WIRE REINFORCEMENT INSTITUTE®

CS 294-R-21

# Case Study


## Kohl's Corporation Distribution Center, Findlay, Ohio

**WELDED WIRE REINFORCING HELPS ENSURE QUALITY CONCRETE CONSTRUCTION WHILE MAINTAINING LOW COSTS**

Sound engineering judgments and good construction decisions were made by the construction team to build a quality distribution center in the heartland of Northwest Ohio. One of those decisions was to use welded wire reinforcement (WVVR) in all the flatwork, i.e., slab-on-grade, the supported slab as well as the paving and override considerations to substitute materials or use unreinforced designs

On August 1, 1994, the Kohl's Distribution Center officially opened to provide a central location to serve and supply their products for a large segment of the population from the heart of the midwest. The slab on grade for this 756,000 square foot industrial facility was placed in less than a month. Consideration was given to a synthetic fiber admixture in place of the steel reinforcement specified for the project.The owner and contractors would not approve the substitution because, although they knew they had a well compacted engineered fill for the support of the slab on grade, they were unsure whether they would encounter settlement in the sub-grade during slab placement or later after the full curing had taken place. They knew that cracking, if it did occur, would have to be restrained to prevent wide cracks. They knew that with properly placed and supported welded wire reinforcement (WWR) in the slab, the occurrence of cracks would be kept tightly closed by the WWR working in tension and bond to prevent wide cracks.

Another concern was that with the highly sophisticated conveyor equipment that Kohl's uses in their distribution centers, slab displacement and settlement in the building could not be tolerated. The owner wanted additional or reserve strength to help carry the loads, whether internal or external, over and above the cracking strength of the concrete alone. After the superior performance of the interior slab-ongrade was known, the contractors decided to place WWR in the 8 " paving around the building. It had originally been designed to be unreinforced. A photo shows one of the concrete strips. The strips were cut at 20' centers and there are no visible cracks.

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**REMEMBER**: More cost effectiveness and easier placing of WWR can be achieved by using step through styles (12x12 and larger).

The result is quality welded wire reinforced concrete that is free of displacement and settlement. The contractors maintained a rigid quality control on the ready mix. The welded wire reinforcement was properly placed and the concrete cover was watched very closely. The saw-cut control joints were done efficiently and timely so that shrinkage occurred at the control joints as planned.

A well engineered fill, a quality mix design and sophisticated placing of materials results in a quality slab-on-grade.

The well engineered fill consists of 3 1/2 feet of compacted base (gravel and sand). The top 6” has 4” of #304 stone (1/2 ” to 3/4 ”) and 2 ” of #411 stone fill (1/2 ” with fines) on the surface. Because there was too much rain late in 1993 and the subbase was too saturated, there was a 3 month time interval between when the engineered fill was completed and the start of the slab placement, which allowed more time for natural compaction of the sub-grade.

The concrete design specified a 4,000 psi minimum compressive strength mix. The main ingredients were: 61/2 sacks of cement, 2% accelerator, and 0.45 w/c ratio with a 4 1/2” maximum slump desired. On-site concrete testing assured that the specifications were followed. Early 3-day compressive strength breaks were over 4,000 psi and many 28-day breaks were over 6,000 psi.

Sheets of welded wire reinforcing were placed on the subgrade. Sufficient areas of WWR were installed to stay ahead of the slab placement. Concrete block supports were used at 3’ centers to position the reinforcing 2” from the top of the 6” slab. The Portland Cement Association (PCA), book on Concrete Floors on Ground contained in the American Concrete Institute’s (ACI) Design and Construction of Concrete Slabs on Grade, SCM-11(86), suggests reinforcement for primarily temperature and shrinkage purposes be placed 1/3, the depth below the top of the slab. The supports were placed around the ready-mix trucks as the concrete was being tail-gated. When the trucks pulled ahead, completion of the support placement was made. The WWR was lifted with special jacking bars at the WWR intersections and supports were inserted. The laser screed would move across the supported WWR but did not deform the reinforcing. The few supports that were turned over or were out of position were quickly reset.

A laser screed vehicle was used to obtain proper slab thickness, adequate vibration for consolidation of materials and slab flatness. The flatness factor was over twice the average flatness when compared to hand screeding (the Ff measured 3436). Specific floor flatness was not required, but the contractor took measurements for future reference. Saw-cutting at 12’ and 16’ intervals was made the day after a previous day’s cast. Sawcuts were made to a depth of 1/4 of the slab thickness, which conforms to the PCA/ACI reference noted above. That was the correct timing for the winter period. In summer months, curing is speeded up by the warmer weather, therefore the saw-cutting would have to be done when the concrete can be walked on (generally between 6 and 8 hours). The interior slab on grade took less than a month to place (January 12 to February 10, 1994). The largest single day cast was 516 cubic yards (64, 8yard capacity trucks). The largest 5-day cast was 2,242 cubic yards.

The result is a slab on grade with an exceptional surface quality with minimal intermediate cracks. Shrinkage at the majority of the floor panels occurred at saw-cuts. Minimal curling and no detectable displacement were due to the presence of welded wire reinforcement and overseeing that it was properly positioned. The reality is a properly reinforced, quality slab-on-grade that will save the owner future maintenance and possible costs accrued for shutdown if repairs were needed.

## BENEFITS OF USING HIGH STRENGTH WELDED WIRE REINFORCEMENT

It is to owners' advantage to have their construction teams consider the inherent high strength characteristic of coldworked welded wire reinforcement. ACI 318 allows the use of high strength reinforcement for flexure, shear and temperature/shrinkage purposes, when tests for extension show that the specified yield strength (up to 80 ksi) is developed at 0.35% strain. Larger wire spacings (12 x 12 and larger) are being specified more today, allowing greater support spacings and enabling easier placing by stepping through and in between wires. In addition, welded wire reinforcing (WWR) is used as an alternate to rebars for structural applications. Wire, either deformed or plain, can be cold-drawn for specific requests up to 1/2" diameter and even greater by some producers. Whatever the reason, both types of reinforcement, either rebar or WWR are equally recognized and permitted by the codes for structural reinforcement in concrete systems, with each having its own set of design requirements. WWR sheets can be used in combination with other reinforcing materials to provide efficiency of placing and aid in the quality of concrete construction, e.g., in prestressed/precast and post-tensioned structures—utilize high strength tendons and high strength welded wire sheets. There are no substitutes or alternatives for the reserve strength and crack width control that steel reinforcement in the form of welded wire reinforcement has to offer.

The project credits and key people who worked on the concrete construction for the Findlay, Ohio, Distribution Center are:

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