CS 299-R-03

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Pavement and Slabs Researched...

Studies Show Properly Covered WWR Produces High Performance Concrete

Three research studies have shown that properly covered welded wire reinforcement (WWR) produces high performing, durable concrete structures that continue to serve their owners well after as many as 30 years or more of use.

In fact, principal researcher, Professor Luke Snell of Southern Illinois University at Edwardsville, noted that research results in at least one study indicated the concerns some design professionals have about the use of WWR are not justified. Professor Snell, who conducted his research project for WRI, studied the performance of both concrete highway paving and industrial slabs-on-ground that were constructed using WWR.

A key element in these examinations was determining the depth of WWR and comparing the results to specifications at the time of construction. This was accomplished with the aid of a battery-powered cover meter that induces a magnetic field into the concrete through a hand-held probe. Steel in the pavement/slab will disturb the induced field, resulting in a variation of the field that is proportional to the depth of the steel. Past research has proven the equipment to be very accurate in determining the amount of cover. Another element in the examination was a visual inspection to determine the current state of the pavement/slabs.

In all three cases, Professor Snell's results showed that 95 percent or more of the WWR cover measurements were in compliance with the original specifications and that the cover for the reinforcement was determined to be acceptable. In the case of the 30-plus-year-old highway, Professor Snell found the pavement to be in good shape for its age. Some micro surface cracking existed, but no major stress cracks or displacement at joints or intermediate cracks existed. Both industrial slabs [one in excess of 10 years old, the other just under four] were judged excellent in overall appearance, despite "non-existent" maintenance.

The Illinois DOT test section on interstate I-57, south of Champaign, IL.

An expanded discussion of Professor Snell's work and findings is presented below.

Improved Durability
Properly Covered WWR Highway Pavement Still Serving Illinois More Than 30 Years Later

CASE STUDY 1

A 3-mile section of interstate route I-57, south of Champaign, IL, was chosen as a test subject for Professor Snell's research in part because the Illinois Department of Transportation (DOT) had elected to keep this portion of the highway open for study. Its original surface, therefore, has never had an overlayment.

Mr. Milt Sees, vice president of Southern Illinois Concrete Products, Inc., in Mt. Vernon, IL, designed the roadway over 30 years ago [mid 1960s] when he worked for the IL DOT. Mr. Sees, who is a past executive director of WRI, provided photos for this case study. The roadway he designed is reinforced with one layer of WWR 6 x 12-W8.6 x W8.6 (152 x 305-MW55 x MW55) which was placed in the top portion of the 10"

The Illinois DOT has not added an overlayment to the test section so they can study it.

The Illinois DOT test section has given acceptable performance for over 30 years.

thick cross-section. The concrete was placed in two strikeoffs, one 7" (178mm) thick pour and the other 3" (76mm) thick. The sheets of WWR were placed in between the two strikeoffs.

The location of the WWR was within the depth tolerance that IL DOT specified, or 2.5" (64mm) ± 1" (25mm). The contractor actually placed the reinforcing with 3" (76mm) of cover. Forty locations were randomly selected to determine the cover of the pavement reinforcement, WWR. Test results showed an average cover of 3" (76mm) with a standard deviation of 0.07 inch. At all measured locations, the WWR was within the stated tolerance of 1-1/2 (38mm) to 3-1/2 (89mm) inches. Thus, 95% or more of the WWR cover measurements were within compliance. The cover for the reinforcement was determined to be acceptable.

Professor Snell's summary of his study stated: "Based on the research, the concerns some design professionals have about the use of WWR are not justified. The cover of WWR can be controlled within specification limits if the reinforcement is in sheet form and adequate supports are provided. The paving project has been in use for over 30 years and has given acceptable performance for the owners." Professor Snell found the paving to be in good shape for its age. Some micro surface cracking exists, but no major stress cracks or displacement at joints or intermediate cracks exists.

TWO WWR INDUSTRIAL BUILDING SLABS-ON-GROUND SHOW HIGH DEGREE OF DURABILITY FOR HEAVY LOADS.

Professor Snell's reported findings:

CASE STUDY 2

This first of two buildings researched for appropriate cover is a slab on ground at a large manufacturing plant in North Carolina constructed approximately 10 years ago. The specifications required welded wire reinforcement i.e., WWR14 x 14- D6 x D6 (356 x 356- MD39 x MD39) with a cover of 2 inches (52 mm). The design professional did not specify a tolerance limit. The contractor, Baker Construction of Monroe, Ohio, used a tolerance limit for the WWR of 1/3 to1/2 the depth of the slab thickness. The slab had a total depth of 6 inches (152 mm). In a conversation with the contractor's project manager, he stated that the WWR was placed on supports and that a great deal of attention was given to keeping the WWR at the correct depth.

Thirty locations were randomly selected to determine the cover of the WWR with Professor Snell's cover meter. The testing indicated that the average cover was 2.36 inches (60 mm) with a standard deviation of 0.11 inches (3 mm). At all measured locations, the

Professor Snell and the battery-powered cover meter used to detect placement of WWR reinforcement in the industrial slabs.

WWR was between the 1/3 and 1/2 the depth (no measurements were out of tolerance limits). This testing indicated that 95% or more of the WWR cover measurements were within compliance and the cover for the WWR was acceptable.

Workers walk on or into wide spaced welded wire reinforcement without deflecting or displacing it during concrete placement.

CASE STUDY 3

The second industrial building case history was a slab on ground of a large distribution facility built approximately 4 years ago. The slab is reinforced with WWR12 x 12-D8 x D8 (305 x 305-MD52 x MD52) with a cover of 2 inches (52 mm). The design professional did not specify a tolerance limit; thus a tolerance limit was set by the contractor, Murphy & Son, Southaven, MS for placement of the WWR to be in the upper 1/3 to 1/2 of the slab thickness. The slab had a depth of 6 inches (152 mm). During construction, there was an independent inspection of the construction, which indicated the WWR was uniformly supported with approximately 2 inches (50 mm) of cover.

Fifty two locations were randomly selected to determine the cover of the WWR. The testing indicated the average cover was 2.64 inches (66 mm) with a standard deviation of 0.25 inches (6 mm). Four values were outside of the tolerance limits (were not in the upper 1/3 to 1/2 the depth of the slab). The overall testing indicated that 95% or more of the WWR measurements were in compliance and that the cover for the WWR was acceptable.

A final note on the two industrial slabs – overall appearance of both projects was excellent. Intermediate cracking was minimal. No wide cracks were noticed, thus no displacement. No breakdown or excessive wear at contraction joints was observed. Both owners advised that maintenance on the slabs was non-existent and they both were very satisfied with their performance.

Professor Snell's report can be read in it's entirety by contacting the Hanley-Wood Group in Addison, Illinois. It is published in the July 1997 issue of Hanley-Wood's Concrete Construction periodical and is titled: "Cover of Welded Wire Reinforcement in Slabs and Pavements." We are very grateful to the Illinois DOT for their assistance in rerouting traffic and providing a safe working area to do the necessary research work. Also, the two owners of the industrial plants were very receptive and assisted in providing background materials for the studies. The WRI wishes to thank Professor Snell for his thorough research and the owners and contractors that provided input. WRI is very grateful to the Aberdeen Group for publishing the article referred to above.

Please turn the page for suggested support spacings and types of support for WWR.

It only takes two workers to easily carry two 8' x 15' sheets of WWR.

Workers walk on or into wide spaced welded wire reinforcement without deflecting or displacing it during concrete placement.

The suggested spacings of supports in Table 1 may be used for estimating and construction. However, the preceding factors should be considered.

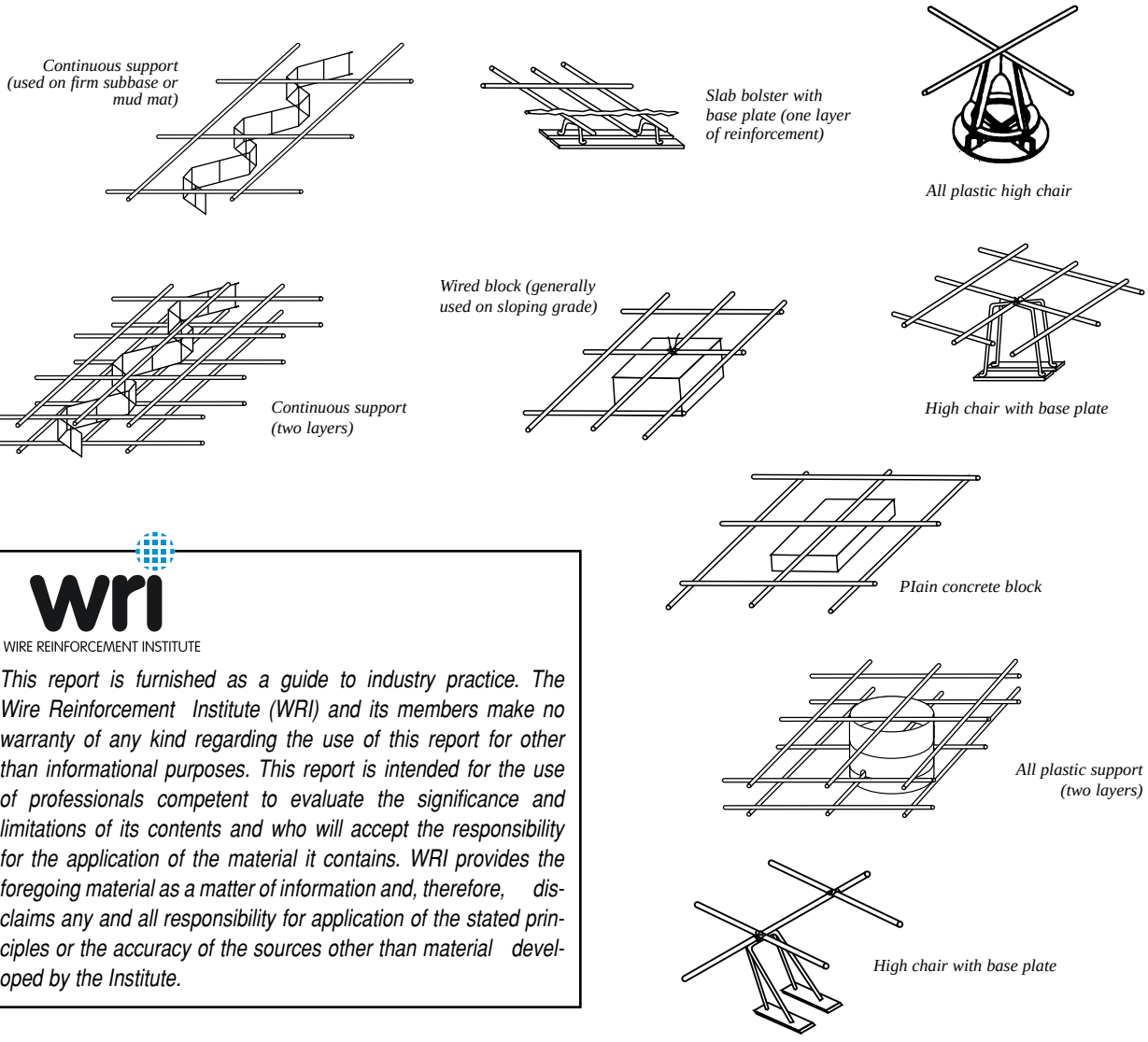
TABLE 1. SUGGESTED SPACINGS OF SUPPORTS

Welded Wire Reinforcement Range	Welded Wire Spacing	Suggested Support Spacing
W or D 9 or larger*	12" and greater	4-6 ft.
W or D5 to W or D8	12" and greater	3-4 ft.
W or D9 and larger	Less than 12"	3-4 ft.
W or D4 to W or D8	Less than 12"	2-3 ft.
Less than W or D4**	Less than 12"	2-3 ft. or Less

*Spacing of supports for WWR with wires larger than W or D9 could possibly be increased over the spacings shown depending on the construction loads applied.

**Consider using additional rows of supports when large deflections or deformations occur — also spacing of supports may be increased provided supports are placed and properly positioned as concrete is screeded.

FIGURE 1 — TYPES OF SUPPORTS



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