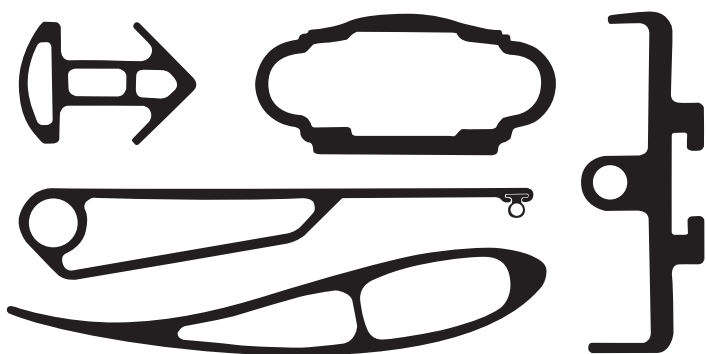
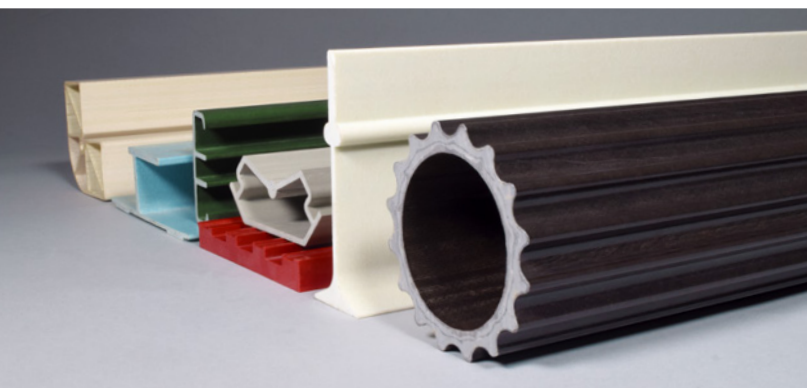




GEF Incorporated
Innovative Solutions in Fiberglass

CUSTOM PULTRUSIONS

TECHNOLOGY . CAPABILITIES . SOLUTIONS



ABOUT PULTRUSION

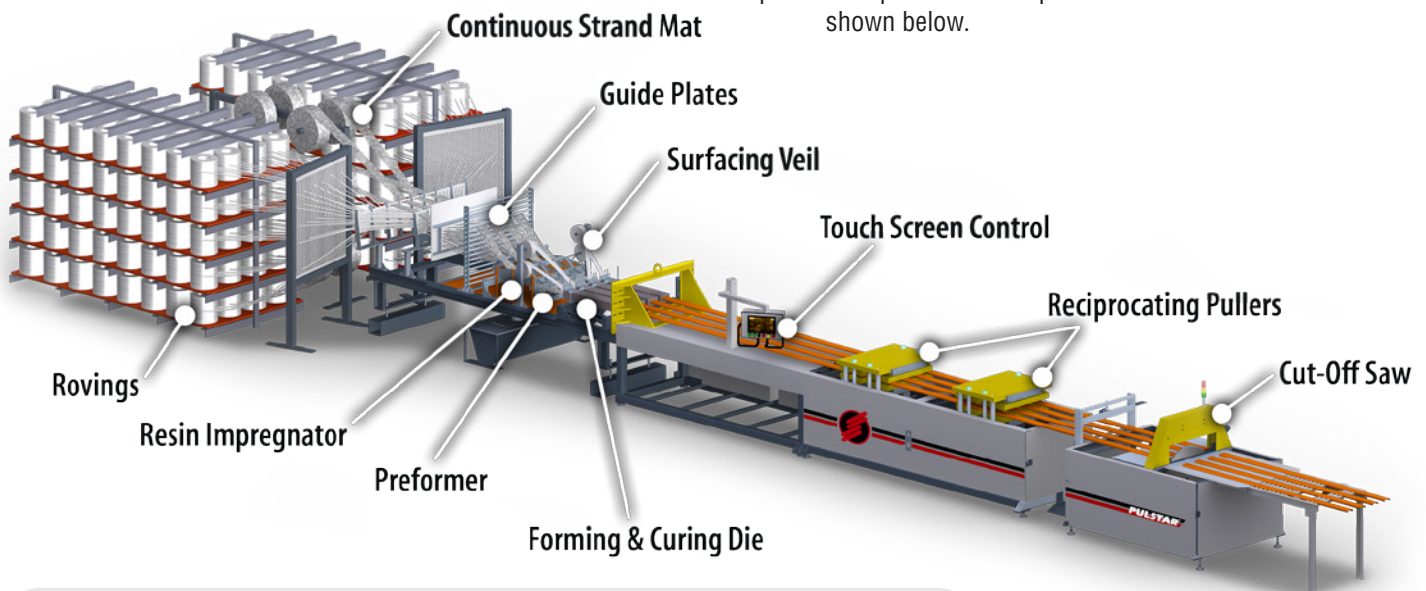


Manufacturing Process

Pultrusion is a manufacturing process for producing continuous lengths of reinforced polymer structural shapes with constant cross-sections. Raw materials are a liquid resin mixture (containing resin, fillers and specialized additives) and flexible textile reinforcing fibers. The process involves pulling these raw materials (rather than pushing, as is the case in extrusion) through a heated steel forming die using a continuous pulling device.

The reinforcement materials are in continuous forms such as rolls of fiberglass mat, doffs of fiberglass roving or tows of carbon fiber, etc. As the reinforcements are saturated with the resin mixture ("wet-out") in the resin bath and pulled through the die, the gelation, or hardening, of the resin is initiated by the heat from the die and a rigid, cured profile is formed that corresponds to the shape of the die.

While pultrusion machine design varies with part geometry, the basic pultrusion process concept is described in the schematic shown below.



BENEFITS OF PULTRUDED FIBER REINFORCED POLYMER COMPOSITES



Corrosion Resistance

Superior resistance to a broad range of chemicals. Unaffected by moisture or immersion in water when sealed. Will not rust like metal and will not rot like wood.



High Strength

Stronger than steel and aluminum, pound-for-pound in lengthwise direction. This makes holding, using and transporting easier.



Lightweight

Pultruded fiberglass shapes generally weigh 75-80% less than similar steel shapes and 30% less than similar aluminum shapes.



Durability & Weatherability

Resists impact, non-denting and hard to break. Pigmented resin, surfacing veil and UV-Inhibitors prevent moisture absorption and warping.



Low Conductivity

Low electrical and thermal conductivity properties and high dielectric capability. This means it won't spark or conduct electricity, nor will it transmit cold or heat to the hands.



Virtually Maintenance Free

Will not permanently deform under impact. Corrosion resistance eliminates need for constant painting and upkeep. Provides long-term, cost effective solutions with lower life cycle costs.



Versatility

FRP can be pultruded in a wide variety of profiles for many different markets. Multiple resin types and custom color options are available.

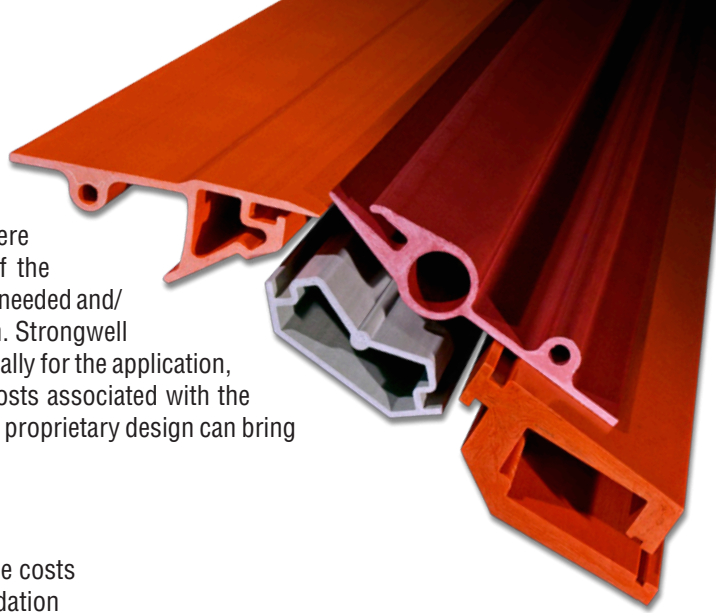


Easy Installation

Can be field fabricated using simple carpenter tools and is easily lifted into place during installation.

WHY CONSIDER CUSTOM PULTRUSION?

A custom pultruded part manufactured by Strongwell can be an excellent solution to a wide range of problems in practically any application where standard materials or other fiberglass shapes do not meet the needs of the customer. A custom pultrusion should be considered when a unique shape is needed and/or when the properties of other materials are not suitable for the application. Strongwell can work with the customer to develop custom pultrusions designed specifically for the application, resulting in better performance, increased reliability and lower life cycle costs associated with the custom pultrusion. Parts consolidation and the competitive advantage that a proprietary design can bring are also attractive reasons to consider a custom pultrusion.



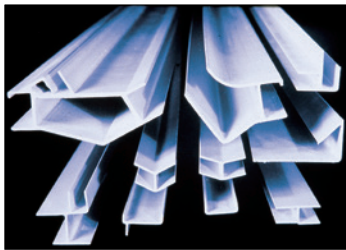
Benefits of Custom Pultrusion

- Designed specifically for the application
- Results in lower life cycle costs
- Provides better performance
- Allows for parts consolidation
- Provides increased reliability
- Creates a competitive advantage

With more than 65 pultrusion machines running up to 40 lines per machine, Strongwell has the unmatched production capacity to manufacture custom pultruded parts. Combined with the broadest range of pultrusion design and engineering expertise, Strongwell offers more custom capabilities than anyone in the industry.

The Custom Pultrusion Checklist, found on Strongwell's website at www.strongwell.com, is an important starting point for both the customer and Strongwell's custom pultrusion design team. We strongly encourage customers to submit the checklist early in the consideration process to ensure Strongwell can properly design and quote a custom pultrusion.

TECHNICAL CAPABILITIES



Shapes & Sizes

Virtually any shape with a constant cross-section can be pultruded. This allows for the integration of various parts.

Strongwell has the expertise and capability to produce custom

pultrusions in a wide range of sizes in almost any shape from a 36" x 18" double web beam (Large) for infrastructure applications to small 1/4" square bars (Thin) used as circuit board stiffeners.



Large



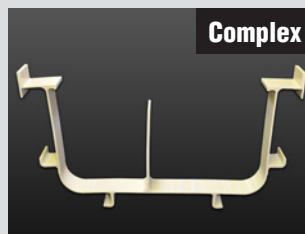
Small



Thick



Thin



Complex



Simple



Reinforcements

The type, form, placement and quantity of reinforcements can be customized to maximize economy, develop oriented strength and create or enhance other physical characteristics of a pultruded part. Typical reinforcements used include glass or carbon fibers in multi-filament strands, mat (long fibers held together with a resinous binder) or stitched fabrics.

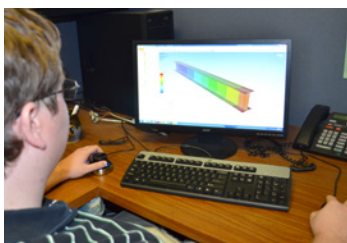
TECHNICAL CAPABILITIES (CONTINUED)



Resins & Colors

Standard resins can be modified or special resins can be used to optimize the performance of the pultrusion in challenging environments, such as those found in high temperature or extremely caustic areas. Typical resins include polyesters, vinyl esters, PVC, epoxies, phenolics, urethanes and blends.

Strongwell also offers color matching capabilities for resins, finished pultrusions and topcoats.



Composite Design

A standard shape can be made into a custom pultrusion by customizing the resin or reinforcement to achieve a particular customer need.

Strongwell has in-house composites analysis capabilities including Finite Element and Classical Laminated Plate Theory using in-house generated lamina data.

Strongwell also offers rapid prototyping via in-house 3D printing capabilities, which offer the ability to quickly create test fixtures and concept prototypes.



Special Pultrusion Processes & Materials

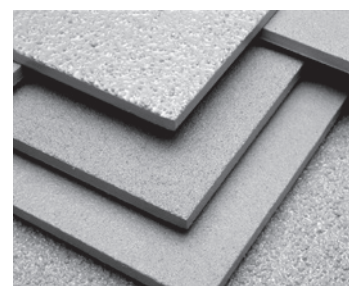
Strongwell has extensive experience in pultruding over various core materials including foam, balsa, polyethylene and aluminum. In other applications, foam can be added after the part is pultruded.

Circumferential wrap pultrusion adds reinforcements in the 90° direction, which adds crosswise strength to pultruded tubes offering screw strength improvement.



Surface Treatments

Graphics or text can be pre-printed on the surfacing veil, embedding these features as a permanent feature of the finished part. Peely ply veil is also available for ease of future fabrication. Additionally, Strongwell can abrade, apply non-skid texture (in various grits) or paint any of its pultruded parts.

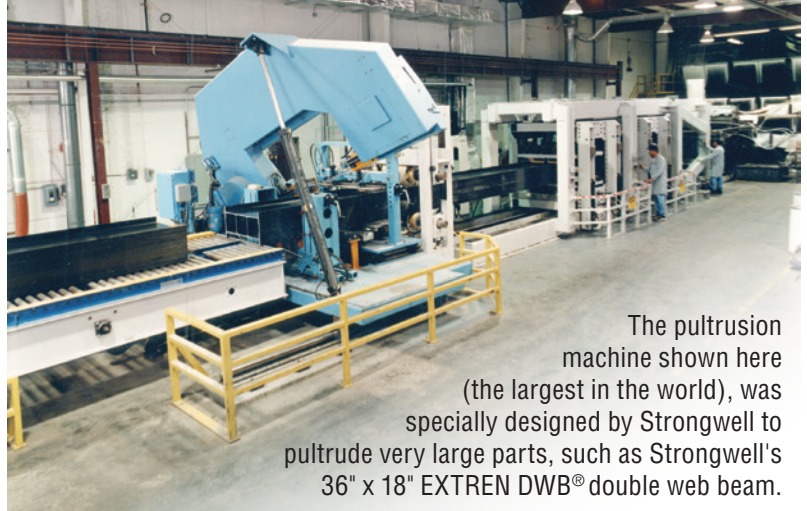


PRODUCTION & FABRICATION CAPABILITIES

Strongwell's expertise in pultrusion design, engineering and manufacturing makes it possible to offer unique solutions to meet the customer's exact requirements. Strongwell uses award-winning pultrusion processes in its ISO-9001 certified manufacturing facilities. In-house composite engineers, mechanical engineers, and certified structural engineers assist in product conception and ensure custom products meet specifications. In-house drafting, solid modeling and 3-D printing capabilities also provide customers with expert solutions to specific needs.

Key Capabilities

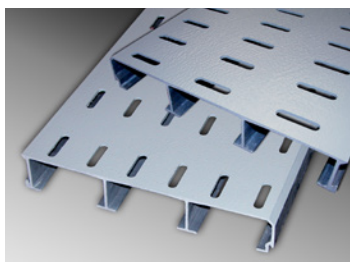
- Strong composite and process engineering
- In-house structural design engineering (registered Professional Engineers)
- In-house laboratory for ASTM structural and electrical testing
- Extensive research and development capabilities
- Solid modeling, 3-D printing, mechanical and structural detailing
- Equipment and machine shop for design and build of advanced pultrusion machinery, tooling and dies
- In-house chrome plating capabilities
- Unmatched production capacity, including multi-cavity pultrusion machines which allow for efficient multi-line production on a single machine
- Complete fabrication facilities to cut or machine parts for custom applications



The pultrusion machine shown here (the largest in the world), was specially designed by Strongwell to pultrude very large parts, such as Strongwell's 36" x 18" EXTREN DWB® double web beam.



Strongwell can perform many secondary operations on pultruded parts using CNC equipment. These operations include vertical and horizontal drilling, machining, cutting and routing. The customer benefits from this additional service because it adds value to the part and provides a product that will more closely meet the specifications and end use.



MARKET SOLUTIONS

Strongwell works every day to provide solutions to tough engineering and design challenges like the examples shown here. The unique properties possible with pultruded composite materials offer cost-effective solutions. As engineers become aware of the features and benefits of pultrusion, the range of applications for composite materials continues to grow.



Architectural

Strongwell manufactures numerous products used in the architectural market. From walkways and handrail, to fully customized shapes like the one above, Strongwell's fiberglass pultrusions are strong, light weight, corrosion resistant and durable.



Building / Construction

Strongwell's FRP has been used for decades to save weight, increase corrosion resistance, provide aesthetic beauty and reduce maintenance costs. Strongwell offers over 100 standard shapes through its EXTREN® line, and can manufacture other profiles used in building and construction.



Cellular

Strongwell's FRP products are an ideal choice for the cellular industry. Nearly invisible to cellular emissions and radio frequencies, Strongwell FRP has been used extensively for applications ranging from architectural screening to entire structures - anywhere that electro-magnetic (EMI) or radio frequency interference (RFI) is a concern.



Coastal / Marine

Fiberglass handrail, pultruded grating, decking, structural shapes and plate from Strongwell offer an attractive, low-maintenance and long-lasting alternative to steel and wood in corrosive marine and freshwater environments.



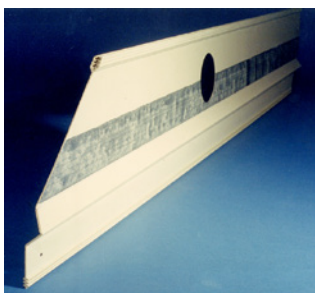
Electric Utility

The high strength to weight ratio, low electrical conductivity and proven durability of Strongwell's FRP make it an attractive option for electric utilities seeking to upgrade or install new materials.



Hotel / Motel

Constant maintenance at hotel and motel facilities have driven many operators to select Strongwell FRP to replace traditional materials, especially in exterior handrail, stairways and walkways and water play areas.



Industrial

Strongwell offers the broadest range of industrial grade fiberglass structural material, systems and fabricated structures available from a single source. The proven durability over time of Strongwell's pultrusions and the broad range of existing profiles makes Strongwell a well-known name in the Industrial market. The added ability to develop custom profiles for specialty applications makes Strongwell an attractive option for potential customers.



Infrastructure

Strongwell is actively involved in the advancement of FRP technology for civil infrastructure applications. These efforts include the research and development of new products as well as in the establishment of engineering and performance standards.



Ladder Rail

Originally developed for electrical utility workers, fiberglass ladders now hold a significant share of the overall ladder market. Ladders made with Strongwell FRP rails are steadily replacing those made with aluminum and wood.



Mining

Engineers and end-users are replacing traditional materials with fiber reinforced polymers (FRP) in corrosive mining environments. FRP provides lower life cycle costs, offers outstanding performance and provides superior quality.



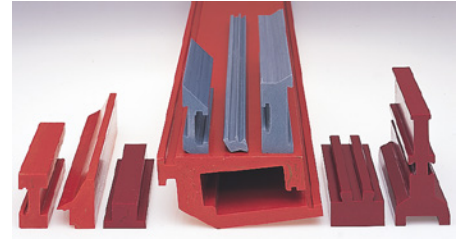
Oil & Gas

Strongwell's structural composites have proven to be an effective long term solution in the Oil and Gas market. Weight savings, durability, and resistance to salt air and seawater are just a few of the benefits which fiberglass composites provide over steel.



Parks & Recreation

Strongwell's pultruded fiberglass materials can replace wood and metal to help reduce maintenance costs, reduce downtime and increase the beauty of parks and recreational areas, especially in areas which currently require frequent maintenance.



Pulp & Paper

FRP has been widely accepted for use in the Pulp and Paper industry due to its durability, corrosion resistance and abrasion resistance, high strength to weight ratio, low maintenance, cost, and ease of design.



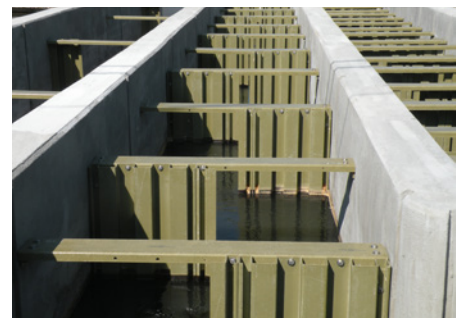
Tool Handles

Originally designed for industrial tools, fiberglass handles have gained wide acceptance. Fiberglass tool handles are used in a variety of implements including shovels, rakes, hoes, pruners and post hole diggers.



Transportation

Incorporating FRP into structures and designs reduces the overall structure weight and foundational requirements. Installation can also be much faster and less complicated, reducing congestion in work zones and improving safety.



Water / Wastewater

Whether you need an NSF compliant structure for use in potable water or a baffle system for a chlorine contact chamber, Strongwell offers a wide range of fiberglass solutions for the water and wastewater treatment industries.

WHY CHOOSE STRONGWELL?

Strongwell is the world's largest pultrusion company and the recognized leader in the pultrusion industry. Strongwell has pultruded fiber reinforced polymer (FRP) composite structural products since 1956 and today offers unequalled capacity, versatility and flexibility to meet the needs of its customers and allied partners. Here are a few specific reasons you should select Strongwell as your manufacturer of choice:

- **Reliable, Long-Term Supplier:** Strongwell has an outstanding track record of stable ownership and management, excellent debt-free financial strength and a well-branded business reputation.
- **Manufacturing Capacity and Pultrusion Expertise:** Strongwell has more capacity than any other pultrusion company, owning more than 65 pultrusion machines and over 645,000 square feet of manufacturing space. Strongwell designs and builds its own machinery, dies and auxiliary tooling, which offers great flexibility to its customers based on demand.
- **Value-Added Capabilities:** In addition to pultrusion, Strongwell offers in-house structural fabrication, a machine shop, and numerous other value-added operations up to and including assembling finished products.
- **Assurance of Quality:** All three Strongwell custom pultrusion manufacturing locations hold ISO-9001 certification which supports assurance of quality and on-time shipments.
- **Materials, Process Technology and Engineering Support:** Strongwell has a 10,000 square-foot, fully-staffed laboratory capable of conducting nearly all ASTM or other mechanical testing on its products. Technical support is offered from design, process and structural engineers to assist in technology advancement and product development. Strongwell also has working relationships with multiple academic engineering partners.
- **Materials Technology:** Strongwell has ongoing joint development programs with first class raw material suppliers for both specific and general improvements to pultrusion raw materials. Often something learned in developing a raw material for one product proves broadly and specifically applicable to other products in cradle-to-grave life cycle analysis.
- **Green Commitment:** As a responsible corporate citizen, Strongwell continually seeks to improve its manufacturing practices to further protect the environment, while providing essential, environmentally friendly products to its customers.
- **Made in the U.S.A.:** When you order a custom pultrusion from Strongwell, you will receive a product made exclusively in the U.S.A. by workers who take pride in the products they make.
- **Longevity:** Strongwell has been manufacturing FRP pultrusions since 1956.

The company is financially strong, total quality oriented, technically advanced, and customer focused. Strongwell's customers include Fortune 500 industrial and commercial firms, major architectural and engineering firms, leading contractors and distributors, and many other companies - both large and small - in a variety of markets.



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