COBRAE

COmposite BRidge Alliance Europe

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COBRAE NEWS is distributed to over 1.900 addresses among the composites industry, bridge builders, bridge designers & bridge owners.

COBRAE NEWS gives information about bridge- and other structural engineering projects worldwide, related to the development and application of lighter and more durable construction materials, in particular fiber reinforced polymer composites. **COBRAE** News is a collection of news items gathered from many sources, such as papers, magazines, newsletters, our readers, exhibitions within AND outside the Composite Industry. Contributions from other sources are welcome and will be included, if they fall within the scope of **COBRAE** News, **so please submit your articles and news!**

YOUR BEST RESOLUTION FOR 2008 - BECOME A FOUNDING MEMBER OF COBRAE - SEE THE NEXT PAGE

COBRAE MEMBERSHIP INFO

NOT A COBRAE MEMBER YET?

We would like to ask our readers to become a member of this Alliance. **COBRAE** will need more members to accomplish all its goals. The Alliance has already established a close co-operation with IABSE, IIFC in Hong Kong and the ACMA. For more information about the Alliance and its goals, please visit our website at http://www.cobrae.org. You are also invited to contact the administrative office to discuss activities or actions, which you think **COBRAE** should take. You can either call to (31) 33 4343 500 or e-mail to info@cobrae.org.
We look forward to your positive response. At the end of this newsletter you will find a registration form for membership.

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COBRAE Round Table: 'Options for Lightweight Composite Bridge Decks'

Composite Bridge Decks Engineering Round Table Session
Part of the Rotterdam COBRAE Meeting on November 14th, 2007 was devoted to a Round Table discussion and Information on the latest developments in Lightweight Composite decking systems for bridges/flyovers/parking garages and other structures.
After a brief introduction round where the participants introduced themselves, the COBRAE Alliance Secretary, Mr. Jaap Ketel showed the movie about the by the COBRAE Alliance organized Excursion to Korea. In this excursion visits were paid to 6 fully loaded traffic bridges with all composites decks. (Refer to article on this subject)

The 1st Round: Focused on Why Composite bridges and bridge decks.
The obvious advantages are: lightweight, easy and quick installation, prefabrication.
The disadvantages are: higher cost and proof of expected lifetime. Very important is maintenance and guarantee! The politicians, and therefore the authorities in most countries want a 100 years guarantee. In Germany there are no full traffic bridges in GRP yet. Therefore try to get an “example” bridge.

2nd Round: Focused on How to get Test-installations.
In Germany construction tests are done. However there is no demonstration project as yet. In the Netherlands Rijkswaterstaat (RWS), Ministry of Transport, is doing tests together with contractors. Fatigue tests are very important. The EURO-code for lifetime and maintenance is 100 years or more. This applies equally to aluminum, steel, concrete and composites. Durability is the key word. Proof this by known LCA for composites.
Few real life-cycle analyses are known. One is the performance of radomes (radar-domes) on Awacs planes, which is 50 years. Another is underground storage tanks in the USA. In Italy there will be a study available next year. In Norway composites have to have a long lifetime because of the salt sea, which is very costly.
Unfortunately there is no living proof at this time of composites in service of 100 years.
Steel has corrosion. We know this is a fact. The second Firth of Fourth Bridge in UK is a lightweight bridge. The cables are of steel, but are rusted through. They are thinking about a new bridge. Eiffel expected the same problem when he build the Eiffel Tower. But then, it was only build for the World exhibition and not to be there for a 100 years. Scientific research also has to be done about the use of energy in structures, savings in weight and material, and the effects on CO2 emissions when producing structural materials.

3rd Round: Constructions and Applications.
It is very important to teach people about composites. There is a lot of lobbying from the steel, aluminum and concrete industry. Learn from previous experiences. For example, pipes (Hobas) and covers (Röchling) in sewage treatment plants.
In Spain an all-composite bridge has been in service.
In the Netherlands there are now +/- 1000 foot/bicycle bridges with composite decks.
Contractors are focused on lowest initial cost. This is very important in the bidding stage. If you have a low price for a bridge-deck, you will get the job. But with composites it is still two times as costly, so you won’t get the job. To change this is very much political.
One benefit is often overlooked and that is shorter installation time, consequently less out of service time for the bridge. An example is the Hollandsche Brug in the Netherlands. The deficient bridge will now be repaired in concrete; this will take about one and a half year time. If done with composites it would have taken about half a year. There are more sectors than only bridges. Private sector: industry, windmills, boat marina’s, parking houses.

4th Round: Certification
One of the participants gives a brief presentation on standards, certification and recommendations for composite products in civil engineering. In Italy and Norway the EURO-code is coming. The law does not allow building composite bridges as yet.
Windmill energy blades made of composites are now very successful. There many are tests done on dynamic loading. The methods used for these tests could possibly be used for bridges, but lifetime and behavior of composite bridges are different than blades.
Learning from other countries overseas. There is a video to be made with ACMA and Creative Pultrusions for educational purposes; they try to get more funds.
In USA they make bridge-decks first and then prove. In Europe they try to prove first and then make the deck.

5th Round: Conclusions on future options for Composite Bridge Decks in Footbridges, Traffic Bridges, Flyovers, Parking Garages etc.

Delegates at the Round table concluded that a lot of seeding work still needs to be done. Education is very important. Also universal standards for calculation, testing and certification methods must be developed. It will be a slow process, but a great task. COBRAE Members and other interested parties are invited to come forward with suggestions and/or propose formats for these important issues. The COBRAE office can compile this information, make a recommendation-list and circulate for comments.

Note from the Editor: A special thanks was due to the input of Mr. Bas Obladen (Strukton Contractors NL) and Mr. Ane de Boer (Bouwdienst, Ministry of Transport, Public Works & Water Management, NL).

Invitation for COBRAE Membership

May we invite you to join the COmposite BRidge Alliance Europe (**COBRAE**) to help us achieve our mission to promote the research, development and application of fibre reinforced polymer composites in rehabilitation, upgrade and new build bridge constructions and infrastructure.
If your company registers now, you will become a Founding Member of **COBRAE** for the year **2008**. The total fee to pay will be Euro 950,-. This fee is made up of the joining fee of Euro 500,- (to be paid once) plus the Annual Membership fee for 2008 of Euro 450,-.

In this Newsletter you will find announcements of events organised by **COBRAE** in 2008.

If you join COBRAE as a Founding Member you are entitled to the following:

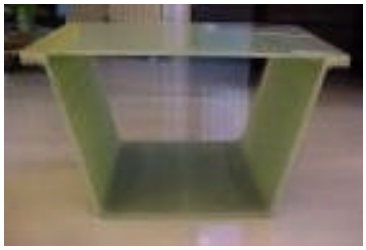
- **20% discount on all COBRAE activities**
- **Company website linked from COBRAE website**
- **Company Profile placed in COBRAE News**

To join COBRAE please use the FOUNDING MEMBERS REGISTRATION FORM on the last page of this Newsletter.Company Profile new COBRAE Member: Lightweight Structures B.V.

Company Profile new COBRAE Member: Lightweight Structures B.V.

Lightweight Structures B.V. (www.lightweight-structures.com), based in Delft, Netherlands, focuses its business on creative product development, engineering and manufacturing of structures for markets where weight reduction is one of the design drivers, while improving sustainability, safety and performance.
Our core competences are in the composites (fibre reinforced plastics) area, although we do not limit ourselves to composites. We have a background of 260 manyears in structural applications in various markets and for various end-users.

On page 14 you will find a case story of Lightweight Structures B.V. on a composite pedestrian bridge in Delft, NL.



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Company Profile new COBRAE Member: GRP Constructions, Inc.

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- President: Mr. Eiji Maeno
- Contact person : Drs Marten Mallinckrodt
- Type of business: Design and Construction of FRP structures
- Area of business: Municipal and leisure amenities.

GRP Constructions,Inc has already earned itself an enviable reputation for its use of FRP pultruded profiles in public structures such as pedestrian bridges, decks and boarwalks.

GRP Constructions, Inc. is also concentrating its efforts on getting FRP specified for use in areas such as street and park furniture. (bollards, pergolas, shelters etc.)

For further information and questions, please contact Drs. Mallinckrodt by e-mail.

Please find below several pictures from past project carried out by GRP Constructions. Inc.

COBRAE Composite Bridge Deck Excursion to Korea

Six "State-of-the-Art" Composite Bridge Deck Bridges in four days.

Picture A: Gwangyang Bridge

There is a saying in my Dutch language "***Something gotten from afar, is a pleasant treat***". The "***treat***" was not the only reason for a small group of COBRAE members to set out for South Korea in October 2007 to inspect a number of bridges in this country. Apart from exciting cultural and culinary "***treats***", there were excellent bridge engineering lessons to be learned on the 4-day tour, principally arranged by the Korean Member of COBRAE, professor Sung Woo Lee of the Kookmin Technical University of Seoul. Apart from this excellent impression of the status of Composite Bridge Deck Technology in Korea, the group experienced the great hospitality of the Korean people and their eagerness to share their know-how with colleagues from around the world. The international group of bridge Engineers all agreed at the end of the excursion that the Korean know-how on Composite Bridge Deck Technology could be considered as globally "State-of-the-Art".

During the tour, covering over 1200 km by busses and high speed (TGV) train, 4 heavy traffic bridges and 2 foot/bicycle bridges were inspected. All these bridges were fitted with the 200 mm Delta Deck, developed by KCI (Kookmin Composite Infrastructure Inc.). The decking program was initiated under the auspices of the Korean Ministry of Public Works, with a background based on a Research and Development Program run by the Kookmin University. Current laboratory and field experiences amount to more than 6 years, of which 4 yours in service.

The most eye-catching projects were the Gwangyang Bridge (picture A) and the Noolcha Bridge (picture B). The Gwangyang Bridge experienced the most severe field test, with heavy traffic of 400 dump trucks day and night, each vehicle weighing 30 tons, crossing the bridge during a period of 4 years. The only damage noticed was some minor cracks in the covering asphalt but nowhere was any deficiency in the composite deck structure itself. The Noolcha Bridge, currently being build, is a unique project worldwide; whilst it is the largest composite deck bridge structure anywhere. 320 meters long and 32 meters wide, it carries 6 highway lanes and two pedestrian/bicycle lanes on either side. The whole deck is made of composite Delta Deck beams, holding a total composite material weight of over 300 tons of glass reinforced polyesters. Because the asphalt had not been applied, the COBRAE group visiting the bridge, got an excellent chance to make a full inspection of the deck.

Picture B: Noolcha Bridge

Preceding the excursion a "COBRAE Group Welcome Dinner" was arranged by Professor Lee, where participants had a chance to meet several of Korean's most qualified experts on Bridge Engineering. This included Professor Dr. Byung-Suk Kim, Professor at the Korean Institute of Construction Technology in Seoul. Professor Kim is one of the worlds most renowned Bridge Engineers and peer to Professor Lee. It was noticed that the technology of composite bridge decks was not considered as something experimentally and exceptionally new, but already considered by Korean Engineers as "State-of-the-Art", applicable in many situations, under severe loading conditions and especially to be used in aggressive environments, such as over seawater.

The tour concluded with a factory visit where both the reinforcements for the pultruded profiles are being made and the profiles themselves are being pulled on computer controlled, modern pultrusion machines. On this location also a demonstration was given of the recently developed "Snap-Fit" joint, integrated into the KCI Delta Deck. This product is an advanced development to the Delta Deck series of standard profiles. This newly patented and very innovative connection makes it possible to avoid the horizontal assembly method, but allows making a fixed-click connection in the vertical way. The product evolved from this is not only to be used as a bridge deck system, but is also applicable as a "road mat" for heavy traffic loading. The first applications are found in oil and gas explorations in Northern Canada to support the heavy drill rig vehicles on weak Arctic soils. Therefore the products are called "Rig mat"

Pictures and a short video of the Korean excursion by the COBRAE Group visit to Korea can be found on the COBRAE website: www.cobrae.org. The Kookmin Composite Infrastructure website is: www.kookminci.com

FRP Bridge Evolution:
TxDOT Advances Viability of custom FRP Bridge Beams in new Hybrid Structural Construction Research project

PROJECT PROFILE:
In its continuing research of new structural highway construction technologies, the Texas Department of Transportation (TxDOT) has expanded its implementation of custom fiber-reinforced polymer (FRP) composite bridge beams for a new drainage ditch bridge (FM-1684) in Refugio County, TX. The bridge is a replacement: of a single-span girder-bridge (50' long x 32' wide) that utilizes customized FRP flanged U-Shaped Beams (50' long x 30" deep) and a concrete deck construction.

Thirty-five miles from Corpus Christi, the Refugio County Bridge will be the state's second FRP hybrid-bridge endeavor—following the successful construction of the San Patricio County Bridge nearly three years ago. The county has a humid subtropical climate (averages thirty-seven inches of rain annually) which results in corrosive salt and brackish water. Therefore, although more costly upfront, TxDOT specified the FRP beams to advance the research of the long-term corrosion and structural performance benefits of FRP materials vs. traditional steel or concrete beam solutions.

With the FRP beams specified by TxDOT, General Contractor Haas-Anderson Construction (Corpus Christi, TX) enlisted Molded Fiber Glass Construction Products (MFG: Independence, KS), who had produced the previous FRP beams at San Patricio, to manufacture eight (8) customized flanged U-Shaped beams whose depth and composite structure would provide optimal deflection under load. Once completed, the beams would weigh approximately 5, 000 lbs. each and sit on abutments where the concrete deck would be poured onto it. Beginning in late 2006 and scheduled for completion in summer 2007, the project's goal was to take the lessons learned from the previous bridge project and evolve the current customization and production processes in hopes of optimizing performance and cost variables for future projects.

FRP CHALLENGE/FORMING PROCESS:

MFG fabricated the beams in its Texas location utilizing a Vacuum Infusion Process (VIP) versus the previous project's hand lay-up to optimize the physical properties of the beam and facilitate production. This process was selected because vacuum infusion provided a number of benefits including; consistent fiber-to-resin ratio, less wasted resin, unlimited set-up time and much lower emissions. The VIP utilizes a vacuum bag to de-bulk or compact the parts' complete laminate ply schedule of reinforcements and or core materials that are laid onto the mold. For the Refugio beams, a male mold was produced to the beam design and then dry sheets of stitched glass fabric and chopped strand mat were laid over the U-Shaped mold. This process was applied in a series of layers to achieve the appropriate 1.5" beam thickness, and then a plastic film was laid on top to serve as a vacuum bag. Once a complete vacuum was achieved, liquid resin was then introduced into the laminate via carefully placed tubing. The vacuum then draws the resin through the fibers, filling all the voids and eliminating any remaining air along the flow-front. According to Rich LaFountain, MFG Business Unit Leader/Open Molding, "The trick is to get the bag to draw down correctly so that wrinkles don't develop in the individual layers of fabric which could affect the ultimate strength of the composite."

MATERIALS UTILIZED:

- Woven Fabric:
• 3-Tex Material— 77 oz. per square yard / 3WEAVE™ using PPG Roving / (3K lbs. per part)
- Chopped Strand Mat:
• Owens Corning OC® 1.5 oz. / (300 lbs. per part)
- Resin:
• AOC Vipel® — corrosion resistant vinyl ester resin / (1,700 lbs. per part)

Once completed, Robert Sarcinella, TxDOT Materials Brach Manager/Construction Division and his staff, went to MFG Texas to inspect the fabricated beams for approval and noted, "This project's production went as if it were on steroids…MFG took lessons learned from the first project and fabricated the beams more quickly and with better quality than before via their vacuum process."

ASSEMBLY/INSTALLATION:
Once completed, the beams were cured, trimmed and assembled with shear transfer members (brace bars) that included flange plates/tubes across every 16" in a 50' beam. Holes were drilled into the vertical sides and brace bars (2" diameter) were inserted through the beam at the top of the webs (lips) on either side. The beams were placed at 4'-0" centerto-center spacing with the concrete reinforced deck placed on top. The deck was then tied to the beams with horizontal pipe (2.6" deep x 2.3" wide) close to the top of beams. The concrete deck pour was deep enough to engage the brace pipe for optimal strength to tie the beams to the deck. The goal was to achieve composite action between the beams and the deck; creating an inflecture-solid connection between the deck and beams.

ACOUSTIC EMISSION TESTING:
Prior to installation, in April 2007, Beam Nos. 1 and 2 were given the Acoustic Emission Evaluation Test by The University of Texas at Arlington's Guillermo Ramirez, PhD and Paul Ziehl PhD from the University of South Carolina. The tests monitored emission during the background check prior to loading, during load holds, and during the background check after completion of loading.
The test threshold was 40 dB and the evaluation threshold was 48 dB. The main sensors used were type R15I (resonant in the range of 150 kHz) manufactured by Physical Acoustics (PAC). Broadband sensors were used for supplemental evaluation. Activity from the R15I sensors was monitored and recorded with a 24-channel Transportation Instrument; also manufactured by PAC.

According to Dr. Ramirez, "The test verifies the performance of the beams under the load criteria set forth by the project specifications. The beams performed well during load testing— passing the major criteria selected for the Acoustic Emission test. In fact, the beams' stiffness tested better than expected substantiating their ability to sustain in service loads." Ramirez added, "The beams looked very nice, with no visible flaws. The method of fabrication resulted in a very good product."

RESULTS / CONCLUSION:
Roy Tijerina, Superintendent for Haas-Anderson Construction, assessed the short term benefits of the FRP beams stating, "They delivered all the FRP beams in one truck and handling and installation were easier; using a small crane or large track hoe vs. multiple cranes with steel or concrete options.
This means minimal equipment and people are required; which equates to built-in time and cost efficiencies on the project." Tijerina concluded that, "In addition to the lightweight FRP beams allowing for rapid onsite deployment, its material strength over time will reduce maintenance costs on the overall construction of the bridge."
A post-construction assessment by TxDOT/Federal Highway Administration Division Bridge Engineer Peter Chang noted, "The funding to promote the new fiberglass girder technology was allocated by TxDOT as a research project. With the load testing calculated and installation complete, the beams are actually stronger than we anticipated, thus proving the research positive."

CORPORATE PROFILE:
MFG Construction Products Company, formed in 1962 and a charter member of the World of Concrete, manufactures a complete range of one-piece round column forms (RCFs), dome and pan forms for one-way and two-way joist slab floors, and customer forms for cast-in-place concrete construction applications. Made of fiberglass-reinforced thermo-set composites, MFG concrete forms can significantly reduce finishing costs and are fully re-usable.
Comprised of twelve key entities in eight states Molded Fiber Glass Companies (EST: 1948) has been a pioneering force in optimizing resins and fiber reinforced polymer (FRP) materials and continues to build strength through focused diversity in providing superior composite material solutions worldwide.

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Bridge Strengthening Research

These days, a drive across a bridge is not always a pleasure cruise. Mindful of the war on terrorism, it can often be a cautious experience.

In one scenario, someone sets off a series of bombs to weaken the cables and the key structural connections of a major city bridge, all during rush hour. Not easy to do, but now thinkable. This summer, the possibility of sabotage was quickly examined—then dismissed—when the I35W bridge in Minneapolis tragically collapsed into the Mississippi River.
As authorities monitor and stand guard over bridges, the Homeland Security Science & Technology Directorate is looking to scientists and engineers for the security technologies of tomorrow. What if, for instance, we could one day not only guard bridges but fortify them? Like Superman's blue suit, what if the cables and connections on bridges could be shielded with protective sleeves or covers, making them nearly impossible for the villains to penetrate?
This is the goal of the Directorate's bridge-strengthening research. Through a partnership with the U.S. Army Corps of Engineers' Engineer Research and Development Center, the Directorate's Infrastructure and Geophysical Division is testing current bridge designs and investigating advances in steel and reinforced concrete to explore whether such shields could work.

The first step is to determine which bridges and materials are most vulnerable, says Stanley Woodson, who oversees the project at the Center's Geotech and Structures Lab. A major focus, he says, are the cables and the support columns—or towers—that are used in the cable-stayed design of bridges. Unlike the cables of a suspension bridge, which are attached from tower to tower, the cables in a cable-stayed bridge are connected directly to accessible points along the horizontal bridge deck.
"In controlled experiments, Woodson's team has been re-creating the forces holding up these bridges and blowing up samples of their cables using various kinds of explosives," say Dr. Mary Ellen Hynes, director of the research. "They then use sophisticated software to analyze the impact and results."
"We tension the cables just like a real bridge," Woodson explains. "We want to see just how they'd react in an actual terrorist event."

The next step will be more complicated, says Woodson: Determining what material would suffice for another layer of protection, and what form it should take. "We're looking at the practical as well as the innovative," he says, recognizing the potential for high costs.

By the end of 2008, Woodson and his team will be imitating concrete bridge towers and subjecting them to the same explosive testing.

Source: http://www.sciencedaily.com

New Delft material concept for aircraft wings could save billions

Building aircraft wings with a special aluminium fibre combination makes them nearly immune to metal fatigue. The application of this technology, partly developed at TU Delft, will lead to substantial savings. The unusual qualities of this special material (called CentrAl, an abbreviation of Central Reinforced Aluminium) can make a significant contribution to the development of truly energy-efficient, 'green' aircraft. Lower fuel consumption and reduction of maintenance costs could lead to worldwide savings as high as €75 billion.
Fatigue is a phenomenon that affects materials after long-term exposure to cyclic loading. As a result of varying loads, fractures eventually occur. The new, high-quality CentrAl aluminium constructions are stronger than the carbon fibre reinforced plastic (CFRP) constructions that have recently been used in aircraft wings such as the Boeing 787. By using CentrAl wing constructions, the weight can be reduced by another 20 per cent compared to CFRP constructions. Furthermore, using CentrAl results in considerably lower manufacturing and maintenance costs.
The CentrAl concept comprises a central layer of fibre metal laminate (FML), sandwiched between one or more thick layers of high-quality aluminium. This creates a robust construction material which is not only exceptionally strong, but also insensitive to fatigue. The CentrAl technique allows for simple repairs to be carried out immediately, as is the case in aluminium constructions, – but not the case when using CFRP constructions.
This patented new concept is one of the results of an intensive collaboration between the company GTM Advanced Structures, founded in The Hague in 2004 and specialising in new aircraft materials and constructions, the American aluminium company Alcoa, and the Faculty of Aerospace Engineering of TU Delft. During a conference in Delft (Conference on Damage Tolerance of Aircraft Structures: 25-28 September 2007), GTM and Alcoa will present the new concept to international experts in the field of metal fatigue and damage sensitivity of aircraft constructions. The US Air Force, Alcoa and GTM will also shed new light on the fact that the new CentrAl materials create possibilities for so-called 'Carefree structures'. These are aircraft constructions that are less sensitive to damage caused, for example, by fatigue, hail storms, other weather phenomena, trucks that collide with the aircraft and corrosion. Carefree aircraft constructions will be characterised by significantly reduced maintenance costs.

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For more information on the conference, visit the official website: www.dtas2007.nl.

Quickly Assembled Bamboo Bridge, Strong Enough for Trucks, opens in China

USC professor's sustainable design is the first of its kind: 10-meter span in Hunan province was assembled in days without heavy equipment and easily carries 8-ton vehicles.

In China bamboo is used for furniture, artwork, building scaffolding, panels for concrete casting and now, truck bridges. Yan Xiao, a professor at the University of Southern California Viterbi School of Engineering is the designer of a new span in the village of Leiyang, Hunan Province, which formally opens for traffic December 12.
Made from pre-fabricated structural elements, the bridge was erected within a week by a team of eight workers without heavy construction equipment. While traffic on the Leiyang bridge will be limited to the 8-ton design capacity, preliminary tests on a duplicate bridge erected on the campus of Hunan University have shown much higher strength -- tests are continuing.

The 10 meter long modern bamboo bridge under construction. (Credit: Yan Xiao, Image courtesy USC Viterbi School of Engineering)

The new bridge is the latest installment in research on structural bamboo being carried on by Xiao, who in addition to his appointment at the USC Sonny Astani Department of Civil and Enviornmental Engineering holds an appointment at the College of Civil Engineering of the Hunan University, China.
Last year, Xiao demonstrated a high capacity bamboo footbridge, which was a featured attraction at a recent conference organized by Xioa in Changsha, China.
Prof. Xiao expects his modern bamboo bridge technology to be widely used in pedestrian crossing, large number of bridges in rural areas in China, as a environmental friendly and sustainable construction material. Besides bridges, Xiao's team has also built a mobile house using similar technology they developed.
Meanwhile, they are also constructing a prototype 250 square meter, two-story single-family house, similar to the lightweight wood frame houses widely built in California, where Dr. Xiao lives.

Source: http://www.sciencedaily.com

Super Bolivian Bridges being built

Construction work has started on one of the three bridges being built by contractor Consorcio in Bolivia's capital La Paz. The project is costing some US$ 14.4 million in total and involves building structures measuring 247m, 223m and 227m long, according to Business News Americas. The construction work is expected to take 818 days. Consorcio is a consortium comprising Bolivian firms Incotec and Compañia Boliviana de Ingenieria, Spanish firm Prointec and Colombian company Puentes y Torones. Funding for the project is coming from the Andean Development Corporation.

Source: http://www.worldhighways.com

New Wireless Bridge Sensors Powered By Passing Traffic

Clarkson University researchers have developed technology that uses the vibrations caused by passing traffic to power wireless bridge monitoring sensors.

Wireless battery-powered sensors that monitor bridges and report changes that may lead to failure are easy to install, but it is unwieldy to provide power for the sensors. Each bridge needs at least several sensors, many installed in hard-to-access locations. Replacing millions of batteries could become a problem, adding to the expense of maintaining the bridges. The Clarkson researchers have found a way around this problem.
"We have completely eliminated the battery from the equation," says Assistant Professor Edward S. Sazonov, who developed the technology along with Professor Pragasen Pillay. "Hermetically sealed wireless sensors powered by bridge vibration can remain on the bridge without need of maintenance for decades, providing continuous monitoring of such parameters as ice conditions, traffic flows and health status."

Clarkson University Assistant Professor Edward S. Sazonov and graduate students Darrell Curry and Haodong Li check data from a wireless bridge sensor on the Route 11 bridge in Potsdam, N.Y. Clarkson researchers have developed technology that uses the vibrations caused by passing traffic to power wireless bridge monitoring sensors. (Credit: Clarkson University photo by Christopher Lenney)

The two electrical and computer engineering professors, along with graduate students Darrell Curry and Haodong Li, used the New York State Route 11 bridge, a steel girder structure, which runs over the Raquette River in Potsdam, N.Y., as a case study.
Energy was harvested by locating an electromagnetic generator on a girder. The harvester responded to one of the natural vibration frequencies of the bridge. Each time a car or a truck passed over the bridge, even in a different lane from the sensor installation, the whole structure vibrated and excited the mover in the generator, producing electrical energy. Harvested electrical energy powered unique wireless sensors that increased energy output of the harvester and consumed only microwatts of power while performing useful tasks.
Sazonov and Pillay have been invited to present their work at the Transportation Research Board of the National Academies Meeting in Washington, D.C., in January. The board provides support for their research.
They are also working on using the energy harvesting technology to power the various sensors in passenger cars.
Wireless monitoring of bridges and overpasses has gained much attention in the past few years. Bridge collapses happen suddenly and unpredictably, often leading to tragic loss of human life. In 2006, the Federal Highway Administration listed 25.8 percent of the nation's 596,842 bridges as either structurally deficient or functionally obsolete. While many of these bridges will remain in service for years, they need monitoring and rehabilitation. Currently, bridge monitoring is performed through periodic visual inspections. In the tragic example of I-35W Mississippi River bridge collapse, the bridge passed a visual inspection a year prior to failure.

Source: http://www.sciencedaily.com

Interesting website: http://www.fhwa.dot.gov/engineering/geotech/pubs/04107/index.cfm

On this website of the Federal Highway Administration of the US Department of Transportation the following report can be downloaded as a PDF.

Behavior of Fiber-Reinforced Polymer (FRP) Composite Piles under Vertical Loads

Abstract
Composite piles have been used primarily for fender piles, waterfront barriers, and bearing piles for light structures. In 1998, the Empire State Development Corporation (ESDC) undertook a waterfront rehabilitation project known as Hudson River Park. The project is expected to involve replacing up to 100,000 bearing piles for lightweight structures. The corrosion of steel, deterioration of concrete, and vulnerability of timber piles has led ESDC to consider composite materials, such as fiber-reinforced polymers (FRP), as a replacement for piling made of timber, concrete, or steel. Concurrently, the Federal Highway Administration (FHWA) initiated a research project on the use of FRP composite piles as vertical load-bearing piles.

A full-scale experiment, including dynamic and static load tests (SLT) on FRP piles was conducted at a site provided by the Port Authority of New York and New Jersey (PANY&NJ) at its Port of Elizabeth facility in New Jersey, with the cooperation and support of its engineering department and the New York State Department of Transportation (NYSDOT). The engineering use of FRP-bearing piles required field performance assessment and development and evaluation of

reliable testing procedures and design methods to assess short-term composite material properties, load-settlement response and axial-bearing capacity, drivability and constructability of composite piling, soil-pile interaction and load transfer along the installed piling, and creep behavior of FRP composite piles under vertical loads.
This project includes:

* Development and experimental evaluation of an engineering analysis approach to establish the equivalent mechanical properties of the composite material. The properties include elastic modulus for the initial loading quasilinear phase, axial compression strength, inertia moment, and critical buckling load. The composite material used in this study consisted of recycled plastic reinforced by fiberglass rebar (SEAPILETM composite marine piles), recycled plastic reinforced by steel bars, and recycled plastic reinforced with randomly distributed fiberglass (Trimax), manufactured respectively by Seaward International Inc., Plastic Piling, Inc., and U.S. Plastic Lumber.
* Static load tests on instrumented FRP piles. The instrumentation schemes were specifically designed for strain measurements. The experimental results were compared with current design codes as well as with the methods commonly used for evaluating the ultimate capacity, end bearing capacity, and shaft frictional resistance along the piles. As a result, preliminary recommendations for the design of FRP piles are proposed.
* Analysis of Pile Driving Analyzer® (PDA) and Pile Integrity Tester (PIT) test results using the Case Pile Wave Analysis Program (CAPWAP)(1) and the GRL Wave Equation Analysis of Piles program GRLWEAP(2) to establish the dynamic properties of the FRP piles. The PDA also was used to evaluate the feasibility of installing FRP piles using standard pile driving equipment. Pile bearing capacities were assessed using the CAPWAP program with the dynamic data measured by the PDA, and the calculated pile capacities were compared to the results of static load tests performed on the four FRP piles.

The dynamic and static loading test on instrumented FRP piles conducted in this project demonstrated that these piles can be used as an alternative engineering solution for deep foundations. The engineering analysis of the laboratory and field test results provided initial data basis for evaluating testing methods to establish the dynamic properties of FRP piles and evaluating their integrity and drivability. Design criteria for allowable compression and tension stresses in the FRP piles were developed considering the equation of the axial force equilibrium for the composite material and assuming no delamination between its basic components. However, the widespread engineering use of FRP piles will require further site testing and full-scale experiment to establish a relevant performance database for the development and evaluation of reliable testing procedure and design methods.

Enquiry

With interest I visited your website during my search for information on the internet for Composite constructions.
As mentioned in the header of the website: COBRAE's mission is to promote the research, development, standardisation and application of fibre reinforced polymer composites in rehabilitation, upgrade and new build bridge constructions and infrastructure applications.

Although civil engineering is not our field of activities I have the idea that creating of a bridge is possible between your field of activities (composite constructions of bridges) and ours, maritime engineering.

I am interested in further investigations / research to use the Composite theories in other maritime applications than only yachting.

What are the possibilties to use the knowledge of your organization for Composite technologies in bridges in our field of interest: maritime industry.

Thanks in advance and awaiting your reply,

Best regards,

Durk Nijdam.

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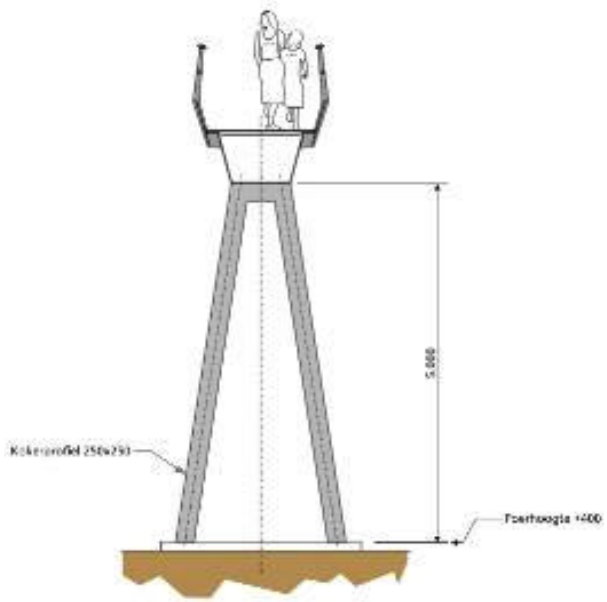
Composite pedestrian bridge in Delft

In assignment of the municipality of Delft, Netherlands a Dutch consortium consisting of Lightweight Structures B.V. (detailed engineering and manufacturing of the composite structure), Groot Lemmer B.V. (detailed design, assembly, hand rails and stairs) and Nebest B.V. (project management and design) will construct a composite pedestrian bridge, crossing the Provinciale Weg near the Stanislas College.

< ***temporary steel bridge***

The total length of the bridge is 44 m. The biggest span of the bridge is 13.5 m and the width is 1.5 m. Willembart Savelkoel made the architectural design.
The composite bridge will replace a concrete (and temporary steel) bridge using the existing foundation. The municipality of Delft asked Nebest B.V. to design a new pedestrian bridge for this site and to compare a composite design to steel and concrete. The evaluation was based on overall life-cycle costs. The main advantages of the composite structure were the fast delivery, low maintenance costs and the use of the existing foundation with minimum adjustments.



< ***cross section of bridge structure***

Due to its effective structure, optimised for manufacturing by means of vacuum infusion, the composite concept of Lightweight Structures B.V. came out best of the evaluation on overall costs. Nebest B.V. was consequently assigned the project of the realisation. The load-bearing structure will consist of 2 segments of 22 m of a glass fibre reinforced vinylester (Atlac E-Nova, DSM Composites Resins), U-shaped girder and a deck, both manufactured with vacuum infusion, the core competence of Lightweight Structures B.V. and bonded by an adhesive (Neobond, DSM Composite Resins).

Bridge with handrails, ready for transport to Delft

Installing first part and the second part on the background

Source: Lightweight Structures B.V.

COMPOSITE STRUCTURES & COMPOSITE BRIDGES EVENTS

Composite Products 2008
March 6-9, 2008, Istanbul, Turkey
http://www.kompozitfuari.com

9th World Pultrusion Conference
"Profiting from Pultruded Profiles"
Hotel Crowne Plaza Rome St. Peter's
March 27-28, 2008, Rome, Italy
http://www.briskevents.nl
info@briskevents.nl

PLASTEX - 2nd International Plastics, Rubber and Composites Fair
May 13-16, 2008. Brno, Czech Republic
http://www.bvv.cz/plastex

Internation fib Symposium 2008: "Tailor Made Concrete Structures: New solutions for our society"
May 19-22, 2008, Amsterdam, The Netherlands
http://www.fibamsterdam2008.nl

SUPPORTED COBRAE CONFERENCE
Lightweight Bridge Decks Conference II with COBRAE Session
June 18-20, 2008, Hotel Haarhuis, Arnhem, The Netherlands
This conference includes an excursion to Wesel, Germany to a Rhine Bridge Construction site.

Draft program:

- June 18	PM: Excursion to Rhine Bridge Wesel
- June 19	AM: Conference
	PM: Bridge excursion
- June 20	AM: Conference

PAPERS ON LIGHT BRIDGE DECK INNOVATIONS ARE INVITED !

http://www.briskevents.nl
info@briskevents.nl

Footbridge 2008
Third International Conference
July 2-4, 2008, Porto, Portugal
http://www.footbridge2008.com

Compotec
October 29-31, 2008, Marina di Carrara, Italy
http://www.compotec.it

N.B. COBRAE TAKES NO RESPONSIBILITY FOR THE CORRECTNESS OF THE ABOVE LISTED INFORMATION

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COBRAE

COmposite BRidge Alliance Europe

REGISTRATION FORM FOR FOUNDING MEMBERS

We wish to participate in the COBRAE group as one of the founding members.

We pay Euro 950, - for the year 2008. **COBRAE** will be an unincorporated association, which will be run by Ketel Consulting Agents B.V. in The Netherlands. The Euro 950, - is made up out of Euro 450, - for annual membership for the year 2008 and Euro 500, - for a one time joining fee. Payment can be made after receipt of invoice.
Members will receive 20% discount on all **COBRAE** activities.

COBRAE's mission is to promote the research, development and application of fibre reinforced polymer composites in rehabilitation, upgrade and new build bridge constructions and infrastructure.

Organisation	: …… (Please write clearly)		
Department	: ……	**VAT No**.: ……	
Address	: ……		
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Phone	: ……	**Fax**	: ……
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Website	: ……		
This website to be linked from the COBRAE website:		Yes / No	
Contact person	: ……		

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Date : ……

Signature : ……

Please return this registration form by fax, mail or e-mail to the **COBRAE** office.

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