Properties of common polymers used in FRPs. (Taken from Illston, JE et al, 2nd Ed., 1994)

Material properties	*Specific weight*	*Ultimate tensile strength MPa*	*Modulus of elasticity in tension GPa*	*Coefficient of linear expansion $10^{-6}/°C$*
Thermosetting				
Polyester	1.28	45–90	2.5–4.0	100–110
Epoxy	1.30	90–110	3.0–7.0	45–65
Phenolic (with filler)	1.35–1.75	45–59	5.5–8.3	30–45
Thermoplastics				
Polyvinyl chloride (PVC)	1.37	58.0	2.4–2.8	50
Acrylonitrile butadiene styrene (ABS)	1.05	17–62	0.69–2.82	60–130
Nylon	1.13–1.15	48–83	1.03–2.76	80–150
Polyethylene (high-density)	0.96	30–35	1.10–1.30	120

Some Properties of Thermoplastic, Elastomeric, and Thermosetting Polymers (from J.F. Young, et al, Prentice-Hall, 1998)

Polymer	Tensile Strength (MPa)	Modulus of Elasticity (GPa)	Elongation at Failure (%)	Density (kg/m^3)	Heat Deflection (Temp. 66 psi (°C)	Examples of Application
Thermoplastics						
Polyethylene[a]						
Low density	8.5–22	0.1–0.3	50–800	920	42	Packing films,
High density	22–40	0.4–1.3	15–130	960	85	pipes
Polypropylene[a]	28–42	1–1.5	10–700	900	115	Tanks, fibers
Polyvinylchloride (PVC)[a]	35–64	2.1–4.3	2–100	1400		Pipes, floor tiles
Polystyrene[a]	23–57	2.7–3.2	1–60	1060	82	Insulating foams, lighting panels
Polymethyl-methacrylate[a] (PMMA) (Perspex)	43–86	0.14–0.36	300–450	1220	93	Windows, windshields
Polytetrafluo roethylene[a] (Teflon) (PTFE)	14–50	0.4–0.55	100–400	2170	120	Seals, coatings
Thermosettings						
Epoxies[b]	28–107	2.8–3.6	0–6	125-	—	Adhesives
Polyurethanes[b]	35–71	3–6	1300	—		Coatings, insulating foams
Polyesters[b]	43–93	2.1–4.6	0–3	1280	—	Matrix in FRP, laminates
Elastomers						
Polychloroprene[c] (Neoprene)	25	—	800	1240	—	Hoses
Butadiene-styrene[d] (SBR)	4.3–2.1	—	600–2000	1000	—	Coatings
Silicones[e]	2.5–7	—	100–700	1500		Sealants

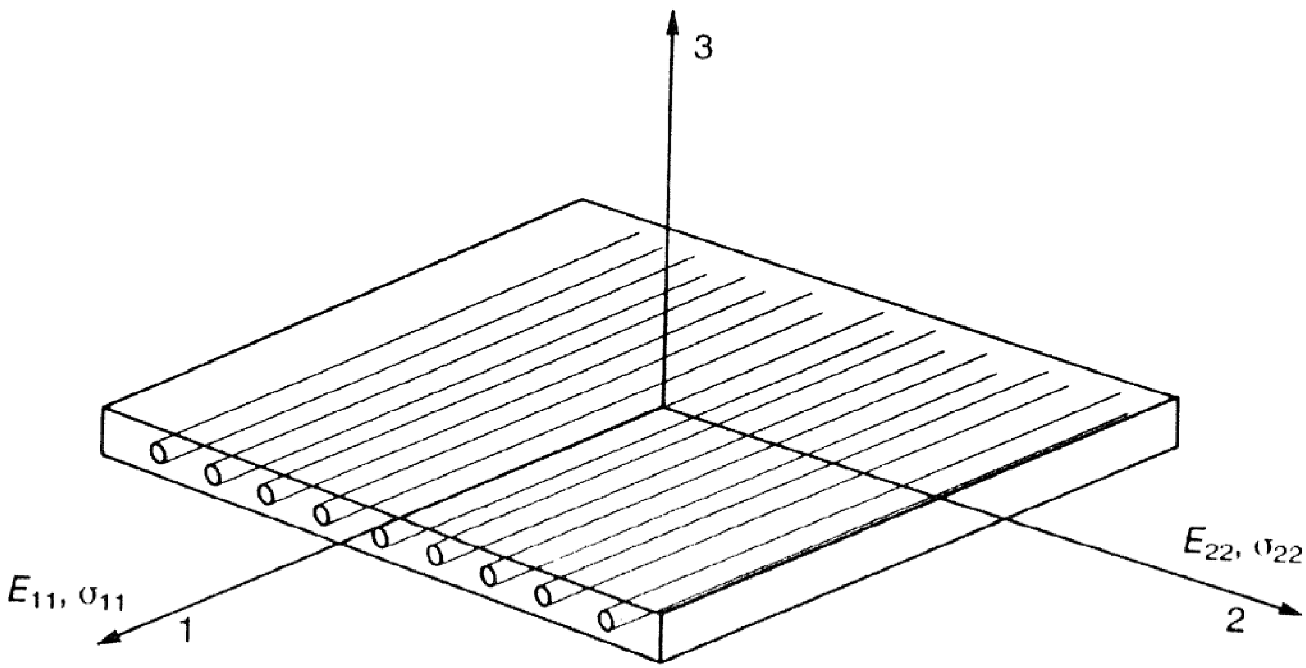
Properties of common fibers used in FRPs. (Taken from Illston, JE et al, 2nd Ed., 1994)

Material properties	*Specific weight*	*Ultimate tensile strength (GPa)*	*Modulus of elasticity in tension (GPa)*
Carbon fibre			
Type I	1.92	2.00	345
Type II	1.75	2.41	241
Type III	1.70	2.21	200
E-glass fibre	2.55	2.4	72.4
S2-glass fibre	2.47	4.6	88.0
Kevlar fibres			
29	1.44	2.65	64
49	1.45	2.65	127

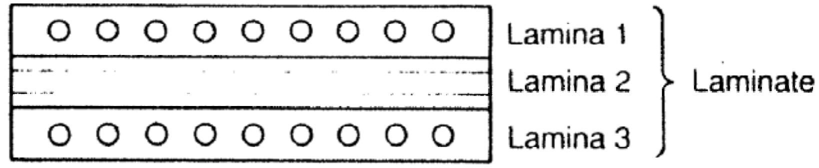
Some Properties of Common Fibers (from J.F. Young, et al, Prentice-Hall, 1998)

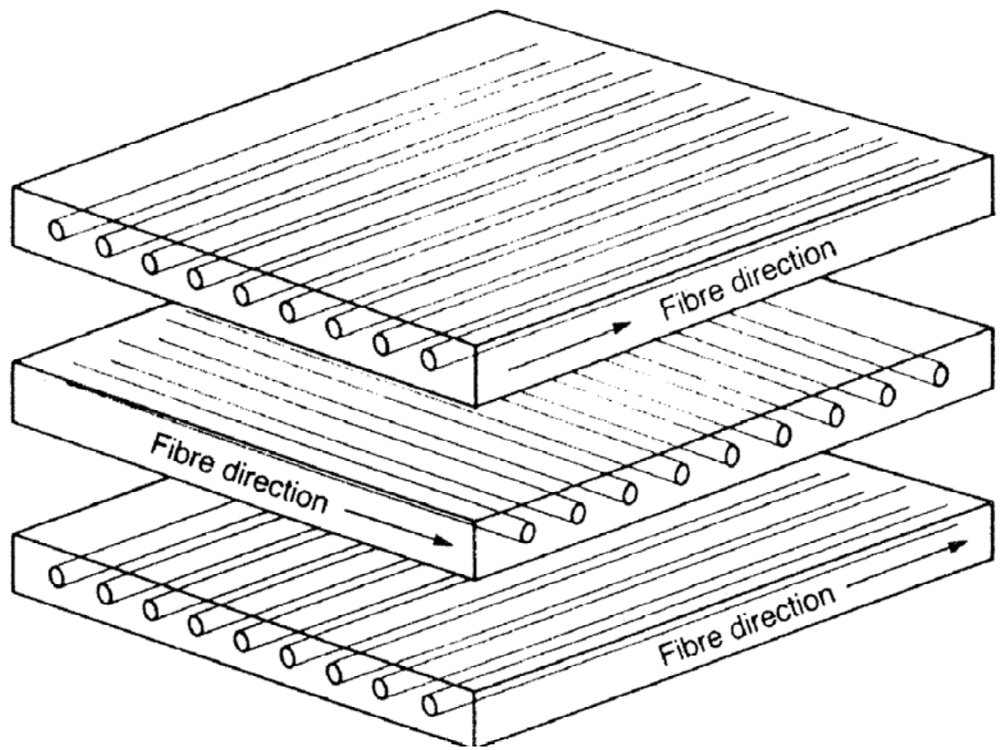
Fiber	Diameter (μm)	Relative Density[a]	Modulus of Elasticity (GPa)	Tensile Strength (GPa)	Elongation at Break (%)
Steel	5–500	7.84	200	0.5–2.0	0.5–3.5
Glass	9–15	2.60	70–80	2–4	2–3.5
Asbestos					
Crocidolite	0.02–0.4	3.4	196	3.5	2.0–3.0
Chrysotile	0.02–0.4	2.6	164	3.1	2.0–3.0
Fibrillated polypropylene	20–200	0.9	5–77	0.5–0.75	8.0
Aramid (Kevlar)	10	1.45	65–133	3.6	2.1–4.0
Carbon (high strength)	9	1.90	230	2.6	1.0
Nylon	—	1.1	4.0	0.9	13.0–15.0
Cellulose	—	1.2	10	0.3–0.5	—
Acrylic	18	1.18	14–19.5	0.4–1.0	3
Polyethylene	—	0.95	0.3	0.7×10^{-3}	10
Wood Fiber	—	1.5	71.0	0.9	—
Sisal	10–50	1.50	—	0.8	3.0

[a]Formerly specific gravity.

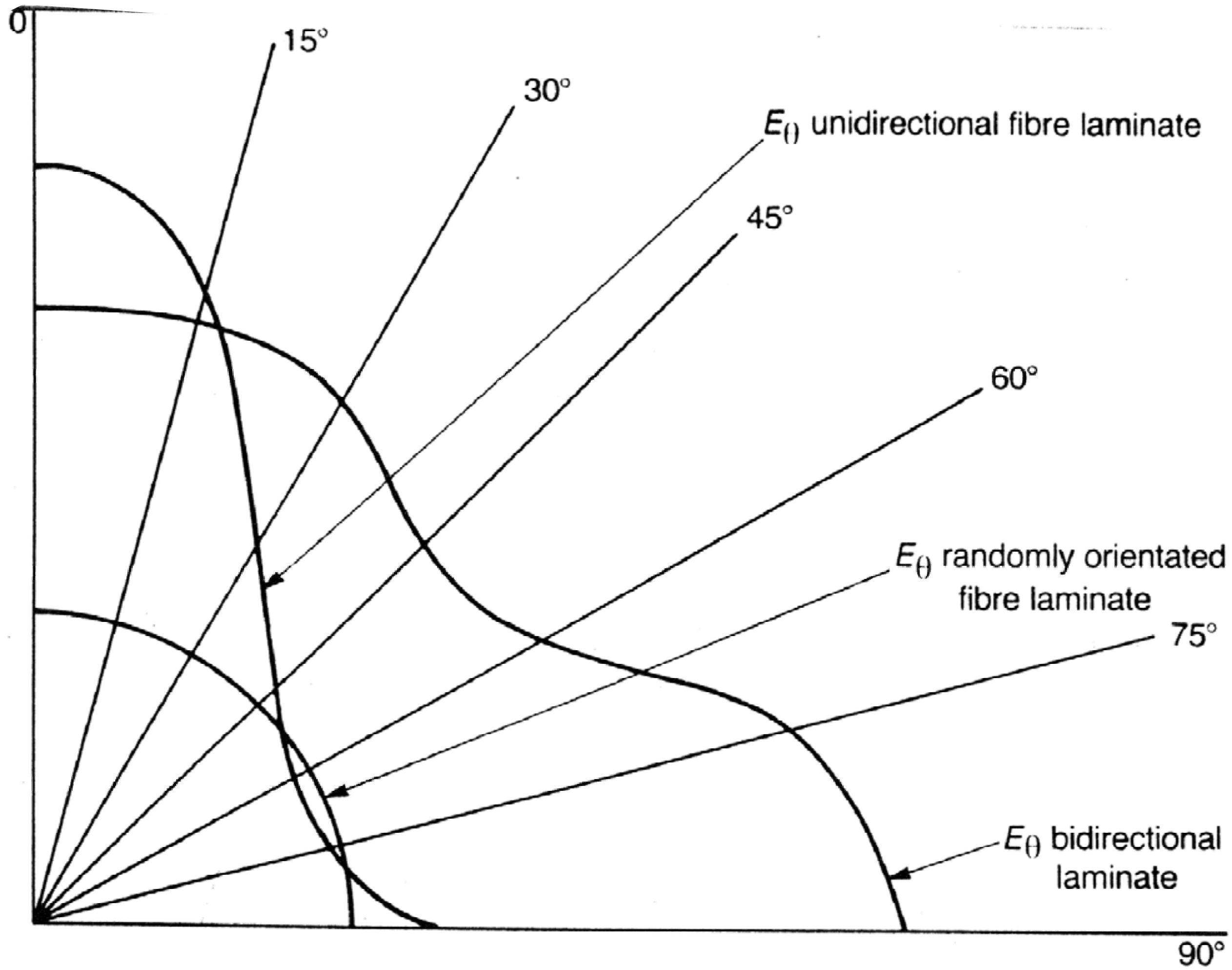


Schematic of unidirectional ply of fibers (This figure adapted from Illston et al, 2nd Ed., 1994.)





Multi-ply 0-90-0 laminated composite. (Adapted from Illston, et al 2nd Ed. 1994.)



Directional dependence of stiffness in a bi-directional composite