1.3 – Background

CHAPTER 2 – Notations and Definitions
- 2.1 – Definitions

CHAPTER 3 – SUBGRADES and SUBBASES
- 3.1 Pavement Support System
- 3.2 Subgrade/Subbase Failure Modes
- 3.3 Subgrade Considerations
- 3.4 Subbase Considerations

CHAPTER 4 – PAVEMENT DESIGN
- 4.1 - Introduction
- 4.2 - Loads
- 4.3 - Concrete properties
- 4.4 - Jointing
- 4.5 – Reinforcing
- 4.6 – Joint Stability (Load Transfer)
- 4.7 - Thickness Design
- 4.8 - Other Design Features

CHAPTER 5 – CONCRETE MATERIALS AND MIXTURE PROPORTIONING
- 5.1 – Introduction
- 5.2 – Cementitious Materials
- 5.3 – Mixing Water
- 5.4 – Aggregates
- 5.5 – Admixtures
- 5.6 – Concrete Mixture Design

CHAPTER 6 – CONSTRUCTION
- 6.1 Introduction
- 6.2 Subgrade and Subbase preparation
- 6.3 Layout for construction
- 6.4 Forming and the use of rigid screed guides
- 6.5 Concrete placement, screeding and finishing
- 6.6 Installation of the different joint types
- 6.7 Joint sealing or filling
- 6.8 Curing
- 6.9 Special considerations for adverse weather conditions
- 6.10 Striping
- 6.11 Opening to traffic

CHAPTER 7 – INSPECTION and TESTING
- 7.1 - Introduction
- 7.2 - Site preparation
- 7.3 - Subgrade and subbase
- 7.4 - Forming
- 7.5 – Reinforcing steel
- 7.6 - Concrete quality
- 7.7 - Concrete Curing
- 7.8 - Jointing
- 7.9 - Surface texture

CHAPTER 8 –MAINTENANCE, PRESERVATION and REPAIR
- 8.1 - Introduction
- 8.2 - Surface sealing
- 8.3 - Joint re-sealing and crack sealing
- 8.4 - Partial-depth repair
- 8.5 – Full Depth Repair
- 8.6 – Under-Sealing and Leveling

CHAPTER 9 –SUSTAINABILITY and INDUSTRIAL CONCRETE PAVEMENTS
- 9.1 Sustainability Considerations
- 9.2 Concrete as a Sustainable Industrial Pavement System
- 9.3 Life Cycle Analysis

CHAPTER 10 –References

APPENDIX
- Appendix A (Soils classifications and testing info)
- Appendix B (Design software, design example)
- Appendix C (Enhanced aggregate interlock method)
- Appendix D (Shrinkage, curling & warping influences)

Refined guidance on characterization and support value of subgrade / subbase combinations

Table 3.3 - Modulus of subgrade reaction k and resilient modulus M_R for typical subgrade soils

Soil Type	Support	Resilient Modulus (M_R), psi	Typical k-Values, pci
A. Fine Grained with high amounts of silt/clay	Low	1455 - 2325	75 - 120
B. Sand and sand-gravel with moderate silt/clay	Medium	2500 - 3300	130 - 170
C. Sand and sand-gravel with little or no silt/clay	High	3500 - 4275	180 - 220

Table 3.4.4.1a—Resilient modulus values for different subbase and stabilized subgrade types (American Concrete Paving Association 2012)

Type	Subbase Resilient Modulus (M_R), psi
Dense/free draining unbound compacted granular materials	15,000 to 45,000
Lime modified subgrade	20,000 to 70,000
Bituminous stabilized subbase	40,000 to 300,000
Cement stabilized subgrade	50,000 to 1,000,000
Hot-mix asphalt subbase	350,000- to 1,000,000
Cement treated subbase	500,000 to 1,000,000
Lean concrete/econocrete subbase	1,000,000 to 2,000,000

k-values can also be estimated from the resilient modulus for an unbound soil, through the equation

$$k \text{ (pci)} = M_R \text{ (psi)} / 19.4 \text{ (AASHTO 1993)} \quad (3.4.4.1a)$$

If the soil resilient modulus is not known, M_R can be estimated from CBR through the equation

$$M_R \text{ (psi)} = 1500 \times \text{CBR (AASHTO 1993)} \quad (3.4.4.1b)$$

Refined guidance on characterization and support value of subgrade / subbase combinations

Table 3.4.4.2a—Composite *k*-values for asphalt/bituminous treated subbase

Soil type*	Soil layer *k*-value	Thickness of subbase with M_R between 40,000 to 1,000,000 psi			
		4 in.	6 in.	9 in.	12 in.
A	100	120 to 176	138 to 239	165 to 339	192 to 445
B	150	171 to 251	192 to 334	226 to 463	259 to 599
C	200	220 to 323	244 to 424	282 to 579	320 to 740

* Refer to Table 3.3

Table 3.4.4.2b—Composite k-Values for Cement Treated Subbase and Lean Concrete/Econocrete Subbase

Soil type*	Soil layer *k*-value	Thickness of subbase with M_R between 500,000 to 2,000,000 psi			
		4 in.	6 in.	9 in.	12 in.
A	100	162 to 191	212 to 269	290 to 396	371 to 533
B	150	231 to 273	297 to 376	397 to 541	500 to 718
C	200	298 to 351	376 to 477	496 to 676	618 to 887

* Refer to Table 3.3

Table 3.4.4.1c—Composite *k*-values for unbound granular subbase and lime modified subgrades

Soil type*	Soil layer *k*-value	Thickness of subbase with M_R between 15,000 to 70,000 psi			
		4 in.	6 in.	9 in.	12 in.
A	100	106 to 128	116 to 152	132 to 187	149 to 223
B	150	152 to 183	163 to 212	181 to 256	201 to 300
C	200	200 to 235	206 to 269	226 to 319	248 to 370

Thickness tables – OTR trucks

Table 4.2.4d – Axle load distributions

Axle load (1000 lbs)	Axle load (kN)	Number of axles per 1000 trucks
Single axles		
16	71	57.07
18	80	68.27
20	89	41.82
22	98	9.69
24	107	4.16
26	116	3.52
28	125	1.78
30	133	0.63
32	142	0.54
34	151	0.19
Tandem axles		
24	107	71.16
28	125	95.79
32	142	109.54
36	160	78.19
40	178	20.31
44	196	3.52
48	214	3.03
52	231	1.79
56	249	1.07
60	267	0.57

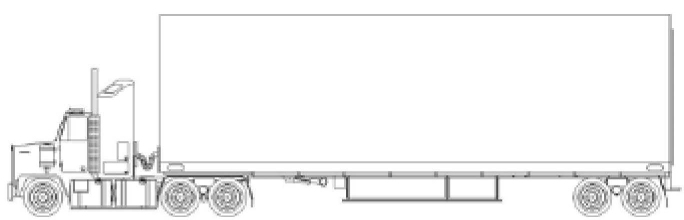


Table 4.2.4a – Thickness and joint spacing table for over the road trucks: *k* = 150 pci

No. of trucks per day in the design lane	Modulus of rupture, psi					
	550		650		750	
	d, in.	Maximum *JS*, ft	*d*, in.	Maximum *JS*, ft	*d*, in.	Maximum *JS*, ft
1	6.0	13	5.5	11	5.0	11
10	7.0	14	6.5	13	6.0	12
50	7.5	15	7.0	14	6.5	13
100	8.0	15	7.0	15	6.5	13
200	8.0	15	7.5	15	7.0	14
500	8.5	15	7.5	15	7.0	14
1000	8.5	15	8.0	15	7.0	15

Table 4.2.4b – Thickness and joint spacing table for over the road trucks: *k* = 200 pci

No. of trucks per day in the design lane	Modulus of rupture, psi					
	550		650		750	
	d, in.	Maximum JS, ft	*d*, in.	Maximum JS, ft	*d*, in.	Maximum JS, ft
1	6.0	12	5.5	11	5.0	10
10	7.0	14	6.0	13	5.5	12
50	7.5	15	6.5	14	6.0	13
100	7.5	15	7.0	14	6.5	13
200	8.0	15	7.0	14	6.5	13
500	8.0	15	7.5	15	7.0	14
1000	8.5	15	7.5	15	7.0	14

able 4.2.4c—Thickness and joint spacing table for over the road trucks: *k* = 300 pci

No. of trucks per day in the design lane	Modulus of rupture (psi)					
	550		650		750	
	d, in.	Maximum *JS*, ft	*d*, in.	Maximum *JS*, ft	*d*, in.	Maximum *JS*, ft
1	5.5	10	5.0	9	5.0	9
10	6.5	12	6.0	11	5.5	10
50	7.0	13	6.5	12	6.0	11
100	7.0	14	6.5	12	6.0	11
200	7.5	14	7.0	13	6.0	12
500	7.5	15	7.0	13	6.5	12
1000	8.0	15	7.0	14	6.5	12

Criteria includes 30-year design life, 85% reliability, 15% cracked slabs @ design life end

Thickness tables – lift trucks

(Dual wheel table shown)

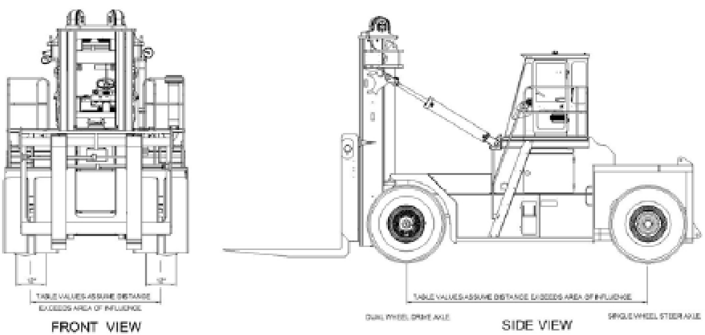


Table 4.7.1b - Thickness table for industrial vehicles with dual wheel

				Subgrade reaction k = 150 pci; Modulus of rupture, psi			Subgrade reaction k = 200 pci; Modulus of rupture, psi			Subgrade reaction k = 300 pci; Modulus of rupture, psi		
Total axle load, lb	Tire pressure, psi	Contact area, in.^{2}	Distance center to center of dual wheels, in.	550	650	750	550	650	750	550	650	750
60,000	75	200	12	11.0	10.0	9.5	11.0	10.0	9.0	10.5	9.5	9.0
	100	150	12	11.5	10.5	9.5	11.0	10.0	9.5	11.0	10.0	9.0
	125	120	12	11.5	10.5	10.0	11.5	10.5	9.5	11.0	10.0	9.5
70,000	75	233	12	12.0	11.0	10.0	11.5	10.5	10.0	11.5	10.5	9.5
	100	175	12	12.5	11.5	10.5	12.0	11.0	10.0	11.5	10.5	10.0
	125	140	12	12.5	11.5	10.5	12.5	11.5	10.5	12.0	11.0	10.0
80,000	75	267	12	13.0	11.5	11.0	12.5	11.5	11.0	12.0	11.0	10.5
	100	200	12	13.0	12.0	11.0	13.0	12.0	11.0	12.5	11.5	10.5
	125	160	12	13.5	12.5	11.5	13.0	12.0	11.0	13.0	11.5	11.0
90,000	75	300	12	13.5	12.5	11.5	13.5	12.0	11.5	13.0	12.0	11.0
	100	225	12	14.0	13.0	12.0	13.5	12.5	11.5	13.5	12.0	11.5
	125	180	12	14.5	13.0	12.0	14.0	13.0	12.0	13.5	12.5	11.5
100,000	75	333	12	14.5	13.0	12.0	14.0	13.0	12.0	13.5	12.5	11.5
	100	250	12	14.5	13.5	12.5	14.5	13.0	12.5	14.0	13.0	12.0
	125	200	12	15.0	14.0	13.0	15.0	13.5	12.5	14.5	13.0	12.0
110,000	75	367	12	15.0	13.5	12.5	14.5	13.5	12.5	14.0	13.0	12.0
	100	275	12	15.5	14.0	13.0	15.0	14.0	13.0	14.5	13.5	12.5
	125	220	12	16.0	14.5	13.5	15.5	14.0	13.0	15.0	14.0	13.0
120,000	75	400	12	15.5	14.5	13.5	15.5	14.0	13.0	15.0	13.5	12.5
	100	300	12	16.0	15.0	13.5	16.0	14.5	13.5	15.5	14.0	13.0
	125	240	12	16.5	15.0	14.0	16.0	15.0	14.0	15.5	14.5	13.5
130,000	75	433	12	16.0	15.0	14.0	16.0	14.5	13.5	15.5	14.0	13.0
	100	325	12	17.0	15.5	14.5	16.5	15.0	14.0	16.0	14.5	13.5
	125	260	12	17.0	15.5	14.5	17.0	15.5	14.5	16.5	15.0	14.0
140,000	75	467	12	17.0	15.5	14.5	16.5	15.0	14.0	16.0	14.5	13.5
	100	350	12	17.5	16.0	14.5	17.0	15.5	14.5	16.5	15.0	14.0
	125	280	12	18.0	16.5	15.0	17.5	16.0	15.0	17.0	15.5	14.5
150,000	75	500	12	17.5	16.0	15.0	17.0	15.5	14.5	16.5	15.0	14.0
	100	375	12	18.0	16.5	15.5	17.5	16.0	15.0	17.0	15.5	14.5
	125	300	12	18.5	17.0	15.5	18.0	16.5	15.5	17.5	16.0	15.0

Punching shear stress – concentrated loads

Table 4.7.5 – Minimum thickness to prevent punching shear, in. (mm)

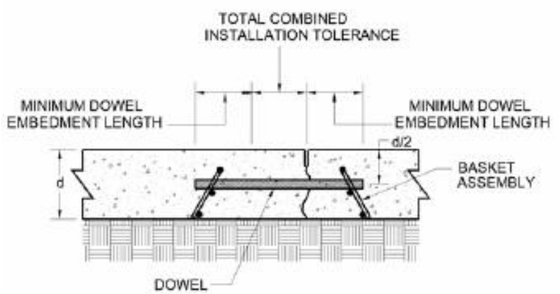
Load, lb (kg)	Modulus of rupture, psi (MPa)		
	550 (3.8)	650 (4.5)	750 (5.2)
	Minimum thickness	Minimum thickness	Minimum thickness
10,000 (4536)	5.0 (127)	5.0 (127)	4.5 (114)
12,000 (5443)	5.5 (140)	5.0 (127)	5.0 (127)
14,000 (6350)	6.0 (152)	5.0 (127)	5.0 (127)
16,000 (7258)	6.0 (152)	5.5 (140)	5.0 (127)
18,000 (8165)	6.5 (165)	5.5 (140)	5.5 (140)
20,000 (9072)	6.5 (165)	5.5 (140)	5.5 (140)
22,000 (9979)	6.5 (165)	6.0 (152)	5.5 (140)
24,000 (10,886)	6.5 (165)	6.0 (152)	5.5 (140)
26,000 (11,793)	7.0 (178)	6.0 (152)	6.0 (152)
28,000 (12,701)	7.0 (178)	6.0 (152)	6.0 (152)
30,000 (13,608)	7.0 (178)	6.0 (152)	6.0 (152)
32,000 (14,515)	7.0 (178)	6.5 (165)	6.0 (152)
34,000 (15,422)	7.5 (191)	6.5 (165)	6.0 (152)

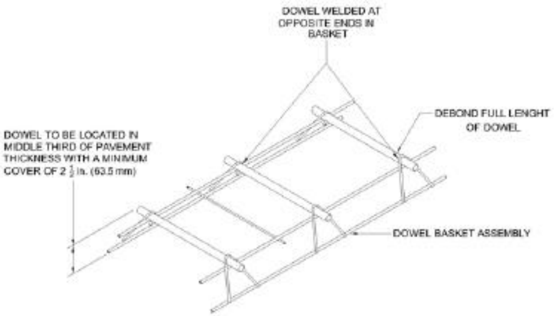
Bearing stress design – concentrated loads

Table 4.7.6 – Minimum compressive strength for bearing stress, psi (MPa)

Load, lb (kg)	Area, in.^{2} (mm^2)		
	2 (1290)	3 (1936)	4 (2581)
	Minimum compressive strength	Minimum compressive strength	Minimum compressive strength
10,000 (4536)	3620 (25.0)	1609 (11.1)	905 (6.2)
12,000 (5443)	4344 (30.0)	1931 (13.3)	1086 (7.5)
14,000 (6350)	5068 (34.9)	2252 (15.5)	1267 (8.7)
16,000 (7258)	5792 (39.9)	2574 (17.7)	1448 (10.0)
18,000 (8165)	6516 (44.9)	2896 (20.0)	1629 (11.2)
20,000 (9072)	NA	3218 (22.2)	1810 (12.5)
22,000 (9979)	NA	3539 (24.4)	1991 (13.7)
24,000 (10,886)	NA	3861 (26.6)	2172 (15.0)
26,000 (11,793)	NA	4183 (28.8)	2353 (16.2)
28,000 (12,701)	NA	4505 (31.1)	2534 (17.5)
30,000 (13,608)	NA	4827 (33.3)	2715 (18.7)
32,000 (14,515)	NA	5148 (35.5)	2896 (20.0)
34,000 (15,422)	NA	5470 (37.7)	3077 (21.2)

Load transfer design & construction guidance





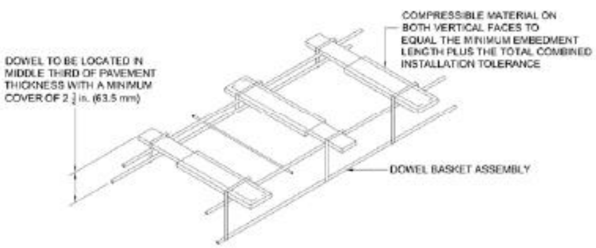


Table 4.6.2.1 - Dowel size and spacing for round, square and rectangular dowels.

Pavement depth, in. (mm)	Dowel dimensions[*], in. (mm)					Dowel spacing center-to-center, in. (mm)		
	Construction joint[†]		Contraction joint[†]			Round	Square	Rectangular
	Round[‡]	Square[§]	Round[‡]	Square[§]	Rectangular[§, ‖]			
5 to <7[#] (130 to <180)	-	-	-	-	3/8 x 2 x L[**] (10 x 50 x L[**])	12 (300)	14 (360)	19 (475)
7 to <8 (180 to <200)	1[††] x 13 (25 x 330)	1[††] x 13 (25 x 410)	1[††] x 16 (25 x 410)	1[††] x16 (25 x 410)	½ x 2-1/2 x L[**] (12 x 60 x L[**])	12 (300)	14 (360)	18 (450)
8 to <11 (200 to <280)	1-1/4 x 15 (32 x 380)	1-1/4 x15 (32 x 380)	1-1/4 x 18 (32 x 460)	1-1/4 x 18 (32 x 460)	¾ x 2-1/2 x L[**] (19 x 60 x L[**])	12 (300)	14 (360)	18 (450)
11 + (280 +)	1-1/2 x 15 (38 x 380)	1-1/2 x 15 (38 x 380)	1-1/2 x 18 (38 x 460)	1-1/2 x 18 (38 x 460)	¾ x 2-1/2 x L[**] (19 x 60 x L[**])	12 (300)	14 (360)	12 (300)

Notes:

[*]Table values based on a maximum joint opening of 0.20 in. (5 mm). Carefully align and support dowels during concrete operations. Misaligned dowels may lead to cracking. Spacings are based on dowels in direct contact with a thin bond breaker.

[†]Total dowel length includes allowance made for joint opening and minor errors in positioning dowels.

[**]Refer to 4.6.2.6 and Fig. 4.6.2.1 for recommended rectangular plate dowel length.

[‡]ACI Committee 325 (1956), Teller and Cashell (1958).

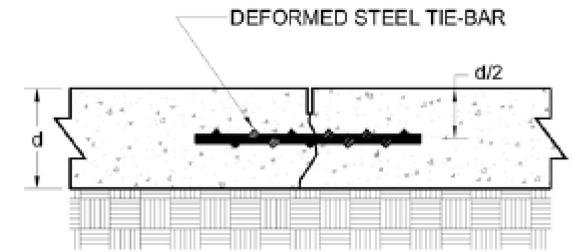
[‖]Walker and Holland (1998).

[§]Square and rectangular dowels should have a void space or compressible material securely attached on both vertical faces.

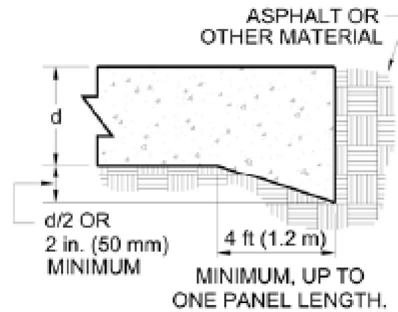
[#]Current industry guides do not recommend the use of round dowels in pavement sections less than 7 in. (180 mm) (ACI 330R, American Concrete Paving Association 2012).

[††]Current industry guides don't recommend the use of round dowels below a 1 in. (25 mm) diameter in pavements with truck traffic because of the high bearing stresses on the concrete at the intersection of the joint (ACI 330R). Others recommend a minimum round dowel diameter of 1-1/4 in. (31.75 mm) (FHWA).

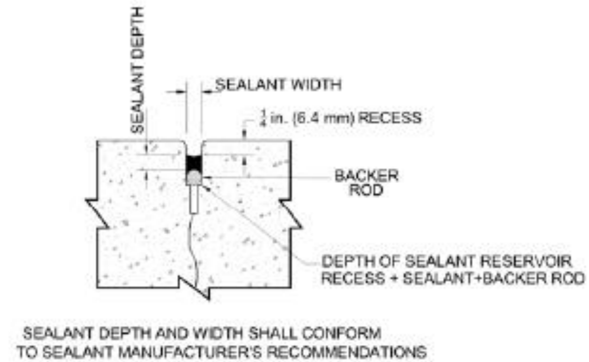
Recommended details



SECTION
(CAN BE INSTALLED IN A BASKET ASSEMBLY, ON CHAIRS OR WITH MECHANICAL INSERTION)



SECTION



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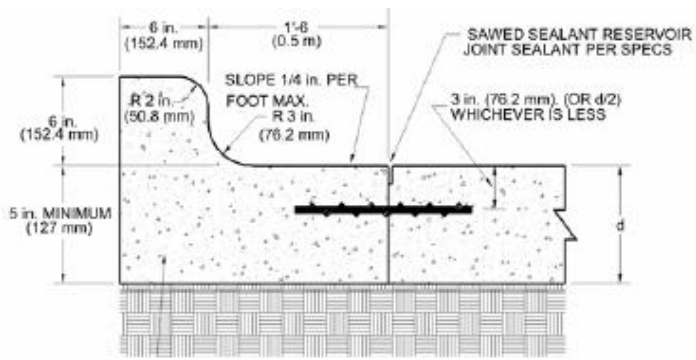


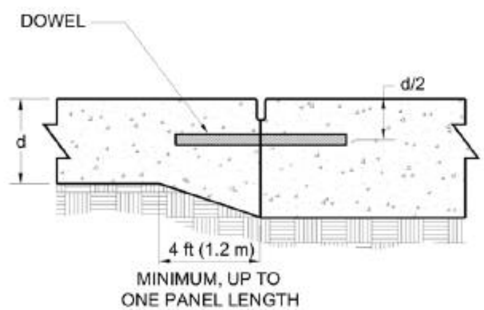
SECTION

SLOPE GRADE AS REQ'D
FOR DRAINAGE

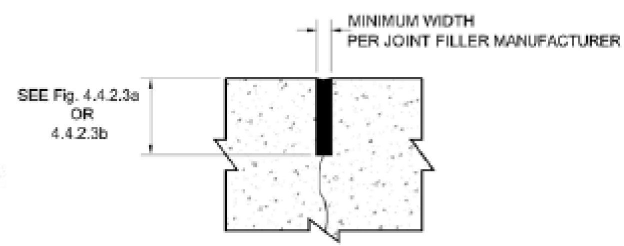
GEOMETRY OF RAISED CURB TO
VARY WITH LOCAL PRACTICE

TRANSVERSE JOINTS IN PAVEMENT TO EXTEND
THROUGH CURB

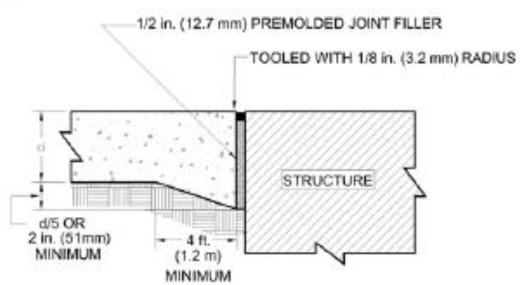
SEE CURB DESIGN FOR REINFORCING DETAILS
DISCONTINUE REINFORCING AT JOINTS



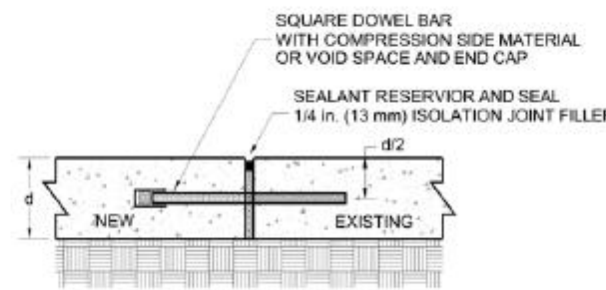
SECTION



SECTION



SECTION



SECTION

Guidance on which document to use (330R vs. 330X)

This document has been developed to support the design and construction of industrial and trucking facility pavements as described previously. It should be noted that ACI 330R, might also be a guide document that could be used for some similarly-described facilities. Each document has been developed as a stand-alone guide that provides critical design information and recommended construction practices for successful paving projects. The selection of which guide document to use for a particular project should consider not only the specific traffic level to be accommodated but the types of design loads (especially when they may include industrial lift trucks and other special loads), the percentage of accommodated vehicles which are very heavy, site geotechnical considerations such as in-place subgrade character and drainage, joint spacing, and potential future uses of the facility. In general, this guide is intended for facilities with heavier design loads, non-standard vehicles, and/or higher volumes of heavy trucks. Examples of such facilities may include warehouses, factories, truck terminals, heavy equipment sales and service distribution centers, and ports. ACI 330R is intended for use when truck loads are generally lighter, traffic volumes lower, or both, though many successful projects accommodating higher average daily truck traffic of mixed vehicle loads have been designed using ACI 330R. Examples of typical parking lots most consistent with the intended scope of ACI 330R would include concrete pavements for apartment complexes, shopping malls, convenience stores, gas stations, banks, and office buildings.

Questions?

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