

GLOSSARY OF TERMS

Aramid Fiber-Reinforced Polymer

Composite material comprising a polymer matrix reinforced with Aramid fiber cloth, mat, or strands.

Batch

Quantity of material mixed at one time or in one continuous process.

Binder

Chemical treatment applied to the random arrangement of fibers to give integrity to mats, roving, and fabric. Specific binders are used to promote chemical compatibility with the various laminating resins used.

Carbon Fiber-Reinforced Polymer (CFRP)

A composite material comprising a polymer matrix reinforced with carbon fiber cloth, mat, or strands.

Catalyst

A substance that accelerates a chemical reaction and enables it to proceed under conditions more mild than otherwise required and that is not, itself, permanently changed by the reaction. *See initiator or hardener.*

Coating, Intumescent

A covering that blisters to form a heat shield when exposed to fire.

Composite

Engineering materials (*for example, concrete and fiber-reinforced polymer*) made from two or more constituent materials that remain distinct, but combine to form materials with properties not possessed by any of the constituent materials individually; the constituent materials are generally characterized as matrix and reinforcement or matrix and aggregate.

Contact-Critical Application

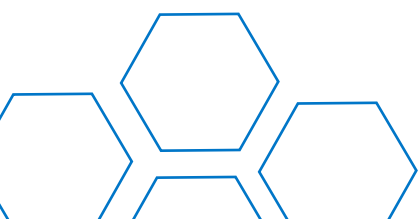
Strengthening or repair system that relies on load transfer from the substrate to the system material achieved through bearing or horizontal shear transfer at the interface.

Content, Fiber

The amount of fiber present in a composite, usually expressed as a percentage volume fraction or weight fraction of the composite.



Content, Resin	The amount of resin in a fiber-reinforced polymer composite laminate, expressed as either a percentage of total mass or total volume.
Creep-Rupture	Breakage of a material under sustained loading at stresses less than the tensile strength.
Cross-Linking	Forming covalent bonds linking one polymer molecule to another. <i>Note: An increased number of cross-links per polymer molecule increases strength and modulus at the expense of ductility.</i>
Cure, A-Stage	Early period after mixing at which components of a thermosetting resin remain soluble and fusible.
Cure, B-Stage	An intermediate period at which the components of a thermosetting resin have reacted sufficiently to produce a material that can be handled and processed, yet not sufficiently to produce specified final properties.
Cure, Full	Period at which components of a thermosetting resin have reacted sufficiently for the resin to produce specified final properties.
Cure, Thermosetting Resin	Inducing a reaction leading to cross-linking in a thermosetting resin using chemical initiators, catalysts, radiation, heat, or pressure.
Curing Agent	A catalytic or reactive agent that induces cross-linking in a thermosetting resin (<i>also hardener or initiator</i>).
Debonding	Failure of cohesive or adhesive bond at the interface between a substrate and a strengthening or repair system.
Delamination	A planar separation in a material that is roughly parallel to the surface of the material.
Durability	The ability of a material to resist weathering action, chemical attack, abrasion, and other conditions of service.
E-Glass	A family of glass with a calcium alumina borosilicate composition and a maximum alkali content of 2.0%. A general-purpose fiber that is used in reinforced polymers.
Epoxy	A thermosetting polymer that is the reaction product of epoxy resin and an amino hardener (<i>see also resin, epoxy</i>).



Fabric	A two-dimensional network of woven, nonwoven, knitted, or stitched fibers.
Fiber	A slender and greatly elongated solid material, generally with a length at least 100 times its diameter, that has properties making it desirable for use as reinforcement.
Fiber, Aramid	Fiber in which chains of aromatic polyamide molecules are oriented along the fiber axis to exploit the strength of the chemical bond.
Fiber, Carbon	Fiber produced by heating organic precursor materials containing a substantial amount of carbon, such as rayon, polyacrylonitrile (PAN), or pitch in an inert environment and at temperatures of 2700 °F (1500 °C) or greater.
Fiber, Glass	Filament drawn from an inorganic fusion typically comprising silica-based material that has cooled without crystallizing. Types of glass fibers include alkali resistant (AR-glass), general purpose (E-glass), high strength (S-glass), and boron free (ECR-glass).
Fiber Content	The amount of fiber present in a composite, expressed as a percentage volume fraction or mass fraction of the composite.
Fiber Fly	Short filaments that break off dry fiber tows or yarns during handling and become airborne; usually classified as a nuisance dust.
Fiber-Reinforced Polymer (FRP)	A general term for a composite material comprising a polymer matrix reinforced with fibers in the form of fabric, mat, strands, or any other fiber form. <i>See composite.</i>
Fiber Volume Fraction	The ratio of the volume of fibers to the volume of the composite containing the fibers.
Fiber Weight Fraction	The ratio of the weight of fibers to the weight of the composite containing the fibers.
Filament	<i>See fiber.</i>
Filler	A finely divided, relatively inert material, such as pulverized limestone, silica, or colloidal substances, added to portland cement, paint, resin, or other materials to reduce shrinkage, improve workability, reduce cost, or reduce density.



Fire Retardant	Additive or coating used to reduce the tendency of a resin to burn; these can be added to the resin or coated on the surface of the FRP.
Flow	Movement of uncured resin under gravity loads or differential pressure.
FRP	Fiber-reinforced polymer.
Full Cure	Period at which components of a thermosetting resin have reacted sufficiently for the resin to produce specified properties.
Glass Fiber-Reinforced Polymer (GFRP)	A composite material comprising a polymer matrix reinforced with glass fiber cloth, mat, or strands.
Grid, FRP	A rigid array of interconnected FRP elements that can be used to reinforce concrete.
Hardener	In a two-component adhesive or coating, the chemical component that causes the resin component to cure.
Impregnate	To saturate fibers with resin or binder.
Initiator	A chemical (<i>most commonly organic peroxides</i>) used to start the curing process for unsaturated polyester and vinyl ester resins.
Lamina	A single layer of fabric or mat reinforcing bound together in a cured resin matrix.
Laminate	Multiple plies or lamina molded together.
Layup	The process of placing reinforcing material and resin system in position for molding.
Layup, Wet	The process of placing the reinforcing material in the mold or its final position and applying the resin as a liquid.
Load, Sustained	A constant load that in structures is due to dead load and long-term live load.
Mat	A thin layer of randomly oriented chopped filaments, short fibers (<i>with or without a carrier fabric</i>), or long random filaments loosely held together with a binder and used as reinforcement for a FRP composite material.



Matrix	The resin or binders that hold the fibers in FRP together, transfer load to the fibers, and protect them against environmental attack and damage due to handling.
Modulus of Elasticity	The ratio of normal stress to corresponding strain for tensile or compressive stress below the proportional limit of the material; also referred to as elastic modulus, Young's modulus, and Young's modulus of elasticity; denoted by the symbol E.
Monomer	An organic molecule of relatively low molecular weight that creates a solid polymer by reacting with itself or other compounds of low molecular weight.
Nsm	Near-surface-mounted.
Pitch	Viscid substance obtained as a residue of petroleum or coal tar and used as a precursor in the manufacture of some carbon fibers.
Ply	<i>See lamina.</i>
Polyacrylonitrile (PAN)	A polymer-based material that is spun into a fiber form and used as a precursor in the manufacturer of some carbon fibers.
Polyester	One of a large group of synthetic resins, mainly produced by reaction of dibasic acids with dihydroxy alcohols; commonly prepared for application by mixing with a vinyl-group monomer and free-radical catalysts at ambient temperatures and used as binders for resin mortars and concretes, fiber laminates (<i>mainly glass</i>), adhesives, and the like. Commonly referred to as "unsaturated polyester."
Polymer	The product of polymerization; more commonly a rubber or resin consisting of large molecules formed by polymerization.
Polymerization	The reaction in which two or more molecules of the same substance combine to form a compound containing the same elements and in the same proportions but of higher molecular weight.
Polyurethane	Reaction product of an isocyanate with any of a wide variety of other compounds containing an active hydrogen group; used to formulate tough, abrasion resistant coatings.



Postcuring	Application of elevated temperature to material containing thermosetting resin to increase the level of polymer cross-linking and enhance the final material properties.
Pot Life	Time interval, after mixing of thermosetting resin and initiators, during which the mixture can be applied without degrading the final performance of the resulting polymer composite beyond specified limits.
Prepreg	A sheet of fabric or mat containing resin or binder usually advanced to the B-stage and ready for final forming and cure.
Pultrusion	A continuous process for manufacturing fiber reinforced polymer composites in which resin is impregnated on fiber reinforcements (roving or mats) and are pulled through a shaping and curing die, typically to produce composites with uniform cross sections.
Resin	Generally a thermosetting polymer used as the matrix and binder in FRP composites.
Resin, Epoxy	A class of organic chemical bonding systems used in the preparation of special coatings or adhesives for concrete or as binders in epoxy-resin mortars, concretes, and FRP composites.
Resin, Phenolic	A thermosetting resin produced by the condensation reaction of an aromatic alcohol with an aldehyde (<i>usually a phenol with formaldehyde</i>).
Resin, Thermoset	A material that hardens by an irreversible three-dimensional cross-linking of monomers, typically when subjected to heat or light energy and subsequently will not soften.
Roving	A parallel bundle of continuous yarns, tows, or fibers with little or no twist.
Shear, Interlaminar	Force tending to produce a relative displacement along the plane of the interface between two laminae.
Shelf Life	The length of time packaged materials can be stored under specified conditions and remain usable.
Sizing	Surface treatment applied to filaments to impart desired processing, durability, and bond attributes.



Substrate	Any material on the surface of which another material is applied.
Temperature, Glass-Transition	The midpoint of the temperature range over which an amorphous material (<i>such as glass or a high polymer</i>) changes from (or to) a brittle, vitreous state to (or from) a plastic state.
Tensile Strength	The maximum stress sustained by a fiber or composite part before it fails under a tensile load.
Thermoset	Resin that is formed by cross-linking polymer chains. <i>Note: A thermoset cannot be melted and recycled because the polymer chains form a three-dimensional network.</i>
Tow	An untwisted bundle of continuous filaments.
Vinylester Resin	A thermosetting reaction product of epoxy resin with a polymerizable unsaturated acid (<i>usually methacrylic acid</i>) that is then diluted with a reactive monomer (<i>usually styrene</i>).
Volatile Organic Compound (VOC)	An organic compound that vaporizes under normal atmospheric conditions and is defined by the U.S. Environmental Protection agency as any compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, which participates in atmospheric photochemical reactions.
Wet-Out	The process of coating or impregnating roving, yarn, or fabric to fill the voids between the strands and filaments with resin; it is also the condition at which this state is achieved.
Witness Panel	A small mockup manufactured under conditions representative of field application, to confirm that prescribed procedures and materials will yield specified mechanical and physical properties.
Yarn	A twisted bundle of continuous filaments.

