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Position Paper

Concrete Reinforcement: Nycon Fibers vs. Welded-Wire Fabric

Authored by
Bob Cruso, Executive Vice President, Nycon, Inc.

Fibers in Concrete

Concrete, by nature, cracks when hardened, and reinforcing it with fibers is not a new building technique. The practice of adding fibers to concrete, mortar and other cement composites to inhibit cracking began thousands of years ago. There is evidence that fibers -- human and animal hair, straw and other natural fibers -- were used in cementious materials as far back as the Greek and Roman Empires and earlier in the Egyptian dynasties.

When Nycon introduced nylon fiber as a concrete admixture in 1986, we transformed a centuries-old, tedious practice into a technologically superior, value-engineered building process. Because nylon fibers are easily handled, simple to apply, cost-effective, and create a stress-resistant concrete product, Nycon's fibers have been used successfully in hundreds of millions of square feet of construction worldwide. At Nycon, we believe our services and fibers are the standard for concrete reinforcement in the building industry.

Welded-Wire Fabric Limitations

When the industry decided it needed steel reinforcement for massive concrete sections in large-scale construction, welded-wire fabric (WWF) was introduced as an alternative to natural-fiber reinforcement. However, it was quick to rust, corrosive, difficult to manage, and hard to fit, but widely accepted for lack of anything better.

WWF is a "*passive-reactive*" technology that functions only after concrete cracks: Tech Facts Bulletin #202 published by the Wire Reinforcement Institute (WRI) states, "*The primary purpose of welded-wire fabric...in slabs is to control cracking and crack width in both directions...so cracks are less noticeable and movement of water through the slab at cracks is minimized.*" WWF's single residual benefit, then -- controlling *"crack width in both directions"* -- implies that concrete must fail for WWF to have any benefit.

WWF must also be installed properly: WRI's Tech Facts Bulletin #701 and Engineering Data Report #37 from the Concrete Reinforcing Steel Institute (CRSI) also state that WWF *"...within a slab prevents cracks from opening and becoming wide and objectionable..."* These documents go on to stress the importance of using chair techniques when placing WWF: *"The fabric must be located in the middle third of four- to six-inch slabs, positioned* *approximately two inches below the surface..”* Further, WRI’s Tech Facts #202 notes that the two most important factors for WWF’s proper placement are, “ *....chairing fabric and placing concrete in two courses with fabric on the first course.”* Other industry sources can be sited: A document published by the National Ready-Mix Concrete Association (NRMCA) states, “*The use of mesh cannot prevent cracking – mesh becomes effective only after the crack has formed and then serves only to hold the crack tightly together.”*

We can readily conclude from the guidances issued by these industry authorizities that WWF's sole benefit is reactive, in that it holds concrete sections together after failure, and only if it is placed properly.

WWF has other limitations: While its effectiveness depends on proper placement, WWF is also user-unfriendly, labor-intensive, and costly. Consequently, in real-world construction, time-consuming techniques like chairing and other recommended precautions are rarely, if ever, used. Instead, in the rush to project completion, welded-wire fabric is positioned directly on the subgrade, where it has no benefit whatsoever. A random visit to any construction site will confirm the short-cuts taken with WWF to bring jobs in on time and on budget.

Lacking the industry’s ability to inspect and control every job site, the recommended positioning of wire fabric is hollow theory and not practice.

Concrete Reinforced with Nycon Fibers

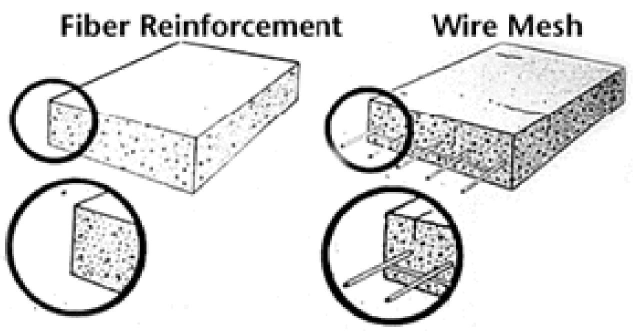
Nycon fibers, on the other hand, proactively work to hold concrete together and, therefore, inhibit cracks from plastic and early-drying shrinkage.

Nylon fibers impart crack resistance by improving concrete’s integrity.

Testing conducted by Paul Kraai, a professor of Engineering at San Jose University, compared concrete's cracking behavior in unreinforced, fiber-reinforced, and WWF-reinforced samples. The results showed a 71.5% plastic-shrinkage crack reduction in the fiber-reinforced sample over plain concrete; and, there was only a 6.5% crack reduction in the welded-wire fabric sample. In further comparisons, nationally recognized independent laboratories tested concrete reinforced with Nycon fibers: There was an 83% reduction in plastic-shrinkage cracking when the fibers were applied at the rate of one pound per cubic yard of concrete.

With over 34 million fibers per pound evenly distributed throughout a cubic yard of concrete, Nycon fibers are more than just crack inhibitors. Their multidimensional benefits far exceed anything welded-wire fabric can offer: Fibers make concrete more workable, enhance its engineering properties and distribute stress more evenly and effectively. The result is a concrete that is more durable overall with a prolonged
service life.

Fiber Provides a Three Dimensional Reinforcing Network



In its plastic state, Nycon-reinforced concrete has more flexural (tensile) strength and toughness to ductility fracture; it has increased impact resistance, fatigue life, thermal-shock resistance, and abrasion resistance. With the length, width, and frequency of cracks reduced, there is lower water migration, less permeability and volume change. Finally, fibers are non-corrosive, non-abrasive, rustproof, and that means less spalling because of oxidation and steel corrosion.

The Value of Nycon Fibers

Value-engineered Nycon fibers offer real solutions to real problems with real results. They are the most cost-effective secondary reinforcement in the business today. Compared to wire mesh, fibers significantly reduce or eliminate the cost of material, delivery, labor, handling, fitting, placement, storage, and liability. Further, while cost is an important consideration for some, many building professionals want the assurance of well-placed reinforcement. Unlike wire mesh, Nycon fibers are easy to use and fit, have no waste, pose no danger of injury, and are always properly placed.

Conclusion

Nycon fibers are an advanced technology for prolonging the durability and service life of concrete and cement composites. This reinforcement technology is a proactive approach to minimizing and controlling concrete's inherent cracking "birth defect." Further, Nycon fibers are proven to reduce permeability, water migration and spalling, while increasing impact resistance and fatigue strength. The success of Nycon's fiber technology as a building standard is evidenced in the confidence that engineers, architects and building owners have in specifying Nycon fibers as the reinforcement of choice for building smarter and better.

About the Author:

Robert Cruso , Nycon's executive vice president, studied Engineering and Construction Sciences at Roger Williams University in Rhode Island. Mr. Cruso began his career in construction in 1980 as a sales engineer in the exterior wall facade industry. In his current position, he works with Nycon's customers and industry associates worldwide to optimize Nycon's fiber applications. His memberships include the American Concrete Institute's (ACI) Committee 544 for Fiber Reinforced Concrete, ACI's 544-F Sub-Committee for Testing Fiber Reinforced Concrete, the American Society for Testing and Materials (ASTM) Main Committee C 09 on Concrete and Concrete Aggregates, and the Syntheric Fiber Association. Mr. Cruso was also a past treasurer and a director of the Synthetic Fiber Association.

NYCON®
101 Cross Street
Westerly, RI 02891
Phone 800 456 9266, 401 596 3955
Fax 401 596 4242
E-mail **{** HYPERLINK mailto:info@nycon.com **}**
Web Site **{** HYPERLINK http://www.nycon.com **}**