Aslan FRP®

ASLAN™ 400

CARBON FIBER REINFORCED POLYMER (CFRP) LAMINATES FOR STRUCTURAL STRENGTHENING

EASY BOND PRE-CURED RECTANGULAR PLATES

CORROSION RESISTANCE

HIGH FLEXURAL & SHEAR PERFORMANCE

ALTERNATIVE TO STEEL PLATE BONDING

THEY ARE USING **ASLAN™** SOLUTIONS

ASLAN™ 400
SOLUTIONS

BENEFITS & **MECHANICAL** PROPERTIES

BENEFITS

> Furnished with **guaranteed properties** based on measured results: Aslan™ 400 carbon FRP laminate is manufactured in a controlled environment and not subject to vagaries of field wet lay-up systems

> **Furnished with one face prepared** for bonding to adhesive

> **Much lighter weight** than steel plate bonding

> Will **not rust or corrode**

> Can be used with **multiple commercially available high strength adhesives**

Aslan™ 400 Carbon FRP "Laminates" are used to structurally strengthen existing concrete, wood, or masonry members in flexure and shear. The Aslan™ 400 CFRP Laminate is a pre-cured plate with a surface texture on one face, which helps improve bond with the structural adhesives. Structures that are deficient due to either a structural flaw, deterioration or because of a change in use can often be brought to a useful capacity using Aslan™ 400. Externally bonded FRP strengthening is analogous to steel plate bonding. Successful implementation of CFRP plate bonding is dependent on proper surface preparation, leveling and bond of the structural adhesive to the concrete and CFRP plate interfaces. Externally bonded CFRP Laminates work best in overhead applications for flexural strengthening where sufficient bond and development lengths can be achieved.

Since 1993, we have been at the forefront of worldwide academic and industry efforts to define consensus FRP standards and methods. Hundreds of structures have extended service lives due to Aslan™ 400 CFRP Laminates.

EXTERNALLY BONDED **STRUCTURAL STRENGTHENING**

> Flexural Strengthening of: bridge decks, parking garages, floor slabs
> Shear Strengthening
> Change of Use Situations – Higher Loads
> Return Deteriorated Members to Capacity
> Additional Structural Capacity Without
> Additional Dead Weight

MASONRY

> In plane and out of plane strengthening of masonry shear walls
> "Event" loading of masonry – blast, & seismic
> Restore capacities of cracked masonry

MECHANICAL PROPERTIES

Dimensions				Nominal Area		Garanteed Tensile Strength		Ultimate Tensile Load		E_f Tensile Modulus of Elasticity		Ultimate Strain
Width in	**Width** mm	**Thickness** in	**Thickness** mm	**mm^2**	**in^2**	**MPa**	**ksi**	**kN**	**kips**	**GPa**	**psi 10^6**	**%**
2	50	0.055	1.4	70	0.1102	2400	350	168	38.57	131	19	1.87%
4	100	0.055	1.4	140	0.2204	2400	350	336	77.14	131	19	1.87%

We reserve the right to make improvements in the product and/or process which may result in benefits or changes to some physical-mechanical characteristics. The data contained herein is considered representative of current production and is believed to be reliable and to represent the best available characterization of the product as of July 2011. Tensile tests per ASTM D3039.

DESIGN TENSILE & **MODULUS** PROPERTIES

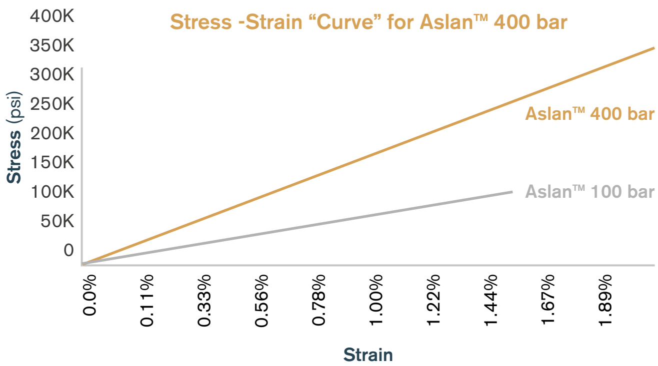
Tensile and Modulus Properties are measured per ASTM D7205-06, Standard Test Method for Tensile Properties of Fiber Reinforced Polymer Matrix Composite Bars. The ultimate tensile load is measured and the tensile modulus is measured at approximately 10% to 50% of the ultimate load. The slope of the stress-strain curve is determined as the tensile modulus. Ultimate Strain is extrapolated from the ultimate load divided by the nominal area and modulus. The area used in calculating the tensile strength is the nominal cross sectional area. The "Guaranteed Tensile Strength", f^*_{fu} is as defined by ACI 440.1R as the mean tensile strength of a given production lot, minus three times the standard deviation or $f^*_{fu} = fu_{,ave} - 3\sigma$. The "Design or Guaranteed Modulus of Elasticity is as defined by ACI 440.1R as the mean modulus of a production lot or $E_f = E_{f,ave}$.

NET FIBER AREA VS. MEASURED MATERIAL PROPERTIES

There is a great deal of confusion and debate over reporting material properties of FRP strengthening materials. The two methods used are: 1) Net Fiber Area and 2) Gross Laminate Area. Net Fiber Area is often used with field wet lay-up systems where the amount of fiber in an un-cured fabric mat is known but the final thickness of the cured composite with impregnated resin is unknown. The resin is thus excluded from the composite. The strands or fibers are impregnated with resin, cured and then tested in tension. The properties are calculated using the area of the fibers and the area of the resin is ignored. The Gross Laminate Area of an FRP system is calculated using the total cross sectional area of the cured composite including all fibers and resin. This gives the appearance that the material has a lower tensile strength. It is important to recognize that the stress is lower but with the larger area the loads are similar. We report all material properties based on the "Gross Laminate Area" method using actual production lot tests per ASTM D3039. "Since the design procedures in consensus guides such as the ACI 440.2R limit the strain in the FRP material, the full nominal strength of the FRP is NOT used and should not be the basis of comparison between two FRP systems" (from ACI 440.2R section 15.2, pg 43)

DENSITY

Nominal Diameter		Unit Weight / length	
Size	**mm**	**kg/m**	**lbs/ft**
2''	50	0.1637	0.11
4''	100	0.2976	0.20



MATERIAL CERTS

Material test certs are available for any production lot of Aslan™ 400 Laminate.

TRANSITION TEMPERATURE OF RESIN (T_g)

Known as the "glass transition temperature" or the temperature at which the resin changes from a "glassy state" and begins to soften. T_g = 230°F (110°C)

DESIGN GUIDANCE **HANDLING** & **PLACEMENT**

DESIGN GUIDES

> **ACI 440.2R “Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures”** Provides authoritative, consensus guidelines for the use of Aslan™ 400 CFRP laminate.

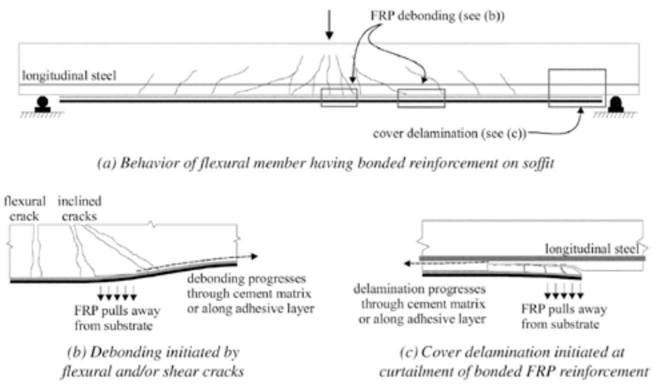
> **ACI 440.7R “Guide for the Design and Construction of Externally Bonded Fiber-Reinforced Polymer Systems for Strengthening Unreinforced Masonry Structures”** An ACI “Emerging Technology Series” document provides state of the art guidance for masonry strengthening with Aslan™ 400.

> **FIB Task Group 9.3 – bulletin 14 “Externally bonded FRP reinforcement for RC Structures”** In Europe, the Federation Internationale du Beton FIB Task Group 9.3 has published a technical report “Bulletin 14”, which is a thorough guide for the design and installation of Aslan™ 400 CFRP Laminates.

> **CSA S-806 “Design and Construction of Building Structures with Fibre-Reinforced Polymers”** The Canadian guideline includes provisions for externally bonded structural strengthening.

BOND CRITICAL EFFICACY

The effectiveness of externally bonded FRP strengthening is directly related to the bond interfaces between the concrete, adhesive and FRP. The typical failure mode is generally de-bonding rather than rupture of the FRP. For this reason, surface preparation, leveling of the substrate and caliber of the workmanship has much more influence on a successful outcome than with the NSM method.



(a) Behavior of flexural member having bonded reinforcement on soffit

(b) Debonding initiated by flexural and/or shear cracks

(c) Cover delamination initiated at curtailment of bonded FRP reinforcement

HANDLING & **INSTALLATION**

Aslan™ 400 product is furnished in continuous coils that are 250ft in length. Do Not Shear FRP Laminates. When field cutting of Aslan™ 400 CFRP Laminates is necessary, use a grinder, carborundum or diamond blade. Carbon FRP is semiconductive and NOT appropriate for non-magnetic applications or in direct contact with dissimilar materials.

EXTERNALLY BONDED INSTALLATION INSTRUCTIONS

After assessment of the existing structure and design by a competent professional, installation of Aslan™ 400 CFRP Laminates is performed according to the following general outline. Concrete, masonry or wood surfaces must be sound and free of scale, mill or other surface contaminates.

> **Step #1** Surface preparation by sand or water blasting is performed to expose course and fine aggregate surfaces. Surface preparation should be in accordance with ACI 546R and ICRI 0370.

> **Step #2** Perform bond pull-off tests of the concrete substrate soundness per engineers guidelines.

> **Step #3** Measure evenness or levelness of the prepared surface. An uneven surface will result in premature peeling of the laminate under load. This is measured by placing a straight edge against the prepared surface. Uneven areas should be leveled with an appropriate leveling mortar or putty.

> **Step #4** Before applying structural adhesive to the CFRP Laminate, the sanded or roughened side of the laminate is wiped with acetone or other solvent until any excess residue is removed from the carbon plate.

> **Step #5** Prior to application of the structural adhesive to the substrate and laminate, appropriate climatic conditions are measured to ensure they are within the tolerance required by the structural adhesive.

> **Step #6** Structural adhesive is applied to both the carbon and substrate surfaces.

> **Step #7** The Laminate is carefully positioned and pressed in place using a hard rubber roller to achieve a void free bond line thickness between 0.07" (2mm) to 0.11" (3mm). Excess adhesive is then removed from the sides of the Aslan™ 400 product before it can cure.

> **Step #8** If specified, the Aslan™ 400 laminate is coated with an epoxy coating or decorative elastic polymer.

> **Step #9** To facilitate quality control inspection, test patches adjacent to the area being strengthened should be prepared simultaneously to each of the above operations. Bond pulloff tests can then be performed to validate proper installation.

ASLAN™ 400 "SYSTEM" ~ APPROVED ADHESIVES

The following high strength structural adhesives are recommended for use.

> Pilgrim EM 5-2 Gel
> DeNeef Enforce CFL Gel
> SikaDur 30

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Owens Corning
Composite Materials, LLC.
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Toledo, OH 43659
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