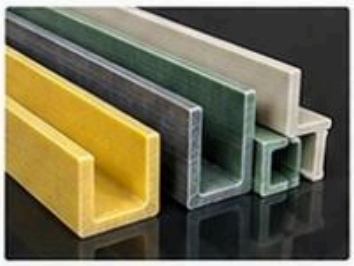
TECHNICAL DATA SHEET
Product Data · Design Formulas · Applications

FRP Channel Profile

PULTRUDED GFRP C-CHANNEL

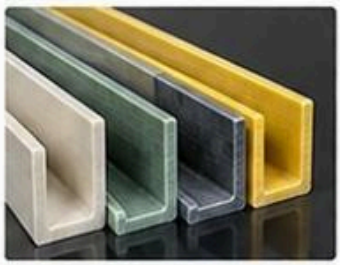




Sections & Sizes



Specifications



Colors & Finish



Applications

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NABAK COMPOSITE FRP channel (FRP / GRP Channel Profile) is a pultruded C-shaped GFRP profile with one web and two flanges. Lightweight, rust-free, electrically insulating and paint-free, it replaces UNP and galvanized steel channel in joists, purlins, platform frames, cable-tray supports, stairs and light structures in corrosive environments.

50 – 300 mm	≥ 240 MPa	≥ 23 GPa	≈ 1/4
Channel web height	Longitudinal tensile strength (E23)	Longitudinal modulus of elasticity	of the weight of an equal steel channel

What is FRP channel (GFRP channel profile)?

Composite channel, also known as **FRP channel**, **GFRP channel**, **fiberglass channel**, **composite channel profile**, **composite C and U profile** and **pultruded channel**, is made by pultruding continuous glass-fibre rovings and transverse mats impregnated with resin through a heated C-shaped die. Longitudinal fibres in the web and flanges provide the bending stiffness and strength of the channel beam, while transverse mats increase shear strength, bolt bearing and corner integrity.

FRP is the general name for fibre-reinforced polymers, and GFRP (or GRP) is FRP made with glass fibre. Composite channel is an **open, singly symmetric section**; its shear centre lies outside the web, and load applied to the web tends to twist the beam. Lateral restraint, the point of load application and the use of double channels are therefore especially important in the design of FRP channel beams (pages 4 and 5).

Parts and structure of composite channel

Web	Flanges	Inside corners	Surface veil
The main shear element and source of section depth; where the channel is bolted to columns and beams.	Two parallel flanges carrying most of the moment of inertia and bending strength.	Corner radius with continuous fibres to reduce stress concentration between web and flange.	Resin-rich surface for UV and chemical resistance of GFRP channel.

Advantages of FRP channel over steel channel

- **Corrosion-resistant:** composite channel does not rust in seawater, chlorine, acids or sewage; no galvanizing or painting.
- **Lightweight:** a 152×42×6.4 GFRP channel weighs only 2.6 kg/m; installed by hand without a crane.
- **Insulating and non-magnetic:** suited to substations, cable trays and sensitive equipment.
- **Flat faces for connections:** the flat web and flanges of FRP channel allow simple bolting to columns, grating and decking.
- **No welding or hot work:** cut with a diamond saw and joined with bolts and structural adhesive.
- **Flexible combinations:** double channels, channel with angle and channel with tube create complete composite structures.

Applications of FRP composite channel

Joists and platform frames	Stair stringers	Cable tray and rails
Joists under composite grating and framing of industrial platforms	Stringers for composite stairs with FRP grating treads	Brackets, posts and rails supporting cable trays in electrical installations
Purlins and light roofs	**Cooling towers**	**Double channels**
Canopy purlins, light cladding and roofs in corrosive environments	Internal beams and bracing of towers in GFRP channel	Symmetric columns and beams from two back-to-back channels

Size and weight table of composite channel

Table 1 — FRP channel: sizes, weight and properties about the strong x-axis (ρ = 1.85 g/cm³)

Size h×b×t (mm)	A (mm²)	Weight (kg/m)	I_x (mm⁴)	W_x (mm³)	i_x (mm)
50 × 25 × 4	368	0.68	1.31×10^{5}	5.23×10^{3}	18.9
76 × 22 × 4.8	530	0.98	3.85×10^{5}	1.01×10^{4}	27.0
100 × 30 × 5	750	1.39	9.81×10^{5}	1.96×10^{4}	36.2
102 × 35 × 6.4	1019	1.88	1.40×10^{6}	2.75×10^{4}	37.1
120 × 40 × 6	1128	2.09	2.19×10^{6}	3.65×10^{4}	44.1
152 × 42 × 6.4	1428	2.64	4.29×10^{6}	5.64×10^{4}	54.8
152 × 42 × 9.5	2062	3.81	5.92×10^{6}	7.79×10^{4}	53.6
200 × 55 × 9.5	2764	5.11	1.42×10^{7}	1.42×10^{5}	71.6
254 × 70 × 12.7	4681	8.66	3.85×10^{7}	3.04×10^{5}	90.7
300 × 90 × 15	6750	12.49	7.95×10^{7}	5.30×10^{5}	108.5

Weak-axis, torsional and shear-centre properties

Table 2 — FRP channel: properties about the weak y-axis and torsional properties

Size h×b×t (mm)	$\bar{x}$ centroid (mm)	I_y (mm⁴)	i_y (mm)	J (mm⁴)	e_0 shear centre (mm)	C_w (mm⁶)
50 × 25 × 4	7.7	2.07×10^{4}	7.5	1.96×10^{3}	8.6	7.51×10^{6}
76 × 22 × 4.8	5.8	1.85×10^{4}	5.9	4.07×10^{3}	6.1	1.63×10^{7}
100 × 30 × 5	7.5	5.16×10^{4}	8.3	6.25×10^{3}	8.7	8.20×10^{7}
102 × 35 × 6.4	9.5	9.90×10^{4}	9.9	1.39×10^{4}	10.5	1.57×10^{8}
120 × 40 × 6	10.2	1.46×10^{5}	11.4	1.35×10^{4}	12.2	3.32×10^{8}
152 × 42 × 6.4	9.9	1.88×10^{5}	11.5	1.95×10^{4}	11.9	7.11×10^{8}
152 × 42 × 9.5	11.0	2.56×10^{5}	11.1	6.20×10^{4}	11.3	9.01×10^{8}
200 × 55 × 9.5	13.3	6.13×10^{5}	14.9	8.32×10^{4}	15.3	3.94×10^{9}
254 × 70 × 12.7	17.2	1.67×10^{6}	18.9	2.52×10^{5}	19.4	1.72×10^{10}
300 × 90 × 15	22.5	4.18×10^{6}	24.9	5.06×10^{5}	26.1	5.98×10^{10}

t is the web and flange thickness (assumed equal); $\bar{x}$ is the distance of the centroid from the back of the web; e_0 is the distance of the shear centre from the web centreline, outward (behind the web). Properties are calculated with the formulas on page 4 for sharp corners. Sizes are common market sizes of pultruded composite channel; standard length 6 m and tolerances per EN 13706-2.

Selection guide for composite channel

Table 3 — Recommended FRP channel for common applications

Application	Recommended channel (mm)	Design note
Cable-tray rails and brackets	50 × 25 × 4 / 76 × 22 × 4.8	Web bolted to the column
Platform joist under grating (span 1 – 1.5 m)	102 × 35 × 6.4 / 120 × 40 × 6	Grating bolted to the flange, continuous lateral restraint
Stair stringer	152 × 42 × 6.4 / 200 × 55 × 9.5	Treads provide lateral restraint to the stringer
Main platform beam (span 2 – 3 m)	200 × 55 × 9.5 / 254 × 70 × 12.7	Check deflection and lateral-torsional buckling (Table 6 on page 3)
Light column	Double 120 × 40 × 6 or 152 × 42 × 6.4	Double channel with spacers (Formula 7)
Purlins and canopy frames	100 × 30 × 5 / 120 × 40 × 6	Roof sheet bolted to the flange

Mechanical properties of composite channel

Table 4 — Reference properties of pultruded GFRP channel (based on EN 13706 grade E23)

Property	EN 13706 grade E23 minimum	Typical value, FRP channel	Relevance to channel design
Longitudinal modulus E_L	23 GPa	23 – 28 GPa	Beam deflection and buckling
Shear modulus G_{LT}	–	3 – 4 GPa	Shear deflection and lateral-torsional buckling
Longitudinal tensile / flexural strength	240 / 240 MPa	250 – 350 MPa	Beam strength when fully restrained
Transverse tensile / flexural strength	50 / 100 MPa	50 – 80 / 100 – 130 MPa	Flange bending and web-to-flange junction
Transverse compressive strength	–	70 – 120 MPa	Web crushing under concentrated loads and supports
Apparent shear strength	25 MPa	25 – 35 MPa	Web shear
Pin-bearing strength, longitudinal / transverse	150 / 70 MPa	180 – 220 / 90 – 120 MPa	Bolted web connections
Density / expansion coefficient	–	1.8 – 1.9 g/cm³ / 8 – 10 $\times 10^{-6}$	Weight and compatibility with steel

Values are typical ranges of the FRP and GFRP composites industry and of EN 13706-3, and are not NABAK COMPOSITE's own laboratory results. Common design references for pultruded profiles: ASCE/SEI 74 (LRFD design of pultruded FRP structures) and the European CEN/TS 19101.

Composite channel compared with steel channel

Table 5 — FRP channel vs UNP steel and aluminium channel

Feature	GFRP channel 152×42×6.4	Steel channel UNP 160	Aluminium channel, same size
Weight (kg/m)	2.6	≈ 18.8	≈ 3.9
Modulus E / G (GPa)	23 / 3	210 / 81	70 / 26
Corrosion in marine and chemical environments	**None**	**Severe**	**Moderate**
Electrical conductivity	Insulating	Conductive	Conductive
Sensitivity to lateral-torsional buckling	**High (restraint needed)**	**Low**	**Moderate**
Governing beam design criterion	Buckling and deflection	Strength	Deflection and strength

Shear centre of a channel: in composite channel the shear centre lies at distance e_0 behind the web (Table 2). A load passing through the web or the centroid twists the beam as well as bending it. To avoid torsion, transfer load through a connection on the back of the web near the shear centre, restrain the compression flange, or use back-to-back double channels.

Resin, colour and length of FRP channel

NABAK composite channel is produced with **isophthalic polyester** resin for general use, **vinyl ester** for severe chemical environments and **fire-retardant resin** (ASTM E84 ≤ 25) for public spaces and electrical installations. Common colours are **yellow, grey, green, cream and black**, with pigment dispersed through the full thickness of the GFRP channel. Standard length is 6 m; lengths up to 12 m and cutting and drilling to drawing can also be ordered.

Effect of unbraced length on channel bending capacity

Table 6 — Ultimate moment of FRP channel (kN·m) by unbraced length of the compression flange (Formula 8, minimum with section strength)

Channel (mm)	Section strength $\sigma_u W_x$	L_b = 0.5 m	L_b = 1.0 m	L_b = 1.5 m	L_b = 2.0 m
100 × 30 × 5	4.7	2.09	0.66	0.37	0.26
120 × 40 × 6	8.8	6.73	1.96	1.04	0.70
152 × 42 × 6.4	13.5	10.97	3.07	1.57	1.03
152 × 42 × 9.5	18.7	15.27	4.76	2.67	1.86
200 × 55 × 9.5	34.0	34.0	12.61	6.32	4.06
254 × 70 × 12.7	72.8	72.8	42.0	20.47	12.80

Values are ultimate and must be divided by a safety factor (e.g. 2.5) for design. Calculated with E = 23 GPa, G = 3 GPa and load at the shear centre; this is an illustrative example and detailed design should follow ASCE/SEI 74.

Section formulas for composite channel

1. Cross-section area and weight

$$A = 2\,b\,t_f + (h - 2t_f)\,t_w\,, \quad w = \rho\,A$$

152×42×6.4: A = 2 × 42 × 6.4 + 139.2 × 6.4 ≈ 1428 mm²; w ≈ 2.64 kg/m

2. Moment of inertia about the strong axis

$$I_x = \frac{b\,h^3 - (b - t_w)(h - 2t_f)^3}{12}\,, \quad W_x = \frac{2\,I_x}{h}$$

152×42×6.4: $I_x \approx 4.29\times10^6$ mm⁴ and $W_x \approx 5.64\times10^4$ mm³

3. Centroid and weak-axis moment of inertia

$$\bar{x} = \frac{\Sigma\,A_i\,x_i}{A}\,, \quad I_y = \Sigma\left(\frac{h_i\,b_i^3}{12} + A_i\,(x_i - \bar{x})^2\right)$$

152×42×6.4: $\bar{x} \approx 9.9$ mm from the back of the web; $I_y \approx 1.88\times10^5$ mm⁴ (about 4% of I_x)

4. Torsion constant of an open section

$$J \approx \frac{2\,b\,t_f^3 + (h - 2t_f)\,t_w^3}{3}$$

152×42×6.4: J ≈ 1.95×10⁴ mm⁴; grows with the cube of thickness (thickness 9.5 → 6.2×10⁴)

5. Shear-centre location (thin-walled section)

$$e_0 = \frac{b'^2 \cdot h'^2 \cdot t_f}{4\,I_x}\,, \quad b' = b - t_w/2\,, \quad h' = h - t_f$$

152×42×6.4: b' = 38.8, h' = 145.6 → $e_0 = 38.8^2 \times 145.6^2 \times 6.4 / (4 \times 4.29\times10^6) \approx 11.9$ mm behind the web centreline. To avoid torsion, the line of action of the load must pass through this point.

6. Warping constant

$$C_w = \frac{t_f\,b'^3\,h'^2\,(3\,b'\,t_f + 2\,h'\,t_w)}{12\,(6\,b'\,t_f + h'\,t_w)}$$

152×42×6.4: $C_w \approx 7.11\times10^8$ mm⁶; the section's resistance to warping under torsion and an input to the lateral-torsional buckling formula (Formula 8)

7. Back-to-back double channel

$$I_{y,2} = 2\left[\,I_y + A\left(\bar{x} + \frac{g}{2}\right)^2\right], \quad I_{x,2} = 2\,I_x$$

Two 152×42×6.4 channels with gap g = 10 mm: $I_{y,2} \approx 1.01\times10^6$ mm⁴ (about 2.7 times the sum of I_y of two single channels); shear centre on the axis of symmetry and no load-induced torsion.

Section design note: in composite channel, I_y is only 4 to 5 percent of I_x and the torsion constant J is very small; these two numbers, not I_x, govern the capacity of an unbraced beam. Increasing thickness from 6.4 to 9.5 mm more than triples J and, for FRP channel beams with limited lateral restraint, is more effective than increasing web height.

Beam design with composite channel

8. Critical moment for lateral-torsional buckling (classical approximation)

$$M_{cr} = \frac{\pi}{L_b}\sqrt{(E I_y \cdot G J)}\cdot\sqrt{\left(1+\frac{\pi^2 E C_w}{G J L_b^2}\right)}, \quad M_a = \frac{\min(M_{cr}, \sigma_u W_x)}{FS}$$

Example — FRP channel beam 152×42×6.4, E = 23 GPa, G = 3 GPa, FS = 2.5:

Section strength: $\sigma_u W_x = 240 \times 5.64\times10^4 \approx 13.5$ kN·m

Unbraced $L_b = 2.0$ m: $M_{cr} \approx 1.03$ kN·m → $M_a \approx 0.41$ kN·m → $q_a \approx 0.82$ kN/m

Braced every $L_b = 0.5$ m: $M_{cr} \approx 11.0$ kN·m → ≈ 10× higher capacity

Without lateral restraint, a composite channel beam reaches only about 8% of its section capacity. Fixing FRP grating or decking to the compression flange at close spacing, or lateral bracing every 500 mm, brings capacity close to the section strength. The relation is for load at the shear centre; load on the top flange reduces M_{cr}.

9. Beam deflection (bending + shear)

$$\delta = \frac{5 q L^4}{384 E I_x} + \frac{q L^2}{8 G A_w}$$

152×42×6.4, L = 2 m, q = 1 kN/m, $A_w = t_w(h - 2t_f) \approx 891$ mm²: δ ≈ 2.11 + 0.19 ≈ 2.3 mm (L/870)

10. Web crushing at supports

$$R_a = \frac{\sigma_{c,T} \cdot t_w \cdot (N + 2.5\, t_f)}{FS}$$

$\sigma_{c,T} \approx 70$ MPa, N = 50 mm bearing, FS = 3: $R_a = 70 \times 6.4 \times 66 / 3 \approx 9.9$ kN (simple estimate; use a web stiffener plate for higher loads)

11. Bolted web connection capacity

$$P_{br} = \frac{n\, d\, t_w\, \sigma_{br}}{FS}; \quad e_1 \geq 2d, p \geq 4d$$

3 M12 bolts in a 6.4 mm web, $\sigma_{br} = 150$ MPa, FS = 3: $P_{br} \approx 11.5$ kN

12. Thermal expansion of the beam

$$\Delta L = \alpha \cdot L \cdot \Delta T$$

6 m channel, $\alpha = 9\times10^{-6}$, ΔT = 40 °C → ΔL ≈ 2.2 mm; compatible with steel and concrete structures

Fabrication guide for composite channel

1. **Orientation:** install the channel with the web vertical and flanges horizontal; transfer load as far as possible through the back of the web near the shear centre.
2. **Lateral restraint:** restrain the compression flange of FRP channel beams with grating, decking or bracing at close spacing.
3. **Cutting and drilling:** use diamond or carbide saws and drills; hole diameter 1 to 1.5 mm larger than the bolt.
4. **Sealing:** coat cut surfaces and holes with compatible resin.
5. **Connection:** composite clip angles and stainless or FRP bolts with wide washers; in critical joints, structural adhesive together with bolts.
6. **Double channel:** fix two channels back-to-back with spacers and stitch bolts every 400 to 600 mm.

Request a quote for FRP channel: send section size, length and number of bars, colour, resin type and the cutting and drilling drawing.
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Disclaimer: The information in this data sheet is based on general, typical data of the FRP and GFRP composites industry and the EN 13706 standard, and is intended as guidance only. Examples are for illustration; structural design must be carried out by a qualified engineer. NABAK COMPOSITE reserves the right to change technical specifications without notice.