DuFLEX®

lightweight panel solutions

MARINE | ARCHITECTURAL | INDUSTRIAL | TRANSPORTATION

The DuFLEX Building System minimizes weight, maximizes mechanical properties, simplifies quotations, and reduces VOC emissions

Contents

THE DUFLEX BUILDING SYSTEM ____ 02

TECHNICAL DATA ____ 03

TECHNOLOGY VS COST - KITS ____ 07

TO COMPLIMENT THE DUFLEX SYSTEM ____ 08

BASIC TECHNIQUES ____ 11

SAFETY AND STORAGE ____ 13

MARKETS ____ 14

The DuFLEX® Building System

The DuFLEX Building System incorporates DuFLEX® and Featherlight® panels that are specifically designed to reduce construction time and to optimise structural weight in high performance composite structures. Time consuming laminating, coring and vacuum bagging steps normally required to fabricate high performance composites are avoided, and material waste, labour and tooling costs are greatly reduced.

Standard panels are 1200mm x 2400mm and are cored with rigid end-grain balsa or structural and non-structural foam cores, and laminated with a high performance epoxy resin reinforced with multiaxial E-Fibreglass or carbon fibre skins. Fibre orientation and ply schedules are based on design and engineering specifications to best meet weight targets, stress and impact loads, and other design parameters.

Custom DuFLEX and Featherlight panels can be manufactured, on request, and a selection of core types and densities, and reinforcement combinations, are available to provide a range of weight, strength and cost options. From economical lower density foam cores through to aramid honeycomb/carbon combinations used in weight critical, high performance projects.

MANUFACTURE

DuFLEX® and Featherlight® panels are manufactured in a controlled environment and under-go strict Quality Inspections at all stages during the manufacturing process to ensure dimensional stability and consistent thickness.

The core and laminates are co-cured in a hot press, a method that consolidates the laminate under pressure increasing the fibre volume and therefore the strength of the finished panel. The E-glass fibre content of the laminates is approximately 62% by weight.

The panels are finished with peel ply to protect the laminates from contamination and to reduce the amount of preparation required prior to secondary bonding or laminating.

Featherlight panels are specifically designed for non-structural applications and cores are chosen to provide superior levels of stiffness, and thermal, or acoustical, insulating properties. They are also available with sanded, calibrated hardwood veneers. These timber-faced panels are ready for decorative veneer application, painting or secondary bonding with decorative laminate.

- Strength
- Durability and Damage tolerance
- Lightweight
- Dimensionally Stable
- Code Approved Manufacture Available

SUPPORT

The DuFLEX Building System is backed with comprehensive technical information and an experienced Technical Team. Technical assistance is available to provide guidance on how to utilise the structural advantages of DuFLEX during the construction process.

Engineering Support Services are also available to ensure that projects meet design loadings and regulatory requirements.

- Consultation with designers, architects and structural engineers
- Composite engineering expertise including Finite Element Analysis
- Recommendations for approved fabricators
- Consultation and technical support for fabricators during construction process.

Technical Data

EPOXY MATRIX

By using epoxy rather than polyester resin as the matrix, a reduction of laminate thickness is achieved while improving damage tolerance. Epoxy exhibits better moisture and fatigue resistance, and has superior strain capabilities which provides DuFLEX laminates with greater impact resistance than polyester/E-glass laminates that are up to 3 times thicker.

Epoxy's excellent adhesion to balsa and foam cores, fibreglass, aramid and carbon fabrics allows the builder the advantage of selectively integrating these materials into a structure to optimise strength, cost and weight.

Compared to polyester resins, epoxies have greater strength, less shrinkage, better moisture and fatigue resistance, and there is no chance of osmotic blistering occurring in an epoxy matrix.

Tensile Modulus	3.650 MPa	(0.53+6 psi)
Tensile Strength	83.3 MPa	(12,800 psi)
Tensile Elongation	9.8%	
Compressive Strength (Yield)	98 MPa	(14,210 psi)
Compressive Strength (ultimate)	130 MPa	(18,850 psi)
Izod Impact	0.598 ft.lb/in notch	

SKIN MECHANICAL PROPERTIES

Standard DuFLEX skin laminates are constructed using stitched biaxial E-glass, the material provides excellent properties in both warp and fill directions, surpassing American Bureau of Shipping (ABS) requirement for balanced laminates.

Compared to the ABS minimum tensile strength for basic laminate, DuFLEX skin laminates show far superior performance.

ABS Basic Laminate	Tensile Strength ASTM D3039	Tensile Modulus
Warp (0°)	124.1 MPa (18,000 psi)	6,890 MPa (1.0E + 6 psi)
Fill (90°)	99.28 MPa (14,400 psi)	6,890 MPa (1.0E + 6 psi)

DuFLEX Skin Laminate	Tensile Strength ASTM D3039	Tensile Modulus ASTM D3039
Biaxial-Warp (0°)	371.9 MPa (53,900 psi)	21.27 GPa (3.08E + 6 psi)
Biaxial-Fill (0°)	327.6 MPa (47,500 psi)	18.22 GPa (2.64E + 6 psi)
Laminate Thickness	0.53mm per 600gsm	
Fibre Fraction	62-64% weight fraction	
Poisson's ratio	0.10	

Compressive values have been extrapolated from sandwich flexural tests (ASTM C-273) conducted at the University of Southampton, UK in which skin bending was negligible.

DuFLEX Skin Laminate	Compressive Strength	Compressive Modulus
Biaxial-Warp (0°)	293.8 MPa (42,600 psi)	21.27 GPa (3.08E + 6 psi)
Biaxial-Fill (90°)	255.5 MPa (37,000 psi)	18.22 GPa (2.64E +6 psi)

DuFLEX Skin Laminate	Increase over ABS
Biaxial-Warp (0°) Tensile Strength	+300%
Biaxial-Fill (90°) Tensile Strength	+330%

CORE MECHANICAL PROPERTIES

RIGID END-GRAIN PROBALSA®		
Nominal Density	ASTM C-271	155 kg/m³
Tensile Strength	ASTM C-297	13.5 MPa
Compressive Strength	ASTM C-365	12.7 MPa
Compressive Modulus	ASTM C-365	4,100 MPa
Shear Strength	ASTM C-273	3.0 MPa
Shear Modulus	ASTM C-273	166 MPa

PVC FOAM DIVINYCELL® H60		
Nominal Density	ISO 845	60 kg/m³
Tensile Strength	ASTM D-1623	1.8 MPa
Tensile Modulus	ASTM D-1623	75 MPa
Compressive Strength	ASTM D-1621	0.9 MPa
Compressive Modulus	ASTM D-1621-B-73	70 MPa
Shear Strength	ASTM C-273	0.76 MPa
Shear Modulus	ASTM C-273	20 MPa
Shear Strain	ASTM C-273	20%

PVC FOAM DIVINYCELL® H80		
Nominal Density	ISO 845	80 kg/m³
Tensile Strength	ASTM D-1623	2.5 MPa
Tensile Modulus	ASTM D-1623	95.0 MPa
Compressive Strength	ASTM D-1621	1.4 MPa
Compressive Modulus	ASTM D-1621-B-73	90.0 MPa
Shear Strength	ASTM C-273	1.15 MPa
Shear Modulus	ASTM C-273	27.0 MPa
Shear Strain	ASTM C-273	30%

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STANDARD PANELS

DuFLEX BALSA		
Order Code	Core Thickness	Nominal Weight kg/m²
→ 1 x 600g Biaxial E-glass either side of core*		
DP1010C6	10mm	4.2
DP1013C6	13mm	4.6
DP1016C6	16mm	5.1
DP1019C6	19mm	5.6
DP1025C6	25mm	6.4
→ 2 x 600g Biaxial E-glass either side of core*		
DP2010C6	10mm	6.0
DP2013C6	13mm	6.4
DP2016C6	16mm	6.9
DP2019C6	19mm	7.4
DP2025C6	25mm	8.3

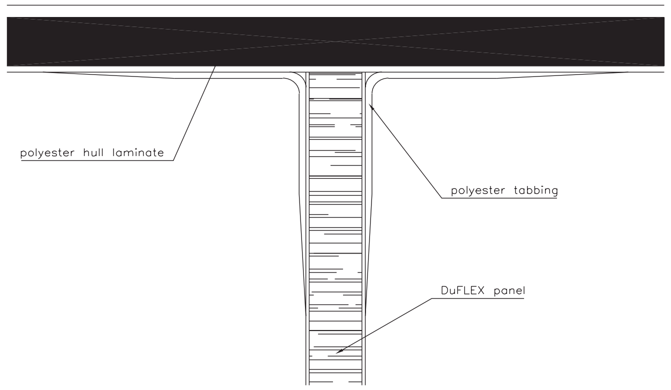
DuFLEX FOAM		
Order Code	Core Thickness	Nominal Weight kg/m²
→ 1 x 600g Biaxial E-glass either side of core*		
DD1010C6	10mm	3.1
DD1012C6	12mm	3.3
DD1015C6	15mm	3.5
DD1020C6	20mm	3.8
DD1025C6	25mm	4.2
→ 2 x 600g Biaxial E-glass either side of core*		
DD2010C6	10mm	4.9
DD2012C6	12mm	5.0
DD2015C6	15mm	5.2
DD2020C6	20mm	5.7
DD2025C6	25mm	6.2

FEATHERLIGHT		
Order Code	Core Thickness	Nominal Weight kg/m²
→ 1 x 600g Biaxial E-glass either side of core*		
FF1009C6	9mm	3.1
FF1012C6	12mm	3.2
FF1015C6	15mm	3.4
FF1019C6	19mm	3.7

* Alternative laminates and cores are available on request.
ATL Composites Pty Ltd reserve the right to alter specifications without prior notice. Weight may differ slightly (up or down) due to variations in core density.

SECONDARY BONDING

The issue of secondary bonding between polyester and epoxy substrates has been an area of concern for some time. Comparative in-house tests have abounded, but without quantitative results they can only demonstrate modes of failure and give a ‘feel’ for the force required at break. ISO 527 was modified to accommodate a tensile double lap joint. Four types of specimen were tested to show that polyester tabbing has the same strength when bonding polyester or epoxy substrates.



(See table below for specifications).

SECONDARY BONDING LAP JOINT TEST RESULTS			
	FAILURE LOAD	APPARENT SHEAR STRENGTH	FAILURE MODE*
A	42.45 kN (9,540 lbf)	5.66 MPa (820 psi)	Interlaminar Shear**
B	48.47 kN (10,900 lbf)	6.46 MPa (937 psi)	Interlaminar Shear
C	46.50 kN (10,450 lbf)	6.20 MPa (899 psi)	Interlaminar Shear
D	47.08 kN (10,580 lbf)	6.28 MPa (911 psi)	Interlaminar Shear

* International Failure occurred with the CSM layer of tabbing laminates.
A - Polyester peel piled substrate, polyester tabbing
C - Epoxy peel plied substrate, polyester tabbing

** One specimen showed adhesive failure between the tabbing and substrate.
B - Polyester sanded substrate (80 grit), polyester tabbing
D - Epoxy sanded substrate (80 grit), polyester tabbing

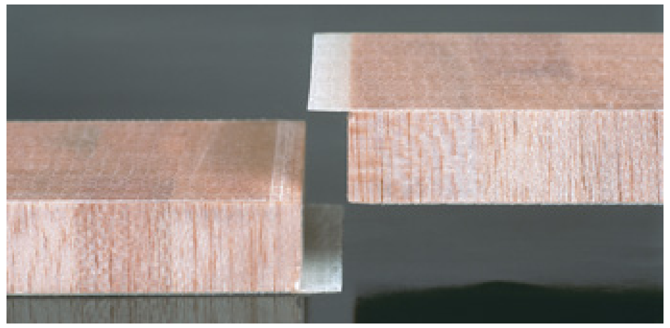
This data is provided as an aid to materials selection only. No express or implied warranty is made regarding the accuracy of the information contained herein.

Z-JOINT

To offset their individual size, DuFLEX® and Featherlight® panels can be supplied with both long edges pre-machined to facilitate joining. This Z-Joint is structurally effective and achieves a smooth and fair surface profile. The Z-Joint must be bonded with a high density epoxy adhesive mixture.

Particularly in strength critical applications the Z-Joint must be given adequate consideration. It can be considered analogous to a weld in aluminum, as a strength reduction exists.

Testing indicated no reduction in modulus, resulting in continuity of panel stiffness and fairness during formation. For example in the majority of marine applications stiffness is critical and therefore a strength reduction in the laminate due to the joints presence is normally of little consequence. A weft unidirectional tape can be used in situations where strength continuity is desired.



DuFLEX Skin Laminate	Tensile Strength ASTM D3039	Strength Reduction
Biaxial-Warp (0°)	298.6 MPa (43,310 psi)	19.8%
Biaxial-Fill (90°)	262.9 MPa (38,130 psi)	19.8%
Unidirectional-Warp (0°)	488.6 MPa (70,870 psi)	16.6%
Unidirectional-Fill (90°)	23.0 MPa (3,330 psi)	0.00%

Technology vs Cost - Kits

Whether in computers, airplanes or boats, high tech is often associated with high cost. Time is valuable and there is no doubt that DuFLEX, especially in kit form, speeds up construction.

Computer-aided design and manufacture (CAD/CAM) processes combined with computer numeric control (CNC) equipment allows the production of pre-fabricated DuFLEX Kits. Parts to be formed into curved surfaces can be translated by design software into the correct flat panel shapes allowing for all parts required for the project to be nested together within the panels to reduce wastage.

Once the panels are manufactured, the CAD information is used by a CNC router to machine the programmed shapes into the panels, and Z-Joints are machined on the edges, either long or short, depending on nesting orientation, to facilitate joining of the kit.

The panels are sequentially numbered to indicate the correct joining sequence, and a nesting diagram, showing part numbers and descriptions is supplied for easy identification.

Each pre-cut part is left attached to the panel by small tabs to ensure the kit arrives with all components securely in place. The tabs are easily cut away, when the panels have been joined.

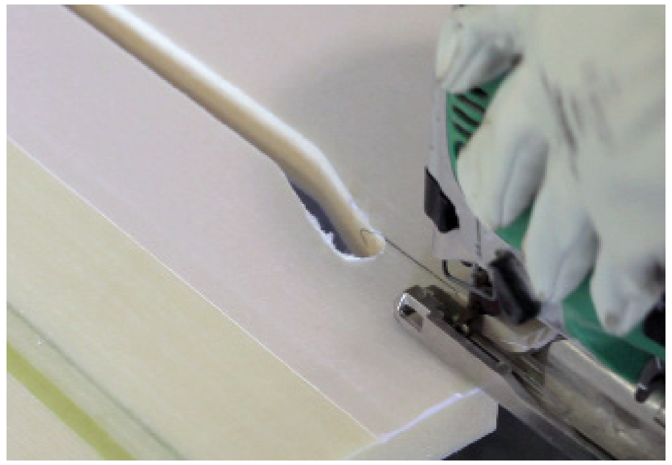
Custom kits can be engineered to meet the rules of all major regulatory authorities including Lloyd's Register, American Bureau of Shipping, DNV-GL, CE-ISO, BV and USL/AS4231.

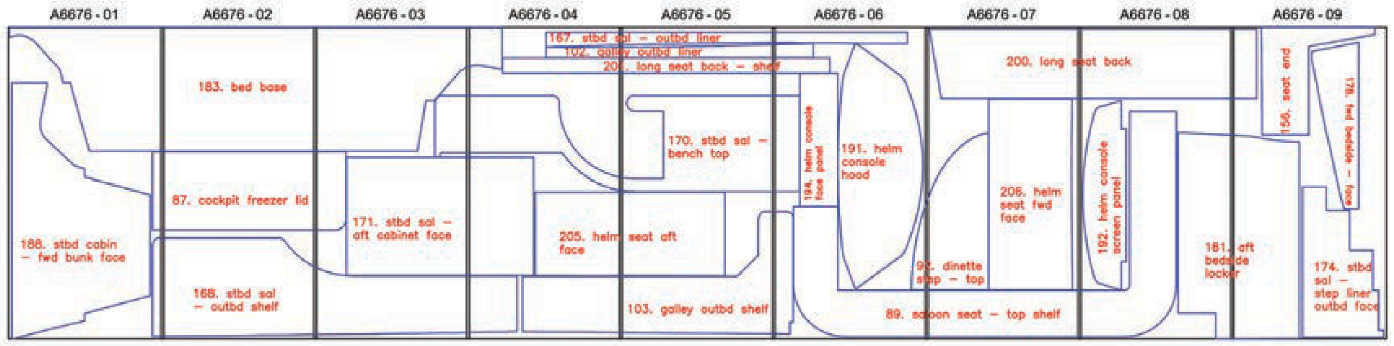
With the DuFLEX system, fabricators can use widely spaced temporary frames to create a required shape. Large parts may extend through two of more panels, so the panels are joined before the tabs are cut, Flat surfaces, such as bulkheads in yachts, floors in camper vans and walls in architectural applications are used as-cut, and curved surfaces are created by bending the flat panels around the frames into the required shape.

A strong, lightweight monocoque structure is achieved after adjacent parts and internal support structures are bonded together. For example, in a marine application, on the hull interior, the joints are epoxy/fibreglass taped at points where differently angles panels meet – typically the keel, gunnels and chines.

OPTIMISED KIT TECHNOLOGY

- Minimises material waste, labour & tooling costs
- Maximises mechanical properties
- Tightens design allowables
- Improves product quality
- Simplifies quotations
- Reduces VOC emissions





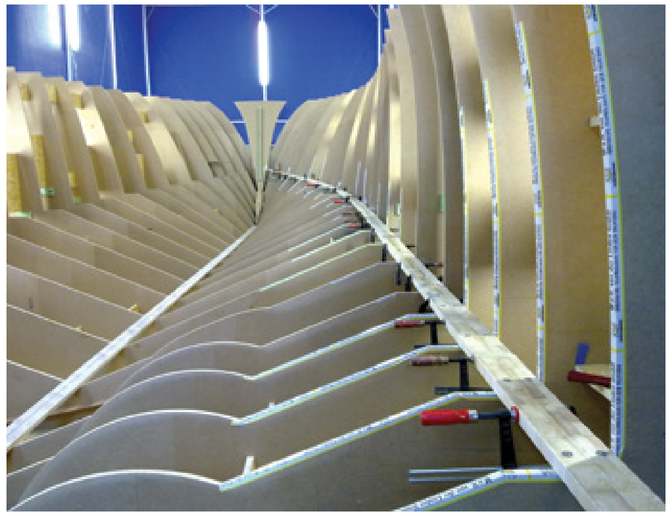
NESTING EXAMPLE

To compliment The DuFLEX System

CNC-ROUTED TEMPORARY FRAMES

CNC-Routed plywood or MDF (medium density fibre-board) temporary frames can also be supplied to provide the builder with accurate sections, cut exactly to drawing specifications. Frames can be cut to shape and flat packed, and shipped to the fabricator. Parts are labeled and stacked sequentially on the pallet, and can include details like station numbers, reference lines, and notches, and an assembly booklet is supplied.

Frames can be assembled without the need for power tools or heavy equipment, and parts lock securely and accurately to optimise assembly time, reducing waste and improving job site safety.



STRIPS

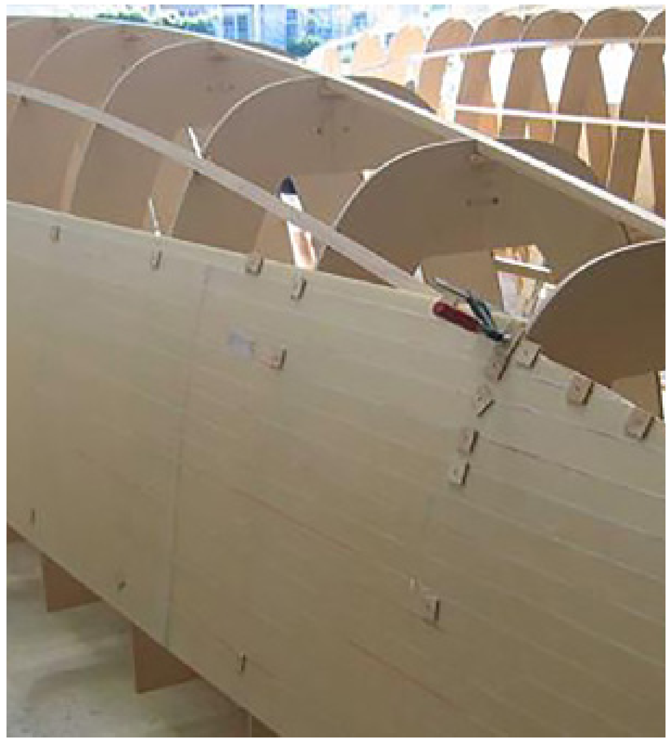
Compound surfaces are common in marine applications, for example sail boat hulls and the flared topsides in sport fishing boats. These surfaces can be made by bending and edge gluing DuFLEX Strips around temporary frames, as with traditional strip planking.

DuFLEX strips are pre-laminated with unidirectional reinforcements, in a 1200mm x 2400mm sheet with Z-Joints on both short ends.

The unidirectional fibre allows the planks to conform readily to highly convex or concave contours and can provide up to 50% of the total laminate. The ability to place a large percentage of the reinforcement mass during planking has obvious time-saving benefits.

The stiffness of the DuFLEX Strips allows them to bend fairly over half the number of the frames required by other strip systems, and increases the stability when turning a boat hull.

The laminating required to complete the structure can be applied after the part shape has been stripped.



LAMINATE TYPE	TENSILE STRENGTH ASTM D3039	TENSILE MODULUS ASTM D3039
Unidirectional@(0°)	585.6 MPa (84,900 psi)	34.73 GPa (5.04E + 6 psi)
Unidirectional@(90°)	23.00 MPa (3,330 psi)	8.295 GPa (1.20E + 6 psi)
Laminate Thickness	0.88mm per 800gsm (0.035" per 23.5oz)	
Fibre Fraction	62-64% weight fraction	
Poisson's Ratio	0.26	

HIGH DENSITY INSERTS

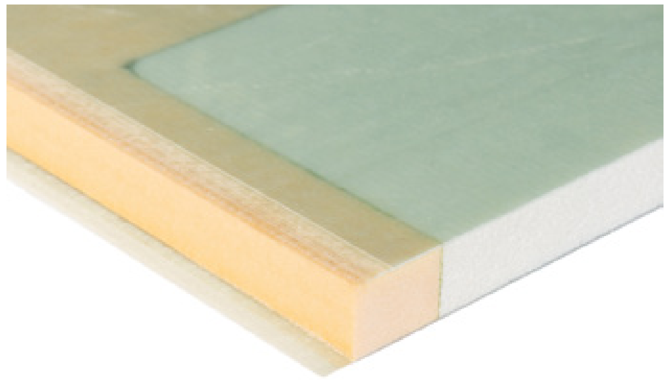
DuFLEX and Featherlight panels can also incorporate High Density Inserts using materials such as PVC foam, PET foam, high density Coosa polyurethane foam and solid FRP.

By including High Density Inserts it will allow for effective surface screw fixing, tapping and through-bolting without the risk of localised pull-out, buckling or compression failures. Inserts can also be used locally for perimeter edging in order to offer a more robust and impact resistant panel edge, often eliminating the need for de-coring.

Having Inserts included in the panel manufacture, and not having to fit on the job, offers fabricators significant savings in labor and wastage.

All DuFLEX and Featherlight Panels are compatible with a variety of resins for post lamination and bonding including Polyester, Vinyl Ester, Epoxy and Polyurethane.

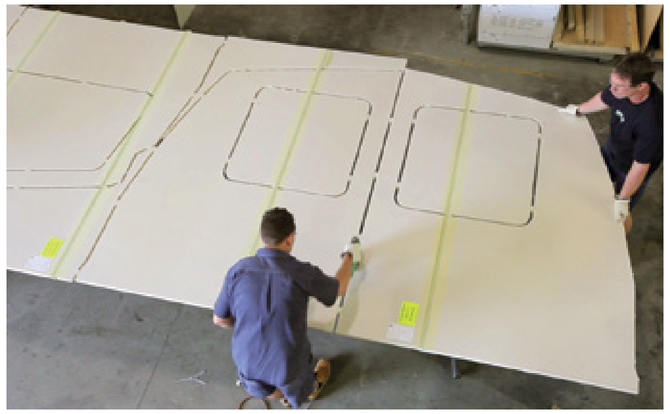
*Options are also available for specialised inserts including aluminium flat bar, PVC conduit and FRP pultrusions.



FULL SIZE COMPONENT PACKS

Full Size Component Packs can be supplied to reduce build times and wastage.

DuFLEX and Featherlight panels are manufactured and routed as per our standard processing, then our trained staff join the panels, release and trim the parts at our facility, to supply Full Sized Parts including Bulkheads, Floors, Soles, and Interior Fit-Outs directly to our customers. The Full Sized Components are securely packed for freighting and arrive ready to install, simply tape into place.



FRP BONDING ANGLES

Composite 90° Bonding Angles have been designed to provide a quick and effective means for making right angle joints between DuFLEX and Featherlight Panels. These pre-cured angles can be bonded in place with an epoxy paste adhesive, speeding up assembly. No wet lay-up is required, they are simply installed with appropriate surface preparation, and are ideal for inaccessible areas where taping would be difficult.

All FRP Bonding Angles are supplied in 2400mm lengths and consist of layers of multiaxial E-glass in a high performance epoxy matrix, with the fiber direction tailored for optimum load-carrying capability and stiffness. The bonding angles are manufactured with peel ply, to provide a textured surface to aid in secondary bonding, which is removed prior to supply.

ADVANTAGES

- Lighter and More Consistent than Wet Lay-Up
- Faster to Install, especially Over-Head
- Extremely High Strength to Weight Ratio
- Can be Kerffed and Curved for Partition Bases
- Improved stress transfer between laminates
- Fatigue resistance

PERFORMANCE DATA

Queensland University of Technology (QUT) test report CET 4149/3 - Tensile tests to fibreglass connections - fins.

→ SAMPLE DATA: Specimen 1 - polyester bonded
Specimen 2 - epoxy bonded
Test Equipment: Grade A Tinius Olsen Universal Testing Machine, loading rate = 5mm/min

SPECIMEN THICKNESS	FAILURE LOAD (KN)	FAILURE MODE	APPARENT SHEAR STRENGTH (MPA)	NOMINAL AREA RESISTING SHEAR (MM²)
21	77.6 part shear through polyester bond	Adhesive Failure	1.60	48,400
14	68.5kN shear through epoxy bond	Adhesive Failure	2.25	30,400

In both circumstances, failure of the joins was through the adhesive rather than the Bonding Angle.

STANDARD ANGLES

ORDER CODE	DESCRIPTION	LEG LENGTH	NOMINAL WEIGHT
ANT3042	90° Bonding Angle	42 mm	0.30 kg/m
ANT5084	90° Bonding Angle	84 mm	1.00 kg/m

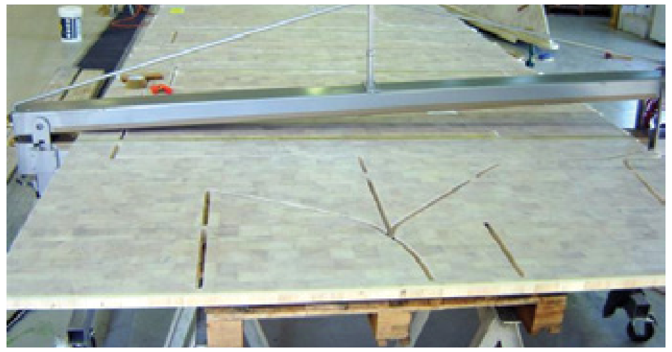
Basic Techniques

JOINING THE PANELS

Z-PRESS

To streamline the joining process, the proprietary Z-Press applies heat and pressure to cure the epoxy adhesive on the Z-Joints. Joins are fully cured in 7 to 20 minutes, depending on the ambient temperature, type of hardener, core type and thickness of the panel. Checking the “squeeze-out” on the joint until it has become rubbery, will indicate when you can proceed with the next join.

Drums, or a purpose-built receiving stand, should be set up to support the full sized panel being joined. Once joined, the tabs can be cut to remove the full size parts of the kit.



APPLYING ADHESIVE TO THE Z-JOINT

Prior to applying adhesive to the Z-Joint, carefully remove approximately 25mm of peelply from the outside edge of the male scarf, taking care not to damage the laminate. Scarfs should be brushed with a clean brush to remove dust and any contamination that would inhibit adhesion.

It is important to apply enough high-density adhesive to cover both Z-joints and exposed core, and to allow adequate squeeze out when the joints are pushed together.

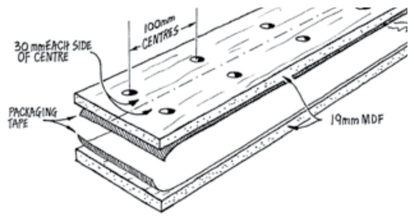
The panels should be pushed together by sliding them back and forth to make a tight join of no more than 1mm, prior to applying pressure with the Z-Press or manual joining strips.

MANUAL JOINING

STEP 1

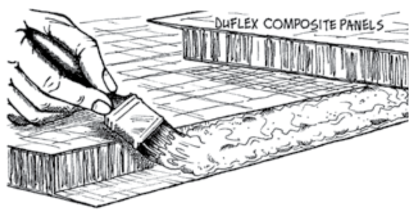
Take two strips of 100mm wide, 19mm MDF (fibreboard) the length of the long side of the composite panel (2400mm).

Cover one side of each strip with plastic tape as shown. Drill pairs of 3mm (approx.) screw holes, 30mm each side of centre, through one strip at 100mm centres.



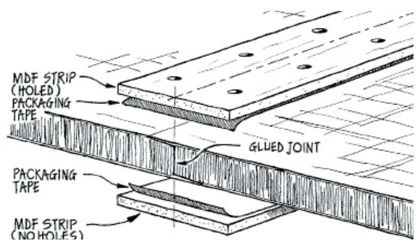
STEP 2

Apply a high-density epoxy adhesive to both Z-Joints, making sure there is adequate adhesive to cover all core and scarf joint areas, and push joints together with a maximum gap of 1mm.



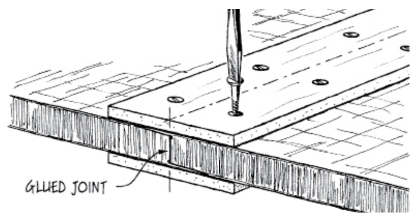
STEP 3

Lay the strip with no holes, plastic side up, underneath the glue joint; lay the holed strip, plastic side down, on top of the glue joint.



STEP 4

Screw through the holed top strip into the bottom strip, ensuring faces are squeezed together firmly. Leave to cure overnight.



PROCESSING E-GLASS LAMINATES

Diamond-coated fiberglass tooling is recommended for cutting for best tool life, for example, a jigsaw with a Makita No.10S Type 150 blade to cut out parts. The best edge finish is achieved with circular saws running aluminum cutting blades, however blade life is greatly reduced.

CURVATURES AND RADII

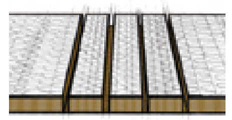
Curved surfaces are achieved without effort by simply kerf-cutting the inside skin. The need for elaborate moulds is not necessary, simple jigs can be used to form a variety of corners and curves.

METHOD A - Construction of large radii curves

Curves of 60 to 90 degrees are achievable with no loss of structural integrity.

STEP 1

A series of narrow parallel slots (kerfs) are cut into the sandwich panel along the inside of the proposed curve, through the facing skin and core to the rear face of the outside skin. The saw cuts should never break through the outer facing skin, which serves as a hinge.



Initially determine the desired internal angle, and outer corner radius. Following the calculations below, will provide the required details on number of slots, and their spacing, to achieve the required curve.

a - Internal angle 0.52 (150°) 1.57 (90°) 1.05 (120°) 2.62 (30°)	t - Panel thickness
	c - Saw cut centres
	R - Corner radius
s - Saw cut width	n - Number of slots

$$n = \frac{t.a}{s}$$

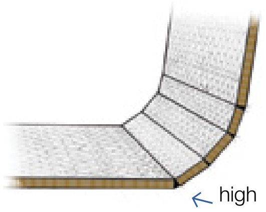
Example: $\frac{16\text{mm} \times 1.57 = 12}{2}$

$$c = \frac{R.a-s}{n-1}$$

Example: $\frac{50\text{mm} \times 1.57 - 2.2 = 5\text{mm}}{12}$

STEP 2

Fill the saw cuts with a thickened epoxy mixture and bend to the final shape and allow to cure. The shape should be held in position, while the epoxy cures, with clamps or jigs.



STEP 3

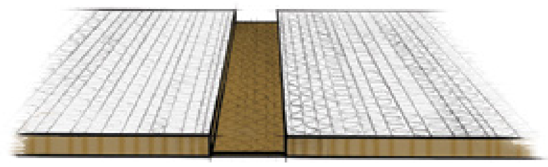
An additional layer of fibreglass cloth is applied to the inside of the curve with an epoxy laminating system, covering all the slots and overlapping the end slots by 30mm to 40mm.

METHOD B - Construction of small radii curves

STEP 1

A strip of the panel is removed by cutting through the facing skin and core to the rear face of the outside skin. The slot width is calculated by:

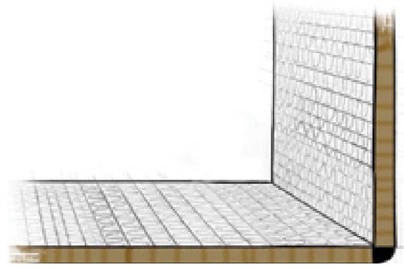
Slot width = $a.t$



STEP 2

The cut should be filled with a mixture of WEST SYSTEM 105 resin with 206 Slow hardener, modified with 411 Microsphere Blend. This combination will produce a strong, waterproof bond that will hold the curve when cured.

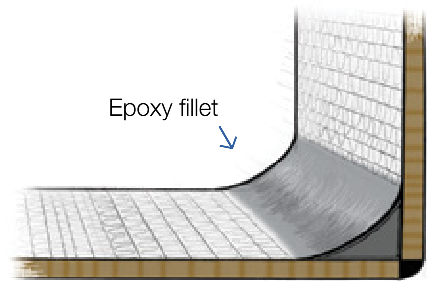
Apply enough modified epoxy to fill the internal angle left by the removed skin and core material. Allow to cure. The shape should be held in position, while the epoxy cures, with clamps or jigs.



STEP 3

Fill the internal angle, with a 20mm radius of modified epoxy and allow to cure.

Apply an additional layer of fibreglass cloth to the inside of the angle, overlapping the fillet by 25mm on each side.



Safety and Storage

SAFETY

Avoid inhalation and eye contact with machining dust. Wear protective equipment such as hearing protection and safety glasses during cutting operations, and gloves to avoid cuts. Use guards as per machinery manufacturers instructions.

STORAGE

DuFLEX and Featherlight panels should be stored flat, out of direct sunlight, and kept dry and clean. Panels supplied with fibreglass skins have peel-ply on the surface, which should be left in place as long as possible, to protect them from surface contamination.

Markets

MARINE

DuFLEX and Featherlight panels have become an industry standard for composite boat construction and can be engineered and manufactured to meet the rules of all major Marine Authorities including Lloyd's Register of Shipping, American Bureau of Shipping, CE, DNV-GL and Australian Standard.

- Recreational / pleasure craft
- Cruising and racing yachts
- Mega-yachts
- High speed ferries
- Water taxis
- Patrol craft

ARCHITECTURAL

With DuFLEX and Featherlight panels, complex forms can be created, broadening design freedom and offering rapid processing and construction which helps to lower costs significantly.

They can provide new construction solutions, alone or in conjunction with traditional materials.

- Building facades
- Structural cladding
- Doors, gates & window frames
- Long span roofing
- Acoustic insulation
- Prefabricated housing
- Composite decks & bridges

INDUSTRIAL

DuFLEX and Featherlight panels offer excellent durability, acoustic insulation properties and high chemical resistance, making them an ideal alternative to steel, iron and concrete for industrial applications, reducing maintenance and life cycle costs.

- Holding Tanks and Lids
- Staging, Walkways and Scaffolding
- Form Work
- Audio Visual Equipment Containers

TRANSPORTATION

Composite materials provide strength, lower vehicle weight and improved energy efficiency in transportation applications.

DuFLEX and Featherlight panels allow for design flexibility and deliver the optimum combination of weight, performance, reduction in operating costs and safety.

Road Transportation

- Truck beds, bodies and side walls
- Bus floors

Rail Transportation

- Flooring
- Roof / ceiling construction
- Cabinetry and interiors
- Doors

ATL composites

Company Name ATL Composites Pty Ltd

12-14 Production Ave
Molendinar QLD, Australia 4214

Phone +61 7 5563 1222
Fax +61 7 5563 1585
Email info@atlcomposites.com

BESTPRACTICE CERTIFICATION
ISO9001 QUALITY MANAGEMENT SYSTEM

DNV·GL
DNVGL-CP-0421
#AMPM000003M
for the manufacture of fibre reinforced plastics

vdL Composites
lightweight panel solutions

Company Name vdL Composites GmbH

An der Windmühle 2,
46483 Wesel, Germany

Phone +49 (0)281 33830 0
Fax +49 (0)281 33830 30
Email info@vdlcomposites.de

www.duflex.com.au