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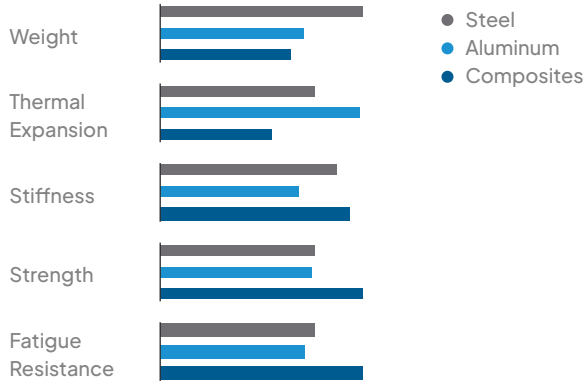
Composites vs steel and aluminum

Composites have a high strength-to-weight ratio. Carbon fiber is about 75 percent lighter than steel and about 30 percent lighter than aluminum. Fiberglass is about 60% lighter than steel and about 20% lighter than aluminum, yet both are much stronger than both materials by weight. A cubic foot of cast steel weighs approximately 490 lbs, but a composite part of the same dimensions could weigh as little as 145 lbs.

Composites unite the best qualities that traditional materials have to offer. The two composite components are a reinforcement, often a high- performance fiber, such as carbon or glass, and a matrix, such as an epoxy polymer. The matrix binds the reinforcement together to merge the original components into composite.

Fiber-reinforced composites using carbon fiber and fiberglass present innovative design opportunities for engineers, and each year composites continue to replace traditional materials, such as steel and aluminum, across many industries.

Automotive engineers use composites to decrease vehicle weight by as much as 60 percent while improving crash safety, because multilayer composite laminates absorb more energy than traditional single- layer steel. And, in vehicle components such as gas tanks, there are specialized resins that meet UL specifications.



How does pricing vs weight factor into your decision?

Cost comparison, steel vs FRP depends on the application and design. Raw material cost is just one part of the analysis. Steel is denser than FRP, so a steel structure would weigh up to 35 percent more and requires more maintenance. A fiberglass part will be about 10 times less costly than a carbon part.

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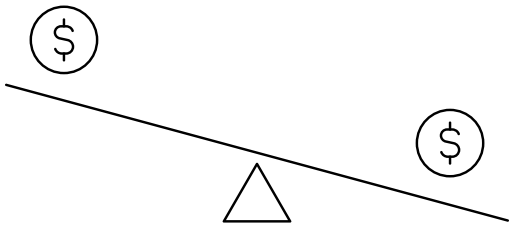
Steel
$0.50–$1.00/lb

FRP
$1.00–$3.00/lb



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Advantages of Composites

Composites never rust, regardless of their environment. Their high-dimensional stability allows them to maintain their shape through extreme temperature changes, whether they are wet or dry. This makes them popular materials for outdoor structures, such as wind turbine blades. Engineers choose composites over traditional materials to reduce maintenance costs and ensure stability, which are long-term benefits for structures that are designed to last decades.

Composites also offer design options that would be hard to achieve with traditional materials. Composites allow for part consolidation, as a single composite part can replace a full assembly of metal parts, plus, surface texture can be altered to mimic any finish, from smooth to textured. Over 90 percent of recreational boat hulls are now constructed from composites—in part because they can be molded into a wide range of boat shapes.

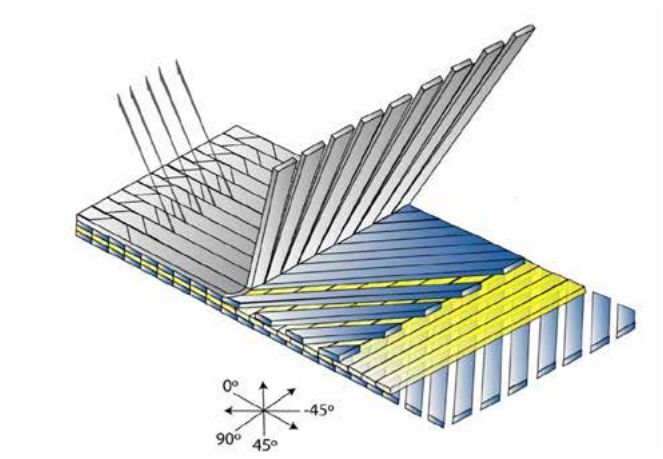
In addition, by their very nature, metals conduct electricity. Composites are superior insulators—they do not respond to an electric field and resist the flow of an electrical charge.

According to Dr. Jason Gibson, Ph.D., Chief Applications Engineer with Composites One LLC, "FRP offers several advantages over traditional metals in certain applications. FRP is a superior choice where lightweight, corrosion-resistant, or design flexibility are important characteristics—thus making it suitable for weight-sensitive industries, marine environments, and architectural elements. Its electrical and thermal insulation properties make it safer and more efficient for electrical enclosures and temperature-sensitive applications. FRP's impact resistance and cost-effectiveness, despite higher initial costs, contribute to its durability and long-term savings."

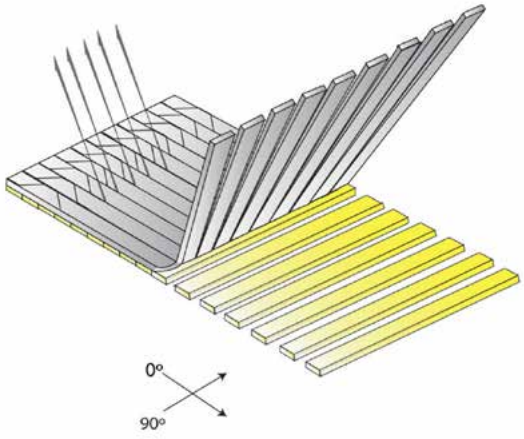
With composites, you can put strength in the areas and directions you want, which allows for stronger and lighter end designs with less material waste.

ie. Isotropic vs anisotropic

Isotropic



Anisotropic



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