July/August 2014

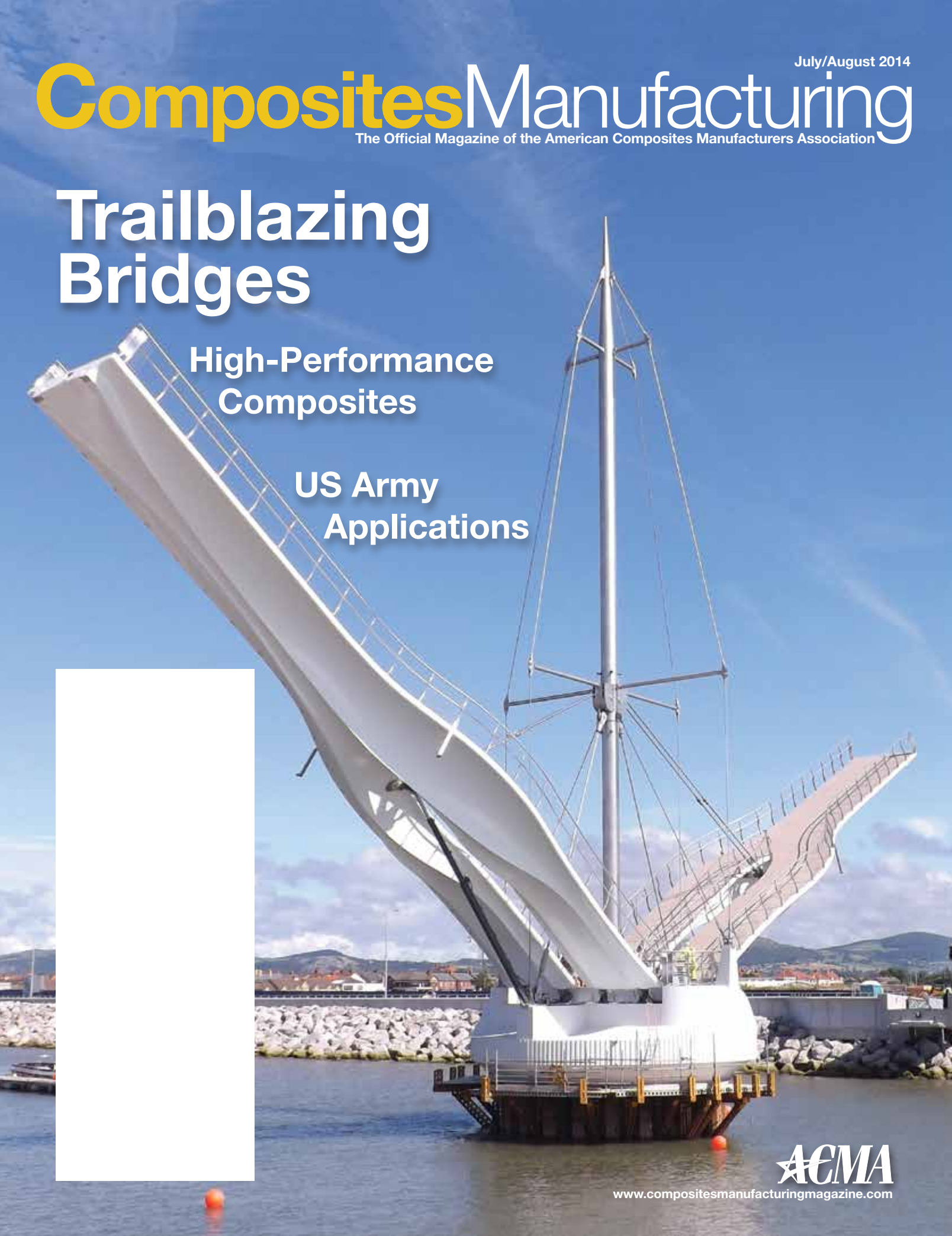
# CompositesManufacturing

The Official Magazine of the American Composites Manufacturers Association

# Trailblazing Bridges

## High-Performance Composites

## US Army Applications



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# CompositesManufacturing

July/August 2014

The Official Magazine of the American Composites Manufacturers Association






## Departments & Columns



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## Market Segments

### Education



### Military



### Sports & Recreation



## Features



While highway bridges often garner the most attention, FRP pedestrian bridges are gaining a foothold in the market thanks in part to the growing number of recreational trails.

*By Patrice Aylward*



High-performance composites are pushed to the limit as end users in all market segments seek stronger, stiffer materials. Check out some amazing applications, as well as trends for the future.

*By Susan Keen Flynn*

**About the Cover:** *Photo courtesy of AM Structures*

# Our Industry is Flying High

Here we are just a few months away from CAMX – The Composites and Advanced Materials Expo. It will be a terrific display of our industry, bringing together material suppliers, manufacturers, equipment suppliers, designers, engineers, specifiers and end users. More than 500 exhibitors will showcase their products and services. Companies and individuals have the opportunity to get or renew educational certificates and learn about new technologies and processes. Industry leaders will share new ideas in the form of technical paper presentations, panel discussions and seminars. ACMA will formally recognize distinguished individuals for their contributions to the composites industry. You will meet new people and refresh old – I mean, "long-time" – friendships.

In a word, CAMX will be fantastic!

There is still time to register for CAMX, which will be held at the Orange County Convention Center in Orlando, Fla., October 14-16. For details and to register, check out the show website at *thecamx.org*.

Much of CAMX will demonstrate newer, high-performance materials and applications. This edition of *Composites Manufacturing* also features an article on high-performance composites. I would like to make a clarification here: When we talk about high performance, we are not necessarily referring solely to carbon fiber reinforced materials. Although carbon fiber and some of the higher-end resin systems and processes can generate some pretty astounding numbers, they may not be the only or best solution to all new application requirements.

In many cases, traditional materials or hybrid combinations of reinforcements and resin chemistries can generate great results. Perhaps changing the processing technology gives the application the necessary properties. Perhaps it is a combination of all three inputs. Read the article "Setting a High Bar" on page 22 and discover innovative applications using carbon fiber, aramid, fiberglass and hybrid materials.

The marketplace's desire for higher performing composite materials will demand our best work and creativity to be successful. I would not be surprised to see material advances coming in leaps and bounds in the next few years. With the potential that exists in our industry, I am quite excited to be involved with ACMA and our members. The composites market is expected to enjoy growth at a higher rate than the rest of the economy. That also excites me!

I would be remiss to write this column and neglect to mention how important our members are to the association. I am very proud to report that membership has been building for the last couple of years. Increased membership allows access to more and better services for our members. The modernization and improvement of the CCT program is but one example. So, here is my normal ask: If you know a company that isn't a member yet, let us know or ask them yourselves to join ACMA. As always, I say thanks for your membership, your volunteering and your commitment to composites.

Jay Merrell
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ACMA and SAMPE, the two leading composites and advanced materials industry organizations, have created CAMX - The Composites and Advanced Materials Expo. With over 500 expected exhibitors and more than 8,500 attendees, CAMX will be the largest industry event of the year.

CAMX brings together ACMA's COMPOSITES Show and SAMPE's Annual Conference, giving you the unique opportunity to engage with the experts who are shaping the future of composites and advanced materials...all in one place.

## Registration Is Open – www.theCAMX.org

### Schedule at a Glance:

| Monday, Oct. 13 | Tuesday, Oct. 14 | Wednesday, Oct. 15 | Thursday, Oct. 16 |
|---|---|---|---|
| **Pre-Conference Tutorials**<br>9:00 AM – 12:00 PM | **Opening Session, Keynote & CAMX Awards**<br>9:30 – 10:45 AM | **CAMX Featured Sessions**<br>8:00 AM – 12:00 PM | **CAMX Featured Sessions**<br>8:00 AM – 12:00 PM |
| **Pre-Conference Tutorials**<br>2:00 – 5:00 PM | **Exhibit Hall Hours**<br>11:00 AM – 5:00 PM | **Educational Programs**<br>8:00 AM – 12:00 PM | **Educational Programs**<br>8:00 AM – 12:00 PM |
| **SAMPE Fellows Dinner**<br>6:00 – 8:00 PM | **CAMX Featured Sessions**<br>2:00 – 5:00 PM | **Exhibit Hall Hours**<br>9:30 AM – 5:00 PM | **Exhibit Hall Hours**<br>9:30 AM – 12:00 PM |
| | **Educational Programs**<br>2:00 – 5:00 PM | **CAMX Featured Sessions**<br>1:00 – 5:00 PM | **Closing Luncheons**<br>12:00 – 1:30 PM |
| | **Welcome Reception**<br>5:00 – 6:00 PM | **Educational Programs**<br>1:00 – 5:00 PM | **CAMX Featured Sessions**<br>1:30 – 3:30 PM |
| | | **Specialized Networking Reception**<br>5:00 – 6:00 PM | **Educational Programs**<br>1:30 – 3:30 PM |

**Schedule subject to change*

### Registration

CAMX registration is officially open! CAMX offers a variety of registration categories to fit every budget and schedule – including discounts for ACMA and SAMPE members. All registrations provide access to the Opening General Session and Welcome Reception. Browse the CAMX registration categories and rates at **www.theCAMX.org**, and start planning your CAMX experience.

### Hotels

Make reservations as soon as possible for the best selection and rates. Official CAMX hotels range from $89 to $245 per night. Shuttle bus service is provided to/from all hotels that are not within walking distance of the Orange County Convention Center. Make reservations online – **www.theCAMX.org/Hotels.php** or call Conference Direct – **US TOLL-FREE: 888-557-0824** or **INTERNATIONAL: 801-512-2547.**

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# EDUCATION

CAMX offers the most robust conference program anywhere for the composites and advanced materials industry. Detailed technical papers, leading edge education sessions, and a poster session with the latest R&D are presented by over 600 industry thought leaders. Build your conference experience by attending sessions in the following areas. A full program is available at **www.theCAMX.org.**

## CAMX Featured Sessions

Working together, ACMA and SAMPE have created a special track that bridges low-cost/high-volume materials with high-performance/low-volume materials. These sessions focus on composites innovation, market growth, and hot topics associated with advanced materials. With presentations by thought leaders and industry experts, CAMX Featured Sessions deliver cutting-edge information you'll use to improve your products and processes, expand your business, and plan for the future.

## ACMA Conference Program

ACMA's conference program has a robust lineup of technical paper, education session, and panel discussion presentations that span the entire spectrum of the composites industry. With sessions geared toward C-level employees, engineers, manufacturing/plant personnel, as well as sales and marketing professionals, program tracks and speakers are as diverse and varied as the composites industry itself. Topics include business management, cutting-edge research best practices, code development, case studies and how-tos.

## SAMPE Conference Program

SAMPE's conference program addresses critical areas of the advanced materials and processes industry – R&D, materials selection/optimization, application of new materials through innovative processing techniques, and support activities (testing, NDE, etc.), and ultimate assurance of service life applications. Thought leaders from industry, government, and academic organizations contribute to SAMPE's conference program via expert led panel discussions, technical papers, and program reviews.

## General Session and Keynote Address

Open to all attendees and exhibitors, the inaugural CAMX 2014 event will officially kick off with a General Session and Keynote Address that embodies the "Combined Strength. Unsurpassed Innovation." of CAMX. The keynote address will inspire anyone involved with composites or advanced materials to "dream it and build it," and the latest innovations in our industry will be highlighted with a presentation of two CAMX Awards. Keynote speaker Kevin Mickey, President of Scaled Composites, will share his viewpoints from one of the most innovative companies in our industry.

# HIGHLIGHTS

## CAMX Exhibit Hall

Offering live demonstrations, innovative product displays, business meetings, and networking, the CAMX exhibit hall is the one marketplace for anyone connected to the composites and advanced materials industry. With over 500 exhibiting companies expected, more than 450 have already confirmed their exhibit space - with more joining each day. See the full list of exhibitors, explore the floor plan, and schedule meetings with exhibitors at **www.theCAMX.org.**

## CAMX Awards

The CAMX Awards recognize cutting-edge innovations that are shaping the future of composites and advanced materials in the marketplace - specifically in areas that bridge low-cost/high-volume materials with high-performance/low-volume materials. CAMX is looking for entries that have the ability to shift industry expectations and shape the future of manufacturing. For more information, visit **www.theCAMX.org/AwardsCompetitions.php**. Submission deadline: August 1, 2014.

## Awards for Composites Excellence (ACE)

Hosted by ACMA, ACE offers six total awards in the following three categories: Design, Manufacturing, and Market Growth. For more information, visit **www.theCAMX.org/AwardsCompetitions.php.** Submission deadline: August 1, 2014.

## Stay Connected!

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*DISCOVER* ***exciting new industry developments***

*GROW* ***your business opportunities***

*DEVELOP* ***industry skills and connections***

*RECOGNIZE* ***your potential impact on the industry***

# Creating a *Real* Competitive Advantage

"What's the number one reason I should do business with you rather than your competitors?" If prospects ask this question, do you have a good answer? Many of the CEOs I work with think they do, but they're often wrong.

Would you answer good customer service, quality, reputation or a knowledgeable staff? If so, you're not alone – but here's the problem: Those qualities aren't differentiators. They're platitudes, and they don't give you a true competitive edge. Without that edge you give customers little reason to do business with you other than price. And competing on price alone is a very dangerous proposition. It not only squeezes your margins and profits, but it also creates little to no long-term loyalty. All it takes to significantly disrupt your business is a new competitor who enters the marketplace and undercuts your prices. Before you know it, your customers have flocked elsewhere in droves.

To create a real competitive advantage – one that withstands even price pressures – take a hard look at your messaging. If you're communicating a vague and imprecise competitive advantage, you need to move to one that's solid, meaningful and relevant to your customers.

Take a look at your website. Is it instantly evident that you are the obvious choice to do business with? If not, you need to make those advantages so obvious that prospects and customers quickly draw the conclusion: "*I would have to be an absolute fool to do business with anyone else but you.*"

With that in mind, start by uncovering your company's unique advantage in the marketplace. To tease this out, gather your executive team, top salespeople, marketing specialists and anyone else in your company who has significant contact with customers. Consider the following three questions:

To create a real competitive advantage – one that withstands even price pressures – take a hard look at your messaging.

1. **What's common?**
   What do you have that your competition has, too?

2. **What's better?**
   Of those things that you share, where does your company excel?

3. **What's unique?**
   What do you have that no other company has?

Keep in mind that all of your answers need to be both compelling and relevant to your customers. For example, if you're more efficient at manufacturing your product, your customer doesn't necessarily care about that – until it means their orders get processed 24 hours faster than your competition.

By understanding *what's common* between you and your competition, you'll begin to commoditize them and reduce their value versus yours. Then, by moving *what's better* and *what's unique* forward in your messaging, you'll significantly widen the gap between you and your competition. You'll also increase your value in the eyes of customers by helping them identify and quantify what you bring to the table.

Once you define what's unique, take it a step further and create what I call your "three uniques": Highlight three defendable, provable qualities that you have that no one else does. This will provide all the material you need to make the case for your business – and turn more prospects into clients. Work in conjunction with your sales and marketing team to integrate your "three uniques" into all of your communications and conversations with customers.

Uncovering your competitive advantage is one of the most important things you can do to ensure survival in today's crowded marketplace. Relevant and compelling messaging that explains to customers why your company is the right choice is a surefire way to close more deals, retain more clients and stay miles ahead of the competition, even if you're not the lowest priced company in your marketplace.

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Kevin McArdle is the founder of McArdle Business Advisors. For additional best practices resources and articles on moving your business forward, visit *McArdleBusinessAdvisors.com.*

To read more of Kevin McArdle's business management columns, visit *CompositesManufacturingMagazine.com.* Click on the "business" tab in the "columns" section.

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# Composites Courses in High School

Students in Washington state are on their way to becoming the next generation of aerospace manufacturers. Through a simple lesson in building carbon fiber composite clipboards using both wet layup and prepreg methods, the *Introduction to Composites Fabrication and Manufacturing* class at Todd Beamer High School in Federal Way, Wash., learned the same basic processes used to fabricate an aerospace part. They understand designing, planning, layup techniques, curing, trimming, assembly and more.

High school students in the Aerospace Composites Technician program at the Pierce County Skills Center in Puyallup, Wash., work in the lab.

Inspired by the state's local aviation economy and aircraft manufacturer Boeing, which has a location in Seattle, teacher Larry DuFresne wanted to provide an opportunity for his students to get a head start on a promising career in aviation. Todd Beamer High School partnered with Advanced Composite Education Services (ACES) in Lakewood, Wash., which created the course and provides educational support to 20 schools in Washington, Alabama and Oregon. After three years of composites training in high school or an intensive one-year program at a technical center, students can earn a certificate and become employable upon graduation. Todd Beamer High School completed its first year of offering the course in June and will introduce a second-year composites manufacturing course in the fall.

"Composites manufacturing seems to be a growing field, and this class is an opportunity to get students started into something that I don't think is going away," says DuFresne. "Aerospace is a major manufacturer in our area, and if this can help kids get a foot in the door, that's a plus."

Students in DuFresne's class as well as other classrooms around the country

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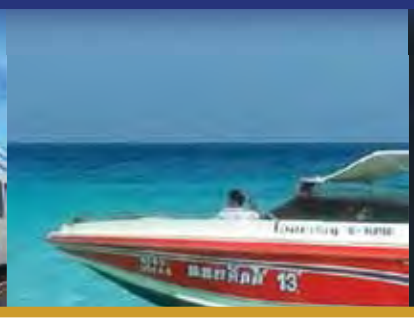
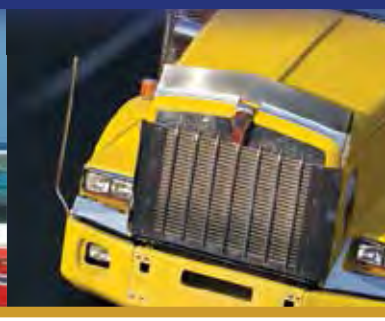

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can help fill a void within the American workforce. "There is a skills gap in education and industry," says Kevin Fochtman, vice president of ACES and owner of Pacific Coast Composites, a global distributor of advanced composites materials. Fochtman cites Boeing as an example, noting that 65 percent of the company's employees will be eligible for retirement within the next five years. "This represents a lot of skilled labor in manufacturing in aerospace," he says. For America to remain the global leader in manufacturing, Fochtman adds that it's critical to include composites in engineering classes "because you can do things with composites that you can't do with wood or metal."

Two years ago, Puyallup High School in Puyallup, Wash., approached Fochtman to provide composites education for its students. In response, Pacific Coast Composites wrote the "Comprehensive Guide to Composites" to support the school's *Introduction to Engineering* class. The company then created ACES and soon after began offering a standard course that encompasses science, technology, engineering and math (STEM) around composites fabrication manufacturing.

The goal of ACES is to supply and support comprehensive composites education in middle schools, high schools, vocational schools and universities nationwide. It provides schools with the necessary tools and information to create a composites shop and teaches the basic requirements for shop setup, tooling, fabrication and material supply.

Ultimately, ACES hopes that schools will begin exploratory education courses as early as elementary school. In fifth or sixth grade, a simple lesson can leave a big impression. For example, students can bury wood, metal and a composite structure in their schoolyard for the entire year. "At the end of the school year, you dig them up and talk about why the wood is soggy, why metal rusted and why composites look the same," says Fochtman. This simple experiment shows the sustainability of composites and teaches students the benefits of building cars, houses, bridges and planes from these materials.

"These are stackable skills that are going to graduate from elementary to middle school to high school," adds Fochtman. "Once the students get into high school they are starting to build on that foundation with quality control, lean manufacturing principles, how to apply [for jobs] and be employable with this new skill. From there, a lot of these students will go right into the workforce because they're qualified to do so."

During a field trip to Boeing, students from Todd Beamer High School brought their lesson with composite clipboards full circle. They saw firsthand how the skills they learned in the classroom can be applied in the real world to the fabrication of the rear tail sections of the Boeing 777 and 787. By observing the manufacturing process from raw fabric to final product, these students may be inspired to become the next generation of composites manufacturers.

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Natasha T. Brown is a communications consultant in Washington, D.C. Email comments to *natasha@thinkbrownink.com.*

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# US Army Addresses Helicopter Lightweighting

4th Combat Aviation Brigade, 4th Infantry Division received its first UH-60 Blackhawk helicopters at Butts Army Airfield in Fort Carson, Colo., Jan. 20, 2013.

Sustainment and modernization of legacy aviation fleets are continual efforts for the U.S. Army aviation community. Performance enhancements such as lightweighting structures and components present significant challenges to Army aircraft as operators regularly seek to increase capability by adding additional mission equipment to the platforms. In turn, as capabilities and weights have increased, so have the loads and stresses imparted to the aircraft themselves. "As operational requirements for the U.S. Army's legacy helicopters have increased, the aircraft are becoming heavier," says James M. White, the team lead for aviation of the U.S. Army Aviation Missile Research, Development and Engineering Center (AMRDEC), ManTech Aviation Branch (ManTech).

"The Army looks to advanced composite technologies and manufacturing processes to meet the needs of the soldier while improving the affordability of today's highly complex and sophisticated aviation systems," says White. "With a high sensitivity to weight, technologies enabling weight optimization or reduction – such as composites – are of paramount importance to the aviation community." Other benefits of composites include improvements in damage tolerance, functionality and performance, manufacturability and costs, adds White.

During the past nine years, ManTech has invested approximately $26 million in weight reduction of rotorcraft components for platforms such as the CH-47 Chinook, the AH-64 Apache and the UH-60 Black Hawk.

## The CH-47 Chinook

"When considering the maximum weight threshold of an aircraft, operators

"The Army looks to advanced composite technologies and manufacturing processes to meet the needs of the soldier."

Photo Credit: Sgt. Jonathan C. Thibault

must make tradeoffs concerning mission equipment versus mission requirements," says White. "Therefore, you may carry more fuel, but in turn it may mean less armament – or vice versa. These are tradeoffs that operators may not want to make in an operational environment."

Currently, the CH-47 Chinook helicopter legacy tunnel covers are composed of an aluminum inner and outer skin, which is bonded to an aluminum honeycomb core. The six covers are located on the top of the aircraft between the fore and aft pylons and prevent environmental and physical damage to underlying components. The legacy covers are attached with rivets and metal bonding, which requires significant surface preparation. They can suffer from poor fit, corrosion, seals that are difficult to maintain and limitations on step zones for mechanics to perform maintenance.

ManTech's proposed redesign uses an improved composite structure that not only lowers weight but increases durability and sustainability and lowers maintenance costs. A single, modular tool is able to manufacture all six of the individual tunnel covers.

During the project redesign, ManTech compared the viability of three potential composite solutions. The legacy aluminum design was evaluated against an autoclave cured sandwich configuration using Nomex® OX-core, an out-of-autoclave (OoA) cured sandwich configuration using Nomex® OX-core and an OoA cured sandwich configuration with 2.5-pound X-Cor™. Skin materials, configurations and resin systems utilized in these trials included those previously approved for use in Army aviation systems. Trades, testing and analysis conducted under the program indicated the Nomex® OX-core material would yield the best overall configuration to meet the requirement while optimizing component weight and durability.

"We have verified a 17-pound weight savings per aircraft with these new covers," says White. Manufacturability and performance also were improved: The modular tooling concept improved production efficiency, part count was reduced by 54 percent and recurring costs were reduced by 44 percent, according to White.

The Chinook composite tunnel cover assemblies are currently undergoing flight testing at the U.S. Army's Redstone Arsenal flight test facility in Huntsville, Ala.



## The UH-60 Black Hawk and AH-64 Apache

ManTech is working with General Electric in the final year of a program, started in 2010, to improve the fuel efficiency and reduce the weight of propulsion engines for UH-60 Black Hawk and AH-64 Apache helicopters through the use of lighter weight, higher temperature capable ceramic matrix composite (CMC) engine components.

"We undertook the development and optimization of processes to manufacture CMC first- and second-stage high pressure turbine shrouds (HPTS) for use in the T700 family of turbine engines," says White. "We anticipate a one-pound reduction in weight, a one percent decrease in fuel consumption, a reduction in carbon dioxide emissions, a manufacturing cycle time reduction of 25 percent and a part count reduction of more than 90 percent."

Photo Credit: Boeing

The latest model of the Chinook helicopter, the CH-47F, has accumulated more than 86,000 combat hours in Afghanistan and maintained an operational readiness rate of more than 80 percent.

The CMC HPTS program will see the use of composite materials beyond traditional airframe applications into the extremely demanding environment of gas turbine engines. For this application, material and component qualities are critical to ensuring aircraft performance and operator safety. Engines utilizing advanced CMCs are expected to be required for next-generation rotorcraft in addition to upgrades in the U.S. Army's legacy fleet.

"While all of these programs not only improve the performance and extend the life of the U.S. Army's legacy fleet, they also advance the development of future aircraft," White explains. "There's an aggressive set of requirements for the next generation rotorcraft. Many of today's technologies present design and manufacturing challenges in meeting these goals. Composites are not only helping us to improve our legacy aircraft; they're going to help us enable future aircraft designs to fly higher, farther, faster and with more payload capability."

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Patrice Aylward is a communications consultant based in Cleveland. Email comments to *paylward@aol.com*.

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# Composite Carriages Roll Through Charleston

Visitors to Charleston, S.C., often skip the tour bus and take in the city's historic neighborhoods by horse-drawn carriage instead. A unique part of Charleston culture, these large, 16-passenger carriages have been rolling along the city's streets for decades. One tour operator, Old South Carriage Company, recently put a modern twist on a longstanding tradition by converting its fleet of carriages from wood to composites.

According to Dick Williams, operations manager at Old South, wooden carriages require "excessive maintenance" including painting, tightening fasteners, replacing corroded parts and rebuilding each carriage with new wood every 10 to 12 years. So, about a year-and-a-half ago, the company began exploring alternative materials.

Old South considered aluminum but decided that it, like wood, would be subject to corrosion and difficult to keep coated. The company also explored epoxy wood systems but realized that laminated wood carriages would be too heavy. In the end, Williams says fiberglass composites were "a total stand out" in in terms of durability, lightness and the ability to reproduce identical components from the same tools.

Even so, Williams admits it was a far stretch for a carriage company to move away from wood. However, the attention surrounding Boeing's new South Carolina facility helped him convince Old South's owner. Part of his argument was "if it's good enough for Boeing, it's good enough for carriages."

Old South sought out Cutting Edge Composites in Summerville, S.C., to discuss the idea. "I think they were a little bit shocked," says Williams. "These guys are in the business of building composite components for military applications. They do some very high end stuff… and we roll in there one day with a carriage to see if they could build it."

The two companies worked together for six months to design the body, roof, running boards and seats for the 6 x 12-foot carriages. There were several considerations to be made, starting with the strength of the vehicle. The carriages must carry a driver and 16 passengers totaling approximately 3,400 pounds.

Tourists in Charleston, S.C., step into the past with a ride on a horse-drawn carriage. But these carriages are anything but antiquated: The body, roof, running boards and seats are made from FRP.

Paul Pace, business manager at Cutting Edge, says the seats needed to be light, yet strong enough to support guests of all body types. The original wooden seats used support beams. The new seats feature an aluminum plate embedded in a fiberglass laminate and tapped so the components can later be fastened together.

The 8 x 15-foot roof also presented a challenge. The initial prototype used heavy laminates like those found in boat tops manufactured by Cutting Edge, but the result was far too heavy. The roof was then redesigned with a very low resin content, reducing its weight by one third.

Finding the right UV-stabilized gel coat was another concern. Old South's carriages are black, which Williams notes is a "tough, tough color" to maintain. He and Pace had multiple conversations with the gel coat supplier to ensure that the gel coat would be able to withstand Charleston's heat and sunlight, plus heavy commercial use. They ultimately selected a marine grade gel coat.

Pace says that once the design was completed, the tooling was made using "old school" wood, Bondo® filler and putty. The tooling was a large upfront investment for Old South. "We could have built a number of wooden carriages for the cost of the tooling alone," notes Williams.

Cutting Edge fabricated the roof and body using resin transfer molding (RTM). The fibers were laid up by hand and vacuum infused with a catalyzed resin, which was specified for its low viscosity and slow cure time to ensure that there weren't dry spots and that the large pieces were adequately cured. Pace says that although vacuum bagging of large parts can pose difficulties, the company's prior experiences building a fully-infused 35-foot bus and 15-foot camper provided the needed expertise. To finish the carriages, the components were fastened together and installed onto the original steel chassis, which had been sandblasted and powder coated.

The end result is a composite carriage

Cutting Edge Composites in Summerville, S.C., fabricated the carriage bodies using resin transfer molding. The bodies are then fastened to steel chassis.

Photo Credit: Roy Wilson, E.T. Techtonics

that has been carefully constructed to look like its wooden predecessor, but is substantially lighter and easier to maintain. "The carriages will never have to be painted," emphasizes Pace. Although Williams hasn't yet weighed a new carriage, he says the old carriages were exceptionally heavy, requiring four or five people to lift them. Now, it takes just two.

Old South has rebuilt 10 carriages to date and plans to rebuild the remaining five with composites as they complete their lifecycles. Not everything, however, is changing at Old South: The wheels and shafts will continue to be hand-made by Amish craftsman in Ohio and Pennsylvania. As for the horses, Williams wishes that they could speak for themselves. But he views the new FRP carriages as one more way to ensure that Old South's horse-athletes have the best conditions and equipment.

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# Blazing a Trail

By Patrice Aylward

## FRP pedestrian bridges gain a foothold in the marketplace, offering innovative designs and lightweight solutions.

On opening day of New Zealand's Auckland Harbor Bridge in 1959, locals walked across the eight-lane motorway bridge. Since then, the 3,348-foot bridge has been reserved for vehicles. But in late 2015, people will crisscross the harbor on foot once again with the opening of SkyPath, a pedestrian bridge that will be attached to the existing steel vehicle bridge.

Still in the design phase, the SkyPath project involves several companies, including Gurit, Core Builders Composites and Aireys Consultants. The bridge will use more than 4,000 square meters of sandwich panel decking composed of fiberglass-reinforced foam core with e-glass and epoxy resin skins. Each section of decking will be equipped with beams and ribs of carbon fiber and fiberglass unidirectional reinforcements and epoxy resin. When completed, SkyPath will be semi-enclosed with a mesh fabric to provide air flow yet ensure the safety of pedestrians.

"While we've had to go through a significant design update and testing program, we have now achieved a composite solution for a similar price to steel and aluminum construction," says Bevan Woodward, project director of the Auckland Harbor Bridge SkyPath Trust. "This means SkyPath will be stronger and lighter, will be easier to implement and have much lower maintenance costs with a service life of at least 50 years."

With a growing interest in the recreational trail movement, increased attention on multi-modal transportation and more applications in urban and industrial settings, demand for FRP pedestrian bridges such as SkyPath is on the rise. Another factor in the momentum shift is the increasing acceptance of FRP building materials on the part of influential players such as the

Federal Highway Administration (FHWA) and American Association of State Highway and Transportation Officials (AASHTO). These organizations have championed FRP through technology transfer programming at industry conferences and the publication of guides and regulations. While acceptance has been slow, the tide may be turning, according to Scott Reeve, president of Composite Advantage, a Dayton, Ohio-based manufacturer of FRP bridge decks and other structural composites.

To date, the 2008 "Guide Specifications for Design of FRP Pedestrian Bridges," published by AASHTO and developed in part by ACMA's Transportation Structures Council, is the industry's primary reference. In 2011, the U.S. Department of Transportation (DOT), FHWA and the U.S. Forest Service reissued their "Guide to Fiber-reinforced Polymer Trail Bridges."

"The development of codes and standards and their expansion will support the growth of pedestrian bridges," says Dustin Troutman, director of marketing and product development for Creative Pultrusions Inc., a manufacturer of FRP bridge decks and custom structural profiles in Alum Bank, Pa. "These standards enable cities, counties and park management entities to more easily incorporate pedestrian bridges into their environment. They are a catalyst for the future of this industry."

If recent projects are any indication, then the future certainly looks bright. Here's a look at three pedestrian bridges, installed in the last year, that are anything *but* pedestrian.

Photo Credit: AM Structures

The Denbighshire County Council held a competition among local primary schools to name the new bridge at the entrance of the Foryd Harbor. The 11-year-old winner aptly named the FRP structure the Pont y Ddraig Bridge, meaning Dragon's Bridge in Welsh. When the two decks open inward, they resemble dragon wings. The name is also a nod to the Welsh flag, which features a red dragon in the center.

## A Movable Marvel

**The Bridge: Pont y Ddraig (The Dragon Bridge), Rhyl, Wales**
**The Client: Denbighshire County Council**
**Project Partners: Ramboll, Dawnus Construction, AM Structures, Gurit**

When the Denbighshire County Council in northern Wales bid out a pedestrian and cycle lifting bridge to cross the entrance of Foryd Harbor where the River Clwyd enters the sea, the desire to establish an iconic aesthetic was a top consideration. Of equal concern was the need to minimize the energy required to operate the lifting bridge in an efficient manner. The new pedestrian

## Funding Pedestrian Bridges

"The funding of pedestrian bridges varies," says Jim Tymon, director of management and program finance for the American Association of State Highway and Transportation Officials. "For most transportation projects, the total level of federal investment is about 45 percent. States and localities pay for the major costs of pedestrian bridge projects, and there has certainly been a push at the state and local level for bike and pedestrian-friendly infrastructure."

When Congress passed the SAFTEA-LU Act in 2005, it created several programs under which pedestrian bridges were eligible for funds, such as the Safe Routes to School Program and the Recreational Trails Program. SAFETEA-LU also authorized the Federal Highway Administration to conduct the Nonmotorized Transportation Pilot Program (NTPP) to construct networks of pedestrian and bicycle infrastructure to demonstrate the extent to which biking and walking can carry a significant part of the transportation load. "Among the broad list of eligible activities, pedestrian bridges fit into this scope," says Tymon.

But the 2012 federal transportation bill – MAP 21 – eliminated the Safe Routes to School and Recreational Trails set-asides, substituting a new, consolidated program called the Transportation Alternatives Program (TAP). TAP program funding was reduced by about one third,

bridge connects the town of Rhyl to Kinmel Bay and is the final link in 15 miles of traffic-free cycling across Conwy and Denbighshire Counties.

Consulting engineering firm Ramboll approached composites manufacturer AM Structures Ltd. and materials supplier Gurit to review its concept of an FRP bridge deck construction. Once Ramboll landed the project, it turned to Gurit to carry out the detailed engineering of the decks, which AM Structures fabricated.

The design combined an iconic central mast-like structure and caisson with two wing-like FRP spans that lift simultaneously to enable boat traffic to pass. The two bridge decks are each 30 meters long and just 6 meters at their widest point, creating a slender and elegant profile, particularly when the wings are raised.

Photo Credit: Composite Advantage

The installation crew of the Germantown MetroPark trail bridge was glad the FRP deck was lightweight. It was a frigid winter morning when they installed the bridge in just one hour.

To meet both longitudinal and torsional dynamics, the decks were fabricated using a mix of materials: They are predominantly glass-reinforced fiber and epoxy resin, plus four planks composed of carbon-reinforced fiber placed at key corners to enhance longitudinal stiffness. The structures were fabricated with Corecell™ M-Foam, Ampreg 21 (an epoxy wet laminating system) and glass and carbon reinforcements supplied by Gurit.

"In addition to the client's desire for an interesting sculptural shape, the use of advanced molded FRP for the bridge decks reduced the weight of the spans, which led to a reduction in energy required to operate the lift cycle several times each day," says Dr. Mark Hobbs, senior engineer with Gurit's engineering services. "Optimizing the use of carbon fiber just where needed provided the necessary robustness without driving up the cost of the bridge materials unnecessarily. It's quite a sophisticated structure." With cables similar to a sailboat's rigging, the 48–meter mast and wing-like decking is visible for miles when lifted.

## A Remote Location

**The Bridge:** Five Rivers MetroParks Bridge, Germantown, Ohio
**The Client:** Five Rivers MetroParks
**Manufacturer:** Composite Advantage

This past spring, the Five Rivers MetroParks of Dayton, Ohio, opened a new 20-foot-long trail bridge in the Germantown MetroPark. The FiberSPAN™ FRP bridge was designed and fabricated by Composite Advantage to span a stream deep within the 16,665-acre park, which is considered the most diverse and significant natural area managed by the MetroParks.

Trail bridges for parks and recreation areas are a natural extension of Composite Advantage's FiberSPAN™ line of vehicle and pedestrian bridges and decks. The prefabricated deck panels help to eliminate the financial strain that trail bridges can place on park

according to Transportation for America, a transportation advocacy group. "There was an effort to consolidate programs," says Tymon. "As a result, some programs were flat out eliminated or merged with other programs. But projects such as pedestrian bridges can still be funded when submitted under TAP."

The 2012 MAP-21 transportation bill needed a general fund transfer of almost $20 billion to supplement declining project resources for the Highway Trust Fund. The Highway Trust Fund is looking at further shortfalls as its main funding source – user fee fuel taxes – declines due to increasingly fuel efficient vehicles. "We still have not solved the funding problem," says Tymon. "Congress is struggling to come up with a source for revenues to meet the program levels that are established in law."

For composites companies with an interest in both vehicle and pedestrian bridge projects, it will be important to watch congressional action on the upcoming transportation bill as MAP-21 nears its end in September. "The next bill is in process on the Senate side," indicates Tymon, "and advocacy at the federal, state and local levels will be critical."

To get involved on the advocacy front, contact M.J. Carrabba, ACMA's legislative affairs coordinator, at 703-682-1688 or *mcarrabba@acmanet.org*.

operations' budgets by providing an affordable acquisition price point, simple installation and zero maintenance, according to the company.

Composite Advantage employs flexible production cells and a vacuum infusion molding process to create a stronger fiber-to-resin ratio for bridge decks than hand lay-up. "It's the most efficient way we've found to fabricate large pieces," says Reeve. "We can mold panels up to 50 feet long and 12 feet wide." The deck also includes curbs, molded simultaneously. "The fiberglass actually wraps all the way around as a continuous fabric," says Reeve. "Eliminating joints means a better structure because problems usually happen at joints."

The newly installed Yellow Creek Bridge helps connect paths on the 323-mile Mid State Trail, which bisects the middle of Pennsylvania and extends from Maryland to New York.

The sandwich-construction panels are composed of fiberglass fabric laid into a mold followed by fiberglass-reinforced foam core and more fabric. "We then bag it and pull the vacuum to infuse vinyl ester epoxy resin, wetting the fiberglass and fiberglass foam core," says Reeve. The cured part is removed from the mold, then finished.

Composite Advantage's secondary finishing area handles drilling, painting and the application of a non-slip grit surface (epoxy with alum oxide). "Many clients are looking for designs that conform to Americans with Disabilities Act requirements. An FRP deck with a non-slip grit surface can be safer than a wood surface," says Reeve.

The Germantown MetroPark trail bridge was installed in just one hour – a time made more impressive by the single-digit temperatures during installation. "We were very impressed with the ease of installation of this product in a remote location," says Chris Pion, park project manager. "The bridge was light enough that we were able to install it without the use of heavy equipment." Making the project even simpler, the bridge was delivered to the site with steel railings pre-attached.

Composite Advantage anticipates the lifespan of the bridge to exceed 50 years. "FRP bridges help owners save money in the long

run. By design, the composite structure is corrosion resistant and maintenance free for years to come," says Reeve.

## A Creek Crossing

**The Bridge: Yellow Creek Bridge, Loysburg, Pa.**
**The Client: Mid State Trail Association**
**Project Partners: E.T. Techtonics, Creative Pultrusions Inc., Structural Fiberglass Inc.**

In early 2014, Pennsylvania's Mid State Trail Association contracted with a trio of suppliers for an FRP bridge to cross the Yellow Creek: E.T. Techtonics designed the bridge, Creative Pultrusions Inc. supplied fiberglass profiles for the trusses and decks, and Structural Fiberglass Inc. fabricated and assembled the bridge. The new 85-foot-long, 4-foot-wide pedestrian bridge replaces a deteriorated wooden swing bridge that had been removed from service.

Creative Pultrusions pultruded structural profiles for the trusses and bridge deck. Troutman says drawing the resin-coated glass fibers through a heated die resulted in an increased fiber volume ratio, delivering the higher strength and stiffness specified and the constant cross section needed for bridge load requirements. Creative Pultrusions selected a polyester resin for its structural properties and resistance to salt corrosion and an e-glass, which exhibits tensile strength and appropriate elastic properties. The company also performed some secondary steps, such as applying the antiskid and drilling holes in the deck panels for attachment to the trusses.

SFI fabricated the pultruded decking and cut to length, drilled holes and bolted the trusses together. The company then delivered the prefabricated, lightweight bridge to the installation site in three sections, which were joined together and hoisted into position in just three hours. "In a word, lightness is the most compelling argument in favor of FRP pedestrian bridges over those constructed of steel, concrete or wood," says Eric Johansen, president of E.T. Techtonics. "These composite structures are significantly easier to move into place. We can get to any site with no constraints, which is helpful when you are constructing a bridge in, say, the back country of Alaska."

Photo Credit: Roy Wilson, E.T. Techtonics

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### Pultrusion Industry Council Sets Standards

ACMA's Pultrusion Industry Council (PIC) and the American Society of Engineers (ASCE) are drafting the first civil engineering community-endorsed design standard for pultruded profiles. The document is entitled the "Prestandard Load and Resistance Factor Design of Pultruded Fiber Reinforced Polymer (FRP) Composite Structures." PIC members are currently participating in an ASCE standards committee to convert the document into an official, ANSI approved, ASCE standard. For more information on the LRFD standard or to join the PIC, contact Andrew Huber at 703-682-1653 or *ahuber@acmanet.org*.

# Setting a High Bar

## High-performance composites evolve as customers seek the ideal material to meet stringent characteristic requirements.

**By Susan Keen Flynn**

During a meeting with engineers from an automaker, Jason Carling got a common reaction – and one he was prepared for – when he suggested they consider using carbon fiber composites to replace a large, heavy metal part. "They got bug-eyed at the cost," says Carling, global director of product development for Toho Tenax America Inc., a carbon fiber supplier based in Rockwood, Tenn. "They needed a material below X dollars per pound." But rather than shrug his shoulders and walk away, Carling turned the tables on the engineers: He asked them to reconsider their design criteria.

The automaker was looking at a one-to-one replacement, swapping steel with high-performance composites. Instead, Carling asked them to think about important characteristics of the part: What strength and stiffness were required, where was the fastening location, and what were the key mounting points? Then Carling suggested a new design, using carbon fiber materials, which had significantly less mass than the original steel part. "The composites design did not look the same, but all the key characteristics were the same and the safety margins were reasonable and acceptable," he says.

When the engineers realized the weight savings, the cost of carbon fiber became irrelevant. "It was a paradigm shift these guys could not even comprehend at the beginning of the conversation," says Carling. The automaker has not switched the part to carbon fiber composites yet because of its capital investment in metal. But the engineers' eyes have been opened to the benefits of composites.

High-performance composites have long been used in aerospace

High-performance composite materials were required to create the smooth lines on the Stedelijk Museum's new addition, appropriately nicknamed "the bathtub."

and luxury automotive applications, but these advanced materials are increasingly found in wind energy, architecture and building construction, pipe and tank and other industrial applications where material performance is critical. The primary advantages of high-performance composites are increased strength and stiffness, but they can be formulated to offer other desirable properties, including heat, corrosion and chemical resistance.

## The High-Performance Debate

While the benefits of high-performance composites may be clear, pinpointing a concise definition is a bit muddy. What *exactly* makes something a "high-performance" composite – or an advanced composite, another term industry insiders use interchangeably? "There is a bit of an inside baseball discussion and bickering about what constitutes high-performance composites," admits Carling. "The industry as a whole tries to capture what all composites are, but high-performance in glass fiber may be something entirely different than carbon fiber."

And it's not as simple as categorizing materials by fiber type. Consider the overlap: The highest performing S-glass rubs up against the standard industrial grades of carbon fiber for tensile strength. Determining if a material is high-performance likely requires closer examination of a few factors, such as the end-use industry, mechanical performance and fiber configuration.

Each market segment has a different concept of high-performance composites: Aerospace may seek different properties than automotive, architecture or other markets. "Some industries are very concerned about a particular mechanical characteristic, like flexural modulus, tensile strength or compressive modulus," says Carling. "For them, that's the driving factor that qualifies a material as high-performance, but it might not be for another industry."

That's why it's critical to consider mechanical performance. "You can accomplish something with a high-performance composite that you cannot accomplish with traditional materials, whether that's strength or modulus or weight," says Gert Frederiks, president and CEO of Teijin Aramid. Suppliers offer a variety of reinforcements designed to meet certain characteristics, such as intermediate modulus fibers, high-tenacity fibers, ultra modulus fibers and more. But the terms are used a bit loosely, says Carling.

"Everybody has their own nomenclature for what constitutes aerospace grade," he says. "I try not to get too settled on the name: I look at the actual mechanical performance of the fiber." Carling defines high-performance as a raw fiber with a tensile strength greater than 5,000 megapascals (MPa) and tensile modulus above 250 gigapascals (GPa).

IDI Composites International, headquartered in Noblesville, Ind., formulates thermoset molding compounds, including sheet molding compounds (SMC) and bulk molding compounds (BMC). It has a new line of Structural Thermoset Compounds™, manufactured in both sheet and bulk formats, for high-performance applications. The molding compounds use specialized resins and higher levels of reinforcement to provide greater strength, lower coefficients of thermal expansion and better corrosion resistance.

Larry Landis, director of technology and quality for IDI, says his company considers a material high-performance if it can be used in structural applications. "In the SMC field, that's materials with more than 40 percent fiberglass," he says. BMC isn't often looked at for structural applications. While it has some very good structural properties, you can't typically load the compound with high levels of fiberglass or carbon fiber. But IDI has structural BMCs.

"We don't use traditional chemistries you often see in BMC,"

Continental Structural Plastics (CSP) created composite battery enclosures for the Chevrolet Spark using prepreg compression molding. "It gives you autoclave performance in parts-per-hour instead of parts-per-day," says Chris Johnston, director of technology and processes at CSP. "Ultimately, we can get to similar throughputs for structural parts that you can get to with traditional SMC technologies." *Photo Credit: © General Motors*

says Landis. "And we've developed methodologies that allow us to use a variety of resins, fiberglass and carbon." He adds that traditional materials in the BMC field are highly loaded with filler, while IDI's formulation has very low amounts of filler. Most of IDI's customers for structural thermoset BMCs are in the automotive market and use the materials for inner structural car parts because they provide lower density and good strength, plus they can mold thinner gauge parts.

## Market Trends

The driver behind advancements has traditionally been the aerospace industry's need for lighter, stronger, stiffer materials. Automotive has followed closely on aerospace's heels. One of the more innovative high-performance applications is the battery pack enclosure for General Motors' 2014 Chevrolet Spark. This year, Continental Structural Plastics (CSP) in Auburn Hills, Mich., will produce 2,600 compression-molded battery enclosures for the Spark. They include a 1 x 1.4 meter tray and cover that are joined together at the automaker's plant once the battery module is installed. The enclosure sits fore and aft of the rear axle between the wheels.

The battery enclosure had to meet stringent performance requirements and pass rigorous testing, including crash, mechanical shock, post-crash integrity, fire-resistance, drop, water immersion and vibration/shock tests. CSP partnered with Cytec Industrial Materials for a materials solution. Cytec created MTM® 23, a volatile organic compound (VOC)-free thermoset vinyl hybrid resin woven glass reinforced prepreg. The material, used in conjunction with a chopped fiber material in an SMC, allowed CSP to form a complex-shaped enclosure that protects the battery in a catastrophic event. The composite is 40 percent lighter than a metal counterpart, according to CSP.

One of the biggest challenges for CSP was that it had not worked with prepreg material in a laminate-type structure before. "The design was adapted to existing space in the vehicle, which made the geometry very challenging to work with as a laminate-based design," says Chris Johnston, director of technology and processes at CSP. "We had to do a lot of work on ply pattern development using draping simulations to see how the fabric would lay across 3D surfaces."

CSP ultimately created nearly 50 different ply shapes, which are cut and laid up by hand in seven layers in the compression mold. The continuous fiber prepreg material features Reichhold's new line of ADVALITE™ resins, a monomer-free vinyl hybrid resin. This was critical to CSP's production. "It takes a considerable amount of time to lay up one of these enclosures by hand, and it may be several days by the time we mold it," says Johnston. "With a traditional styrene-based vinyl ester resin, all the styrene would be lost before we were done and it would not be moldable. This formulation gives us the working time we need."

Probir Guha, vice president of research and development at

The Stedelijk Museum of Modern Art features 185 composite panels that were affixed to the steel structure in nearly 1,800 mounting points. *Photo Credit: Ernst van Duersen*

CSP, says combining the SMC material with the prepreg allowed the company to mold a complex geometry that couldn't be achieved with prepreg alone. "I think this will be an important trend going forward – learning how to combine the strength and performance characteristics you get with continuous fiber format materials with the processability of chopped fiber format materials," says Guha. "Compression molding provides the ideal process for volume production of that type of technology."

Industry professionals cite other trends in the high-performance market:

***Monomer-free resin formulations*** – Customers are seeking chemistries without styrene, says Jim Bono, senior technical manager for Reichhold. That's why the supplier, like many of its competitors, has created a line of monomer-free resins. "You can take the styrene out and replace it with something else, but we took a step back. We wanted to get rid of the monomer altogether," says Bono. "We came up with a thermoset that still meets stringent requirements for high-performance composites, but does not contain any small monomer or VOC-associated material." One highly sought after benefit of monomer-free resins is they give off no or low smell, which make them ideal for indoor applications, says Landis.

***Improved E-glass*** – "New sizing formulations can load higher amounts of fiberglass and get higher performance than ever before," says Landis. The fiber density remains the same and the glass fabric can still be wetted out, he adds. Improved E-glass yields better flexural and tensile properties.

***Better translation from raw material to end use*** – The tensile strength of raw fibers under ideal lab conditions is greater than in end-use applications, after they have been mixed with resins and processed. "The amount of translation of stresses and strains is very important," says Carling. "Our customers are looking to heighten the translation in their end application by having the optimal fiber performance, with surface treatment and sizing chemistry for the specific resin they are using. This is tricky."

***Expansion of thermoplastics*** – Approximately 85 percent of carbon fiber today goes into thermosets, says Carling. Most thermosets are epoxies, vinyl esters, phenolics and polyurethanes. Conversely, thermoplastics have more than 20 resin families with wildly different chemical and mechanical performance benefits. But thermoplastics have been "underappreciated" in composites, says Carling, for good historical reasons: They typically have more elongation and creep or strain to failure. Yet thermoplastics offer the potential for increased manufacturing speed. "If engineers understand all the characteristics, they can design the best part and get the best solution," he says. "There's a whole world to explore in thermoplastics." He cites potential in aerospace applications, pressure vessels and large wind blades.

## Advanced Materials on Display

A high-profile example of another industry trend – combining fibers to achieve desired characteristics – is on display in Amsterdam's Stedelijk Museum of Modern Art, originally built in 1895. An eye-catching new entrance and exhibition space opened last spring. Resembling a bright white bathtub floating above a paved square, the expansion incorporates both aramid and carbon fibers from Teijin Aramid.

Panels made of composite laminates, reinforced with carbon and aramid fibers, offer minimal thermal expansion. *Photo Credit: Ernst van Duersen*

The museum extension was designed by Benthem Crouwel (BCA). The architecture firm envisioned a smooth, seamless building surface, and the only way to create this façade was to construct it from numerous small panels. But there was a hitch: If the panels were made from traditional materials, they would need a little space between the seams to expand and contract as the temperature rises and falls. That would spoil the flawless look. BCA sought materials with minimal thermal expansion. The Dutch engineering firm Solico conducted a feasibility study and determined a composite sandwich construction was the best option.

Holland Composites fabricated 185 panels, with the largest measuring 3.5 x 15 meters. The sandwich construction features polyisocyanurate (PIR) foam between two layers of an FRP laminate. The laminate, in turn, incorporates a layer of unidirectional Tenax® carbon fiber between two layers of unidirectional Twaron® para-aramid fibers. The foam and fabrics are impregnated with a vinyl ester resin during vacuum injection molding.

"The foam on the inside expands, and the aramid and carbon fibers on the outside of the sandwich construction have a negative linear expansion coefficient," says Frederiks of Teijin Aramid. "If you heat the Twaron it doesn't expand, but it strengthens. These two forces make the building neutral."

The panels were mounted onto the museum's underlying steel structure, with a two-inch gap between the outer skins of each panel. Holland Composites glued a strip of aramid-reinforced laminate into this gap, directly onto the exposed PIR foam beneath it, and bonded the laminate skins on either side. This acted as a strengthening bridge between the panels, ensuring the whole façade behaved as one cohesive unit.

Applications such as the Stedelijk Museum of Modern Art expansion only come about when designers, engineers and composites companies work together. And that still happens far too infrequently, according to industry professionals. "There's an education that needs to continue to happen in our global marketplace, where most people have lots of experience with metals," says Carling. "From a composites standpoint, the only industry that is very experienced is aerospace."

The challenge often is trying to beat out a metal that has some of the same properties as composites at a lower price. Landis says the industry has found ways to do this by offering a total lower price gained through parts consolidation, reduced weight and design freedom. But conveying this message to end users takes time. "We need to get through to the 'metal heads,'" says Landis. "The idea is to get the engineering community to understand the nature of our products and the advantages we have. Composites may not have all of the properties that a metal has, but it has others that are better than metal, such as corrosion-resistance for structural applications."

So how do you get through to designers and engineers? Landis says it takes one conversation – one high-performance application – at a time.

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Susan Keen Flynn is managing editor of *Composites Manufacturing* magazine. Email comments to *sflynn@keenconcepts.net*.

# Getting Ahead of Compliance is Good Stewardship

**By John Schweitzer**

Is your air permit up-to-date, and are you in compliance? Did you file your Form-R report for the Environmental Protection Agency's (EPA) Toxics Release Inventory? Do you conduct regular workplace safety audits and maintain the Occupational Safety and Health Administration (OSHA) logs for injuries and illnesses? Are gloves, respirators and other safety equipment being used where needed?

These are important, well-known and accepted components of the compliance programs employed by many composites manufacturers. However, the list has grown, and some recently identified hazards and required practices probably need to be added. Here are a few:

## Combustible dust

Following several fatal workplace accidents related to combustible dust, the U.S. Chemical Safety Board recently called on OSHA to improve the safety of operations that potentially generate combustible dust hazards. OSHA, under what it calls its national emphasis program, is actively inspecting workplaces for combustible dust and issuing citations where uncontrolled hazards are found.

Any material capable of oxidation – including, for example, grinding dust from finishing operations in composites shops – can explode if small particles are distributed in the air and an ignition source is present. When inspecting workplaces, OSHA looks for several measures to reduce the risk of combustible dust incident, including:

- Regular housekeeping programs to minimize accumulation of dust on surfaces, including rafters and other out-of-the way places.
- The use of listed electrical equipment in areas where dust is present, such as grinding booths.
- The location of bag houses, cyclones and other equipment outside of buildings and away from workers.

## Hazard communications

OSHA's Hazard Communication Standard (HCS) requires employers to provide information, training and warning signs describing health risks and protective measures for many of the chemical substances employed in composites manufacturing. In most industries, including composites manufacturing, employers rely on safety data sheets and container labels provided by suppliers and largely do not conduct their own hazards and control assessment.

This approach, however, is not sufficient when a hazardous material is created during the composites manufacturing process. Such is the case with combustible dust. In shops where the grinding, sanding or cutting of molded composite laminate creates dust, OSHA has issued citations for failure to include combustible dust hazards in the employers' HCS program.

Further, employers also are required to use safety data sheets and labels to warn downstream customers and their employees of combustible dust hazards if the customers are known to grind, sand, cut or otherwise work the composite product in a manner that creates dust.

## Styrene

OSHA also has an enforcement emphasis program on workplace exposures to many toxic chemicals, including styrene. Today, agency inspectors are more likely to evaluate whether an employer is providing sufficient protection for employees exposed to these materials.

The OSHA permissible exposure limit (PEL) for styrene is 100 parts per million (ppm) for an 8-hour average exposure time. However, the agency recently posted on its website "annotated" PEL tables, providing the recommended exposure levels issued by other workplace safety authorities. For styrene, the annotated guidance recommends an 8-hour exposure limit as low as 20 ppm.

As strictly a regulatory matter, OSHA only enforces compliance with its official PELs. However, when Congress passed the legislation that created OSHA, it established a responsibility for employers to provide protections from "recognized hazards." This legislative requirement is referred to as the "general duty clause."

OSHA sometimes uses the general duty clause in response to what it considers to be extenuating circumstances. For example, OSHA may cite and fine an employer for styrene concentrations below its 100 ppm PEL in the following cases:

- Ventilation equipment was turned off as a cost-saving measure.
- Problems identified during previous OSHA inspections have not been addressed.
- An employee's physician attributes a health problem to styrene exposure.

Composites manufacturers should consider a more aggressive approach to controlling worker exposure to styrene beyond the common practice of annual worker exposure tests. An enhanced approach might include regular audits to make sure ventilation equipment is working properly and employees are using the needed protective measures.

## Stewardship

While manufacturers are understandably concerned about potential OSHA compliance difficulties, effective compliance is also a matter of good stewardship. Getting a head start on combustible dust and styrene certainly will reduce the chance of an unpleasant encounter with an OSHA inspector. But there is a more important reason for taking additional steps: providing a safe and healthy workplace for your employees.

For help responding to these and a number of other workplace hazards common in the composites industry, ACMA members have access to a wealth of information and resources at *acmanet.org*.

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John Schweitzer is vice president of government affairs for ACMA. Email comments to *jschweitzer@acmanet.org*.

# ACMA is Planning for the Future

Strategic planning is like taking your car to the shop for routine maintenance. You know you should do it, but everything is working fine so there is the temptation to let it slide. That's not happening at your association, where we are currently updating our strategic plan.

In many ways this task is more important to do during good times than when there is a downturn. As the economy and our industry become stronger, it is critical to capitalize on our gains and assure we take a strong course for the future. We don't want to get stuck in a rut of doing the same old things and trying to do them incrementally better. ACMA should be on the forefront of opening new doors for the industry. This is the place where companies can safely explore new opportunities without having to shoulder the entire risk themselves.

> As ACMA updates its strategic plan, we will simultaneously help the government create roadmaps for the industry.

Our last strategic plan launched several new initiatives that benefitted the association and the industry. We will be heading to CAMX in October because it was conceived in ACMA's last strategic plan. The improvements in this magazine and ACMA's newsletters were also driven by our previous strategic plan. Finally, we set a goal to get more federal funding for composites.

As I write this, I am flying back from a conference at Clemson University on automotive composites that is a result of the $140 million Manufacturing Innovation Institute for Composites Materials and Structures FOA that was

launched by the Department of Energy in February. In addition, there are two roadmaps that are being funded by the National Institute of Standards and Technology (NIST) that will spend hundreds of thousands of dollars on identifying obstacles and proposing solutions to foster the growth of the composites industry.

In short, as ACMA updates its strategic plan, we will simultaneously help the government create roadmaps for the industry. ACMA is and will continue to be heavily engaged in these projects and look for opportunities to bring more funding to the industry.

So what exactly will be in ACMA's new strategic plan? It is too early to tell. My hope is that it will have, as author and corporate management expert Jim Collins would say, "a big hairy audacious goal." That goal should be centered around educating architects, engineers and other design professionals about composites to break down the barriers that we face in replacing traditional materials. More to come!

Tom Dobbins, CAE
ACMA President

## ACMA Award Nominations Now Open

Every year ACMA recognizes its leaders through these prestigious awards:

- Outstanding Volunteer Award
- The Lifetime Achievement Award
- Composites Hall of Fame Award

Please consider nominating someone that you have either worked with directly or whose work sets the standard for recognition in the composites industry.
Find more information at *acmanet.org/other-areas/award-programs.*

## Have You Registered for CAMX Yet?

CAMX offers a variety of registration categories to fit every budget and schedule – including discounts for ACMA and SAMPE members. CAMX expects 8,500 attendees from every market across the composites and advanced materials communities. Browse the CAMX registration categories and rates, and make your plans now to join us in Orlando, Oct. 13-16.

CAMX Featured Sessions focus on composites innovation, market growth and hot topics associated with advanced materials. With presentations by thought leaders and industry experts, these sessions deliver cutting-edge information you'll use to improve your products and processes, expand your business and plan for the future. Learn more at *thecamx.org*.



## Update Your ACMA User Profile!

The ACMA Members-Only Portal Page is now open to all member company staff, enabling you to easily access member benefits and maintain your personal information. Please ensure the information we have in our database is correct by visiting *https://myacma.acmanet.org/*.

## Advertise with Us!

ACMA provides a number of great advertising opportunities on our website, our e-newsletters and in *Composites Manufacturing*. Your advertisement will reach thousands of qualified readers. Contact Nick Manis at *nmanis@naylor.com* to learn more about these opportunities.

## ACMA Calendar of Events

For more information regarding ACMA's upcoming events and education, visit *acmanet.org/meetings*.

**September 2014**
CCT-Instructor Course
*Dayton, Ohio*

**October 7-9**
COMPOSITES EUROPE 2014
*Messe Düsseldorf, Germany*

**October 13-16**
CAMX – The Composites and Advanced Materials Expo
*Orlando, Fla.*

**November 2014**
CCT-Instructor Course
*ACMA Headquarters – Arlington, Va.*

**December 9-11, 2014**
CompositesWorld Carbon Fiber 2014
*La Jolla, Calif.*

## Advertisers Index



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## New Members

Advanced Fiberglass Services, Inc.
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Glenmar Manufacturing
*West Grove, Pa.*

Black Hills Fiberglass Tank Company
*Belle Fourche, S.D.*

Pacific Coast Composites
*Lakewood, Wash.*

Everett Community College - Center of Excellence for Aerospace & Advanced Manufacturing
*Everett, Wash.*

Guardian Bridge Rapid Construction, Inc.
*Stratford, Ontario, Canada*

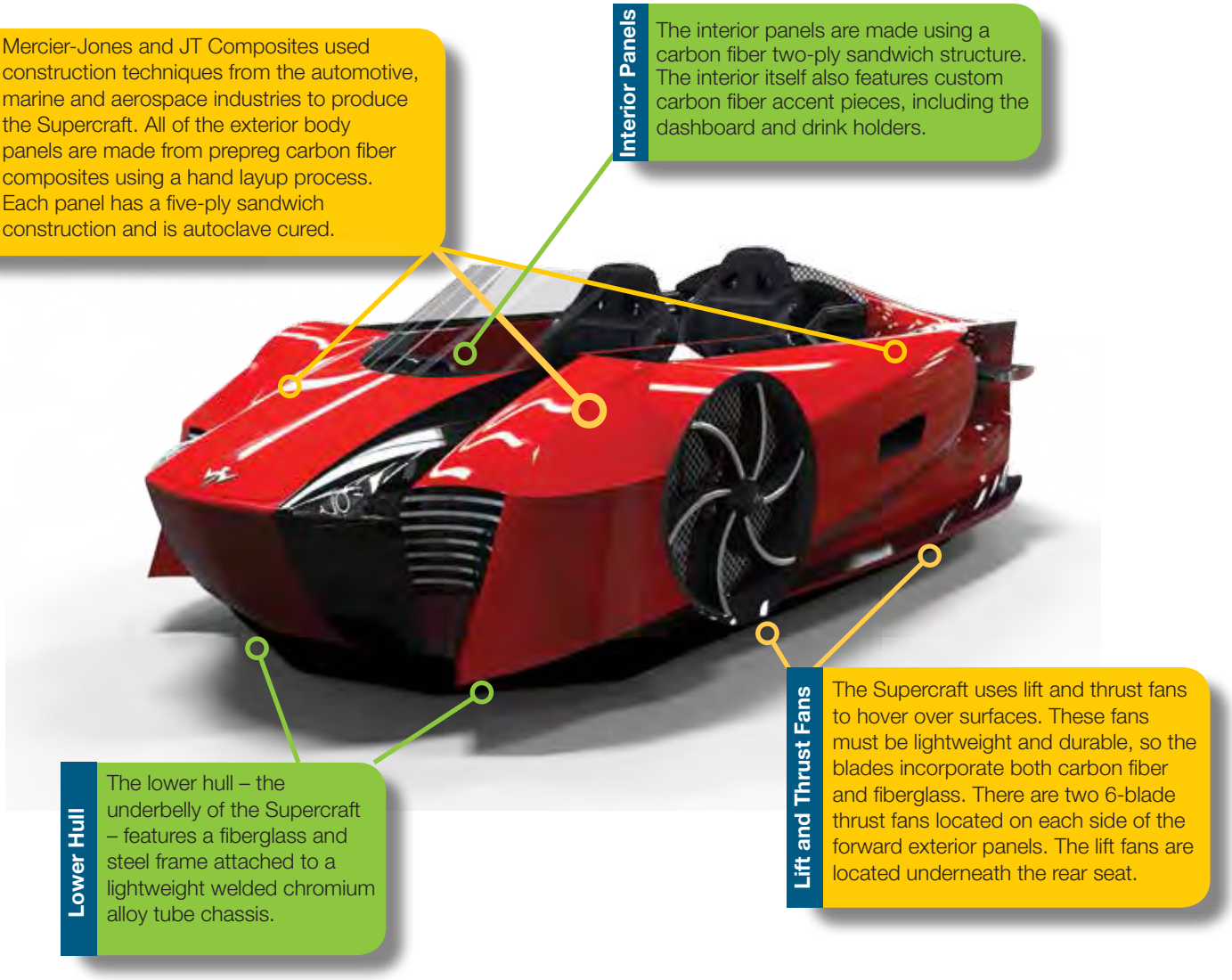
Astro Haven Enterprises
*San Clemente, Calif.*

University of Delaware - Center for Composites Material
*Newark, Del.*

Wetzel Engineering, Inc.
*Austin, Texas*

For more information on becoming a member of ACMA, email *membership@acmanet.org* or call 703-682-1665.

# Composites Hover in Style




Founded in 2013, Mercier-Jones manufactures hovercrafts that travel over land or water on a cushion of air provided by a downward blast from a fan. The company's Supercraft™ luxury high-performance hovercraft is made from carbon fiber composite materials engineered through a partnership with IndyCar fabricator JT Composites of Indianapolis. The Supercraft features a patent-pending technology in its propulsion system and a hybrid powertrain, making it one of the most advanced hovercraft in the world, according to Mercier-Jones.

The two-passenger Supercraft – which is currently in development and scheduled for production in October – features a futuristic sports car look and will be sold for $75,000. It has a carbon fiber and metal alloy construction. The powertrain system includes a single gasoline engine that generates electricity for two independent electric motors. These motors allow for controlled thrust, while the gas engine optimizes fuel efficiency. The battery pack holds reserve power that can be applied to the motors for quick performance boosts.

With a "dry weight" of 700 pounds – no passengers, consumables or fluids – the Supercraft is expected to reach a top speed of 80 mph, beating the current hovercraft land-speed record of 56.25 mph. Mercier-Jones also hopes to beat the water-speed record of 86.5 mph.

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