TECHNICAL BULLETIN FC-3

TUF-STRAND SF THIN WALL AND PRECAST DESIGN FOR BENDING MOMENT STEEL CONVERSION

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The design of reinforced wall sections, such as precast elements and shotcrete, are typically performed by a registered professional. However, when a design has been determined that a certain wall thickness is adequate to resist all flexural and bending conditions applied to the section with conventional steel reinforcement, it is possible to calculate a dosage rate of fiber directly from the specified steel reinforcement to act as an equal or better reinforcing option under the same conditions. The use of fiber-reinforced concrete (FRC) in this type of system can be, and has been, successfully implemented to the point where a more durable and economical structure has been achieved. It should be noted that this analysis is valid only for single layer reinforcing where distributed steel is evenly spaced. This procedure is also very well suited to precast elements and shotcrete products where the steel has been designed to act as temperature and shrinkage reinforcement.

For thin wall precast, poured in place and shotcrete applications where specified steel is distributed and has already been designed, the use of TUF-STRAND SF can be used and calculated to provide an equivalent moment capacity in bending as the originally specified steel. This analysis will also consider the location of the steel and assumes that the existing reinforcing has been correctly placed in the concrete as designed. It is also assumed that all other concrete placement and finishing practices have been properly applied.

Standardized test methods, such as ASTM C1609, measure the post crack performance capacity of FRC. This performance value is commonly referred to as Residual Strength or Toughness. Once the required flexural residual strength has been established, the appropriate dosage of fiber can be determined by converting the residual strength to a moment capacity provided for by the steel reinforcing as determined in accordance with ACI 544.4R, Guide to Design to Fiber-Reinforced Concrete.

Moment capacity provided by actual steel:

$$M_s = \varphi * A_s * F_Y * (d - \frac{a}{2})$$

FRC flexural residual strength:

$$f_{e3} = \frac{6 * M_s}{b * h^2}$$

Example solutions on Page 2.

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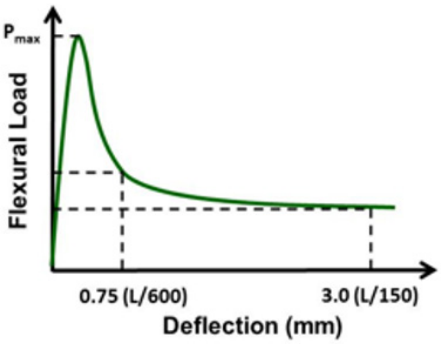
EXAMPLE SOLUTION

Example Solution: A wall product contains #3 bar @ 12" o.c. reinforcing (As=0.110 in2/ft) placed at mid-depth in a 6" wall section. Concrete strength is 4000 psi, steel reinforcing strength is Imperial Grade 60 – 60,000 psi.

$$M_s = 0.9 * 0.110\ in^2 * 60{,}000\ psi * \left(3\ in - \frac{0.16\ in}{2}\right) = 17{,}408\ in - lb$$

$$f_{e3} = \frac{6 * 17{,}408\ in - lb}{12\ in * (6\ in)^2} = 242\ psi$$



Schematics of a typical C1609 test result

Fiber dosage must provide a flexural residual strength (f_{e3}) capacity of 242 psi (1.67 MPa) as measured by ASTM C1609. For TUF-STRAND SF, this will be approximately 6.2 lb/yd³ (3.7 kg/m³).

The Euclid Chemical Company has mobile based calculators to provide easy conversions of single layer conventional reinforcing to appropriate dosage rates of TUF-STRAND SF. The calculators can be found at www.tufstrand.com or can be found in the app store as "**Euco FiberCalc**". An advanced analysis can also be performed for the complete design of a slab on ground system using fiber-reinforced concrete. For more information, please contact Euclid Chemical.