

Standardized Basket Design Reduces Project Costs

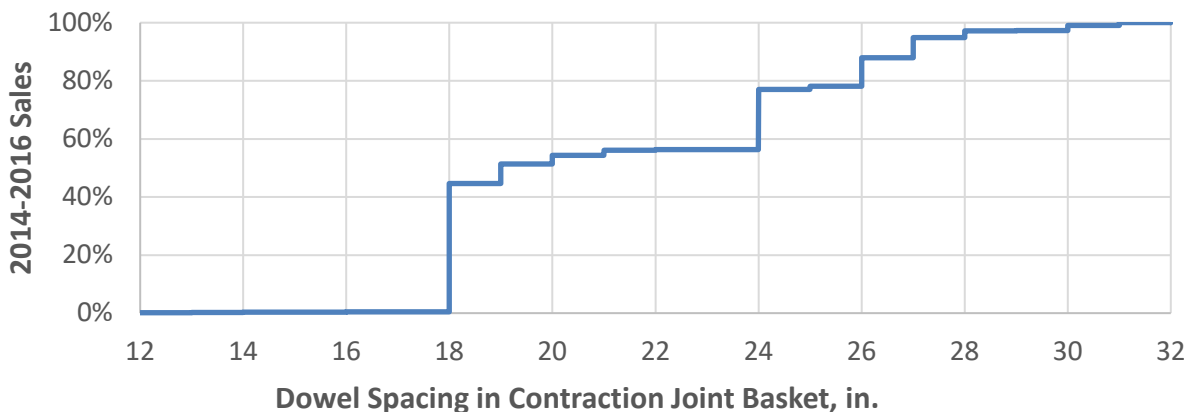
PNA has a strong history of providing custom-engineered doweling solutions for joints in slab-on-ground and pavement applications. Specific to sawcut contraction joints, our PD3 Basket® assembly has offered engineers the flexibility to adjust spacing of tapered plate dowels to optimize the engineered design. With regards to spacing, [ACI 360R-10, “Guide to Design of Slabs-on-Ground,”](#) provides a recommended spacing of 18 in. (460 mm) on-center (o/c) but notes that up to 24 in. (610 mm) spacing has been used successfully [[ACI 330.2R-17, “Guide for the Design and Construction of Concrete Site Paving for Industrial and Trucking Facilities,”](#) contains the exact same guidance]. Paramount to performance of joints is deflection control, with ACI 360R-10 stating:

“Joint or crack stability measurements below 0.010 in. (0.25 mm) for joints or cracks subjected to lift truck wheel traffic with small hard wheels will have good service life (Tarr 2004; Walker and Holland 2007a). For lift truck traffic with large, cushioned rubber wheels, a joint or crack stability measurement of 0.020 in. (0.51 mm) should have good service life (Walker and Holland 1999, 2007a).”

The [Walker and Holland 2007](#) reference of note in this quote is “Performance-Based Dowel Design,” an article authored by these flatwork industry experts at Structural Services, Inc. (SSI) that was written to facilitate design of PNA’s PD3 dowels, which it has successfully done for the past decade. What this design guidance framework from SSI does not include is consideration of common practice and costs. Standardized basket design aims to incorporate such considerations to reduce your project costs.

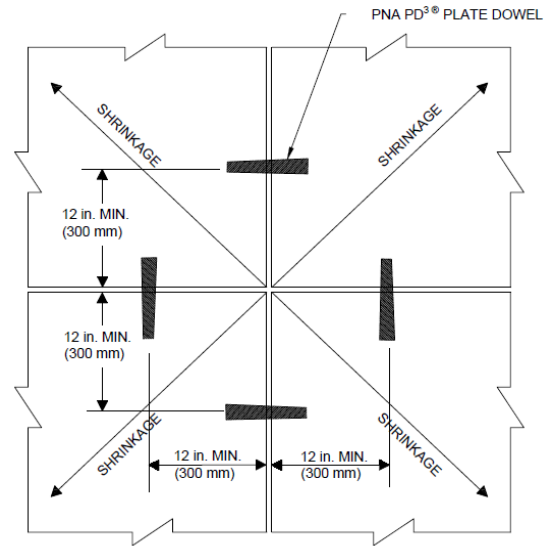
Common Dowel Spacing in PD3 Baskets®

While ACI 360R-10 recommends 18 in. (460 mm) o/c for plate dowels in contraction joints, engineers more commonly specify a further spacing based on the Walker and Holland 2007 reference. Shown below is cumulative sales of PD3 Basket® assemblies for the past 3 calendar years based on dowel spacing. Only 44% of the baskets sold were 18 in. o/c, meaning that the majority were at a further spacing to better optimize the dowel design by using tapered plates. Almost 90% of the total sales were from just 5 o/c spacings: 18”, 19”, 24”, 26”, and 27” o/c.



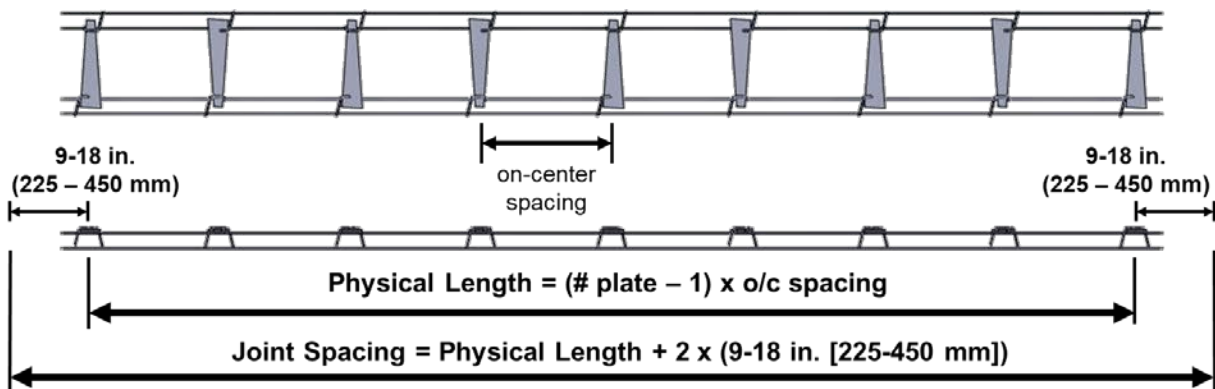
Impact of Dowel Spacing on Costs

Dowel spacing is one of the costliest and most time-consuming variables for a dowel basket manufacturer to change. This, admittedly, is our challenge to manage in our operations and supply chain to your project. However, when this factor compounds with efficiencies in the volume of production, pricing tells the true story. This is easiest to illustrate through an example. Consider a scenario with an 8 in. (200 mm) thick slab and 11 ft (3.35 m) joint spacing. While recommendations vary on the minimum distance between dowels and the joint intersection, with ACI 360R-10 and 330.2R-17 recommending a typical minimum value of 12 in. (300 mm), we will allow for tapered plate dowels to be from 9 – 18 in. (225 – 450 mm) from the joint intersection.



PLAN VIEW

Joint intersection detail (after ACI 330.2R-17).



With a joint spacing of 11 ft (3.35 m) and this tolerance for spacing between end dowel bars on each side of a basket as illustrated above, the physical length of the basket to dowel this joint must be 8 – 9.5 ft (2.4 – 2.9 m). There exist many solutions to providing a PD3 Basket® assembly of this length, including 6 plates at 22 in. (559 mm) or 7 plates at either 18 or 19 in. (457 or 483 mm) o/c. Of course, an engineering check on the suitability of a given dowel size at this spacing is necessary, but, for the sake of illustration, assume that all three of these configurations meet the design requirements. While PNA will produce any dowel spacing you specify, 22 in. o/c is rarely produced and, as such, its price will include a premium because it is a completely custom product. The 18 and 19 in. (457 and 483 mm) o/c options, however, are both more commonly produced, making them lower priced and more readily available.

With changing only dowel spacing, the 7 plate by 18 in. (457 mm) o/c option is a 9 ft (2.7 m) long basket whereas the 19 in. (483 mm) o/c option is a 9.5 ft (2.9 m) basket. **While the \$ per unit length cost might be less for the 19 in. (483 mm) o/c option, the closer 18 in. (457 mm) o/c option might cost less per basket because of its shorter length and the even higher volume-based pricing we can offer you.**

The Value of Dowel Basket Standardization is Well Documented

While PNA is promoting a standardized basket approach to slab-on-ground and exterior pavement design, the approach has been promoted by the concrete pavement industry for more than 5 years. The [National Concrete Consortium \(NCC\)](#), a collection of state agency (DOT and tollway authority) experts in concrete, funded the development of a document titled “[Recommendations for Standardized Dowel Load Transfer Systems for Jointed Concrete Roadway Pavements](#)” (NCC 2011), which notes:

“The adoption of a standard set of dowel basket designs will reduce manufacturer set-up and production costs and will allow manufacturers to more easily maintain a larger inventory of fewer varieties of assembled dowel baskets, **resulting in lower costs and fewer production delays.**”

Dowel Basket Height Standardization

Because PNA utilizes the most modern dowel design framework available, shear cone failure (e.g., breakthrough) of dowels through the concrete cover depth is one of the failure criterion in design, requiring concrete cover depth to become a key design variable. Thorough review of mechanical theories and laboratory and field testing resulted in the following [NCC 2011](#) recommendation:

“The basket height... has been selected to result in placement of the dowel exactly at mid-depth for slab thicknesses at the lower end of each thickness range and placement slightly below mid-depth for slab thicknesses at the upper end of each thickness range.”

The intention of this approach for DOT standardization efforts was to restrict the dowel’s vertical location to the middle one-third of the slab thickness instead of precisely at mid-depth as long as performance is not negatively impacted. This creates opportunity to offer a single basket for a range of slab thicknesses, further reducing basket production and supply costs. PNA has adopted this middle one-third of slab thickness approach while complying with placement tolerances for slab thickness and dowel location per [ACI 117](#) in development of cost-saving standardized basket heights that, when combined with standardized dowel spacing options and PNA’s modern dowel design, will identify the lowest cost PD3 Basket® assembly that meets your project’s performance/serviceability requirements.

For More Information

If you would like to request a complimentary project-specific dowel design for your next project or for more information on this or any other topic related to concrete flatwork:



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