HAHN READY MIX

Fibers for Concrete

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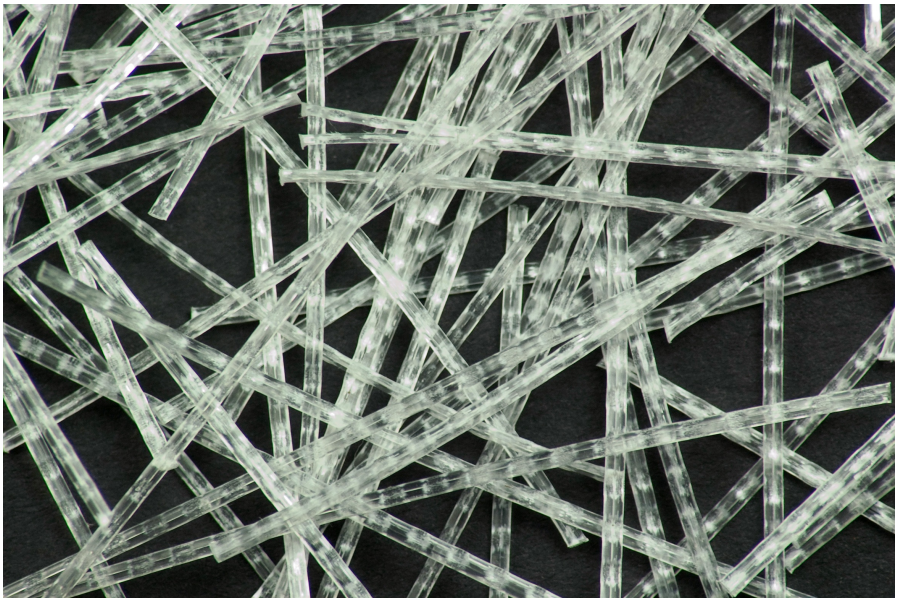
A very important aspect of many concrete pours is proper reinforcement. While concrete is unbelievably strong under compression, it is very weak under tension. Reinforcement, traditionally in the form of rebar, take these structural, thermal, and shrinkage tensile forces to protect the concrete. Over the last two decades, fiber reinforcement of concrete has become more and more popular in lieu of traditional reinforcement like welded wire fabric or tied rebar. Often these changes allow for greater concrete performance and lower construction costs due to labor and time savings, and there are some ultra-thin or strangely shaped projects that do not allow for traditional reinforcement. Unfortunately, there are some misnomers out there about fibers, both in a positive and negative light. We're here to set the record straight and direct you to the right type of fiber for your project. To begin, there are four main types of fiber and we'll discuss each of them in turn.

Microfibers

Microfibers are traditionally polypropylene fibers that come in two forms: monofilament and fibrillated. Dosage rates are .5 - 1.5lbs per cy depending on the type of fiber. These fibers are effective at reducing plastic shrinkage cracks (See Technical Bulletin #6), but do not prevent drying shrinkage cracks or settlement cracks. These fibers do not offer much additional strength to the concrete matrix and **do not adequately replace welded wire fabric** on a slab pour. Microfiber can be a helpful tool for use in extremely low slump concrete, as it's tendency artificially decrease slump allows more water to be used in a mix, making finishing and placing easier. Hahn Ready Mix has experienced finishing issues with the fibrillated microfibers, and has subsequently primarily used the monofilament fibers. Due to the rising costs and supply chain disruptions to polypropylene, we have transitioned over the past year to an Acrylic microfiber called AC-50 from ICF fibers. This fiber, pictured above, is a great deal finer than the polypropylene fibers allowing for less disruption to finishing operations but should never be used at a dosage rate over 1lb/cy.

Macrofibers



Macrofibers, also called Structural Fibers, are a longer, more robust

polypropylene fiber that can be a replacement for wire mesh and light rebar mats. These fibers are typically dosed at 3 - 7.5lbs/cy. Some popular brands of Macrofibers are STRUX 75/32, Forta Ferro, and Tuf-Strand. Benefits of Macrofibers include:

- Increased Flexural Strength
- Increased Tensile Strength
- Minimized Plastic Shrinkage Cracking, similar to microfiber
- Minimized Drying Shrinkage Cracking, assuming proper jointing is performed
- Minimized width of cracks that do develop
- Increased “toughness”, the residual strength of the concrete after it has cracked

Steel Fibers

Steel Fibers are kind of the Rolls Royce of structural fiber reinforcement. Although a wide range of dosage rates and types of fibers provide a wide range of outcomes, the potential is there for significant rebar replacement. Hahn Ready Mix typically uses Dramix 3D 45-50 fibers, but there are a LOT of different types available. Dosages can range from 25-100lbs/cy. Benefits of steel fibers include:

- Light - Medium rebar mat replacement
- Increased Flexural Strength
- Increased Tensile Strength
- Minimized drying shrinkage cracking
- Minimized cracking due to thermal expansion or contraction
- Minimized crack width
- Significantly increased "Toughness", the residual strength of a slab after it has cracked.
- Abrasion and impact resistance

Blended Fibers

A variety of fibers are sold with a combination of the above types pre-blended. Some examples include: Forta Ferro, while marketed as a Macrofiber, actually is a blend of Macro and Micro fibers. Novomesh 950 is a blend of steel fibers and microfibers. The intent of these blends is to leverage the initial plastic concrete benefits of microfiber with the structural benefits of Macro and Steel fibers.

Challenges with Fibers

While fibers can bring great benefits. they also present some challenges that must be accounted for during the design or construction processes.

- All fibers end up decreasing slump and making the concrete more stiff. This phenomenon is minor with a microfiber, but is much more evident with higher dosages of Macro or Steel fibers. The risk here is that extra water is often used to bring the concrete back to the original slump before the addition of fiber. This leads to a higher w/c ratio and a lower quality paste. Sometimes, the shrinking stresses that are being addressed by the fibers are actually increased by the higher w/c ratio. Because of this, Macro and Steel fibers should always be accompanied with a high range water reducer to keep the w/c ratio stable.
- Finishing operations are always to some extent made more difficult. Aside from the lower slump, the presence of fibers make it physically more difficult to smoothly close up the surface.
- Final aesthetics are often affected as fibers will commonly stick out of the slab, making it look “hairy”.
- Particular care must be made with the use of steel fibers in environments where the concrete will be exposed to human interaction. Steel fibers sticking out of a slab can cause injury or damage clothing, tires, or other materials. These fibers are better used where there are floor coverings or in industrial spaces where people and equipment are properly protected from the hazards of sharp fibers.
- Some steel fibers can also present a risk for rusting if they are used in a place that is regularly exposed to water.
- Fiber balling can be a risk with fibers at high dosages. This can be frustrating and disrupting to finishing operations.
- Fibers can plug up grates on a pump, special pvc grates work well with macrofibers to prevent them from hanging up on the grate.
- Concrete production speed can be affected if it takes longer to dose fibers that it does to batch a truck. Often this is the case with steel fibers.
- Fibers end up being randomly oriented throughout the final concrete element. For some projects, this is beneficial to have multi-directional reinforcement throughout the slab. For others, it would be better to align and congregate the fibers, if that were possible, where we know the shrinkage or thermal stresses will occur. This phenomenon often results in engineers overdesigning the structural need for fibers as they cannot predict where the fibers will orient in the final structure.

If you liked all this information of fibers, you might also like Tyler Ley's video on fiber reinforced concrete. Find it HERE.

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