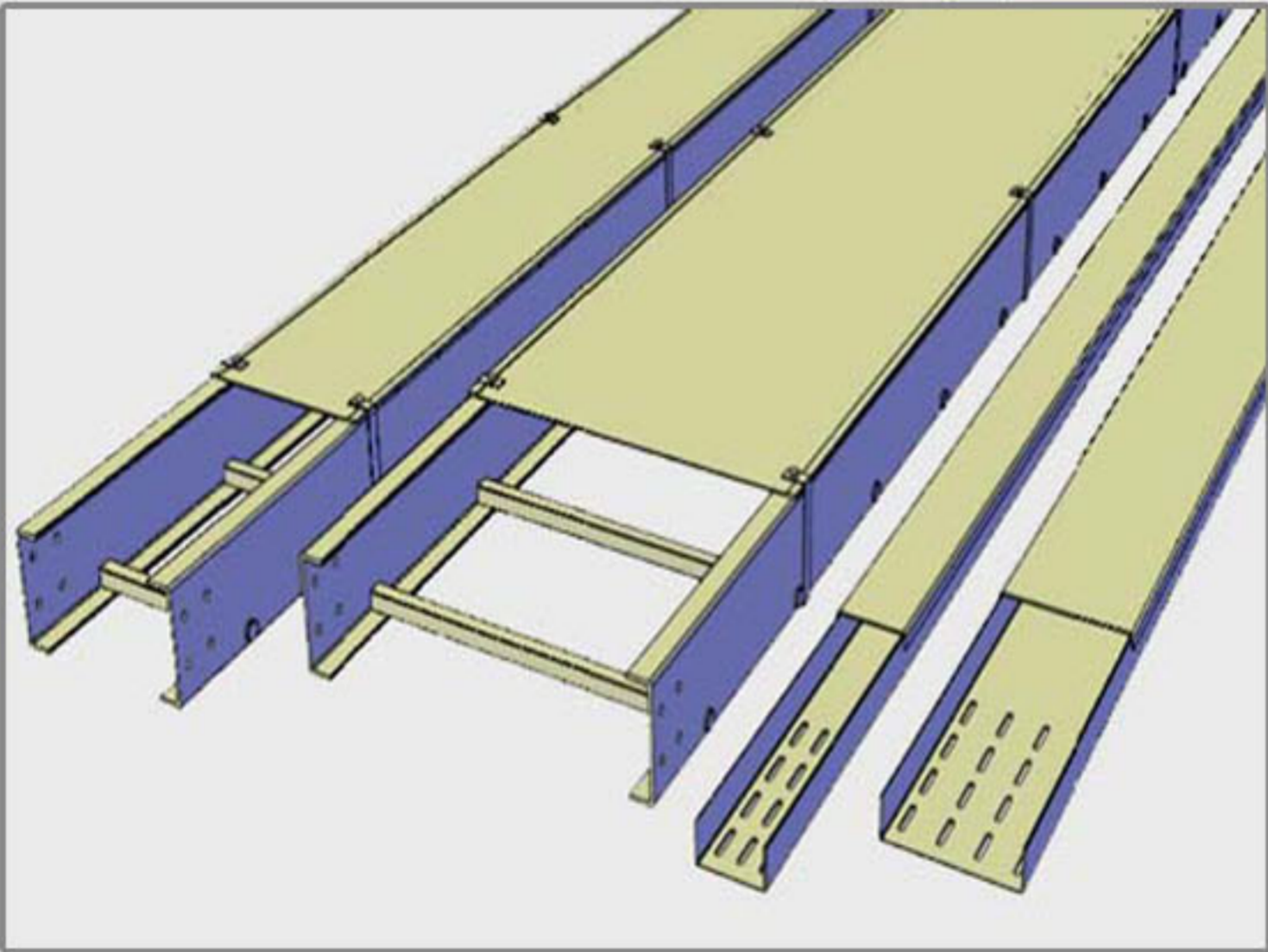
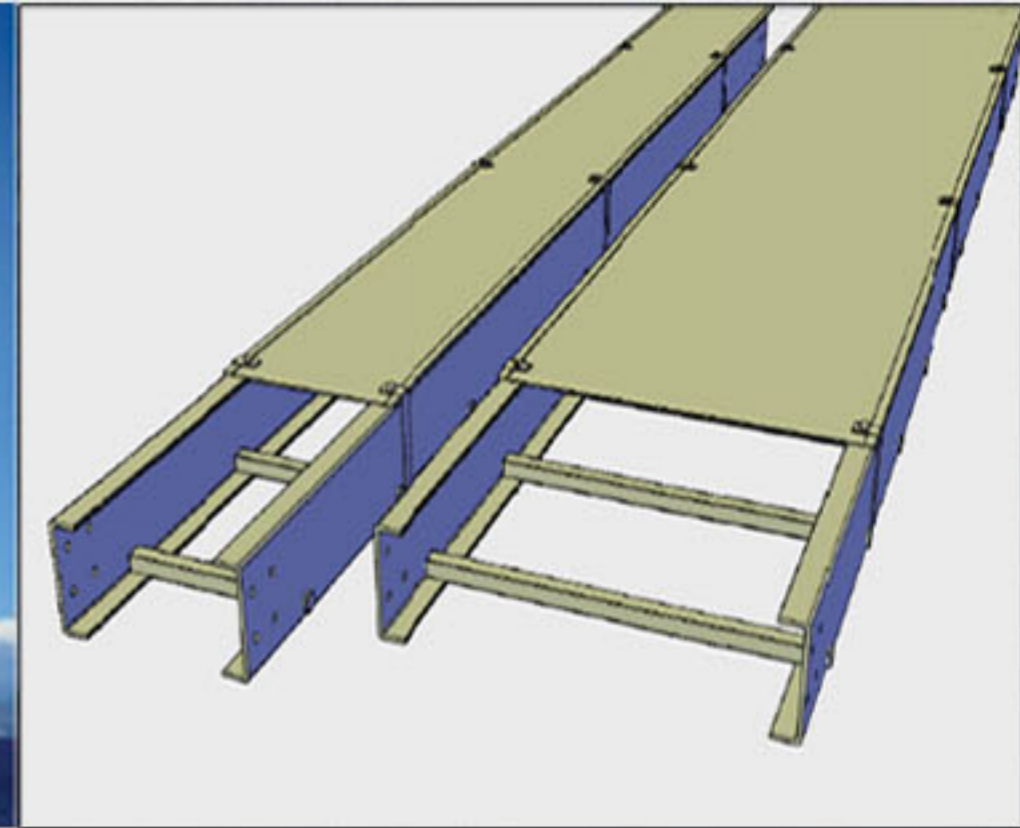


CABLE LADDER & TRAY IN FRP / GRP



NEW REVOTION OF FIBERGLASS
STARSTRUT TRAY





STARSTRUT FRP/GRP Cable Ladder & Tray are offered in a complete range with accessories. It is engineered using special formulated fire retardant resin system and perfect fiberglass composition in order to meet the most aggressive applications such as offshore platform and petrochemical plant.

STARSTRUT Cable Ladder & Tray are tested to comply with NEMA FG-1 loading tests Class 12B, 12C, 20A, 20B & 20C; ASTM E84 Class A and BS 476 Class 1 Fire Tests, Low smoke & halogen free tests, Anti-static property test, ABS Type Approval, etc which is required by Oil & Gas Specifications.

Its extremely long service life up to 20 years and above, light weight, field drillable and cost effective advantages always become convincing reasons for users to use it instead of metallic cable ladder & tray.

PRODUCTS APPLICATION

STARSTRUT Cable Ladder & Tray can be used for new applications or replacing existing applications which is exposed to corrosive environment. It is proven can be used for most aggressive environment in different industries such as:-



Chemical Plant, Refinery, General Industries, Marine, Offshore, Oil & Gas, Mining, Shipyard, Pulp & Paper, Transportation, Air Pollution Control, Water and Waste Treatment, Cooling Tower, Public Amenities, Others

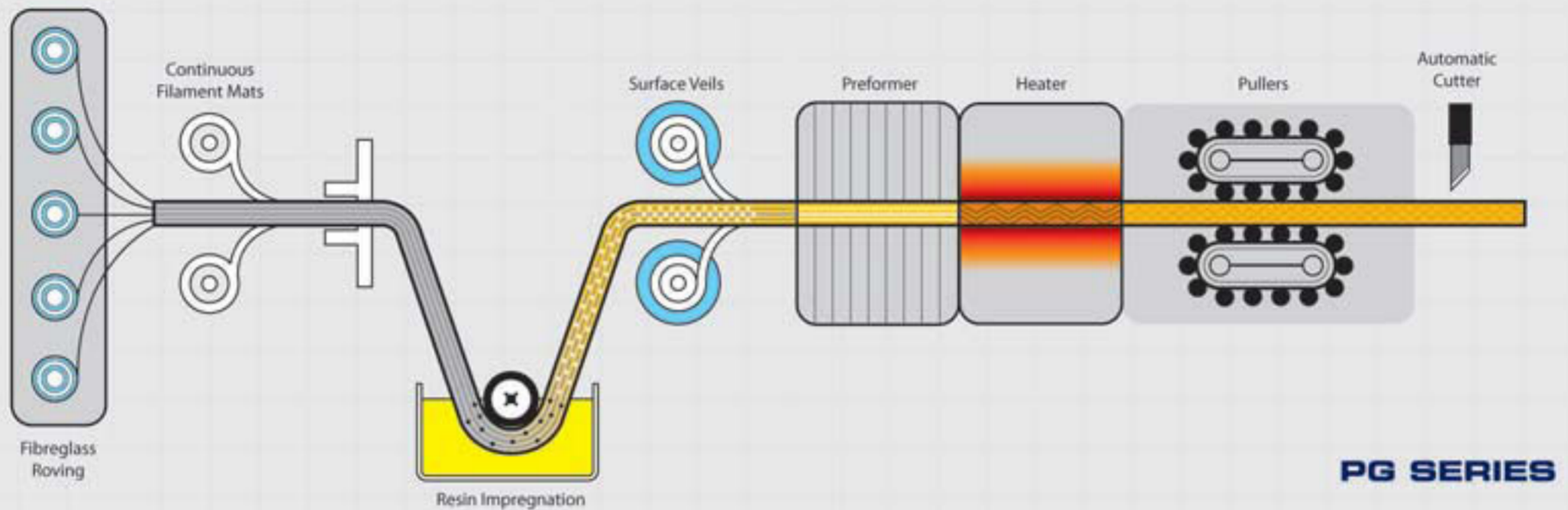
FRP ADVANTAGES

01. Excellent UV / Weathering Resistant
02. Excellent Corrosion Resistant
03. Excellent Strength and Light Weight
04. Long Life Span
05. Fire Retardant
06. Antistatic Property
07. Low Thermal Conductivity and Expansion
08. Non Conductive
09. Cost Effective
10. Outstanding Appearance

Manufacturing Process

STARSTRUT FRP/GRP Cable Ladder & Tray is produced by continuous Pultrusion Process which enables high glass content in the finish goods, contributing to the high strength and loading capacity.

CONTINUOUS PULTRUSION DIAGRAM



Pultrusion is a continuous molding process using fiber reinforcements with thermosetting resin matrices. Pre-selected reinforcement materials, such as fiberglass roving, mat, woven fabrics or stitched fabric, are drawn through a resin bath in which all material is thoroughly impregnated with a liquid thermosetting resin. Typical resins include polyesters, vinyl esters and phenolics. The wet-out fiber is formed to the desired geometric shape and pulled into a heated steel die. Once inside the die, the resin cure is initiated by controlling precise elevated temperatures. The laminate solidifies in the exact cavity shape of the die, as it is continuously pulled by the pultrusion machine. Most any constant cross-section part can be pultruded. Pultrusion allows the designer to customize the selection of the resin system, the type and form of fiberglass reinforcements, and the placement of the reinforcements within the composite profile.

QUALITY TEST AND CERTIFICATION

STARSTRUT FRP/GRP Cable Ladder & Tray is tested and certified by accredited third party laboratories or inspection organization such as ABS, PSB, SIRIM, SGS and Global Group. Our products are tested in accordance with major international test standards such as **NEMA, ASTM, BS, IEC and UL**. Test certificates are available upon request.

Our products are gone through a series of in-house quality control inspection during the production processes like pultrusion, cutting & drilling, assembly, finish goods and packing to ensure the right quality of product is delivered to our customers. All these quality control inspection documents are properly documented in accordance with ISO 9001 procedure.

Product quality is our top concern, we assure the best quality for our clients. We believe in commitment towards quality and best service in order to meet the client requirement and guarantee the satisfaction.

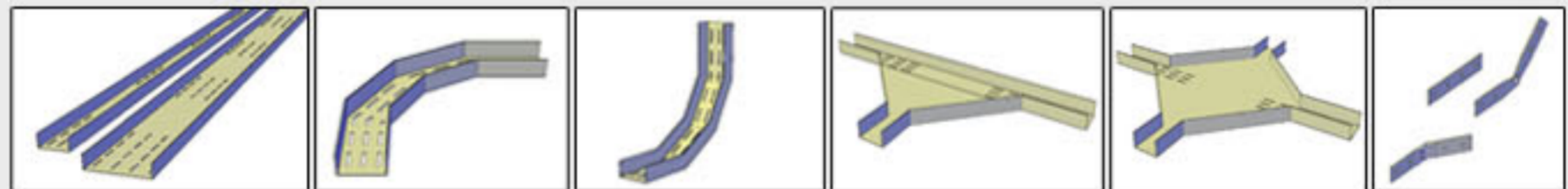
RANGE OF STARSTRUT FRP/GRP CABLE LADDER & TRAY

STARSTRUT CABLE LADDER, FITTING & ACCESSORIES - AL100, AM150, AL150 AND AH150 SERIES



Series	Height	Width	Straight run, 3mL	Horizontal Bend, 90 deg.	Internal & External Riser, 90 deg.	Horizontal Tee, 90 deg.	Cross, 90 deg.	Splices
AL-100	100	150	AL-150100	AL-HB-150100	AL-IR/ER-150100	AL-ET-150100	AL-X-150100	AL-SP100-FG /
		300	AL-300100	AL-HB-300100	AL-IR/ER-300100	AL-ET-300100	AL-X-300100	AL-AH100-FG /
		450	AL-450100	AL-HB-450100	AL-IR/ER-450100	AL-ET-450100	AL-X-450100	AL-AV100-FG
		600	AL-600100	AL-HB-600100	AL-IR/ER-600100	AL-ET-600100	AL-X-600100	
		750	AL-750100	AL-HB-750100	AL-IR/ER-750100	AL-ET-750100	AL-X-750100	
		900	AL-900100	AL-HB-900100	AL-IR/ER-900100	AL-ET-900100	AL-X-900100	
AM-150	150	150	AM-150150	AM-HB-150150	AM-IR/ER-150150	AM-ET-150150	AM-X-150150	AM-SP150-FG /
		300	AM-300150	AM-HB-300150	AM-IR/ER-300150	AM-ET-300150	AM-X-300150	AM-AH150-FG /
		450	AM-450150	AM-HB-450150	AM-IR/ER-450150	AM-ET-450150	AM-X-450150	AM-AV150-FG
		600	AM-600150	AM-HB-600150	AM-IR/ER-600150	AM-ET-600150	AM-X-600150	
		750	AM-750150	AM-HB-750150	AM-IR/ER-750150	AM-ET-750150	AM-X-750150	
		900	AM-900150	AM-HB-900150	AM-IR/ER-900150	AM-ET-900150	AM-X-900150	
AL-150	150	150	AL-150150	AL-HB-150150	AL-IR/ER-150150	AL-ET-150150	AL-X-150150	AL-SP150-FG /
		300	AL-300150	AL-HB-300150	AL-IR/ER-300150	AL-ET-300150	AL-X-300150	AL-AH150-FG /
		450	AL-450150	AL-HB-450150	AL-IR/ER-450150	AL-ET-450150	AL-X-450150	AL-AV150-FG
		600	AL-600150	AL-HB-600150	AL-IR/ER-600150	AL-ET-600150	AL-X-600150	
		750	AL-750150	AL-HB-750150	AL-IR/ER-750150	AL-ET-750150	AL-X-750150	
		900	AL-900150	AL-HB-900150	AL-IR/ER-900150	AL-ET-900150	AL-X-900150	
AH-150	150	150	AH-150150	AH-HB-150150	AH-IR/ER-150150	AH-ET-150150	AH-X-150150	AH-SP150-FG /
		300	AH-300150	AH-HB-300150	AH-IR/ER-300150	AH-ET-300150	AH-X-300150	AH-AH150-FG /
		450	AH-450150	AH-HB-450150	AH-IR/ER-450150	AH-ET-450150	AH-X-450150	AH-AV150-FG
		600	AH-600150	AH-HB-600150	AH-IR/ER-600150	AH-ET-600150	AH-X-600150	
		750	AH-750150	AH-HB-750150	AH-IR/ER-750150	AH-ET-750150	AH-X-750150	
		900	AH-900150	AH-HB-900150	AH-IR/ER-900150	AH-ET-900150	AH-X-900150	

STARSTRUT CABLE TRAY, FITTING & ACCESSORIES - AT50 SERIES

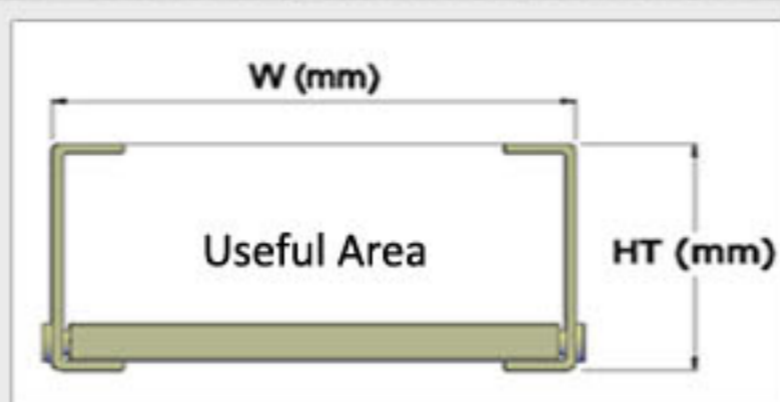


Series	Height	Width	Straight run, 3mL	Horizontal Bend, 90 deg.	Internal & External Riser, 90 deg.	Horizontal Tee, 90 deg.	Cross, 90 deg.	Splices
AT-50	50	50	AT-050050	AT-HB-050050	AT-IR/ER-050050	AT-ET-050050	AT-X-050050	AT-SP50 /
		100	AT-100050	AT-HB-100050	AT-IR/ER-100050	AT-ET-050050	AT-X-100050	AT-AH50 /
		150	AT-150050	AT-HB-150050	AT-IR/ER-150050	AT-ET-050050	AT-X-150050	AT-AV50
		200	AT-200050	AT-HB-200050	AT-IR/ER-200050	AT-ET-050050	AT-X-200050	
		300	AT-300050	AT-HB-300050	AT-IR/ER-300050	AT-ET-050050	AT-X-300050	
		450	AT-450050	AT-HB-450050	AT-IR/ER-450050	AT-ET-050050	AT-X-450050	
600	AT-600050	AT-HB-600050	AT-IR/ER-600050	AT-ET-050050	AT-X-600050			

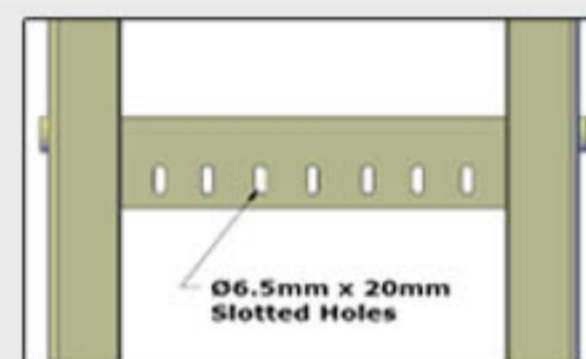
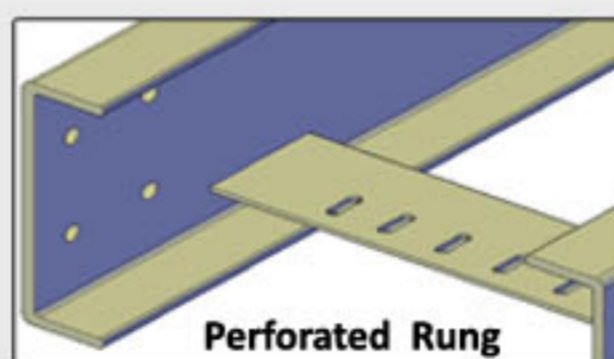
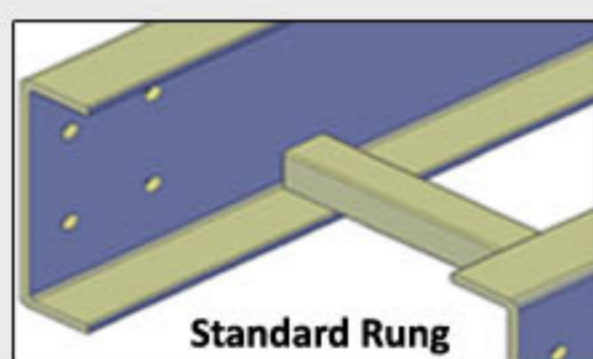
- Note:
- * All STARSTRUT Cable Ladders & Trays are designed to comply with NEMA FG-1 Loading Test Class 12B, 12C, 20B and 20C
 - * Standard resin system used is ISO FR resin. Low smoke & halogen free and antistatic resin systems also available upon request
 - * Above table shows standard width & radius (300R) of cable ladder & tray. Other width and radius also available upon request
 - * Standard lengths of cable ladder straight run are 3 meter and 6 meter. Standard length of cable tray straight run is 3 meter
 - * Cable ladder & tray fitting is available for both mitered and molded joint finishing
 - * Standard cable ladder rung is non perforated with standard spacing of 300mm. Perforated rung is also available upon request
 - * Standard cable tray is perforated type
 - * Other accessories like cover, hold down clamp, vertical fixing clamp, cover clamp, blind end plate, etc are also available

TECHNICAL DETAILS OF STARSTRUT CABLE LADDER & TRAY

STARSTRUT CABLE LADDERS - AL100, AM150, AL150 AND AH150 SERIES



Series	Height	Width	Cable Ladder Part No.	Weight, kg/m		Useful area mm ²
				Cable Ladder	Cover	
AL-100	100	150	AL-150100	3.50	0.8	9410
		300	AL-300100	3.90	1.7	19460
		450	AL-450100	4.20	2.5	29510
		600	AL-600100	4.50	4.4	39560
		750	AL-750100	5.00	5.4	49610
		900	AL-900100	5.40	6.6	59660
AM-150	150	150	AM-150150	4.1	0.8	16580
		300	AM-300150	4.5	1.7	34220
		450	AM-450150	4.8	2.5	51860
		600	AM-600150	5.2	4.4	69500
		750	AM-750150	5.5	5.4	87140
		900	AM-900150	6.0	6.6	104780
AL-150	150	150	AL-150150	5.2	0.8	15820
		300	AL-300150	5.6	1.7	33010
		450	AL-450150	6.0	2.5	50200
		600	AL-600150	6.4	4.4	67390
		750	AL-750150	6.7	5.4	84580
		900	AL-900150	7.1	6.6	101770
AH-150	150	150	AH-150150	7.2	0.8	14820
		300	AH-300150	7.6	1.7	31410
		450	AH-450150	7.9	2.5	48000
		600	AH-600150	8.3	4.4	64590
		750	AH-750150	8.6	5.4	81180
		900	AH-900150	9.1	6.6	97770

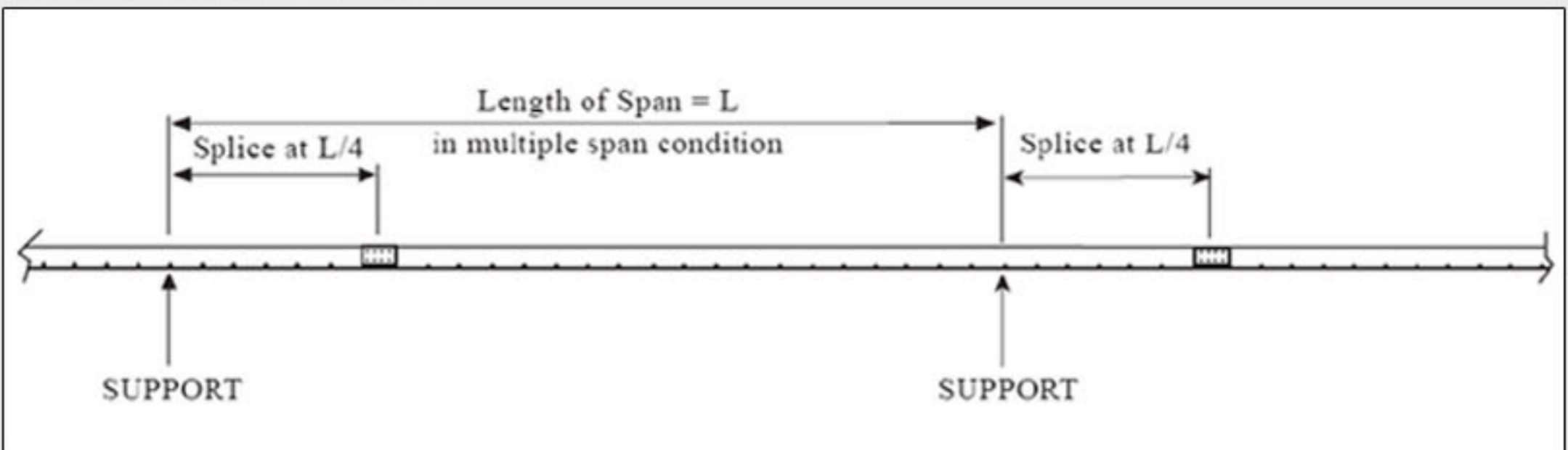


STARSTRUT CABLE TRAY - AT50 SERIES

Series	Height	Width	Cable Tray No.	Part	Weight, kg/m		Useful area mm ²
					Cable Tray	Cover	
AT-50	50	50	AT-050050		0.9	0.5	2500
		100	AT-100050		1.2	0.8	5000
		150	AT-150050		1.5	1.1	7500
		200	AT-200050		1.7	1.3	10000
		300	AT-300050		2.3	1.9	15000
		450	AT-450050		4.0	2.7	22500
		600	AT-600050		5.1	4.7	30000

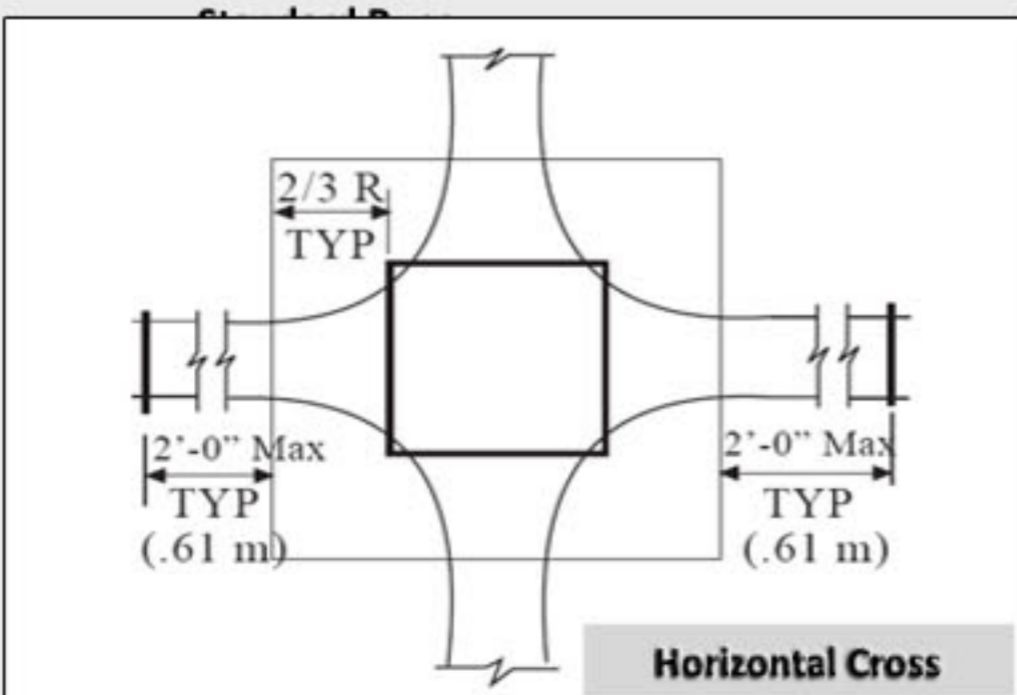
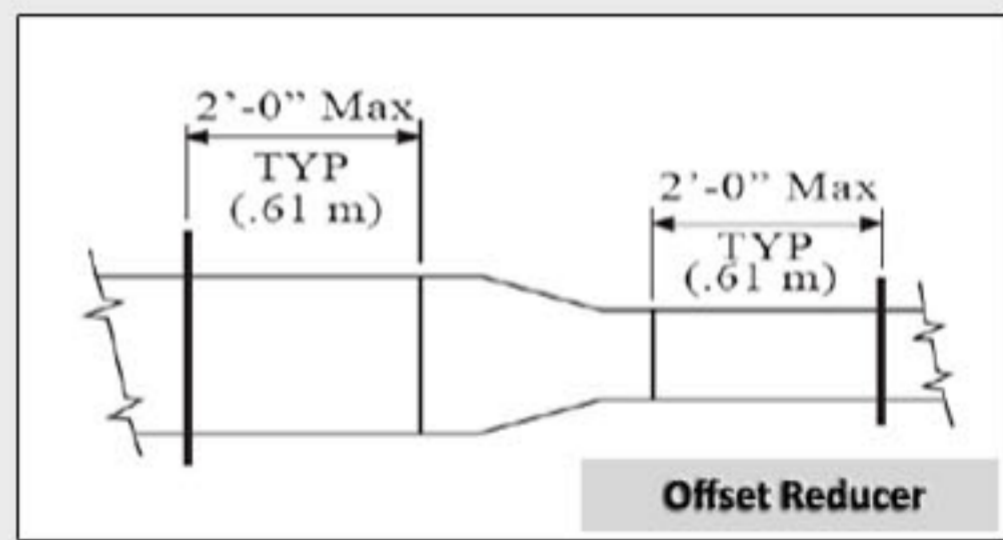
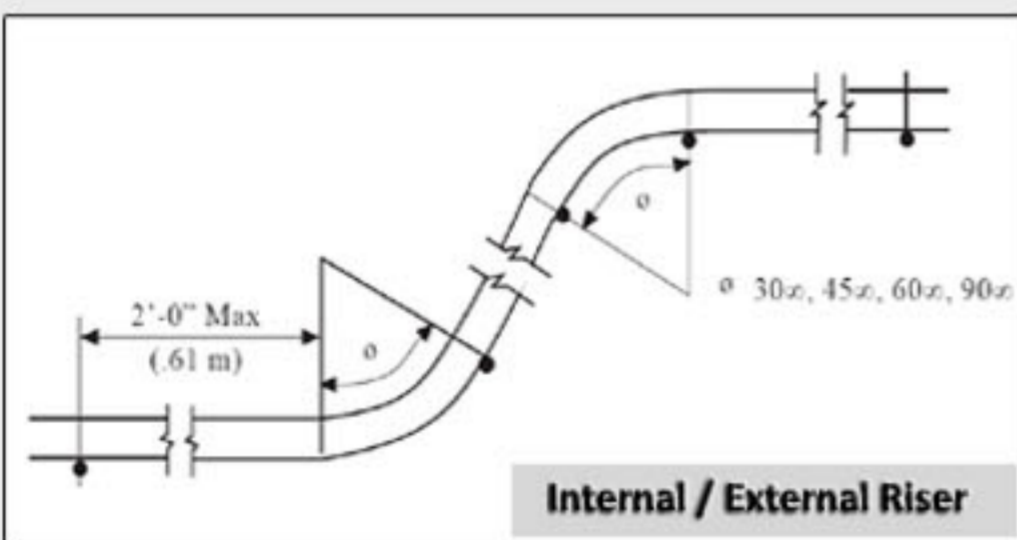
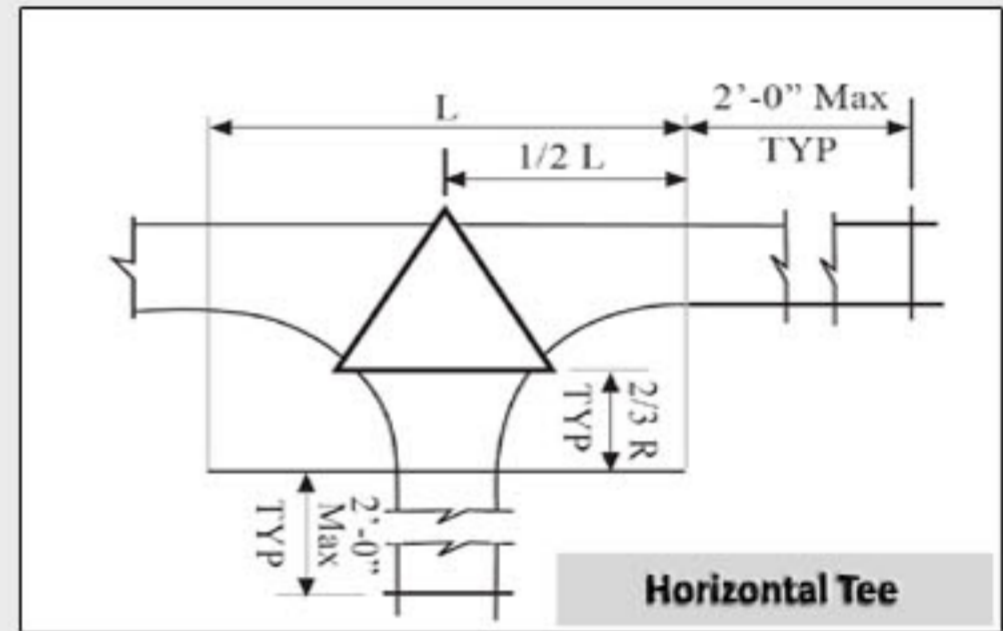
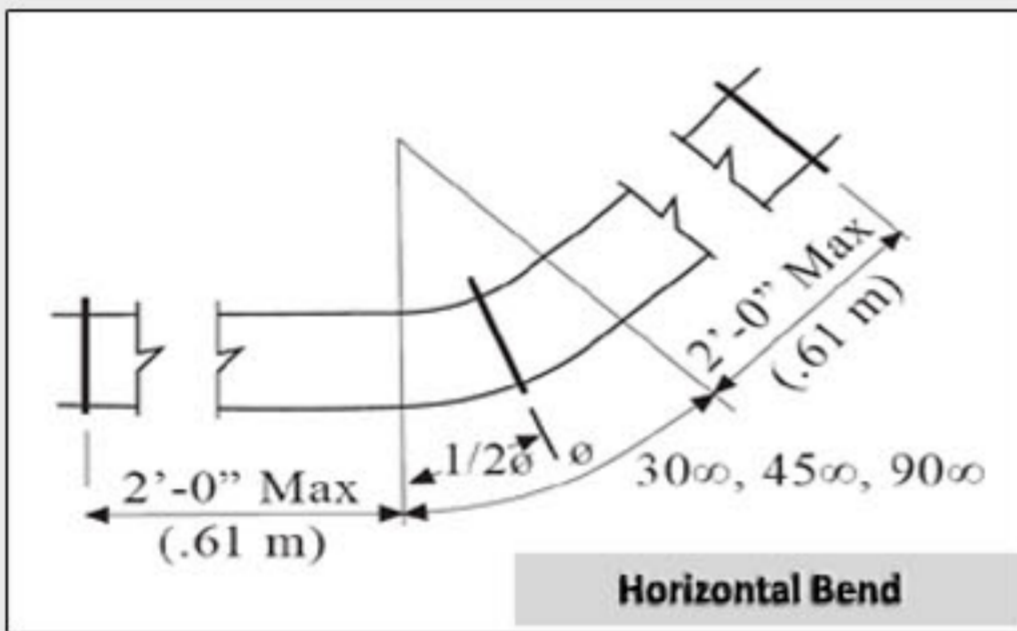
RECOMMENDED SUPPORT IN ACCORDANCE WITH NEMA FG-1


SPLICE PLATE LOCATION



Base on NEMA FG-1 standard, splice plate is recommended to be located at 1/4 of the span from the support, where the bending moment is zero.

SUPPORT LOCATION





WARNING
 NOT TO BE USED
 AS A WALKWAY

Warning! Not to be used as a walkway, ladder or support for personnel. To be used only as a mechanical support for cables and tubing.

COMPARISON OF PULTRUDED FRP AGAINST OTHER SUBSTITUTE MATERIALS

PROPERTY	Pultruded FRP Product	Hand Lay-up FRP Product	Mild Steel / HDG Steel	Stainless Steel	Aluminum
Cost Effectiveness	Extremely durable compare against other materials. Maintenance free.	Durable compare against other materials. Maintenance free.	Cost of steel keep increasing year by year. In some cases, FRP is cheaper than steel. Maintenance required.	Stainless Steel is commonly used as comparison with FRP in terms of price and service life. Nowadays, FRP is far economic compare against SS304 and SS316.	Depend on application.
Flatness & Thickness Consistency	FRP pultrusion product is pultruded from heated die, therefore flatness and thickness are always consistence.	Other FRP product normally produced from hand lay-up process and the flatness and thickness are subjected to workmanship. High possibility of uneven surfaces.	Flatness and thickness are always even and consistent.	Flatness and thickness are always even and consistent.	Flatness and thickness are always even and consistent.
Impact Resistance / Tensile Strength	Continuous glass mat in pultruded FRP products distributes the impact load evenly to prevent surface damage and it will not permanently deform. High in tensile strength about 200-400 MPa.	Chopped strand mat used in FRP hand lay-up products will probably deform or crack under impact. Low in tensile strength about 100-200 Mpa.	Will permanently deform under impact and take a permanent set (dishing in trench application due to overloading). High in mechanical strength about 500 Mpa.	Will permanently deform under impact and take a permanent set (dishing in trench application due to overloading). High in mechanical strength about 500 Mpa.	Will permanently deform under impact and take a permanent set (dishing in trench application due to overloading). Low in tensile strength about 200 Mpa.
Corrosion Resistant	Excellent corrosion resistant under the most aggressive conditions.	Corrosion resistant.	Poor corrosion resistant	SS304 not recommended in off-shore. SS316 has better corrosion resistant.	Corrosion resistant.
Safety	Electrically non-conductive and non-magnetic. Low in thermal conductivity. No sharp edges after cutting.	Electrically non-conductive. Low in thermal conductivity. No sharp edges after cutting.	Conductive. Grounding potential around electrical equipment. High in thermal conductivity. Sharp edges after cutting.	Conductive. Grounding potential around electrical equipment. High in thermal conductivity. Sharp edges after cutting.	Conductive. Grounding potential around electrical equipment. High in thermal conductivity. Sharp edges after cutting.
Fabrication	Produced in light weight and thus easier for handling and installation on site. Field drillable and NO welding required.	Produced in light weight and thus easier for handling and installation on site. Field drillable and NO welding required.	Heavy and require special blade, torch, and harder to cut it. Sometimes requires more manpower to move and place. Welding required.	Heavy and require special blade, torch, and harder to cut it. Sometimes requires more manpower to move and place. Welding required.	Require special blade, torch, and harder to cut it. Sometimes requires more manpower to move and place.
Vandalism	Totally no recycle value, and this helps to reduce vandalism.	Totally no recycle value, and this helps to reduce vandalism.	Mild / HDG steel products carry good recycle value.	Stainless steel products carry very good recycle value.	Aluminum Products carry very good recycle value.

Typical Properties of Pultrusion FRP Products

Typical Properties

MECHANICAL

(Full roving construction)

Tensile Strength, Longitudinal:
400 - 500 MPa

Flexural Stress, Longitudinal:
200 - 400 MPa

Elastic Modulus, Flexural, Longitudinal:
15,000 - 30,000 MPa

Compressive Strength:
150 - 300 MPa

Impact Strength:
1 - 2 kJ/M

Elongation at Rupture
2 - 3%

Hardness (Barcol 934-1)
50 - 60

Specific Gravity:
1.8

THERMAL

Coefficient of Thermal Expansion:
8 - 10 10^{-6} m/m K

Thermal Conductivity:
0.2 - 0.3 W/m.K

Recommended Operating Temperature
-50 to +100 °C

ELECTRICAL

Dielectric Strength:
12 kV/mm

Volume Resistivity:
 10^{10} - 10^{12} Ω /cm²

FIRE RETARDANT & SMOKE

(For ISO FR Resin Formulation)

B.S. 476 P7 - Class 1

B.S. 476 P6

ASTM E84 - Class A

Smoke Development Index < 450

IEC 60695 - 960 °C Max.

Comparisons

The below properties comparison between FRP Pultruded profiles with other materials are based on the typical values.

As summary, FRP Pultruded profiles give high strength with minimum weight solution to your applications. This is absolutely important and convenient for easy handling, installation, maintenance and weight concern applications.

