FRP vs. Traditional Materials

Traditional building materials have their place. But for harsh, corrosive environments, FRP is a smart choice. Here's how FRP compares to several traditional options.

	FRP Composites *Pultruded GFRP*	**Steel** *A 709 Grade 50*	**Aluminum** *6061-T651 & 6061-T6*	**Wood** *Douglas Fir*
CORROSION, ROT AND INSECT RESISTANCE	**Resists a broad range of chemicals and is unaffected by moisture** or immersion in water. **Resists insect damage.** Painting is only suggested when exposed to UV rays/direct sunlight.	Subject to oxidation and corrosion. Requires painting or galvanizing for many applications.	Can cause galvanic corrosion. (Anodizing and other coatings increase corrosion resistance.)	Can warp, rot and decay when exposed to moisture, water and chemicals. Susceptible to attack by insects such as termites and marine borers.
STRENGTH	**Has greater flexural strength** than timber and pound-for-pound is **often stronger than steel and aluminum** in the lengthwise direction. Ultimate flexural strength (F_u): LW = 30,000 psi (30 ksi) CW = 10,000 psi (10 ksi) Compression strength: LW = 30,000 psi (30 ksi) CW = 15,000 psi (10 ksi)	Homogeneous material. Yield strength (F_y) = 36 ksi	Homogeneous material. Flexural strength (F_u) = 35 ksi	Modulus of rupture is 12,000 psi
WEIGHT	Weighs 75% less than steel and 30% less than aluminum.	Could require lifting equipment to move and place. 1/2-in. thick plate = 20.4 lbs/sq ft	Lightweight – about a third of the weight of copper or steel.	Specific gravity 0.48
ELECTRICAL CONDUCTIVITY	**Nonconductive.** High dielectric capability.	Conducts electricity. Grounding potential.	Conducts electricity. Grounding potential.	Can be conductive when wet.
THERMAL PROPERTIES	**Good insulator with low thermal conductivity.** Thermal conductivity = 4 (BTU in. /(hr ft^2 °F) Low thermal coefficient of expansion. = 7 - 8 (in./in./°F) 10^{-6}	Conducts heat. Thermal conductivity = 260-460 (BTU/sf/hr/°F/in.) Thermal coefficient of expansion. = 6 - 8 (in./in./°F) 10^{-6}	Conducts heat. Thermal conductivity = 150 (BTU/sf/hr/°F/in.) Thermal coefficient of expansion. = 13 (in./in./°F) 10^{-6}	Low thermal conductivity. Thermal conductivity = .8 (BTU/sf/hr/°F/in.) Thermal coefficient of expansion. = 1.7 - 2.5 (in./in./°F) 10^{-6}

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STIFFNESS	**Up to 3.3 times as rigid as timber. Will not permanently deform under working load.** Modulus of elasticity: 2.8×10^6 psi	Modulus of elasticity: 29×10^6 psi	Modulus of elasticity: 10×10^6 psi	Modulus of elasticity: up to $1.6\text{-}1.8 \times 10^6$ psi*
IMPACT RESISTANCE	**Will not permanently deform under impact.** Glass mat in pultruded parts distributes impact load to prevent surface damage, even in subzero temperatures.	Can permanently deform under impact.	Easily deforms under impact.	Can permanently deform or break under impact.
ENVIRONMENTAL IMPACT	**Not hazardous to the environment.**	Not hazardous.	Not hazardous.	May be treated with hazardous preservatives or coatings to increase corrosion/rot/insect resistance. Contributes to depletion of forest systems.
COLOR	**Color is molded through; no painting required.** Variety of colors available.	Must be painted for color, and may require repainting over time.	Colors require prefinishes, anodic coatings and paints. Mechanical, chemical and electroplated finishes can be applied.	Must be primed and painted for color, and may require repainting over time.
COST	**Lower installation costs, less maintenance and longer product life allow for a lower lifecycle cost.**	Lower initial material cost.	Part price comparable to FRP.	Has a lower initial cost, but usually requires more maintenance and replacement.
EMI/RFI TRANSPARENCY	**Transparent to radio waves and EMI/RFI transmissions.** Used for radar and antennae enclosures and supports.	Can interfere with EMI/RFI transmissions.	Highly reflective to EMI/RFI transmissions.	Transparent.
FABRICATION	**Can be field-fabricated using simple carpenter's tools** with carbon or diamond tip blades — no torches or welding required. Light weight allows easier transport and installation.	Often requires welding and cutting torches. Heavier material requires special equipment to erect and install.	Good machinability (welding, brazing, soldering or mechanical joining).	Can be field-fabricated using simple carpenter's tools.

*12% moisture content

Compare the Numbers ...

Property	FRP Composites *Pultruded GFRP*		Steel *A 709 Grade 50*	Aluminum *6061-T651 & 6061-T6*	Wood *Douglas Fir*
Density (lb/ft^3)	107-120		490	169	30
Tensile Strength (psi)	30,000 (LW)	7,000 (CW)	65,000	45,000	—
Tensile Modulus (x 10^6 psi)	2.8 (LW)	1 (CW)	30	10	—
Flexural Strength (psi)	30,000 (LW)	10,000 (CW)	65,000	45,000	12,000
Flexural Modulus (x 10^6 psi)	1.8 (LW)	0.8 (CW)	30	10	1.6 - 1.8
Thermal Conductivity (BTU in. /(hr ft^2 °F))	4		323	1,160	0.8
Thermal Expansion (x 10^{-6} in./in./°F)	7 to 8		6 to 8	13	1.7 to 2.5

LW = Lengthwise / CW = Crosswise

References:

1. Datasheets from www.matweb.com
2. Wood Handbook: Wood as an Engineering Material