

Planning leads to high-performance floor

Thanks to meticulous pre-job planning, a project team meets a manufacturing facility's requirements for a tough, smooth, long-lasting floor

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When Rockwell Automation Corp., Milwaukee, Wis., set out to build a new conveyor-drive manufacturing facility in Clio, S.C., one of the top demands was a high-performance floor slab with excellent abrasion resistance and minimal cracking and curling. Nothing less would do, since this 150,000-square-foot floor would serve as the work platform for all the facility's manufacturing operations.

Selected to tackle the job was Ace/Avant Concrete Construction Co. Inc., a contractor with a history of success installing high-performance floors of this type. As the floor design was being finalized, Ace/Avant's team focused on the following key requirements:



Figure 1. A mechanical spreader applies a metallic dry-shake hardener to the floor surface to improve abrasion resistance.

- A well-compacted, level floor-slab base that wouldn't rut under ready-mix truck traffic. Rutting causes slab restraint and leads to cracking. A mix design with a low water content, proper water-cementitious materials ratio, and proper aggregate grading (8% to 18% retained on every sieve but the top size and No. 100). A dowel system at the joints that
- would provide vertical load transfer while reducing restraint by allowing movement both perpendicular and parallel to the joint. A pinwheel isolation-joint design for the columns, to remove the concern for traffic close to the column. (Traditional diamond-shaped isolation joints are more subject to breakdown due to traffic exposure.)

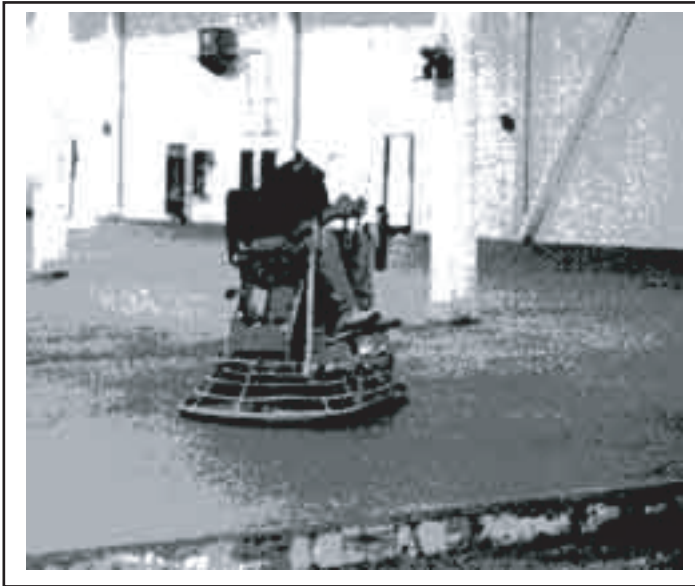


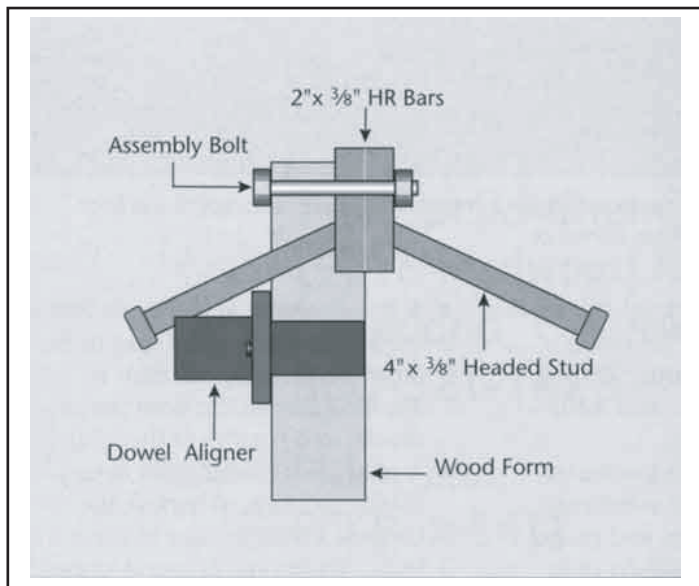
Figure 2. Power trowels give the floor a burnished finish.

- A very flat and level floor surface, metallic-hardened to resist abrasion.

A preconstruction conference held onsite before the floor placement allowed the project team to collaborate on the best ways to meet these requirements. All aspects of the project were examined including fine grading and testing of the subbase, mix design requirements, concrete delivery and testing, slab design, finishing procedures, jointing details, and floor-tolerance requirements.

Getting the right blend

Ace/Avant discussed the concrete mix design requirements with several ready-mix producers, with one of the key concerns being proper aggregate grading. The right



PNA Inc.

Figure 3. Diagram shows the armored construction joint used to prevent joint spalling in high-traffic areas.

blend of aggregates was important to avoid significant early bleeding of the floor surface. If water were present when workers applied the dry-shake hardener to the slab, it would diminish surface strength. However, sufficient water had to be available to thoroughly wet-out the hardener, or delamination could occur. Based on its willingness to come up with mix proportions that fit the requirement for low total water but sufficient water for proper dryshake hardener application, ready-mix producer Apac-Carolina Inc. was selected to supply the concrete. The slump of the concrete also was important, since Ace/Avant needed a mix that could be efficiently placed by laser screed. It was agreed to have an initial slump of 3 inches before the addition of a high-range water-reducing admixture to achieve a target slump of 6 inches.

Placing 14,000 square feet per day

The first of 11 floor placements began on July 12, 1999. An earlier test placement in an office area indicated that the water content of the concrete mix was optimum for reduced shrinkage and curling, yet sufficient for the specified 1 1/2 pounds per square foot of metallic hardener.

Apac-Carolina delivered the concrete from a batch plant about 14 miles from the jobsite. Because the project took place in midsummer, Ace/Avant decided to start placing the concrete at 3:30 a.m. each day to minimize the effects of high temperatures. Workers placed, on average, approximately 14,000 square feet per day, completing the final placement on July 27.

The mix was very workable, with sufficient water to bond the hardener, which workers applied by mechanical spreader immediately after the laser-screed operation (Fig. 1). After giving the floor a burnished steel-troweled finish (Fig. 2), the crew allowed the floor to cure 7 days before applying a liquid densifier/sealer.

Proper joint design was considered very carefully. At construction joints, Ace/Avant used a diamond-shaped plate dowel to reduce restraint and minimize random cracking. In several high-traffic areas, an armored construction joint was used to prevent joint spalling (Fig. 3). Workers cut contraction joints at a spacing of 12 1/2 to 15 feet using an early-entry saw immediately after final finishing. Construction and contraction joints in traffic areas were filled with an epoxy joint filler.

A floor for the long-term

Continuous planning, from the bidding stage through the final curing and sealing of the floor, helped the project team achieve its initial goal: a high-performance floor with a very flat, level surface. The floor tolerance was $F_F 35/F_L 25$, and the floor measured $F_F 49.7/F_L 41.3$.

Based on these initial results, the outlook for the floor's long-term performance are positive. The floor should provide a tough, smooth surface with joints that don't break down under traffic for years to come. ■

**Final mix design
and aggregate grading**

	Weight, per lb	Volume, per cf
Cement	470	2.39
Fly ash	90	0.61
Sand	1,198	7.30
#467 stone	1,234	7.32
#789 stone	755	4.59
Water	282	4.52 (33.8 gal)
HRWR		6 oz/100 wt*
Air (entrapped)		1.0%

Water-cementitious materials ratio: 0.50
Initial slump: 2-3 in.
Final slump: 5-7 in. (after HRWR added)

*Added at jobsite by Ace/Avant.

Credits

Design-builder: Beers York, Greenville, S.C.

Architect: Sarratt & Associates, Greenville, S.C.

Structural engineer: Cary Engineering Inc., Greenville

Concrete contractor: Ace/Avant Concrete Construction Co. Inc., Archdale, N.C.

Ready-mix concrete supplier: Apac-Carolina Inc., Dillon, S.C.

Admixtures, dry-shake hardener, and sealer: The Euclid Chemical Co., Cleveland

Diamond plate dowels and armored construction joints: PNA Inc., Matthews, N.C.

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