

PNA PD3 Basket® Alternatives to Round Dowel Standards

Using PNA’s advanced mechanistic-empirical PD3 Dowel Calculator, the PD3 Basket® assembly designs shown below were determined as alternates for each common round dowel design. Note also that the PD3 Basket® assembly will provide superior performance in terms of less restraints to slab movements compared to the corresponding round dowel basket.

Round Dowels @ 12" o/c	Slab Thickness	Max Joint Spacing	PD3 Basket® Assembly
3/4" dia	6"	12'	3/8" x 2" @ 24" o/c in 5-6.5" standard PD3 Basket® – 8 plates
	7"	14'	3/8" x 2" @ 24" o/c in 7-9" standard PD3 Basket® – 7 plates
1" dia	7"	14'	3/8" x 2" @ 18" o/c in 7-9" standard PD3 Basket® – 9 plates
	8"	15'	3/8" x 2" @ 18" o/c in 7-9" standard PD3 Basket® – 10 plates
	9"	15'	3/8" x 2" @ 18" o/c in 7-9" standard PD3 Basket® – 10 plates
1-1/4" dia	9"	15'	1/2" x 2.5" @ 18" o/c in 7-9" standard PD3 Basket® – 10 plates
	10"	15'	1/2" x 2.5" @ 24" o/c in 9.5-13" standard PD3 Basket® – 7 plates
1-1/2" dia	9"	15'	1/2" x 2.5" @ 18" o/c in 7-9" standard PD3 Basket® – 10 plates
	10"	15'	1/2" x 2.5" @ 24" o/c in 9.5-13" standard PD3 Basket® – 7 plates

Assumptions include: Tire pressure of 150 psi, wheel width of 10", the outside load 5" from the joint intersection, interior load conditions (e.g., not on free edge), wheel load spacing of 48", k-value of 100 psi/in. with a ground-support slab, A36 steel dowel material, 650 psi flexural strength concrete, 90% design load transfer efficiency, joint construction tolerance of ±2", joint crack opening of 0.09 in., modulus of dowel support of 1,500,000 psi, and joint intersection to first dowel distance up to 18". Failure criteria included concrete shear cone capacity, concrete bearing stress, dowel flexural stress, dowel shear stress, and joint differential deflection with a limit of 0.020".

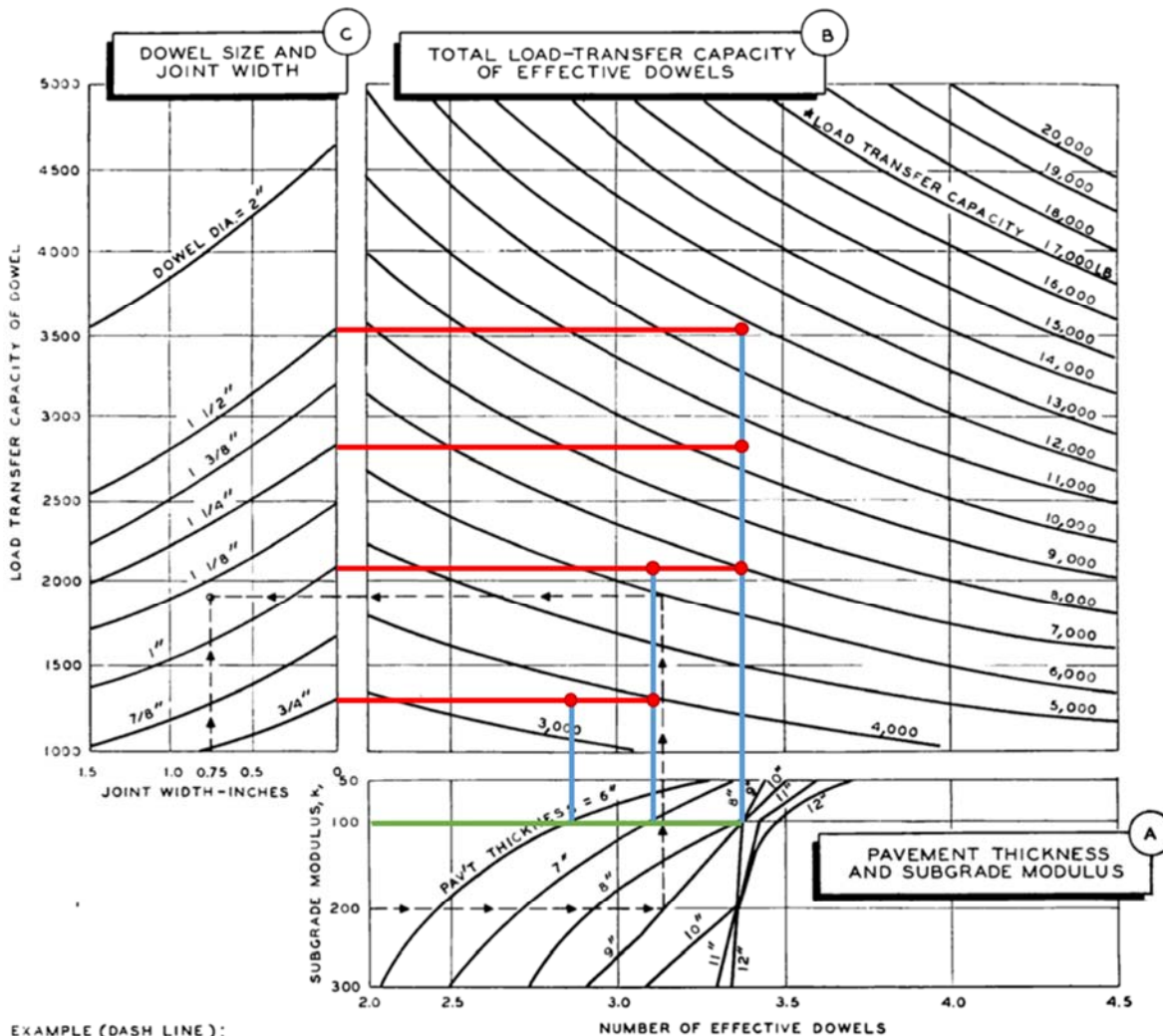
The common round dowel designs above, with their characteristic 12 in. on-center dowel spacing and with the dowel diameter approximately 1/8 the slab thickness, were standardized per guidance in ACI Committee 325’s Report No. 53-1, “Structural Design Considerations for Pavement Joints.” The round dowel load transfer capacity design nomograph on the next page is from this ACI report.

Using this nomograph for 12 in. on-center round steel dowels, axle load capacity ratings were developed for each common round dowel design using the following assumptions:

- Subgrade modulus or k-value = 100 psi/in. (green line)
- Round dowel diameters of 3/4", 1", 1-1/4", and 1-1/2" (red lines)
- Joints negligibly opened (e.g., red lines start at joint widths of 0 in. which will yield an aggressive load capacity compared to the PD3 design that assumes a joint opening of 0.09 in.)
- Slab thickness of 6", 7", or 8/9/10" (blue lines)
- Load transfer capacity of common combinations of round dowel diameter and slab thickness (red dots)

The table following the nomograph on the next page lists the axle load capacities derived from ACI’s guidance that were then used as the basis for the PD3 Basket® designs in the table above.





EXAMPLE (DASH LINE):

K = 200 LB/IN.³
 PAVEMENT THICKNESS = 9 INCHES
 DESIGN LOAD-TRANSFER CAPACITY = 6,000 POUNDS
 JOINT WIDTH 3/4 INCH

RESULTS:
 DOWEL DIAMETER = 1 1/8 INCH

★ LOAD TRANSFER CAPACITY EQUAL TO ONE-HALF DESIGN WHEEL LOAD

Round Dowels @ 12" o/c	Slab Thickness	Transfer Capacity, lb (approximated)	Wheel Load, lb = 2 x Transfer Capacity	Axle Load, lb = 2 x Wheel Load
3/4" dia	6"	3,750	7,500	15,000
	7"	4,000	8,000	16,000
1" dia	7"	6,500	13,000	26,000
	8"	7,000	14,000	28,000
	9"	7,000	14,000	28,000
1-1/4" dia	9"	9,500	19,000	38,000
	10"	9,500	19,000	38,000
1-1/2" dia	9"	11,750	23,500	47,000
	10"	11,750	23,500	47,000

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