

ACI 330.2R-17

Nigel Parkes, PNA Construction Technologies



ACI 330.2R-17, *Guide for the Design and Construction of Concrete Site Paving for Industrial and Trucking Facilities*

12 years in development...

Why did it take so long?

- No one else would take on the project
- Committee of volunteers
- Consensus document
- And its more complex that you might first imagine...

ACI 330.2R-17

Guide for the Design and Construction of Concrete Site Paving for Industrial and Trucking Facilities

Reported by ACI Committee 330



ACI 330.2R-17, *Guide for the Design and Construction of Concrete Site Paving for Industrial and Trucking Facilities*



ACI 330.2R-17: GUIDE FOR THE DESIGN AND CONSTRUCTION OF CONCRETE SITE PAVING FOR INDUSTRIAL AND TRUCKING FACILITIES

ACI 330.2R-17

Guide for the Design and Construction of Concrete Site Paving for Industrial and Trucking Facilities

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This guide provides information useful in the design and construction of a successful site-paving project for heavy-duty industrial and trucking facilities. This information assists architects/engineers, contractors, and testing agencies with designing, detailing, constructing, repairing, and inspecting site paving. Engineers use this guide to make recommendations for the pavement support system, concrete mixture, pavement thickness, joint spacing, and load transfer devices. Thickness design tables are included for common over-the-road trucks and industrial lift trucks. Tables are also provided to check the pavement thickness for punching shear and concrete strength for bearing stress applied by loaded trailers that have been disconnected from the tractor. Contractors use this guide to understand proper ways to construct site paving with block or strip placements and avoid common mistakes made during construction. Proper placing, consolidating, and finishing techniques are described to construct a durable pavement that complies with the project documents. Inspectors and testing agencies use this guide to understand the design and be better equipped to monitor the project from stripping and grading of the site to concrete pavement curing. Testing and inspection included in this guide should only be done by individuals holding the appropriate certifications.

ACI Committee Reports, Guides, and Commentaries are intended for guidance in planning, designing, executing, and inspecting construction. This document is intended for the use of individuals who are competent to evaluate the significance and limitations of its content and recommendations and who will accept responsibility for the application of the material it contains. The American Concrete Institute disclaims any and all responsibility for the stated principles. The Institute shall not be liable for any loss or damage arising therefrom.

Reference to this document shall not be made in contract documents. If items found in this document are desired by the Architect/Engineer to be a part of the contract documents, they shall be restated in mandatory language for incorporation by the Architect/Engineer.

Keywords: industrial pavement; joint stability; lift truck; log loader; over-the-road truck; pavement support system; sustainable industrial pavement system; unreinforced concrete pavement.

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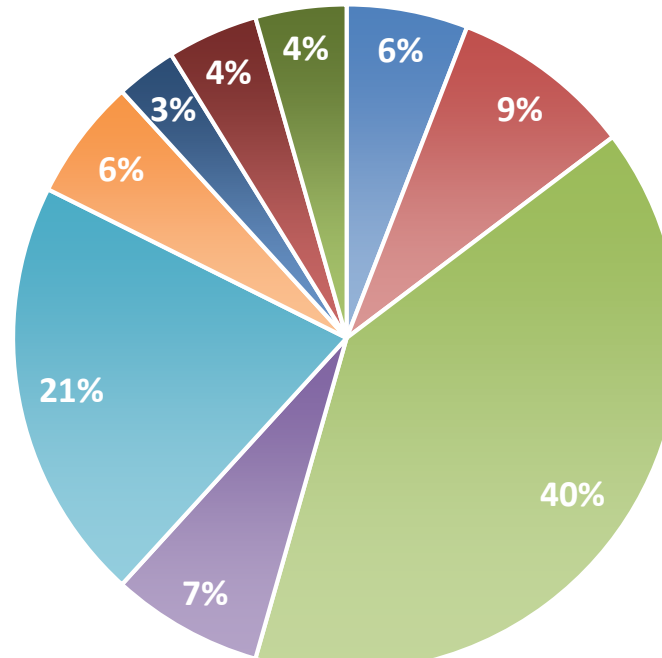
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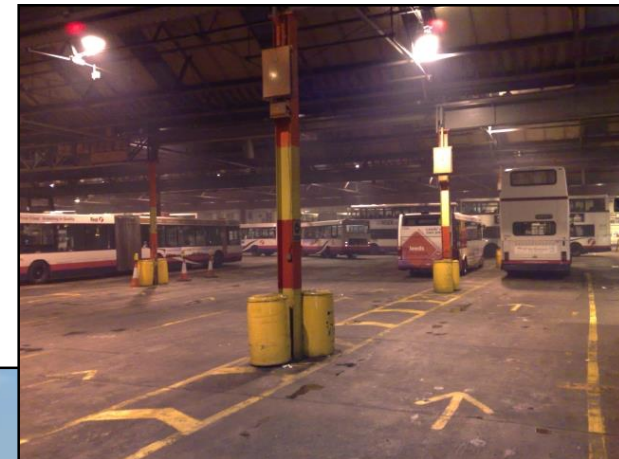
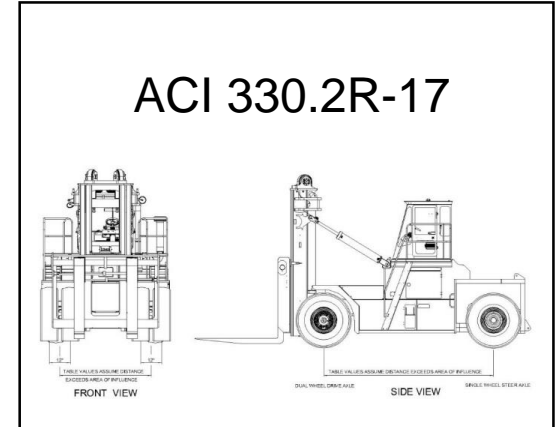
- Intro Materials
- Subgrades & Subbases
- Pavement Design
- Concrete Materials
- Construction
- Inspection & Testing
- Maintenance & Repair
- Sustainability
- References

72 Pages in 10 Chapters and Appendix A to D



WHAT'S INCLUDED IN "INDUSTRIAL & TRUCKING FACILITIES"

- Standard trucks
- Industrial lift trucks
- Front end loaders
- Tracked equipment
- Straddle carriers
- Cranes
- Military equipment
- Buses & coaches
- Agricultural equipment



WHO DESIGNS INDUSTRIAL PAVEMENTS

- Owner / Architect:
 - Loads (vehicle count & growth)
- Geotechnical Engineer:
 - Thickness recommendations based on subgrade support
- Civil Engineer:
 - Concrete strength
 - Joint spacing
 - Joint details & load transfer
 - Drainage details & layout
- Structural Engineer
 - Reinforcement???
- Contractor
 - Construction method
 - Joint layout

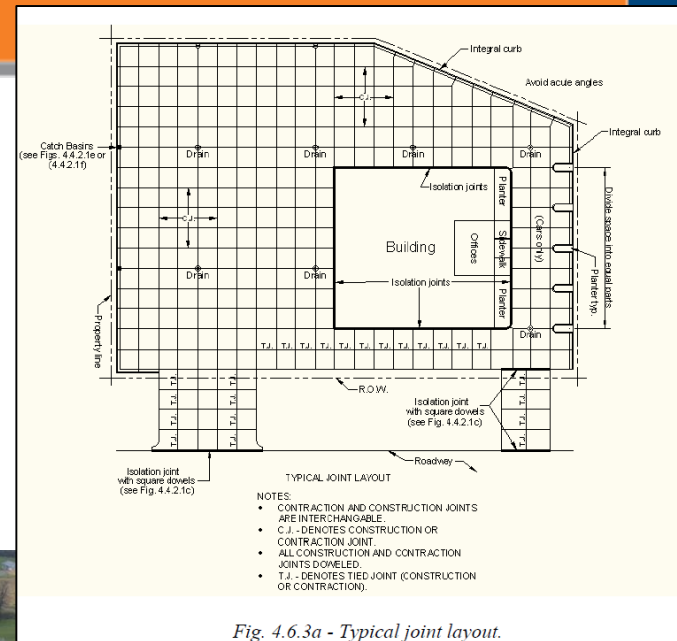


Fig. 4.6.3a - Typical joint layout.



WHO CONSTRUCTS INDUSTRIAL PAVEMENTS

- *“6.5.3.1 Mechanical screeding—Numerous pieces of equipment and machines have been developed for screeding concrete flatwork.”*
- Slip formed
- Truss-Screeded; or
- Laser-Screeded
- ‘Magic’-Screeded; or
- Hand-Screeded



3D LASER SCREED®

“Laser-guided screeds are useful in the construction of large block pavement placements.”



“6.5.3.4 Laser-guided screeds—Laser-guided screeds can be used to consolidate and strike off concrete to the proper grade and slope with great efficiency.”

HOW JOINTING CAN BE DIFFERENT IN INDUSTRIAL FACILITIES

- Pavement thickness can vary significantly in the same project
- More structures and embedment's to consider
- Construction methods can vary
 - Laser-screeding® in large blocks (with truck dumping of concrete or pumping)
 - Slipforming or vibratory-screeding in lanes
 - “Magic” or hand-screeding in complicated / tight areas
- Each joint type can occur in either the transverse or longitudinal directions
 - Two directional doweling
- All joint types can require load transfer devices
 - Construction, Contraction & Isolation

JOINT DETAILS

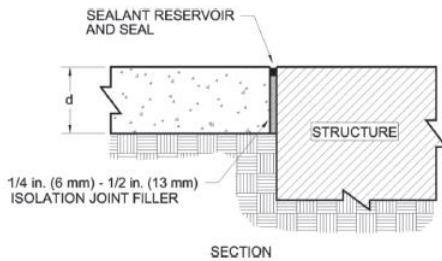


Fig. 4.4.2.1a—Isolation joint.

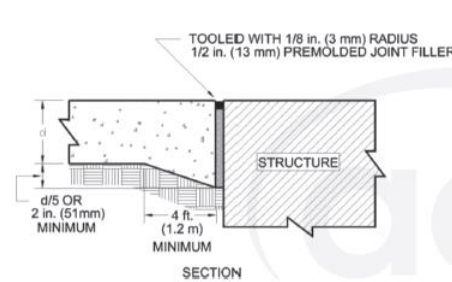


Fig. 4.4.2.1g—Thickened edge isolation joint.

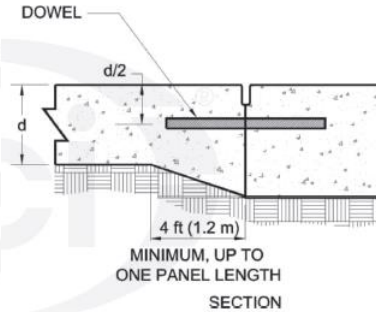


Fig. 4.4.2.2—Transition between sections of pavement different thicknesses.

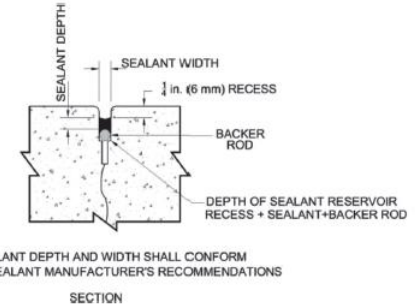


Fig. 4.4.3a—Joint sealant with backer rod.

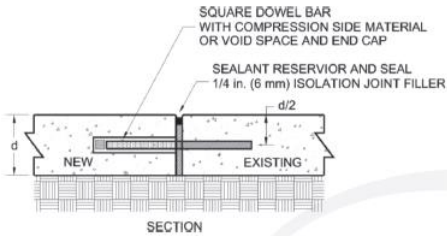


Fig. 4.4.2.1b—Transition between new and existing pavements with different joint spacing.

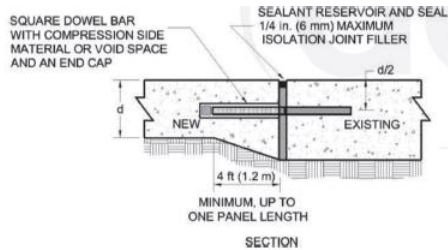
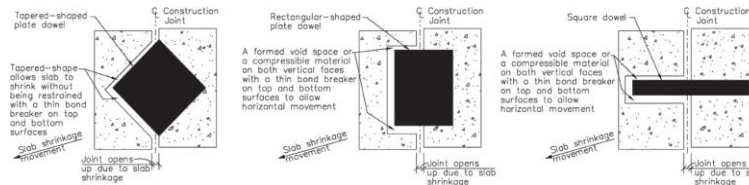
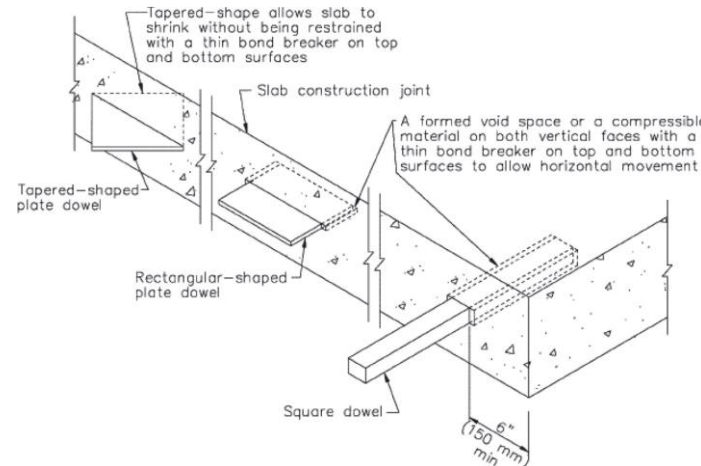


Fig. 4.4.2.1c—Transition between new and existing pavements with different joint spacing and thickness.

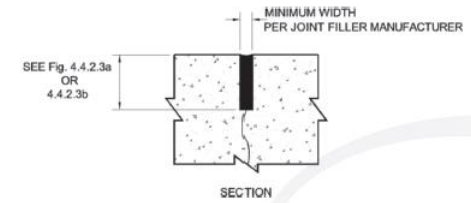
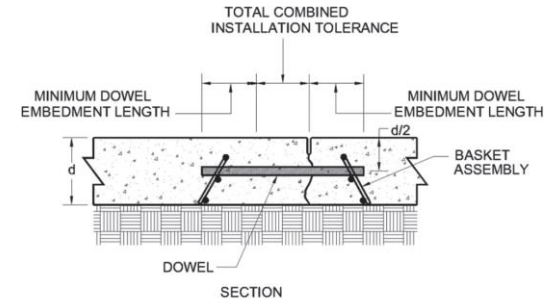


Fig. 4.4.3b—Joint filling.



NOTES:

- DOWELS SHOULD HAVE SQUARE END / EDGES AND BE DEBONDED.
- TOTAL COMBINED INSTALLATION TOLERANCE INCLUDES THE TOLERANCE FOR INSTALLING THE DOWEL BASKET ASSEMBLY AND THE SAW CUT ABOVE IT.
- THE MINIMUM DOWEL EMBEDMENT LENGTH VARIES FOR DIFFERENT GEOMETRIES.

STREETPAVE™ ...FOUNDATION OF THE 330.2R-17 DESIGN TABLES

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

Note: Recommended thicknesses are based on specific joint spacing and positive load transfer.

“**B.1.1 ACPA StreetPave 12**—Although tailored for jointed plain concrete pavement (JPCP) thickness design for streets and local roads, this software (ACPA 2012) can be used to design the areas of trucking and industrial facilities that service primarily truck loads. Based on both mechanistic and empirical formulas, the software considers thickness design concepts, such as design reliability, concrete material properties, subgrade/subbase support, structural features such as dowel bars and edge support, and traffic to calculate an optimized concrete surface course thickness.”

Based on...



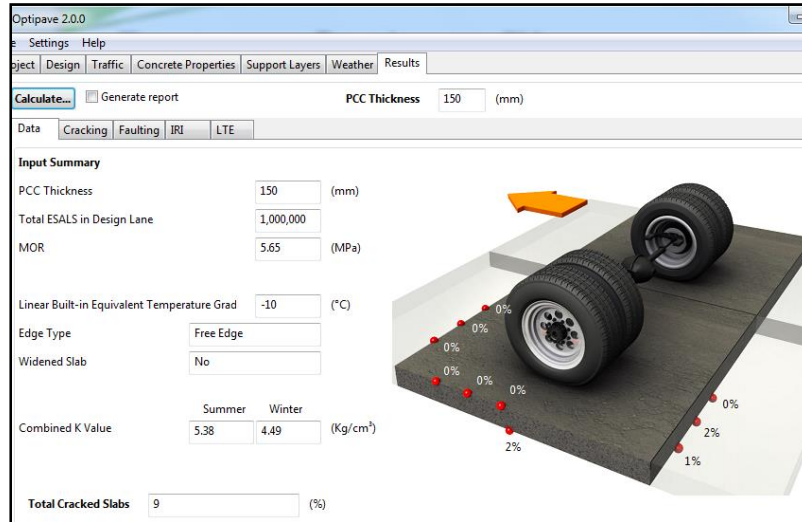
AASHTOWARE PAVEMENT ME

“**B.1.2 AASHTOWare Pavement ME Design**—This software represents a state-of-the-practice design and analysis tool for concrete, with and without internal reinforcement, and asphalt pavements, overlays, and selective rehabilitation techniques. It features advanced analysis tools to calculate pavement responses as a function of load, local environment, materials, and pavement structure, including details such as drainage. Performance predictions, such as pavement smoothness and faulting, relate these computed parameters (mechanistic elements) to observed performance (empirical elements) over time.”



AASHTO
2009-2016
≈ 1,000 inputs
Crack, Fault, IRI
FEA + Field Data

OPTIPAVE™ (“TCPAVEMENTS”)



- Founded in I-Slab
- Developed by Juan Pablo Covarrubias with Lev Khazanovich
- Tested by Jeff Roesler at U. of IL
- 5' to 8' joint spacing (Pavement ME 10' +)

“**B.1.3 TCpavements**—This software is mechanistic-based and specifically developed to design concrete pavements for any set of climate, traffic, subgrade/subbase layers, and material inputs...This methodology designs the concrete pavement thickness by optimizing the slab size to suit a given geometry of truck wheel and axle spacing.”

ACI 330.2R-17 ALREADY IN USE - ALDI DISTRIBUTION CENTERS



800,000 s.f under roof
1,200,000 s.f. exterior pavement

Old Concrete Design:

- AASHTO 93 - 9 ¼" with 15' joint spacing

Proposed Design for Cost Saving:

- Asphalt throughout

New Design:

- Heavy Duty – StreetPave™ 7" with 12' joint spacing
- Medium Duty – OptiPave™ 5.5" with 6' joint spacing
- Light Duty – OptiPave™ 4" with 6' joint spacing

SUMMARY

- 12 years in development
- Industrial is complex
- Designed and constructed by different groups
- Already in use & successfully switching asphalt to concrete
- Promotion underway...

...Please don't let the ACPA, NRMCA & PCA unified design conflict with or contradict this document!

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Thank you

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