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For over 20 years, FRP composite products used in new bridge construction and rehabilitation have provided bridge engineers and owners with innovative and cost effective solutions. As FRP technology evolves, it better preserves historic landmarks, extends service life and benefits new construction. By John Busel

The composites industry is going through exciting changes and there’s only one place where this innovation comes together, and that’s COMPOSITES 2012: THE Premier Exhibition and Convention. Get the inside scoop on what you can expect to see at this year’s show.

Composite technology continues to hurdle stringent military codes and standards in new applications, and it does it almost flawlessly while competing against incumbent traditional materials like steel and aluminum. By Angie McPherson

Nearly 7,000 bills are introduced into Congress each year. Among these thousands of bills, many will have a direct impact on one or more segments of the composites industry. Will they affect yours? By Melinda Skea

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The American Composites Manufacturers Association’s Automotive Composites Alliance (ACA) met for the first time in two years at the Society of Plastic Engineers Composites Conference & Exhibition in Detroit, Mich., to gauge automotive industry needs for an advocate group to educate end users about composite materials.

Composites Manufacturing magazine highlights industry breaking news and delivers it daily straight to you.

Read what leaders of Trek Bicycle, RheTech, Sybo Composites, Ticona Engineering Polymers and more view as the strengths, weaknesses, areas of growth potential and factors affecting the composites industry.
A Sure Bet on Our Industry

Look forward to attending ACMA’s COMPOSITES conference each year. This year, COMPOSITES 2012 will be held in wonderful Las Vegas, February 21-23. This show promises to be the best yet with participation from composite companies all over the world, allowing you to keep up with the latest and greatest of the composites world. The show committee, led by Marcy Offner, marketing manager of Composites One, has been working hard, putting together a show you won’t forget. I look forward to the chance the conference gives me to stay abreast on new processes and materials. The educational track always has something new to learn and is an excellent way to keep up-to-date with what is going on in the industry. And of course the networking is invaluable! You can also learn what is happening on the legislative and regulatory front to prepare you for when regulators come knocking at the door. We all know that pleading ignorance is not an excuse.

At the end of September, I had the opportunity to participate in COMPOSITES EUROPE, held in Stuttgart, Germany, and I can’t tell you what a wonderful and insightful experience it was. I learned more about the similarities and differences within our markets. I learned from talking with many of the participants about their issues, and where and how their markets are expanding. Many of the participants also stated they plan to attend our show to learn more about the U.S. market. I hope that if you have the chance to meet any of our European colleagues you will make them feel welcome and spend time learning about their products, processes and materials.

Of the many things I learned, most striking to me was the amount of carbon fiber they use and how they lean towards closed molding as their main manufacturing process. Much of this is market driven by the increased rates of their petroleum. This gave me an insight into our future here in the U.S., as our petroleum rates continue to increase and our regulatory rules become stiffer and stiffer. There is a lot to learn from our European friends and I hope you get an opportunity at COMPOSITES 2012 to discuss these issues with them and how they’ve overcome their barriers. This also tells me we have a lot of opportunity in the U.S., despite the rising cost of petroleum rates. We can respond positively to this and the need for lighter weight materials—all answers (and more) that this year’s COMPOSITES conference can give you.

You can’t afford to miss out on this once a year event. You can BET it will be an experience you won’t regret. I hope to see you in Vegas!

Lori Luchak
Miles Fiberglass & Composites, ACMA President
lluchak@milesfiberglass.com
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Frankfurt Features Composite Innovation

The 2011 Frankfurt Auto Show in Germany, September 15-25, showcased a number of innovative designs using composite solutions. Carbon fiber has long been used in racing panels and luxury car structures seen at the Frankfurt Auto Show, but this year composites were found in a vast array of developing concepts and production commuter cars for interesting applications. Here are five new designs that highlight the use of composites materials in unique concept cars.

Composites in Hydrogen Fueled Design

Mercedes Benz F125! Concept

Mercedes Benz celebrated its 125 anniversary with the debut of the F125!, a hydrogen-hybrid concept car. The F125! uses a hybrid chassis made of FRP composites and a metal alloy to lightweight the design as well as an integrated carbon fiber hydrogen tank to contain the hydrogen fuel cell. The composite design is the first fuel tank to be integrated into floor assembly and acts as a structural element of the car. The concept car runs similar to a Chevrolet Volt that uses a lithium-sulphur battery pack interchangeably with hydrogen fuel but operates without expelling emissions. Mercedes predicts that the technology used in the F125! may be used to replace Mercedes luxury CL Class in 2025 and some of the sleek exterior components will be replicated in the 2013 S Class.

Eterniti Motors, a new British luxury car company based in London, drew attention from automotive enthusiasts with its first car monikered the Hemera, named after the Greek goddess of daytime. Eterniti claims the car is the first Super SUV capable of reaching top-speeds around 180 mph with a 620 horsepower engine based on an upgraded Porsche twin-turbo 4.8 liter used in the Cayenne Turbo (the Porsche engine only runs 500 horsepower). It uses carbon-composite body panels to lighten the design and to provide stability in the chassis. The design is headed by Hemera’s Lead Engineer Alastair MacQueen, Formula One engineer and designer of the Jaguar, and influenced by Le Mans racing driver Johnny Herber. The company has not revealed the price of the Hemera but the baseline price tag is estimated at $237,000.
Come see us at COMPOSITES 2012, Booth #329
Eco-Friendly Rivalry
BMW i3 and Audi A2

These two cars are in competition for the most energy and cost saving methods to change the face of the electric automotive world. The BMW i3 concept, announced earlier this summer, made its debut at the Frankfurt Auto Show. The i3 uses carbon fiber to provide lightweight material in the passenger compartment framework as well as the roof panel. It is expected to be a production car in late 2013, utilizing a new hydro power plant in Moses Lake, Wash., to produce the carbon fiber in a joint venture with SGL Carbon. The Audi A2 electric rival also debuted at the auto show and criticized BMW for using carbon fiber, which is costly and emits carbon dioxide during manufacturing.

The A2 will not be produced until 2015 and the company is currently investigating alternate fiber material, possibly basalt, to mix with aluminum for light weight and cost-efficient parts. However, Audi is still using carbon fiber in sections of the A2, including the transmission tunnel and rear bulkhead.

Smart Composite Design

A new electric concept design by Smart, in collaboration with German-based chemical company BASF, reveals its future use of passive engineering strategies and carbon fiber composites to increase fuel efficiency in its designs by 20 percent. The Forvision uses reflective paint and windows in addition to increased foam to reduce heat transmission in and out of the car, significantly reducing the energy used to maintain a comfortable temperature in the Smart concept. Smart uses FRP wheel rims, carbon fiber composite doors and body cage to lightweight the already light Smart car. Smart envisions that the new composite elements will make the Smart Forvision even safer when combined with the steel cage, which is rated four stars for front impact and five stars for side impact by U.S. National Highway Traffic Safety Administration.

Angie McPherson is the communications coordinator at ACMA. Email comments to amcpherson@acmanet.org.

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GFRP Rehabilitation in Garage Structures

The Canadian government predicts that it will spend $74 billion to repair and maintain concrete bridges and other concrete structures across the country. Recent advances in glass fiber reinforced polymer (GFRP) research for rehabilitating parking garages and bridges are persuading the Canadian government to take a second look at the material to help expand the life of concrete structures. Reinforcing the concrete with GFRP bars would extend the life of the structure to 100 years or more compared to steel-reinforced concrete, which needs major restoration after 25 years.

In the past five years, several parking garages have collapsed across Canada, spurring the government and municipalities to investigate new ways of reinforcing parking structures to protect against corrosion. “We have thousands, perhaps even millions of bridges and concrete structures suffering from corrosion problems in Canada,” says Dr. Brahim Benmokrane, a professor of civil engineering at the University of Sherbrooke in Quebec, Canada. “We’re convinced that using innovative FRP reinforcements will save billions of dollars per year.”

Dr. Benmokrane has been involved in investigating innovative technology and techniques for parking structures with extended service life since November 2008 when the second floor of an underground parking garage in Montreal collapsed, killing one resident. Since then, Dr. Benmokrane has been investigating full-scale two-way flat concrete slabs reinforced with different types and ratios of GFRP bars. The test results of this project provide a clear overview of the structural behavior of such structural elements and were used to calibrate the new punching shear equation that is being incorporated in the Canadian code for the design and construction of concrete structures reinforced with FRP bars.

Currently, many of the parking garages in Canada are constructed with steel reinforcing bars and concrete. The problem with using concrete and steel is that road salt trekked in by the cars is corrosive and causes the concrete slabs to crack. Once the concrete cracks and the steel reinforcement is exposed to the salt, the steel immediately begins to corrode making the parking garage increasingly unstable.

“We wanted to replace steel bars, which we felt are not a durable material and thus cause problems. In order to do that, we would have to show to engineers and end-users that FRP is a durable material,” says Dr. Benmokrane. In order to achieve that goal, Dr. Benmokrane organized the first Conference on Durability of Fiber Reinforced Polymer Composites for Construction and Rehabilitation (CDCC) in 1998 to push for the advancement of FRP in civil structures. Since then, leaders in the field of FRP civil structure, including the American Composites Manufacturers Association’s (ACMA) Director of the Composites Growth Initiative (CGI) John Busel, have written codes and standards to increase the confidence of end-users to construct using composite materials. So far, there have been four successful meetings of the CDCC; the current focus of those meetings includes composite sustainability as well as durability.

According to Dr. Benmokrane, material advances and improved manufacturing processes have helped push GFRP rebar usage in civil engineering applications. The work the industry has recently completed to write codes and standards for FRP reinforcements has helped to certify and specify the material. In combination with the research and development for FRP materials, composites have grown significantly in the Canadian infrastructure market.

“Canada definitely uses FRP reinforcements in as many concrete structures as the U.S. does, if not more. In Canada, we have to build or rehabilitate hundreds of concrete bridges per year. I know the number of projects will soon multiply to around four times the current amount thanks to the use of GFRP in parking garages,” says Dr. Benmokrane. He strongly believes that for both the Canadian and the U.S. composite infrastructure
markets to succeed, the industry must continue to keep products on the leading edge.

This September, Dr. Benmokrane aided in the rehabilitation of a 3,000 square meter multi-story parking structure using two-way flat concrete slabs reinforced with pultruded GFRP bars. He contacted the Quebec City engineering department and offered his expertise in GFRP reinforcement to rehabilitate the failing parking structure in the city. The project was funded by the municipality of Quebec City and was completed in five months with no major problems. It is the first worldwide application of GFRP reinforcing bars with a structure of this magnitude. The GFRP reinforcement used in this project, called V-ROD, is manufactured by Pultrall Inc., based in Thetford Mines, Quebec, Canada. Pultrall developed the V-ROD in collaboration with the Natural Science & Engineering Research Council (NSERC) Chair through research conducted by Dr. Benmokrane. The parking garage project is part of Dr. Benmokrane’s research to investigate the flexural and shear capacity of GFRP reinforced concrete flat slabs compared to steel and will announce the results of his findings at the 2012 COMPOSITES Show in Las Vegas. He is also in the process of updating the CSA S806, which is a Canadian standard for the design and construction of buildings reinforced with FRP, to include the use of FRP bars in parking garages. The design code should be completed by the end of the year.

“The future looks very, very good from my point of view,” says Dr. Benmokrane. “Recent advances in the fiber-reinforced polymer (FRP) technology led to the development of new generations of the FRP bars with enhanced mechanical and durability characteristics. There is a promising future for this technology in the rehabilitation of deteriorated structures and in new structures as well. It will increase service life and minimize or eliminate the maintenance costs to benefit engineers and society as a whole.”

Angie McPherson is the communications coordinator at ACMA. Email comments to amcpherson@acmanet.org.
Each year the National Marine Manufacturers Association (NMMA) publishes the *Recreational Boating Statistical Abstract*. This report condenses statistics from a series of boating industry surveys and sales figures. These numbers outline the state of the marine industry and can be used by boat manufacturers, suppliers, and distributors to understand market trends. Below are some of the most significant statistics from the report published earlier this year.

### Big Numbers for Boating Industry

- **17,000,000**
  The estimated number of boats in the United States.

- **83%**
  Of boat sales in 2010 were pre-owned boats compared to an estimated 17 percent that were purchased new.

- **99**
  Percent of boaters went boating between January and July 2008, and continued despite rising fuel prices.

- **20%**
  Of all U.S. boaters live in the Great Lakes region. This translates into nearly 17 million boaters residing in Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania and Wisconsin alone, making the Great Lakes region the top region for recreational boating in the U.S.

- **188,230**
  The number of new power and sail boat unit totals.

- **75,000,000**
  The number of U.S. residents that participated in recreational boating in 2010, which is roughly 32.4 percent of the population.

- **$30,400,000,000.00**
  The overall recreational boating retail expenditures for boats, engines, trailers, accessories and services totaled in 2010.

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Trending Turbine Technology

The use of wind turbines continues to change the landscape of energy development around the world. They are dotted along the plains of Texas, along the shores of Europe and hoisted on city and suburbia businesses alike. But as turbines become increasingly technologically advanced, what trends are emerging in their manufacturing and how do composites fit in to this upward drive for lighter, larger and more efficient turbines?

Focused primarily on utility grade, horizontal axis wind turbines, Totaro & Associates of Santa Barbara, Calif., a consulting firm that works with renewable energy companies to develop new products and technologies, collected wind turbine patent filing data and broke these filings down into current or future relevancy. Analysis of the data gives a glimpse into current trends and in what direction those developments are leading turbine evolution. The group’s results concluded that there are six areas of emerging technology. Among them are turbine reliability, weight reduction, transportation, fleet management, performance optimization and creating a “grid friendly” system.

Turbine Reliability

According to Philip Totaro, principal at Totaro & Associates, the blades, generators and electrical systems of a wind turbine have historically been the largest areas of focus because ultimately the efficient conversion of mechanical energy into electrical is the overall intent. “It must be noted that these three areas have been most problematic for manufacturers when it comes to component reliability, so they have garnered a great deal of attention in terms of innovation to improve quality and performance,” he says.

Similar to the automobile industry, the goal of wind turbine manufacturers is to lessen the component loads and decrease part count. “Right now there is a perceived reliability issue with three-stage gearboxes. They require regular maintenance and have been prone to reliability problems. Some in the industry suggest that we replace these gearboxes, which functions to up the RPMs (revolutions per minute) of the wind turbine rotor, with a generator that is directly connected to the blades. While that sounds great because you’re removing a component with a reliability problem and reducing the number of components that could potentially fail, there are other issues created such as stray current mitigation torque regulation and the risk associated with a new overall design paradigm of a direct drive generator,” says Totaro. “Permanent magnet generators are a popular option for direct drive, but acquiring the rare earth metals required to make them is becoming more costly. No one has figured out the end result yet. There are a lot of people that believe gearbox elimination is best, others say that with the 30 years of data the industry has collected on three stage gearboxes, the industry can fix the problems.”

How can composites help?

Most wind turbine blades are made with a hand lay-up process, which can lead to manufacturing defects and lack of consistency. As the wind energy industry moves towards more composite material use in wind blades, manufacturing processes that have been pervasive in the aerospace and defense industries for the manufacturing of wings, fuselages and helicopter rotor blades, need to be more heavily utilized. Specifically, automation in manufacturing around fiber placement and the manufacturing and use of pre-pregs or pultruded rods for structural members in the blades are the largest areas of innovation being talked about right now in the wind sector, says Totaro.

Component Weight Reduction & Transportation

“With turbines getting bigger in physical size, we can see that load mitigation and construction are emerging focuses,” says Totaro. Component weight reduction encompasses optimization of the
total mass to maintain a tower head mass ratio (mass per energy output of the turbine) as well as cost out programs to minimize capital cost of the turbine. Transportation cost reduction associated with getting components to a wind farm site from a factory and installation also require attention. To address these problems, manufacturers are investigating advanced materials such as composites over metals. “A large reason for the shift to eliminate the gear box is because with the heavy mass on top of the tower, it has the potential to introduce cost inefficiency. In other words, an OEM is overpaying on a cost that affects product competitiveness. Thus, a large portion of R&D is going into reduction of the mass and cost of components that are at the top of the tower,” explains Totaro. “In regards to transportation, shipping turbines in modular sections and assembling on-site at a wind farm will be an important area of investigating for land-based turbine manufacturers. Component size has increased to such an extent that transportation of whole blades, towers, and nacelles under bridges and through tunnels is reaching its limit.”

How can composites help?

Materials science R&D will be the most dominant force in influencing the renewables industries over the next 20 years, according to Totaro’s firm. “In any industry, material science ends up being the largest influence in creating change in technology. Some manufacturers would choose to make the blades, the nacelle and even the tower (currently made of tubular steel) of a wind turbine out of composites if it would be cost effective,” he says. Blades are still made from fiberglass and balsa wood due to the input cost comparison with composites, but as components get larger and heavier, improved stiffness or reliability is needed and currently that can only be enabled by composites or hybrids.”

Fleet Management

Monitoring systems within a turbine are essential. From vibration sensors, embedded fiber optics and blade surface mounted sensors, people have tried any way to glean useful information out of component performance and damage accumulation. If OEMs can use this data to control performance in order to prolong a turbine’s life and limit unscheduled maintenance, costs will go down and profit will increase.

How can composites help?

The more composite manufacturers can understand how their product works in a given wind turbine operating element, the more informed decisions can be made by turbine operators.
“By better understanding damage accumulation of turbine components, we can control the turbines life,” says Totaro. For example, instead of letting it run at 100 percent of available capacity, if we run it at 95 percent, will it prolong the life? If so, by how much? Not only that, but how often is maintenance required? Can we cut it down to every three, six or twelve months?

**Performance Optimization**

The struggle of a design engineer is how to optimize energy production regardless of prevailing conditions or locale. How can the optimum amount of energy be achieved 100 percent of the time? “Optimum does not necessarily mean maximum,” says Totaro. “But understanding optimization is important. If a manufacturer sells a product as a 2.5 megawatt (MW) turbine with a design life of 20 years but its components only last 10, then changes of some sort need to be made. Should the product be derated, meaning a 2.5 MW turbine should be run at 2.3? Or are there ways to uprate a turbine, meaning with an increased ability to control a turbine it can output 2.6 MW instead 2.5 MW and therefore be more profitable. GE, for example, has already permanently uprated its 1.5MW turbine to 1.6 MW with the data it has collected.”

**How can composites help?**

Despite a lagging economy affecting the wind energy industry, it continues to innovate. The single largest driver is the desire to displace conventional forms of energy production and at least a 2 cents / kwhr reduction in the production cost of energy is required in order to make that a reality. Major OEMs are focusing on cost-out on their existing platforms as well future technology development with early stage R&D. “We’re at a point where significant R&D investment in furthering technology is resulting in minuscule improvement, says Totaro. “We need something more radical and no one has that figured out yet. We need to talk about implementing carbon nanotube based technologies and composite materials in areas that will have a huge impact.”
**Grid Friendly, Government Approved**

A looming challenge of the wind energy industry is how to increase operational utilization. Requirements by the Federal Energy Regulatory Commission (FERC) and other agencies state that turbines must operate in a manner that will not disturb the grid. Owners and operators of wind farms would like them to operate much like a conventional energy plant where output can be throttled and grid fluctuations can be absorbed—in other words, grid stability. This means variable speed control with the use of synchronous generators, a low voltage ride through (LVRT) capability, and effective energy storage.

**How can composites help?**

Despite current systems, OEMs want to see a 3-4 percent increase in efficiency. On the other end, utility operators that own both gas and turbine plants want them to behave the same. Composite technologies that can increase energy efficiency will be necessary in the coming years.

Melinda Skea is the senior manager of communications at ACMA. Email comments to mskea@acmanet.org.
In the United States, approximately 25 percent of the nearly 600,000 bridges are considered to be structurally deficient or functionally obsolete, as reported by the U.S. Department of Transportation (DOT). According to the American Society of Civil Engineers’ (ASCE) 2009 Report Card for America’s Infrastructure, bridges were given a grade of C with no improvement since the last report in 2005. A $17 billion annual investment is needed to substantially improve current bridge conditions. Currently, only $10.5 billion is spent annually on the construction and maintenance of bridges.

For over 20 years, FRP composite products used in new bridge construction and rehabilitation has provided bridge engineers and owners with innovative and cost-effective solutions. In several instances, composites preserve historic landmarks while ensuring a structure’s structural integrity. In new construction, features such as lightweight, corrosion resistance, and prefabrication have contributed to the goals of accelerated bridge construction by reducing assembly and installation time resulting in lower costs for deploying FRP composites technology. In rehabilitation, features such as speed and minimal disruption to the structure while in service have provided bridge owners with solutions for extending the service life of bridge structures. The technology continues to evolve with better products and solutions for many new applications.

Bridge Decks

The Broadway Bridge in Portland, Ore., has been carrying cars, trucks, buses, bicyclists and pedestrians across the Willamette River for over ninety years. Opened on April 22, 1913, it is one of only three Rall-type bascule bridges still operating in the U.S., and according to Multnomah County, the bridge owner, it is by far the largest. This historic bridge has average daily traffic of 33,000 vehicles per day. Not surprisingly, in February 2003, as the bridge approached its 90th Anniversary, the Multnomah County Bridge Section, which manages and maintains the Broadway and five other Willamette River bridges in Portland, embarked on a major renovation project aimed at upgrading the structure to assure its continued service well into the 21st century.

While the Rall-type opening mechanism is unusual, it poses the same requirements for its double-leaf movable span as most other bascule bridges. The deck must be light enough to allow opening of the bridge using reasonably sized
counterweights, lift motors and gear sets, while providing the strength required supporting modern vehicle loads. At that time, the Multnomah County planners wanted to replace the steel grating with a new decking that offered light weight, a solid surface with good traction in wet, snowy or icy conditions and quiet ride, and low maintenance requirements. The contractor installed the full 11,790 square feet of decking (32 FRP composite panels measuring approximately 46 feet x 8 feet each.)

More recently, the city decided to install rails for street cars on the bridge as part of the Portland Streetcar Loop Project. This modification of the bridge required removal of part of the FRP deck that had been installed in 2004. The Broadway Bridge is one of the few bridges in the country that has two different types of FRP decks installed on it. In August 2010, ZellComp Inc., Durham, N.C., installed the 2-piece, mechanically fastened ZellComp FRP bridge deck on the bridge.

The 5-inch, FRP deck was selected as the replacement deck, primarily due to the system’s performance record and its ability to be adjusted onsite. This project was unusual, because the FRP composite deck had to be installed between the new rail lines (photo page 16), and the deck design offered the flexibility that was needed. The modular design and ease of fabrication allowed the contractor to install the deck in a short amount of time to allow the bridge to be opened allowing marine traffic to pass over this important waterway. Over 3,400 square feet of the ZellComp deck was installed on the Broadway Bridge. The installation contractor was Hamilton Construction, serving as a subcontractor to Stacy and Witbeck. The engineering firm of record for the deck replacement portion of the project was Hardesty & Hanover and for the bridge project was David Evans and Associates, Inc.

“Our number one concern in installing this bridge deck was the safety of drivers, pedestrians, cyclists and streetcar passengers on the Broadway Bridge,” said Dan Richards, president & CEO of ZellComp. In July 2011, another FRP deck was installed on the Morrison Bridge, also in Portland. At over 17,000 square feet, the FRP deck on the Morrison Bridge will be the largest FRP deck ever installed in the United States and one of the largest in the world.

Reinforcement in Concrete

Glass fiber reinforced polymer (GFRP) composite rebar are used to address corrosion issues typically found with steel rebars. FRP composite rebars have been used cast-in-place, non-prestressed reinforcement in concrete members. FRP composite rebar, manufactured using pultrusion, is completely resistant to chloride ion attack, offer a tensile strength of 1½ - 2 times that of steel, weigh only 25 percent of the weight of equivalent size steel rebar, electrically non-conductive, are electromagnetic neutral, and thermal insulator. Hundreds of bridges in the U.S. and Canada have successfully used FRP rebars in bridge deck applications.

The use of fiber-reinforced polymer (FRP) composite rebar in concrete bridge decks has increased in recent years due to the publication of the American Concrete Institute (ACI) design guideline documents ACI 440.1R-06, material and construction standards ACI 440.5 and ACI 440.6, and the AASHTO LRFD Bridge Design Guide Specifications for GFRP-Reinforced Concrete Bridge Decks and Traffic Railings. GFRP bars have been installed in a wide variety of applications such as decks, parapets, sidewalks, abutments and traffic barriers for bridges, sea walls, tunnel soft-eyes, light and heavy rail train beds, and in building applications for MRI rooms in hospitals.

In 2011, Oregon DOT replaced a deteriorating and structurally deficient timber bridge that carries the Oregon Coast Highway (US101) over Millport Slough, Lincoln City, Ore. The existing bridge was an eight-span, timber bridge with a concrete deck and supported by timber piles. Due to badly deteriorated piles, the bridge needed to be replaced with materials best suited for coastal exposure. The new bridge is a four-span, 390-foot long and 75-foot wide precast, prestressed girder bridge. GFRP rebar was used for the top and bottom transverse deck reinforcement and the bottom longitudinal reinforcement. The FRP rebars used were manufactured by Pultrall, Inc. Thetford Mines, Quebec, Canada. The light weight nature of the FRP bars reduces labor and provides a beautiful installation as shown above. The new structure is expected to provide a long service life in this difficult marine environment.

Bridge Girders

Developed at the University of Maine, Advanced Structures and Composites Center (AEWC), Orono, Maine and manufactured by Advanced Infrastructure Technologies, Inc., Orono, Maine,
the Bridge-in-a-Backpack innovative bridge system that utilizes a carbon fiber outer shell that is manufactured using a composites process called vacuum infusion to form a hollow composites shell in the form of an arch, which is then filled with self-consolidating concrete onsite that forms the foundation of a bridge solution that traverses waterways. This hybrid technology marries the strength characteristics of carbon FRP (CFRP) composites with the durability and compressive strength of concrete. The total system comprises of the FRP composite arches, durable composites decking, and fill that is compacted on top of the decking. This technology competes with concrete, steel, and wood construction.

The Bridge-in-a-Backpack technology exemplifies the benefits of FRP composites with its high strength-to-weight that translates to lower installation equipment and transportation costs compared to precast technology, and eliminates the time and cost of formwork. The inherent corrosion resistant properties of FRP composites, along with a smaller carbon footprint compared to traditional materials, provide bridge engineers with a sustainable solution. The system can be deployed in single spans from 25-70 feet, and multiple spans designs exceeding 800 feet.

In June 2011, the Bridge-in-a-Backpack system was installed on the Ashby West Road Bridge over the Scott Reservoir Outlet in Fitchburg, Mass. The 12-inch diameter CFRP composite tubes, weighing about 200 pounds were hand carried to the bridge making for a unique installation compared to traditional materials. The 38-foot span, footing to footing and 36-feet wide used 15 tubes for this bridge installation. The bridge technology exemplifies the benefits of FRP composites with its high strength-to-weight that translates to lower installation equipment and transportation costs compared to precast technology, and eliminates the time and cost of formwork.

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In June 2011, the Bridge-in-a-Backpack system was installed on the Ashby West Road Bridge over the Scott Reservoir Outlet in Fitchburg, Mass. The 12-inch diameter CFRP composite tubes, weighing about 200 pounds were hand carried to the bridge making for a unique installation compared to traditional materials. The 38-foot span, footing to footing and 36-feet wide used 15 tubes for this bridge installation. The bridge comprises of the FRP composite arches, durable composites decking, and fill that is compacted on top of the decking. This technology competes with concrete, steel, and wood construction.
system eliminates the need to use heavy equipment which translates to faster installation time. The contractor planned to install and complete the bridge installation in 70 days. This installation joins eight other bridges built in Maine, with many more to be installed in the near future.

In recent years, another new innovation in bridge girder designs has attracted the attention of many bridge owners and engineers. Originally designed to be a girder for Class 1 Railroad Bridge for BNSF Railway Company, the hybrid composite beam (HCB) developed by HC Bridge Company, LLC, has significantly contributed to the ideals of accelerated bridge construction. The HCB is an award winning structural member that utilizes concrete, steel, and FRP composites that exploits the best of all materials where the strength and stiffness of concrete and steel are combined with the light weight and corrosion resistant advantages of FRP composites. This innovative technology is best demonstrated on the recently completed Knickerbocker Bridge in Boothbay, Maine (to read more on this story, visit compositesmanufacturingblog.com keyword “Knickerbocker Bridge” or pick-up a copy of Composites Manufacturing September 2011 issue.)

These composites technologies are further demonstrated by the use of composites to externally strengthen, seismically upgrade, and rehabilitate over 10,000 installations in bridges, buildings, and other structures to extend the service life and upgrade the many deteriorated structures.

FRP composite is a materials technology that supports accelerated bridge construction and provides bridge owners and engineers with cost efficient, long-term durability solutions to our aging infrastructure. In the FHWA “Every Day Counts” program, composites inspire innovation with different designs using similar materials; composites encourage ingenuity because it allows you to think outside the box; composites facilitates invention by making existing techniques, systems, methods better; composites propels imagination into new frontiers to make an engineers or contractors vision a reality. FRP composites meets the desired goals of using green construction materials providing a sustainable solution and ensuring that bridges we build and rehabilitate today will last for future generations.

John Busel is director, Composites Growth Initiative for the American Composites Manufacturers Association. Email comments to jbusel@acmanet.org.

This article is an expert of the original, printed in the September 2011 issue of Rebuilding America’s Infrastructure magazine.
The composites industry is going through exciting changes. It continues to triumph through economic and regulatory hardship while pushing forward into new areas. From adoption in aviation, innovation in automotive and increased utilization throughout industry segments such as renewable energy and infrastructure, it never ceases to innovate, develop new technologies, products and processes.

There’s only one place where this innovation comes together all at once, and that’s COMPOSITES 2012: THE Premier Exhibition and Convention. By showcasing what’s new – material advancements, upgraded operational efficiencies, green product trends and processes, emerging market applications – COMPOSITES provides tools to expand your business and secure its future.

The following pages outline the exhibits, education opportunities and networking events in Las Vegas, but here are some of the highlights below. To find more information or register for the event, visit us online at acmashow.org.

Keynote Speaker
NASCAR driver Rusty Wallace will provide the opening keynote address. Considered one of the 50 greatest drivers of all time, he is now an ESPN / ABC sports commentator. He’ll discuss the
importance of teamwork in triumph. He will also discuss the use of composites in the automotive racing world.

**Expanded Exhibit Hall**
COMPOSITES 2011 exhibitors increased in number by 18 percent, so expect more of the same this year. Exhibiting companies provide services to all aspects of the composites industry, from basic to cutting materials and processes.

**Innovation Stage**
Each year COMPOSITES has a site on the exhibit hall floor dedicated to education sessions and panel discussions. All attendees and exhibitors are welcome to hear presentations on a wide range of topics. This year, the Innovation Stage will be located in the ACE Pavilion, allowing ACE entrants to discuss their products and highlight the variety of composite innovations.

**ACE Awards**
Products entered into the Award for Composites Excellence (ACE) competition will be displayed in the exhibit hall at COMPOSITES 2012, including entrants in categories such as Design, Manufacturing, and Market Growth. New this year, entries will be available online before the conference begins. The deadline for ACE submissions is December 30. Visit acmashow.org.

**B.E.S.T. Award**
For the second year, Composites Manufacturing magazine is sponsoring the B.E.S.T Awards. This award honors the Brightest, Enthusiastic, Skilled and Trailblazing composites industry leaders. If you know someone who currently is or is destined to be a leader in the composites industry, nominate them for the B.E.S.T. recognition program. Nominations can be submitted at the Composites Manufacturing booth within ACMA booth # 665. Or online beginning February 2012.
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COMPOSITES 2012 is about Innovation. Opportunity. Education. For more than two decades, the industry’s premier exhibition and convention continues to bring together key decision makers.

Everything is covered: from basic materials and processes to cutting edge, high-tech products and equipment. COMPOSITES spotlights what’s new – material advancements, upgraded operational efficiencies, “green” product trends and processes, plus emerging market applications.

You’ll find demonstrations, classroom education, a poster session and plenty of exhibitors showcasing equipment, services and materials. COMPOSITES provides the contacts and knowledge to understand trends and technologies and apply them to your unique business.

Here’s just a sample of what to expect:
- 100+ exhibitors
- More than 100 Education Sessions and Technical Paper presentations
- 200+ expert speakers from inside and outside the industry — from end users to manufacturers to suppliers
- More than 40 countries represented
- 650+ different companies in attendance
- Awards Showcase with more than 50 innovative products on display
- University Poster Session
- Spotlight on: composites in power generation and automobiles

As the industry’s premier event, with decades of proven results for attendees and exhibitors, COMPOSITES is the most diverse gathering of its kind in North America. Produced by the American Composites Manufacturers Association, net revenues are reinvested back into the composites trade association to support efforts on behalf of you, your company and the industry. COMPOSITES 2012 is a vital forum for business, learning and networking.

Schedule-at-a-Glance

<table>
<thead>
<tr>
<th>Tuesday, February 21, 2012</th>
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<tbody>
<tr>
<td>9:00 a.m. – 12:00 p.m.</td>
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<tr>
<td>1:30 p.m. – 3:30 p.m.</td>
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Save money: Register and make hotel reservations by January 18, 2012
Exhibitors

Visit with current suppliers, find the products you need and discover new vendors in the Exhibit Hall.

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Axel Plastics Research Laboratories, Inc.
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Fiber-Line, Inc.
Freudenberg Nonwovens
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Gibco Flex-mold, Inc.
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Tricel Honeycomb Corporation
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United Soybean Board
University of Alabama at Birmingham (UAB)
Valspar Corporation
Vectorply Corporation
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Xamax Industries, Inc.

Educational Programming

All attendees and exhibitors are invited to join us on Tuesday, February 21, for a keynote session with Rusty Wallace, NASCAR driver and ESPN/ABC sports commentator for NASCAR and Indy races. Rusty will discuss the importance of teamwork and the use of composites in the automotive racing world.

Over 100 technical paper presentation and education sessions that include best practices, case studies and discussions with experts take place throughout COMPOSITES. Topics include:

- Aerospace
- Alternative Energy (Solar, Wave, Wind)
- Architectural Composites
- Automotive
- Bath
- Blast & Ballistic Resistance
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- Cast Polymer
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- Compression Molding
- Corrosion Resistance
- Design & Engineering
- Fire Resistance
- General Business Topics
- Green Composites
- High-performance Composites
- Infrastructure

For a current list of exhibitors, program information and to register, visit: www.acmashow.org
Registration and Housing

Registration Information

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Early Bird Rate – On or before January 18, 2012
Regular – After January 18, 2012
Onsite rates slightly higher.

**Full Conference** – Includes all events – general sessions, all programming, two lunches and two receptions.

**Early Bird**
Member: $549
Nonmember: $699

**Regular**
Member: $659
Nonmember: $859

**Exhibit Hall Only** – Includes access to the Exhibit Hall. Tickets to receptions and Awards Luncheon must be purchased separately. Education and Technical Paper session tickets can be purchased onsite.

**Early Bird**
Member: $30
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Member: $35
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**Show Sampler** – Includes access to exhibit hall, general sessions, 3 educational or technical paper sessions, and the Welcome Reception. Tickets to other events must be purchased separately.

**Early Bird**
Member: $299
Nonmember: $399

**Regular**
Member: $359
Nonmember: $479

For ticket prices, onsite rates, and student, spouse/guest and press registration information, see the Registration section at www.acmashow.org.

Housing Information

Make your reservations by January 18, 2012, for the best rates and availability! To make your reservations, go to www.acmashow.org or call 877.632.9001 and mention COMPOSITES 2012. Reduced room rates have been secured at the following hotels.

<table>
<thead>
<tr>
<th>Hotel</th>
<th>Room Rate</th>
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<td>Mandalay Bay</td>
<td>$165/per night</td>
<td>3950 Las Vegas Boulevard South</td>
<td>Las Vegas, NV 89119 USA</td>
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<tr>
<td>Luxor</td>
<td>$75/per night</td>
<td>3900 Las Vegas Boulevard South</td>
<td>Las Vegas, NV 89119 USA</td>
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</tbody>
</table>

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[List of sponsors images and logos]
In every market segment of the composite industry there are advancements that bring change and adaption in order to remain competitive and increase market awareness. This is especially true in the case of the military market, where composite technology is being fielded to protect the lives of roughly 91,700 U.S. troops in Iraq and 111,700 in Afghanistan, as quoted by the Department of Defense’s
Active Duty Military Personnel Strengths Report published March 31, 2011. Not only must the technology hurdle stringent military codes and standards but it must compete against incumbent traditional materials like steel and aluminum. Composite technology is currently used in ballistic panel applications, light weight vehicle protection, aerospace manned and unmanned vehicles, and sonar protection. As stated by Hardwire LLC President George Tunis, this technology is not focused on the advancement of the material but rather in the application. The motivation of these companies is to create composite solutions—by land, air and sea—that you can bet your life on and save another.

Mission: Structural Support in Underbelly Attacks

In April 2008, George Tunis, CEO of Hardwire LLC, Pocomoke, Md., met retired Marine Staff Sergeant Octavio Sanchez at the Defense Advanced Research Programs Agency (DARPA) 50th Anniversary Show in Anaheim, Calif.

While serving in Iraq, Sanchez suffered from third-degree burns over 70 percent of his body caused by a roadside bomb that killed most of his crew in a High Mobility Multi-purpose Wheeled Vehicle (HMMWV or Humvee). Inspired by Sanchez’ story, Tunis focused his advanced composite armor company on alleviating the damage caused during an underbelly attack.

Threat of improvised explosive devices

Roadside bombs, or improvised explosive devices (IED), are homemade explosives that are a common threat to U.S. soldiers serving in Iraq and Afghanistan. In 2010, the number of U.S. troops killed by IEDs increased by 60 percent and reported injuries rose by 178 percent. After meeting Sanchez, Tunis was resolved to investigate the problem of underbelly attacks and submitted a proposal to DARPA, whom it had previously worked with in 2005 to develop armor to protect against explosive form penetrators (EFPs). The proposal to research, build and test prototypes for protecting tactical vehicles from under-vehicle IEDs was accepted, and in August 2009 Hardwire began investigating the impact of IEDs on the Humvee’s structure.

During research, Hardwire evaluated various materials, including high performance composites, as well as design structure and other protective measures. “After base lining with existing designs, we quickly saw ways we could help improve the Humvee’s hull design and do so in such a way as to avoid much of the blast energy,” says Tunis. Hardwire also worked with the Humvee’s original manufacturer, AM General, to incorporate its proprietary design into the Humvee. While competitors attempted to solve the problem by adding more mass into the vehicle design, Hardwire sought to avoid the blast and remain light using lightweight composites.

Tunis’ background in composites manufacturing also influenced the...
project objective to lighten and strengthen the Humvee. “From day one of working in a composites manufacturing company, you set off to make things lighter. In an effort to increase survivability, that key concept became less of a priority as add-on armor increased the overall weight of vehicles in combat,” says Tunis. “Vehicles have to get lighter and this is where high-tech composites like Dyneema can work to provide both high performance and light weight, which pays off in transport and in logistics costs such as fuel.”

Integrating composites into the Humvee

The team chose Dyneema, an ultra-high-weight polyethylene fiber known for dispersing the speed of sound faster than any fiber in the world, as part of the blast mitigation system to help spread the energy in a blast event. Dyneema is used in other Hardwire armor applications and is also used extensively in manufacturing kite sail lines. As an avid kite boarder, this is how Tunis discovered the material.

Hardwire’s Humvee cab design is an integrated suite of proprietary blast mitigation technologies that includes the structural blast chimney (SBC), a unique hull design, an energy-absorbing floor system, and blast-resistant seats. Composites play a key role in the survivability of the Humvee by incorporating light weight, high performance protection in the cab design. According to John Hammond, vice president of business development at Hardwire, “The key to developing protection for the Humvee was to strike the proper balance between performance, weight and cost.”

The SBC is only as wide as a laptop computer and extends from the floor structure to the roof of the Humvee, where the vent is placed to release the extra energy. The flooring system, isolated from the hull structure, uses composites in combination with energy absorbing materials to protect soldier’s feet, legs and lower torso from the blast energy. The proprietary hull design is structurally designed to disperse the incoming blast energy to keep the structure from collapsing on impact. The BLASTech blast-resistant seats, manufactured by Jankel Tactical Systems in Duncan, S.C., have been used in all of the blast tests to date. They are currently being used in British military vehicle designs and provide extra blast mitigation inside the vehicle.

The entire system is designed to be modular, meaning that it can be upgraded if necessary or removed when not required for the mission. It acts in conjunction with the hull design beneath the floor of the Humvee, increasing its structural capacity to withstand blast energy. Overall, this new Humvee demonstrates occupant survivability to the M-ATV underbody threshold threat level.

Testing the cab design

Since the beginning of the project, Hardwire’s cab design has undergone more than 100 blast tests. “That’s a lot of trucks to build and blow up,” says Tunis. “It’s becomes mentally very tough on the team.” This project is still in its testing phase, but Tunis is positive about how the results will be received and adds that the Department of Defense (DOD) has recently made inroads in streamlining technologies such as Hardwire’s cab design to get to market faster.

He expects that more composite and metallic mixed structures will begin integrating into the military market. “My first day many years ago working for Boeing as a consultant, I was told that there would never be a primary airplane structure made from composites and look what’s happening today. The military is starting to see those benefits and how technologies can be integrated to improve performance.”

Mission: A Sea-worthy Unmanned Vehicle

Imagine a stealthy unmanned aerial vehicle smart enough to control itself, capable of being launched from a naval aircraft carrier, able to refuel mid-air, built as large as a fighter-jet and strong enough to carry heavy weapons. The Northrop Grumman X-47B being developed by the U.S. Navy is exactly that—a tailless unmanned combat air system (UCAS), or an unmanned aircraft vehicle (UAV) that can fly autonomously and is capable of carrying large weapons. It uses a series of mouse clicks from the operator to take off and land on an aircraft carrier. The UCAS also uses composite skin panels and doors to save weight and demonstrate material usability for the U.S. Navy.

Composites have historically struggled to integrate into Navy designs and the Navy seldom invests in unmanned technology. “Composites are not 100 percent Navy acceptable due to the operating environment, but it is becoming more acceptable,” says Phil Saunders, Navy UCAS chief engineer at Northrop Grumman. According to Saunders, integrating composite technology into non-structural components of leading experimental programs is a positive solution for highlighting composite strengths in naval applications. Therefore, the use of composite skin on the leading unmanned vehicle design is an excellent demonstration of composite usage on the UCAS design.

The Navy increases mission-based carriers

The U.S. Navy is currently planning to reduce its use of aircraft carriers able to sustain several air squadrons and aircraft for long-term deployments and instead implement
The Northrop Grumman X-47B uses composite skins on the wings and doors to provide corrosion-resistance from the salt water on carrier decks.

U.S. Naval Air Systems Command (NAVAIR) in Patuxent River, Md., named Northrop Grumman as the prime contractor for the UCAS-D program and funded two X-47B aircraft with one craft capable of refueling in the air.

**Carrier-capable solutions**

The X-47B is the first developmental unmanned program to provide a carrier suitable solution. It is structurally different from other UCAS aircraft to handle the loads from landing on an aircraft carrier. The load paths must be strong enough to withstand the arrestment gear loads when landing and the catapult launch loads when taking-off on a carrier deck. All the parts on the aircraft endured structural and durability tests to ensure they would withstand the loads for the carrier operations. “The UCAS structure must be strong enough to support the force of being catapulted into the air,” says Saunders. The Navy aircraft requirements used on the carrier-capable supersonic fighter jets F-18 and F-35 were applied to X-47B.

The X-47B carbon epoxy composite skin is manufactured at the GKN Aerospace facility in St. Louis, Mo., using conventional lay-up with several layers of ply to create the skin. GKN Aerospace, a tier one supplier for the aviation industry, is one of the members of the Northrop Grumman team that also includes Lockheed Martin, Pratt & Whitney, Eaton, General Electric, Hamilton Sundstrand, Dell, Honeywell, Goodrich, Moog, Wind River, Parker Aerospace and Rockwell Collins. The contract to design the composite skins was written in 2006 during the J-UCAS program and continued into UCAS-D. The composite parts are constructed using normal composite manufacturing techniques similar to the approaches used today on other aerospace legacy systems. The X-47B also uses carbon fiber composite skin on the leading edges and controlled surfaces of the aircraft, such as the wings, fuselage and doors. The Northrop Grumman team
chose to implement the composite skins to provide weight savings and corrosive-resistant controlled surfaces on the leading edges, says Saunders. Each wing supports the elevon, aileron and spoiler flight control surfaces used to perform the flight patterns of the UCAS in flight.

Since the X-47B is tailless, it uses control surfaces, called spoilers, to provide the same control a vertical tail would by using high-speed computers to create a similar moment from the drag created when the surface is deflected. The flight control software, developed by Northrop Grumman, detects movement in the directional axis to maintain stable flight patterns and guide the UCAS in the right directional path. It also includes an integrated advanced GPS precision navigation system used to provide the precise position into the flight program and operates using occasional mouse clicks from the mission operator to launch and land the vehicle. The X-47B is designed similarly to the B-2 bomber, which is also a tailless Northrop Grumman construction. “You are essentially stabilizing a Frisbee,” says Saunders.

**X-47B testing and beyond**

Northrop Grumman and NAVAIR recently received the 2011 James S. McDonnell Award for Outstanding Team Achievement in the Field of Flight Test Engineering by the Society of Flight Test Engineers (SCTE), recognizing the design innovation and precision navigation that enable the X-47B to be launched and recovered by a Navy aircraft carrier. The use of the composite skins in the design is pushing the Navy to see the benefits of composite integration into other designs. The X-47B had its first successful flight in February 2011 at Edwards Air Force Base and is expected to demonstrate operations onboard a Navy aircraft carrier by 2013 with autonomous aerial refueling demonstrations planned for 2014.

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**Mission: Protecting Navy Sonar Equipment**

In the world of U.S. Navy shipbuilding, it is a painstaking journey to implement new composite technology in place of a one hundred-year-old shipbuilding process using steel as the primary material. However, composites are finding more applications for providing corrosion-resistant protection for both structural and non-structural parts. Some of the integrated parts including topside electrical and phone boxes, gratings, stanchions, louvers, and screens, manufactured using pultrusion or injection molding. However, no other structural parts are making as much progress in the Navy as the ones providing composite acoustic sonar protection such as submarine sonar domes, the composite mast for the CVN 77 and the deckhouse for DDG-1000 Zumwalt destroyer.

The Naval Sea Systems Command (NAVSEA)—a U.S. Navy organization dedicated to the engineering, building, purchasing and maintaining of ships, submarines and combat systems—is the main office for ensuring that the communication and radar equipment are well protected from the environment and other threats. They have recently made decisions to equip some of the largest current and future ships in the fleet with composite solutions.

**DDG-1000 Zumwalt composite deckhouse**

The Navy is currently investing in large structures for naval applications at the Huntington Ingalls Composites Center of Excellence facility in Gulfport, Miss., (colloquially referred to as the Gulfport facility) the sole provider of composite deckhouse and hangars for the DDG-1000 Zumwalt. The Gulfport facility previously developed composite masts for the amphibious transport ship LPD 17, named the USS San Antonio, launched in 2003 and the final Navy supercarrier CVN 77, or USS George H.W. Bush, launched in 2006. These applications are used to make the ships lighter and less top-heavy. They also provide corrosion resistance for the communications equipment from the salt water environment. The use of composites in the large Navy masts paved the way for the large composite deckhouse on the DDG-1000.

The DDG-1000 is an experimental
multi-mission destroyer that includes a single integrated warfare system, meaning it is the first system to provide surveillance for air, land and sea attacks simultaneously. Composites were chosen to protect the radar equipment from corrosion, reduce the overall weight of the DDG-1000 and decrease its radar signature.

Its composite deckhouse stores the dual band radar systems that support the integrated command system, eliminating the need for a large mast on the top of the destroyer. The deckhouse, which contains the four upper levels that protect the advanced radar equipment, is the only part of the DDG-100 that floats above the water. This is the section of the deckhouse composed of composite material, known as the deckhouse superstructure, and the bottom three levels are manufactured with steel. Most of the ship is submerged below the water and utilizes the composite material to decrease the radar visibility to equal that of a fishing boat. The superstructure is surrounded by carbon fiber and vinyl ester sandwich panels with a balsa core manufactured via vacuum assisted resin transfer molding (VARTM) at the Gulfport facility.

Despite a promising future, the DDG-1000 program has been ridden with setbacks. It survived continuous attacks from the Navy and Congress regarding the $1 billion dollar cast over original estimates per ship, rumors the composite panels were not sealing properly in 2008, and competition from the smaller DDG-51 Destroyer. However, it has overcome these pitfalls and proved to the military that the program is necessary for future growth and development. New contracts were written in September between the Navy and General Dynamics in Bath, Maine for $1.8 billion to begin the initial construction of the second and third DDG-1000. According to the Navy, construction of the first DDG-1000 is 50 percent completed and expected for delivery in 2014.

**Virginia-class submarine sonar dome**

The Virginia-class is a modern nuclear powered, fast attack submarine that replaced the Cold War-era Seawolf class. There are seven Virginia-class submarines currently in operation, which use a composite sonar dome manufactured by Goodrich Engineered Polymer Products in Jacksonville, Fla., to protect sonar equipment in the bow. It is the largest sonar dome in the Navy fleet. As a result of a six year program with the submarine primary contractor General Dynamic’s Electric Boat division, based in Groton, Conn., to develop the technology for the Virginia-class, the composite domes replaced failing steel-rubber sonar domes.

Goodrich has provided submarine sonar equipment for the Navy for over 35 years. In 1997, the 48,827 pound composite structure replaced its traditional steel-rubber sonar domes in Navy ships. The steel-rubber structures were struggling to meet the submarine damage tolerance standards and were constantly requiring maintenance to fix cracks due to corrosion problems. Therefore, it was evident that the sonar dome would need revisions for the new Virginia-class.

The domes are constructed using Goodrich’s patented RHO-COR composite material system which is a fire resistant sandwich-type configuration. Goodrich is the sole proprietor of the rubber wire-composite reinforced system using previous expertise with rubber and steel. The rubber increases the acoustic properties by absorbing surrounding sound energy for a clearer sonar reading while the composites offer a high strength to weight ratio and protection for the equipment. The outer layers of the sandwich are high-strength, fiber-reinforced composite laminates and the core layer is a polymer compound using rubber to minimize noise.

After six years of collaborative effort between the Navy, Electric Boat and Goodrich the new composite sonar domes completed its process design and qualification, tooling design and fabrication, and, $21 million later, Goodrich manufactured the first Virginia-class sonar dome. The first composite dome was shipped to General Dynamics in 2002 and launched in
Composites are used in a variety of naval applications, including sonar domes, flood grates and pump impellers.

The first Virginia-class submarine, the USS Virginia.

**Overcoming price analysis**

Composites integration in large acoustic structures is a positive step towards replacing steel parts in Navy construction. Currently, the Navy uses non-structural and structural composite components to replace metal counterparts if the part can be manufactured at a lower cost and continue to maintain the same job. “With total ownership cost being a critical issue, we rely on business-case analysis to determine whether the use of composite material makes sense in a specific application,” says Owens. The corrosive resistant and low weight properties of composites provide the benefit to using composites in the large sonar protection pieces used in the Virginia-class and DDG-1000 programs. As the learning curve continues to improve for Navy engineers, it is expected that more composite technology may be used for replacement of heavy steel parts.

For example, the most recent Virginia-class submarine, the USS California, was delivered to the Navy eight and a half months ahead of schedule and is much cheaper to manufacturer compared to earlier Virginia-class submarines. It also includes a variety of composite components, ranging from large parts like the composite sonar dome, array support plates and flood grates, to smaller parts like pump impellers. “A significant reason for the cost reduction is that the learning associated with making the unique resin transfer molded parts for Virginia-class submarines have improved the manufacturing process. The Navy expects the learning trends to continue, along with continued lower costs,” says Owen.

The Navy is currently developing new composite manufacturing techniques for large cylindrical parts. Today, the technology for providing such parts requires the use of a large autoclave, which is expensive and time consuming compared to other manufacturing methods.
The U.S. Military continuously investigates new methods for protecting troops with the best available technology. Below are two examples of composites in research programs for enhanced combat equipment.

**Ceramic nanocomposite polymer armor plates**

The U.S. Army upgraded its vests to the new improved outer tactical vests (IOTV). The upgraded vests are lighter and use composite ballistic ceramic plates with a coated ballistic fiber backing for the enhanced small arms protective inserts (ESAPI) and enhanced side ballistic inserts (ESBI). New advances in nanocomposite technology at Nanosonic, in Pembroke, Va., motivated the U.S. Navy and the U.S. Department of Defense (DOD) to investigate nanocomposite ballistic technology, which uses a ceramic copolymer material with shear thickening Kevlar and Dyneema fiber reinforced backings. These new nanocomposites would replace the current ESAPI and ESBI. The military hopes to use the nanocomposite technology to transition into common composite manufacturing techniques, such as pultrusion, compression molding and resin transfer molding (RTM) for ballistic plates.

**Enhanced combat helmets**

The Enhanced Combat Helmet (ECH), designed last December by the U.S. Marine Corp. (USMC) and the U.S. Army, is still in its testing phase. The design differs from the current advanced combat helmet (ACH) in weight and thickness. After studying the impact response of NFL football pad systems, it was determined that increasing the foam thickness of the helmet by one-eighth to one-quarter of an inch greatly affected the impact capabilities of the helmet. However, even though the design must be thicker to provide better protection, the helmet needs to be lighter to allow mobility.

The ECH is designed using Dyneema or Spectrashield fiber, an ultra-high molecular weight polyethylene, as opposed to the Kevlar or Twaron. However, the initial rounds of testing were unable to amply protect from certain rifle rounds. New designs are currently being tested, expected to be completed by December 2011.

For more stories like this, visit compositesmanufacturingblog.com and search using keyword “ballistic.”
The website watchdog GovTrack Insider estimates that nearly 7,000 bills are introduced into Congress each year. Ideas for these legislative actions can come from Congressional members, lobbyists, state legislatures, constituents, legislative counsel, or executive agencies; each bill ranges in scope, focus and applicability. Many are debated, several considered and only a small percentage are passed while others are left by the wayside never to come to fruition. Among these thousands of bills, many will have a direct impact on one or more segments of the composites industry. Here, we have compiled a sampling of bills that when passed or renewed this year will impact your business.

Transportation Reauthorization Bill

One of the House Transportation & Infrastructure Committee’s highest priorities in the current 112th Congress is to enact a fiscally responsible long-term surface transportation law that authorizes funding and sets policy for the federal highway, transit, and highway safety programs. This new bill would also include policy reforms for rail and maritime transportation. If passed, the bill would provide $230 billion over six years from the Highway Trust Fund.

Because Congress will not support a gas tax increase but will run out of funds if it simply extends the expired law, the Committee’s new proposal does not raise taxes. Instead, this proposal reforms surface transportation programs by consolidating or eliminating approximately 70 programs that are duplicative or do not serve a federal purpose. States will be permitted the flexibility to identify and address their most critical infrastructure needs. A multi-year bill that stabilizes the Highway Trust Fund is seen as the responsible approach to investing in the nation’s transportation infrastructure and providing the essential stability for states to plan major projects.

The impact this bill will have on the composite industry depends on whether or not Congress will include Senator David Vitter’s (R-LA) proposed amendment to incorporate life-cycle cost analysis. “The transportation bill amendment is one of the reasons we went to the Hill for the October Fly-In,” says American Composites Manufacturers Association’s (ACMA) Composite Growth Initiative Director John Busel. “We wanted to support Senator Vitter’s proposed amendment and create an equal playing field for composite materials.” Life-cycle cost analysis gives composite materials an advantage by lowering the cost of the installation over its lifetime compared to other materials that are cheaper initial investments but deteriorate overtime. There are still a number of unknown factors that are currently delaying the bill, such as determining the duration of the bill and how it will be funded. The future of the bill relies on Congressional action to create a sustainable funding structure for surface transportation law. (For more information, visit http://republicans.transportation.house.gov.)

CAFE Standards

The U.S. DOT aims to increase the average fuel economy of American cars in future model designs. The Corporate Average Fuel Economy (CAFE) standards are regulations set by the National Highway Traffic Safety Administration (NHTSA) to regulate and improve the fuel economy of compact cars and light trucks in the U.S. Typically, automotive companies ignore the standards and pay the difference in the fuel economy, which is currently $5.50 per 0.1 mpg under 27.5 mpg for each passenger car.

Earlier this year, President Barack Obama entered into an agreement with 13 automotive companies to increase the car and light truck fuel efficiency standard to 54.5 mpg by 2025. The new CAFE standards have not officially been accepted, but if implemented, it would be the first change to the CAFE standard for passenger cars since 1990.

The new agreement pushed OEMs to research reducing vehicle fuel consumption.

One way to raise fuel economy is to reduce vehicle weight, substituting steel heavy parts for alternative materials. If the new CAFE standards are passed, the
In all things legislative and regulatory, the American Composites Manufacturers Association works for the benefit of all composite manufacturers. Most recently, an ACMA Fly-In, held October 11–13, focused on persuading U.S. Congressmen to support a National Academy of Science (NAS) review of the Health and Human Services (HSS) listing of styrene as a reasonably anticipated styrene as well as support Senator Vitter’s proposed amendment to the Transportation Reauthorization Bill to include life-cycle analysis cost. ACMA’s Chief Staff Executive Tom Dobbins, Government Affairs Director John Schweitzer, CGI Director John Busel, and a group of ACMA member representatives arrived at Capitol Hill on Wednesday, October 12 prepared to meet the congressmen. “The meetings went extremely well,” says Busel. “Many of the offices, if not all of them, were well aware of styrene and the impact of the reclassification to our industry.” The consensus was that every one of the legislative assistants would meet with his or her representative to consider the NAS review. “We believe that if they review the data they will side with industry,” says Busel.

The automotive industry could see drastic changes for better fuel economy and integration of alternate materials to help lighten vehicles. “My personal observation,” says Busel “is that much like Boeing took a risk and made a statement with integrating composites into the 787 Dreamliner, the automotive industry needs to make a major statement along the same lines and pick a material. We hope its plastics and composites.”

Federal Renewable Energy Production Tax Credit
The wind industry continues to seek long-term tax

ACMA representatives visit the office of Congressman Joe Wilson (R-SC-2) during the most recent ACMA Fly-In, held Oct. 11-13 in Washington, D.C.
policies, lasting more than just a few years, to provide consistency and market certainty. The federal renewable energy production tax credit (PTC) has been the primary financial policy for the wind industry since its inception in 1992. Through the years it has been extended mostly in one- and two-year intervals, and even been allowed to expire. Congress provided a three-year extension of the PTC through December 31, 2012, as part of the American Recovery and Reinvestment Act. The PTC provides an inflation-adjusted per kilowatt hour (kWh) income tax benefit over the first ten years of a wind project’s operations, which in 2010 was 2.2 cents per kWh, and is a critical factor in financing new wind farms.

The industry believes an extension of at least four years is crucial. According to the American Wind Energy Association (AWEA), failure to extend the PTC will lead to significant job losses and roll back progress that has been made nationally to diversify the U.S. electricity portfolio. AWEA advocates that predictable policies will improve investment in the wind industry. This investment includes R&D into lighter, stronger, larger and more diversified wind turbines in which composite parts are heavily used; ranging from blades, nacelles, platforms and other components.

ACMA believes continued technological innovation around manufacturing and quality are the most important contributions the composites industry can make and it can be better accomplished with government support like the renewal of the PTC. “Historically, the PTC has made a major impact on wind energy installations,” says Busel. “And it will continue to impact the wind market. Additionally, the wind industry needs to address the technical issue of installing larger turbines to continue success in this market. With wind blades continuously getting larger and larger, there is a growing need to automate as much as possible.” Renewing the PTC to extend beyond 2012 would support the renewable wind market and afford R&D opportunities for the composite wind industry.

For more information on what ACMA is doing for you, or how you can become more involved, visit www.acmanet.org.

Melinda Skea is the senior manager of communications at ACMA. Email comments to mskea@acmanet.org.

ACMA believes continued technological innovation around manufacturing and quality are the most important contributions the composites industry can make.
As a member of ACMA you can really make the most of your membership by coming to COMPOSITES 2012. Here are some suggestions for making the most of your convention experience:

- **Submit an entry for the ACE Award program.** It is a great way to get recognition and valuable marketing for your product.

- **Attend the Government Affairs Committee (GAC) meeting.** Most ACMA meetings are open to members and the GAC meeting is the best way to get the latest on regulations that could impact your business. If GAC isn’t your thing, there are committees in other areas that are sure to be of interest to you and your business.

- **Attend the Awards Luncheon.** It is the easiest way to see the leaders of the association and industry in one place.

- **Stop by the CEO reception.** A great place to network with other CEOs and learn what is happening in the industry.

- **Participate in educational sessions.** This year there is more educational content than ever! Whether you register for the full conference or just a day, you will walk away with new ideas that will benefit your company.

You can also meet me, the executive director of your association. Grab me in the hall or set up an appointment now by emailing tdobbins@acmanet.org. We have a lot of accomplishments I would like to share with you and there are a lot of opportunities for you to get involved—so let’s figure it out together!

Tom Dobbins, CAE

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Does Your Company Have a CCT Instructor? Companies with a designated CCT-Instructor on staff can conduct CCT classes for other employees and administer the exam on site. It’s a cost-effective and efficient way to keep your staff updated on the latest processes and techniques in composites manufacturing to increase quality and productivity. Sign-up now for the next CCT-I course, to be held November 15-16 at the new ACMA Offices in Arlington, Va. For more information or to register, visit ACMA’s website.

ACMA is Moving

ACMA Headquarters is Moving!
Effective October 10, ACMA moved to 3033 Wilson Blvd., Ste 420, Arlington, VA 22201. Our main and direct phone lines and email addresses did not change.

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Senator Vitter Briefs ACMA Board

Senator David Vitter (R-LA) met with ACMA’s Board of Directors to discuss key issues impacting the composites industry. Vitter’s introduced legislation that would require the government to look at the life-cycle cost of projects in evaluating the design and construction. “Life-cycle costing could help overcome the bureaucratic barriers to the use of more composites,” said ACMA President Lori Luchak. Vitter has been a champion of styrene, working to educate the administration and the Department of Health and Human Services (HSS) on the impact the NTP’s listing of styrene will have on the industry.

ACI Moving Composites in Concrete

The American Concrete Institute Committee 440 (FRP) held its bi-annual series of technical committee meetings on Oct. 16-18 in Cincinnati, Ohio to discuss ongoing ballots and activities associated with seismic design of concrete structures using FRP composites. It also updated design examples for the design guidelines for FRP rebar reinforcement of concrete, test protocols for durability assessment of FRP products used in concrete, and a state-of-the-practice document on the use of stay-in-place structural formwork used for bridge decks. Much of this work will be applied to several concrete design guidelines that are expected to be updated in 2012.

Come see us at COMPOSITES 2012, Booth #1146

ACE Awards
Call For Entries

The Awards for Composites Excellence (ACE) program is organized under three main categories to reflect the activity and direction of the composites industry. All categories are open to manufacturers. Academia, equipment suppliers, software developers and end-users may also enter specific categories.

For information and to submit, visit www.acmashow.org

Design Category: Innovation in Green Composites Technology
Design Category: Most Creative Application
Manufacturing Category: Equipment Innovation
Manufacturing Category: Process Innovation Award
Market Growth Category: Composites Sustainability Award
“If you look, behave and fly like a fixed-wing aircraft, you’re a hamburger.”

Ed Herlik, an analyst at the Market Intel Group, commenting on future needs of the U.S. military to develop a stealthy UAV capable of high altitudes.

“We must change if we want to grow. We need more boaters and we’re going to have to work together to grow.”

Thom Dammrich, president of the National Marine Manufacturers Association (NMMA), discussing the need to expand the boating market base to attendees at the 21st International BoatBuilds’ Exhibition & Conference in Louisville, Ky.

“A better understanding of lightning strikes on civil aircraft is an exercise in the obvious, because human lives are at stake.”

Jean Botti, chief technical officer for EADS, at the opening of the new Morgan-Botti Lightning Laboratory at Cardiff University in Wales. The new facility will investigate the impact of lightning strikes on composite aircrafts.

“This next generation Portable Helicopter Oxygen Delivery System (PHODS) will provide our soldier with longer oxygen delivery duration as well as a lighter weight vessel.”

Alan Haase, president of Unitech and the AGC Composite Group, announcing a new contract to design the next generation of composite PHODS for the U.S. Army.

“The Fibre Composites Action Plan 2011-2014 seeks to further develop competitive critical mass in the industry, demonstrate the environmental, social and economic benefits of fibre composites, and promote their uptake in national and international supply chains.”

Jan Jarratt, Queensland Minister for Tourism, Manufacturing and Small Business, discussing the implementation of the Fibre Composites Action Plan to support the rapid growth of the new industry in Australia.

To read these and other composites breaking news, visit compositesmanufacturingblog.com and click on “Composites in the News.” For daily composites updates, follow us on Twitter @cmmagazine
<**Overcoming the Composite Sticker Shock**>

Andrew Hopkins is the executive vice president for RheTech Inc., a privately held, reinforced thermoplastics compounding company serving the transportation, consumer, and construction markets. Hopkins earned a doctorate in organic chemistry from the University of Kent, in the U.K., and a bachelor of science in chemistry from the University of London. He is an elected Fellow of the Royal Society of Chemistry and a member of the Society of Plastics Engineers (SPE).

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**In the Evolution of Composites, Where Are We Now?**

Stuart La Haise graduated from Citadel with a BS in business administration in 1984 and joined the composites industry as a material supplier. In 2009, La Haise, vice-president of Sybo Composites in Saint Augustine, Fla., joined with business partner and long-time customer, Dana Greenwood. Sybo produces parts for the marine industry, military prototypes, and parts for infrastructure and other custom projects.

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**The Economics of Recycled Composites**

James Colegrove has been working in the composites industry for nearly 30 years, 20 of which has been with Wisconsin-based Trek Bicycle. He helped develop Trek’s OCLV molding technology and has been involved with design and process development of carbon fiber bikes like the Madone, Speed concept, “Y” bike, and the original 5500 models.

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**Are New CAFE Standards Hastening Composite Adoption?**

Jeffrey Helms is the global automotive director for Ticona Engineering Polymers, in Auburn Hills, Mich., and is responsible for managing the firm’s dealings with automotive OEMs around the world. Previous to assuming his current position, Helms was responsible for high-performance engineering plastics solutions, as Ford Motor Company’s Global OEM Manager.

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To read the interviews with these and other leading members of the composites industry, visit www.compositesmanufacturingblog.com and click on “Q&A Interviews.”
Confounded Composites!

Take a second look and see if you can find the differences in these two pictures.

Original

Modified

The 2011 Frankfurt Auto Show in Germany showcased a number of innovative designs using composite solutions. Composites have long been used in racing panels and luxury car structures seen at the Frankfurt Auto Show, but this year composites were found in a vast array of developing concepts and production commuter cars for interesting applications.

Turn to page 4 for new concept designs such as the BMW i3 and i8 that use composites materials.
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