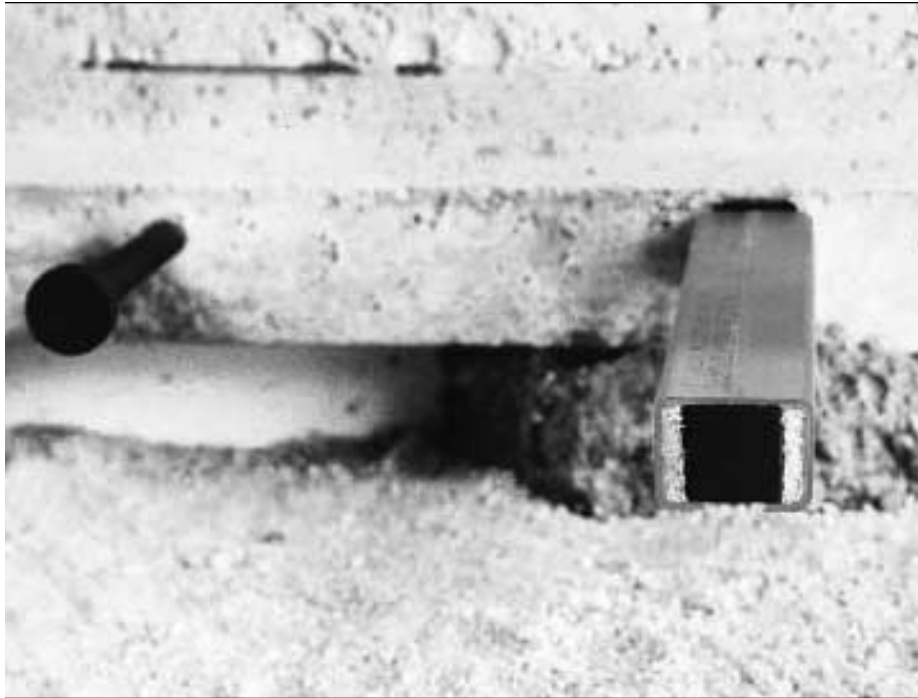


These clips for use on square dowels are made of a hard ABS plastic that transfers floor loads to the dowel with minimal deflection. Compressible material on the sides of the clip allows differential movement of adjacent slabs without causing cracking.



By Ward R. Malisch

In a well-designed industrial floor, the slab's ability to carry loads shouldn't vary. When, for example, a heavily loaded forklift travels across the slab, the forklift should have the required support whether it's in the middle of a floor panel or crossing a joint.

Steel dowels, when aligned carefully and debonded from the concrete, help to carry loads across joints even after the joints have opened too much to prevent load transfer by aggregate interlock. Commonly used at construction joints, and often at contraction joints, dowels also maintain vertical alignment between adjacent slabs by helping to resist faulting and curling at

the joints. However, traditional round dowels may cause slab cracking by restraining movement along doweled longitudinal joints when workers place large floor slabs in long, alternating strips, with infill strips placed later. When the infill concrete tries to shrink, the dowels prevent slab movement parallel to the longitudinal joint, causing internal stresses.

How can engineers economically design for load transfer at joints without restraining movement? Many are solving the problem by using rectangular- or diamond-shaped plate dowels or square dowels fitted with compressible sleeves.

The dowel-clip solution

Square dowels (above) can be fitted with a clip-on device that puts the sides of the dowel in contact with a compressible material. This permits movement along longitudinal joints, reducing restraint cracking. The dowel clip is made of a hard ABS plastic with a compressibility similar to that of concrete. It transmits vertical forces to the square dowel without deforming excessively, thus efficiently transferring loads at the joint (Ref. 1).

The clips cover half of the square dowel and can be used at either construction or contraction joints. When

Move Over, Round Dowels

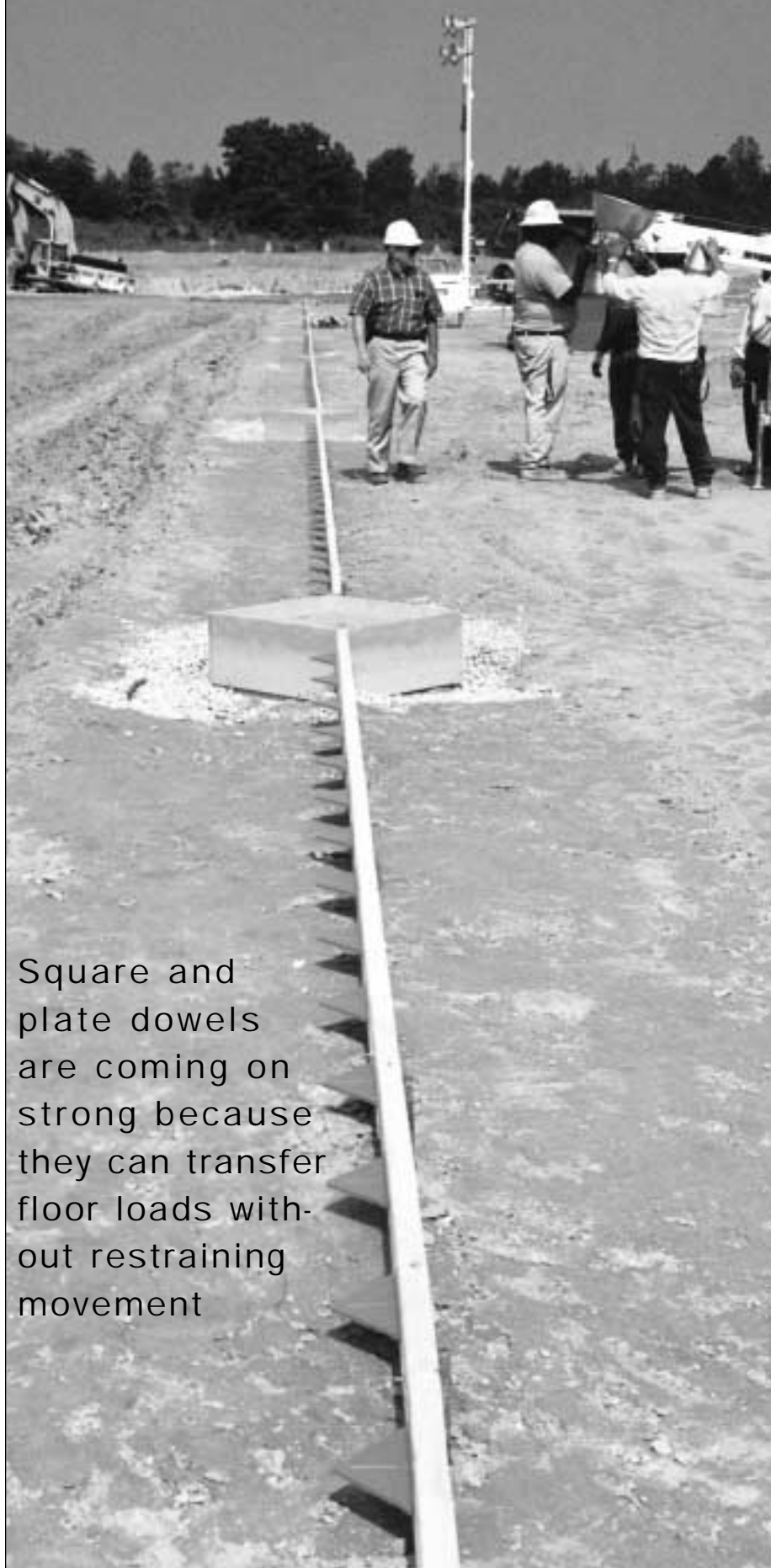
used at contraction joints, the square dowels are held in baskets similar to those used for round dowels.

Plate dowels inserted into leave-in-place formers

Research by Wayne Walker and Jerry Holland (Ref. 2) shows that rectangular- and diamond-shaped plate dowels are more cost-effective than round dowels because they use material more efficiently. Calculations show that the diamond plate dowel has the optimum shape because it's wide where bearing, shear, and flexural stresses caused by loading are highest and narrow where stresses are lower.

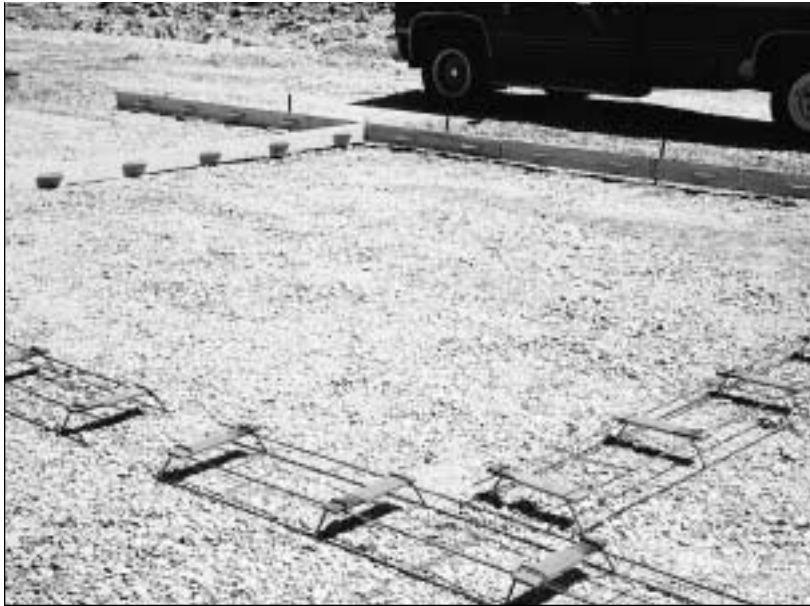
Workers insert the plate dowels into leave-in-place ABS plastic pocket formers with a tight vertical fit that transfers loads across the joint but still allows for slab shrinkage movement. Holland says the ability to accommodate horizontal differential movement is particularly important for slabs with two-directional doweling (see bottom photo, next page), and for slabs that are post-tensioned or made with shrinkage-compensating concrete because these slabs have long joint spacings that produce significant movement along the longitudinal joints.

Workers can attach the plastic pocket formers to bulkheads without



Square and plate dowels are coming on strong because they can transfer floor loads without restraining movement

Workers will insert diamond-shaped plate dowels into leave-in-place plastic pocket formers for this construction joint. The pocket formers don't require drilling holes into the side forms.



they design. They typically use square dowels and clips for the following situations:

- In post-tensioned slabs where the joint opening is substantially wider than the typical 1/4 inch

- In some freezer slabs with wide joint openings

- To provide load transfer between a new slab and an adjacent older existing slab by drilling holes and grouting the dowels

- In very thick slabs where larger dowels are needed (plate dowel systems are presently only 1/4 inch thick)

- In slabs where the stiffer, longer square dowels help to minimize curling

When using plate dowels, they recommend the rectangular shape for contraction joints and the diamond shape for construction joints. Holland says that more than 80 million square feet of floor slabs and pavements have been built using diamond dowels, and nearly all large U.S. floor contractors have used them.

Eric Henry, project manager for J. Rohrer Contracting Co., Kansas City, has managed several projects in which diamond dowels were used. "They're less likely to become misaligned than are round dowels," he says. "And with form-mounted round dowels, you sometimes have to use chairs or concrete blocks to keep the 8- to 10-inch projection of the plastic sleeve from sagging."

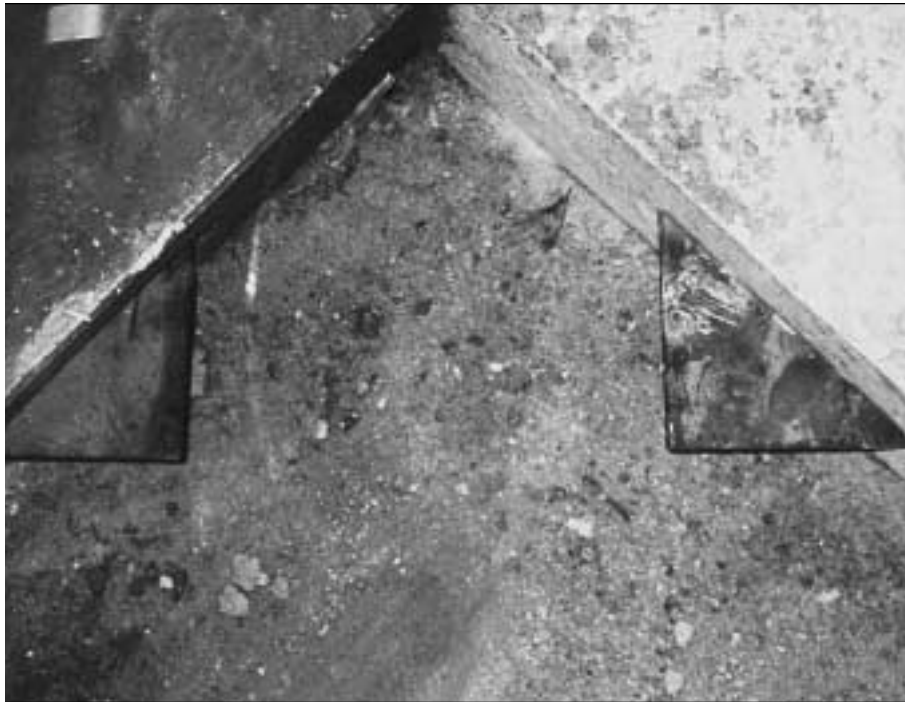
Henry likes the lateral movement permitted by diamond dowels but has some reservations about using them in freezer floors. "With the low temperatures in a freezer, the joint opening gets pretty wide, so you're losing quite a bit of dowel contact area," he says. "I've never heard of a failure caused by this, but I'd be cautious about the possibility of the joint opening so much that there isn't enough dowel area to carry the load." ■

References

1. Ernest K. Schrader, "Square Dowels Control Slab Curling," *CONCRETE CONSTRUCTION*, December 1999, pp. 33-35.
2. Wayne W. Walker and Jerry A. Holland, "Plate Dowels for Slabs on Ground," *Concrete International*, July 1998, pp. 32-38.

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Top: Rectangular plate dowels (foreground) typically provide load transfer at contraction joints. The plastic pocket formers mounted on the forms in the background are for diamond plate dowels.

Bottom: Diamond dowels accommodate horizontal differential movement in slabs with two-directional doweling.

drilling dowel holes. They also don't have to oil or grease the plate dowels before inserting them, thus ensuring a tighter fit but no restraint. When round dowels are greased, workers may apply the grease too liberally. If the top or bottom of the bar is heavily greased, one slab must deflect by an amount equal to the grease thickness before any load is transferred to the adjacent slab. High stresses can build up before load is transferred.

Field acceptance

Holland and Walker use both square and plate dowels in floors