FRP International

Fiber Reinforced Polymers

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Society Profile – CI

The Composites Institute

The Composites Institute (CI) is the largest division of the Society of the Plastics Industry Inc. The CI trade association is the collective and leading voice of the composites industry, with more than 375 member companies. CI was formed in 1945 and is considered to be the foremost association supporting the use of composites in construction and civil infrastructure. Among its notable programs are the Market Development Alliance (MDA), the International Composites EXPO (ICE) and Composites Design and Application (CDA) magazine.

The MDA consists of broad-based CI membership representing fabricators, processors and consultants of the industry. It acts as the coordinating body for CI's generic, pre-competitive market development activities, including development and commercialization of new composites applications. The goal of the MDA is to minimize a product's time to market by evolution from research and development through commercialization in an identified high-growth market. The MDA is currently involved with programs in two focused areas: marine/waterfront development (for example, piling) and civil infrastructure (with initiatives in concrete repair, smart structures, and dowel bars). The MDA also sponsors a variety of other efforts, such as educational courses for civil engineers and publications including "FRP Composites in Construction Applications: A Profile in Progress"; "Composites & Plastics in Construction"; a special publication of "Engineering News Record"; and the "FRP International" newsletter.

The ICE conference and trade show sponsors technical and marketing sessions about the use of FRP composites in construction and civil infrastructure applications. It is the ideal forum for networking between the suppliers of composite parts, products and components, and end-users in the construction/civil engineering community. This conference is attended by approximately 3,000 people.

CDA magazine regularly runs features and other news on the use of composites in construction and the civil infrastructure, as well as in other structural applications and markets. Recent editorial content has focused on the use of composites in bridges, concrete repair, and the marine/waterfront. In addition, the staff of CDA publishes a comprehensive buyer's guide and directory, Composites FirstSource, which lists more than 1,000 composites industry players. Also, the CI will be acting as the secretariat for a new non-profit technical society, the International Society of Composites for Construction (ISCC). The ISCC is

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the creation of a group of civil engineers, academics, and composites industry professionals to promote and support education, research, development, demonstration, and commercial application of fiber reinforced polymer (FRP) composites on a global scale. The CI's role as secretariat, working with ISCC leadership, will be membership development, meeting planning, public relations, communications, and business services. Membership will be open to professionals in the fields of construction/civil engineering, FRP composites and research.

CI is governed by an 11-member Board of Directors and includes a variety of groups that address the various marketing, technical, and regulatory issues of concern to CI members. To stay abreast of market trends and industry issues, the CI operates a flexible committee system designed to accommodate the constantly evolving industry. Member companies are encouraged to actively participate in committees that suit their individual business concerns. CI assists its members in understanding proposed, pending, and enacted government legislation, including how compliance may affect their businesses. For more information on the Composites Institute, contact Catherine Randazzo, Executive Director, 355 Lexington Avenue, 11th Floor, New York, New York, U.S.A., 10017, 212-351-5410 (telephone), 212-370-1731 (fax), crandazz@socplas.org (e-mail).

New Societies

International Society for Composites in Construction

The International Society for Composites in Construction (ISCC) is a new non-profit technical society that seeks to promote and support education, research, development, demonstration and commercial application fiber-reinforced polymer (FRP) composites in the construction industry. As the organization's name suggests, membership and activities will definitely be international in scope. The objectives of ISCC are to address the needs of its members through programs of education, research and technology transfer that encourages communication, innovation and excellence. The goals of ISCC include:

1. Promoting cooperation and understanding among all those concerned with composites in construction and related fields through the exchange of knowledge and experience.
2. Facilitating international exchange and cooperation between the current network of international composites organizations.
3. Providing training and educational programs for producers, designers, specifiers, end-users and members of academic and research communities.
4. Developing standards, codes and specifications to meet the needs of the public and industry.
5. Identifying research and development needs while encouraging application of FRP composites in construction.
6. Offering a professional and technical forum that promotes the use of FRP composites in construction.
7. Serving as a vehicle to consolidate events in popular, traditional construction and composites industry venues.

Presently, Dr. Hota GangaRao of West Virginia University (304-293-7608) is Acting President, and Dr. Charles Goodspeed of the University of New Hampshire (603-862-1443) is Acting Vice President. CI was selected to provide secretariat services (membership records, mailings, meetings, newsletters, etc.) for the first two years of ISCC operation. Bylaws have been drafted and a non-profit organization is being incorporated.

Infomercials will be offered for popular construction and FRP industry events. The first informercial occurred at CI's International Composites Exposition (ICE'97) in January 1997. The first formal ISCC technical meeting will take place later in 1997 at a traditional industry venue to be determined by the ISCC Board of Directors. Over time, ISCC hopes to use electronic communication with newsletters, a website, etc.

Membership in ISCC is international and open to professionals in the fields of construction/civil engineering, FRP composites and research. Membership categories will include individuals, organizations and students.

Persons who register their initial membership during the 1997 calendar year will be classified as "Charter Members" and will join ISCC at no cost for the first year of their membership. Thereafter, annual dues are expected to be approximately $65.00 per year as established by the ISCC Board of Directors. In order to achieve the society's objective, membership must be balanced between professionals, the civil/construction industry, the FRP composites industry, and academia.

To receive additional information regarding ISCC at no cost, call the SPI/Composites Institute's "fax-on-demand" service at 800-SPI-4614 and enter extension 8439 at the prompt.

Italian Association of Fiber Composites for the Construction Industry

The Italian Association of Fiber Composites for the Construction Industry (AICO) is a non-profit organization aimed at the promotion of the use of composites in the construction industry. AICO intends to foster the acceptance of composites in Italy by promoting research and development and educational activities among academia, government and industry, and by contributing to the preparation of construction and design guidelines, as well as codes and standards.

Membership to AICO is welcome from any of the following areas of interest: research, manufacturing, distribution, design, standardization, and application of composites for construction. Only by this collaboration and synergy, will it be possible to utilize these new materials in a safe and effective fashion.

Bylaws and application forms are available to any interested party at web site address http://www.iper.net/aico or directly from the Secretariat, Dr. Marco Arduini, LaRM, UniversitB di Bologna, 051-638-7505 (telephone), 051-638-7503 (fax) or aico@iper.net (e-mail).

New Chair for ACI 440

Dr. Sami Rizkalla is the new Chair for ACI Committee 440 - FRP Reinforcement. Dr. Rizkalla is a Professor of Civil Engineering with the Department of Civil and Geological Engineering at the University of Manitoba in Winnipeg, Manitoba, Canada. Dr. Rizkalla is also President of the Canadian Network of Centres of Excellence on Intelligent Sensing for Innovative Structures and Vice President of the Canadian Network on Advanced Composite Materials for Bridges and Structures. Dr. Rizkalla succeeds Dr. A. Nanni who was responsible for establishing and chairing the committee since 1991. Currently, ACI has 47 voting members, 48 associate members, nine consulting members and ten active sub-committees.

For more information on ACI 440, please contact Dr. Rizkalla by fax at 204-261-5465.

New Chair for ACI 440 – FRP Reinforcement.

Applications

FRP for MRI

Corrosion Proof/Hughes Brothers recently furnished approximately 4,300 linear feet of GFRP rebar for the addition of an MRI room at St. Francis Hospital in Grand Island, Nebraska, United States. The use of GFRP rebar was recommended by the vendor of the MRI unit. Rebar furnished consisted of a variety of straight lengths of #4, #7 and #6 diameters, as well as a large number of J-hooks and 90 degree bends as shown in Figure (1).

Design of the project was completed by Darin Spurling of Davis Design, Lincoln, Nebraska, United States. The contractor was Tri-Valley Builders of Grand Island, Nebraska, United States. For further information, please contact Darin Spurling by telephone at 402-476-9700.

Figure 1. GFRP reinforcement for MRI floor.

FiBRA for Ground Anchors

FiBRA cables were recently used in Japan as ground anchors in place of conventional steel tendons for the temporary retaining wall of a massive ground cut at the entrance of a bypass tunnel in Hokkaido, Japan. FiBRA ground anchors have been used to facilitate the excavation by use of conventional tunnel boring machines which can cut FiBRA cables as the excavation progresses. FiBRA cables were found to be structurally effective to support the temporary wall as shown in Figure (2).

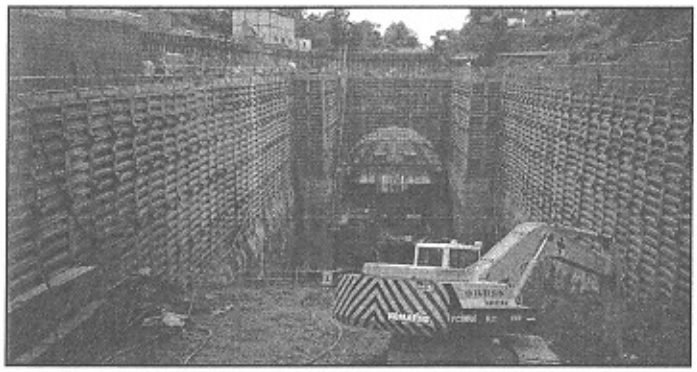

Figure 2. FiBRA ground anchors for temporary wall.

For more information, please contact Kenzo Sekijima of Shimizu Corporation by fax at 81-3-3820-5959 or by e-mail at sekijima@sit.shimz.co.jp.

FRP for Yamanashi Linear Motor Test Track

Construction of the 18.4 km Japan Railways Linear Motor Test Track in Yamanashi has already been completed. Testing will start in the spring of 1997. Aramid FRP (AFRP) Technora rods and carbon FRP (CFCC) have been used in some of the track girders as shown in Figure (3). These track girders (length 12.6 m, height 1.3 m) are of prestressed concrete, each girder being tensioned by 17, 7.4 mm two-strand multi AFRP Technora rods, and 19, 12.5 mm CFCCs. These FRPs have been used due to their non-conductive and non-magnetic properties to prevent loss of the induced current. The effect of the material characteristics on the track will be confirmed by the tests planned this year.

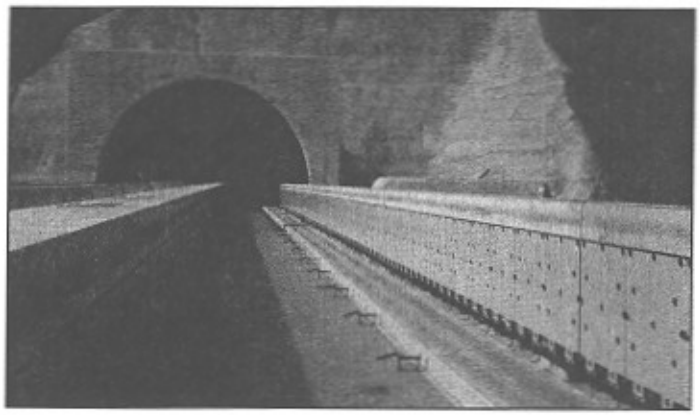

Figure 3. AFRP and CFCC for railways linear motor test track.

For more information, please contact Hisashi Hirai of Shinko Wire Company Ltd. by fax at 81-3-3272-4680.

FRP for TV Ghost Interference

Television interference known as ghosts is caused by TV signals reflecting off buildings. To counteract this occurrence in the Denki Building on Heiwa-odori Avenue in Hiroshima, electromagnetically permeable curtain walls have been adopted, see Figure (4). Steel reinforcement, the major cause of signal reflections, has been replaced by Aramid FRP rods to allow electromagnetic signals to pass through fiber reinforced concrete panels. Among other characteristics, these panels are inexpensive, lightweight and have no restrictions on the surface finish. In a wall area of 500 m², the length of 3 mm and 7 mm Aramid FRP Technora rods used totaled 21,400 m. Electromagnetic signal measurements after completion of the wall confirmed that performance was better than expected.

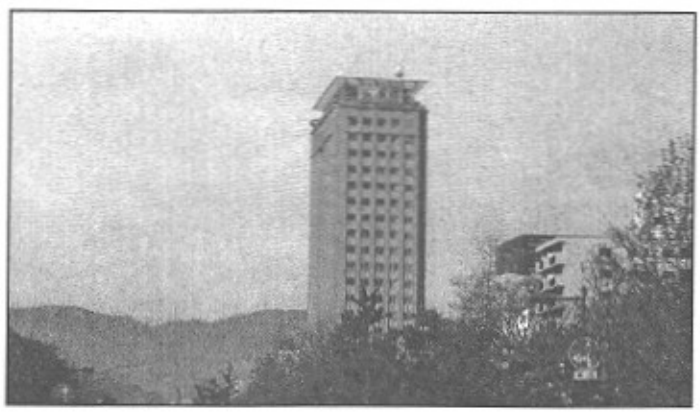

Figure 4. AFRP for electromagnetically TV permeable curtain wall.

First Hybrid I-Girder Bridge

The first hybrid fiber reinforced composite pedestrian bridge of its kind has been constructed at the Daniel Boon National Forest, Bath County, Kentucky. The 60-foot bridge is the result of an effort between GreatLakes Composites Consortium, university researchers, and composite manufacturers, in the use of advanced composite materials for infrastructure applications.

The composite pedestrian bridge was built for the United States Forest Service to provide outdoor enthusiasts access over Clear Creek, which runs through the Daniel Boone National Forest, see Figure (5). The bridge was required to be as unobtrusive in the forest environment as possible, with a design that would blend in with the remote, wilderness setting. The bridge was also required to be easily assembled, without the use of highly skilled labor or heavy equipment, and actually took three students only three days to complete.

Figure 5. Hybrid FRP I-beam bridge.

The main load carrying members are hybrid FRP I-beams, and are notable in that the flanges contain carbon fibers in addition to the fiberglass. The addition of the carbon fibers increased the bending stiffness of the beams substantially, and the beams are the first of their kind to be used in a permanent structure. Morrison Molded Fiber Glass (MMFG) pultruded the 24-inch deep beams, using Owens-Corning fiberglass, Ashland Chemical resin, and carbon fibers from Zoltek Corporation. The total design, fabrication and testing of the bridge and its components was accomplished by researchers at the University of Kentucky.

The work was completed as part of the Technology Reinvestment Project, under the direction of GreatLakes Composite Consortium. The results gained by working with this type of composite material on this particular program will lead toward the design and construction of a vehicular bridge in the future.

For more information, please contact Dr. Harik by fax at 606-257-1815 or by e-mail at iharik@engr.uky.edu.

CFRP for Catwalks of Kurushima Bridges

CFRP strand 1 x 37-Φ30 (made by Nippon Steel Corporation) and CFCC 1 x 37-Φ40 (made by Tokyo Rope Manufacturing Co. Ltd.) were used by Honshu-Shikoku Bridge Authority as stay cables for strengthening the catwalks of Kurushima Bridges (Onomichi-Imabari Route) as shown in Figure (6). CFRP cables were selected due to their light weight, high strength and outstanding corrosion resistance compared with that of conventional steel cable. Light weight CFRP cables were extremely effective in comparison to steel strands and reduced the deflection due to their light

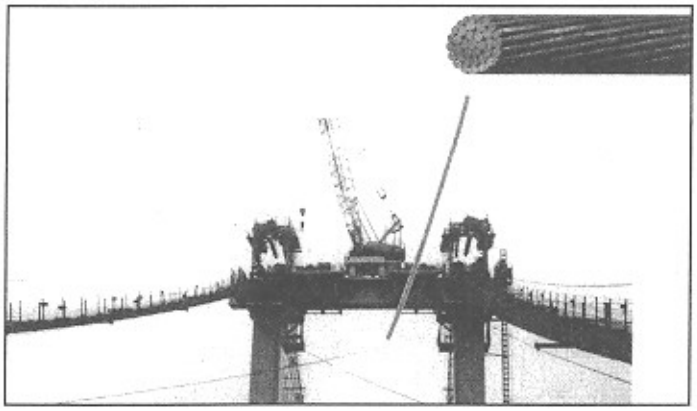

Figure 6. CFRP and CFCC for strengthening the catwalks for Kurushima Bridge.

self weight under the same tension load. The total length of CFRP cables was 1,307 m. For further information, please contact Mr. Toshikazu Takeda of Nippon Steel Corporation by fax at 81-3-3275-6791.

Carbon Fiber Composite Cable for Temporary Tendons

Carbon fiber composite cables (CFCC) were used for temporary tendons in the construction of indoor pools of Suzuka Sports Garden in Mie prefecture of Japan, see Figure (7).

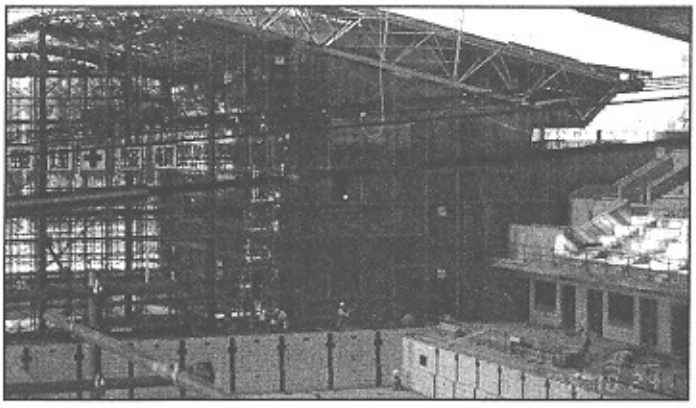

Figure 7. CFCC temporary tendons for indoor pool.

The roof of the indoor pools consists of steel trusses which are 55.5 m wide and 102.2 m long erected by the slide method. In the slide method, roof trusses, roofing material, the ceiling, mechanical equipment and electrical equipment are assembled on a working platform near the structure and erected using a hydraulic jack system. The 28 CFCC temporary tendons were used to provide lateral support of the roof structure during erection.

Selection of CFCC was due to their light weight and ability to minimize the induced stresses due to temperature variation in comparison to steel strand. The erection system proved to be efficient for such elevated roof structures and provided considerable savings of manpower and increased safety to the worker.

For additional information, please contact ISAO Hachiri by fax at 81-52-961-7427.

NEFMAC for Bridge Deck

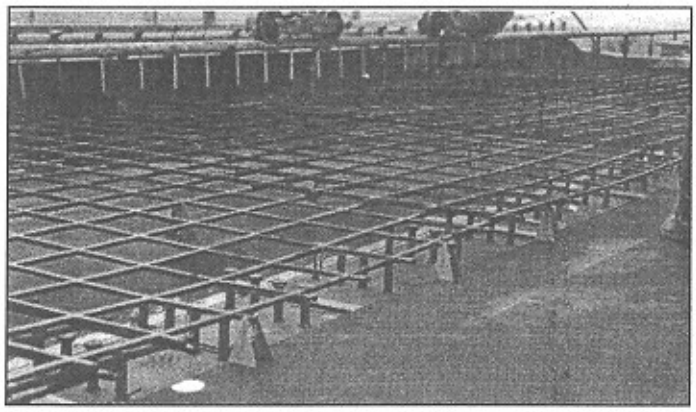

Figure 8. NEFMAC for the overhang slabs of a bridge deck slab.

The new Canadian steel-free deck slab design concept was implemented recently at two outer spans of the Chatham Bridge in Ontario, Canada. The two overhang slabs of the deck were reinforced with CFRP-NEFMACJ grids produced by AutoCon of Toronto, Ontario, Canada, as shown in Figure (8). The barrier walls in the outer two spans were also devoid of corrosive steel and reinforced with GFRP-NEFMACJ grids as shown in Figure (9). The barrier wall is connected to the deck slab with stainless steel double-headed connections. This barrier wall is known as the Ontario Bridge Barrier and its design has been verified by pendulum crash tests. The bridge opened to traffic in November 1996.

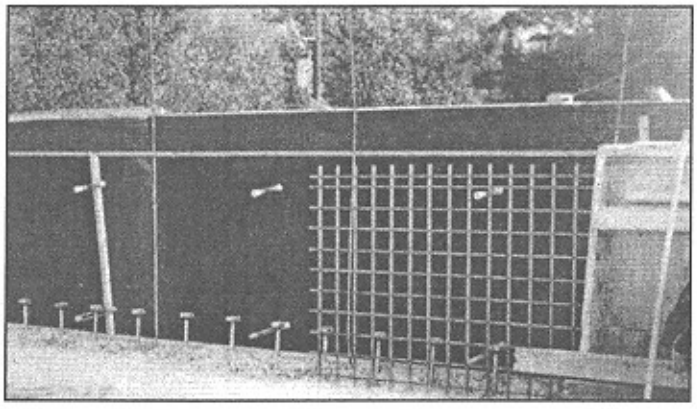

Figure 9. NEFMAC for bridge barrier wall.

Testing of the rehabilitated bridge is planned for early spring 1997. Some of the gauges installed will be monitored remotely on a long-term basis by ISIS Canada. For further information, please contact Dr. B. Bakht by fax at 416-235-2872.

Research

Strengthening of Concrete Bridge Girders

Due to increased traffic load demands, the City of Winnipeg in the Province of Manitoba, has decided to upgrade the 27 year old Maryland Bridge. Carbon fiber reinforced polymer

(CFRP) sheets provide an excellent solution for strengthening since they are extremely lightweight, corrosion-free, and have high tensile strength. When compared with conventional strengthening methods, this technique provides substantial economic benefits and a significant reduction in construction time.

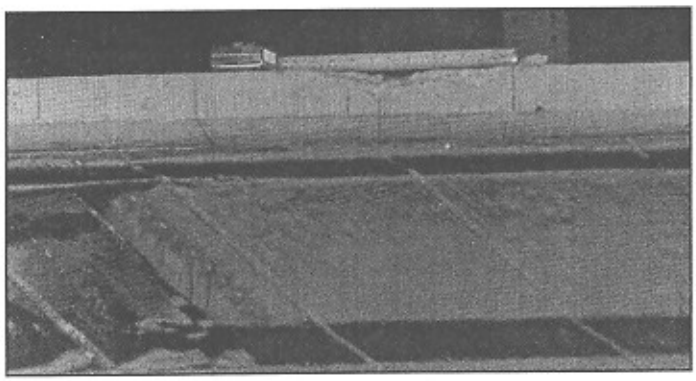

Figure 10. CFRP sheet configuration proposed for Maryland Bridge.

Scale models of the Maryland Bridge girders strengthened with CFRP were tested at the Structures Laboratory at the University of Manitoba, as shown in Figure (10). The first girder tested without any strengthening was used as a control specimen. To date, six different configurations of CFRP sheets have been used to strengthen the prestressed girder. Significant improvements in the shear capacity have been observed. Test results will be used for the design and construction of Maryland Bridge, Winnipeg, Manitoba, Canada.

For more information, please contact Dr. Sami Rizkalla by fax at 204-261-5465.

Products

New Composite System for Strengthening Concrete and Masonry

A system for strengthening concrete and masonry structures and surfaces, has been introduced by Master Builders, Inc. This technology consists of advanced composite materials with system-specific impregnating resins, surface primers and puttys to provide superior external reinforcement and protection compared to conventional strengthening systems.

In launching this new repair system, Master Builders, Inc. has signed a Letter of Intent with the Tonen Corporation of Japan to promote and distribute their FORCA Tow Sheet, both a carbon and glass fiber composite-based technology used for concrete repair and strengthening applications. The Tonen design and application technology, with more than 1,000 field applications already completed in Japan, is the cornerstone of the new MBrace system.

To protect the quality and integrity of the MBrace system, installation will be done only by contractors trained in this technology. Master Builders, Inc. has entered into an alliance with Structural Preservation Systems, Inc. of Baltimore, Maryland in the United States to serve as the master contractor, providing technical support and training for other contractors interested in installing the MBrace composite strengthening system.

The MBrace system represents a new era in concrete repair, offering an alternative to steel plate bonding, enlargement of members with conventional concrete and external post tensioning. It can be used to solve complex repair challenges in a cost-effective manner, while offering ease of application, versatility and long-term performance benefits.

FRP Gritted Panels for Bridge Sidewalk

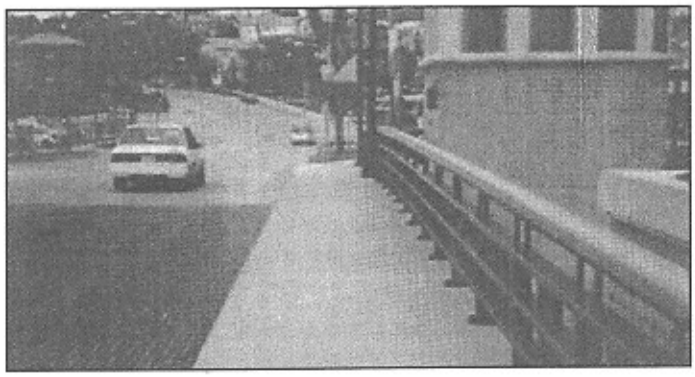

Figure 11. SAFEPLATE™ fiberglass panels for sidewalk.

The City of Milwaukee, Wisconsin, in the United States uses SAFPLATE™ fiber glass gritted plate panels, produced by MMFG, on pedestrian walkways on two of the city's canal bridges as shown in Figure (11). The two bridges are lift-type canal bridges which allow boats to pass through the canal and are designed for truck, car and pedestrian traffic. The corrosion resistant fiberglass plates are expected to double the life cycle as compared to similar steel panels which were heavy and experienced severe corrosion due to the environmental conditions. For further information, please contact Vicki Clark by telephone at 540-645-8143 or by fax at 540-645-8132.

New Structural Shape

MMFG is currently producing a new FRP twin-webbed I-section with transverse stiffeners as shown in Figure (12). By optimizing the geometry, fiber types and fiber orientation, this new structural shape has improved the load-bearing capacity of structural members which can be used for new construction and in the rehabilitation of infrastructure-related applications. The structural member has been pultruded in both vinyl ester and phenolic resin systems. First application of this

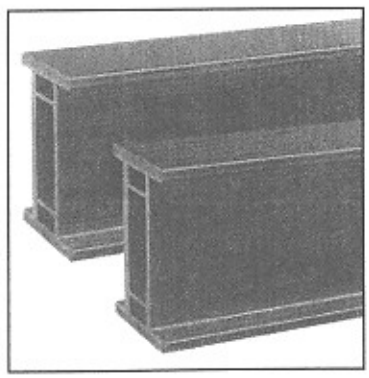

Figure 12. FRP twin-webbed I-section.

type of structural member is scheduled for June 1997 on an 18 ft. short-span vehicular bridge in Blacksburg, Virginia, in the United States. For further information, please contact Vicki Clark by telephone at 540-645-8143 or by fax at 540-645-8132.

Publications

ACC Newsletter

Since founded in 1991, the ACC Club of Japan has been promoting the development and application of FRP tendons or reinforcements in the construction industry. Since 1995, ACC started publishing a newsletter entitled "ACC Topics" to publicize applications of FRP and activities of the club. The newsletter consists of four pages and is published bi-annually. The Chief Editor is Mr. Kenzo Sekijima of Shimizu Corporation, who is also an Associate Editor of "FRP International". For more information, please contact Tatsuhiko Iwasaki, Secretariat of ACC Club, by telephone at 81-3-3231-0690 or by fax at 81-3-3242-7584.

ACI – FRP Student Competition

Seven teams of undergraduate engineering students from universities in the United States and Canada competed in the First Annual Student Competition, FRP Composites, held in conjunction with the American Concrete Institute's Fall Convention in New Orleans, Louisiana, United States, November 3 to 8, 1996. Their challenge was to design and construct a 5.5 inch by 2.5 inch concrete beam using fiber reinforced polymer (FRP) bars as reinforcement. The beams were subjected to a concentrated load applied at the center of a three foot span and were tested to failure. Prizes totaling $2,000 were awarded in two categories: Highest Ultimate Load and Most Accurate Prediction of Load and Deflection.

The purpose of the contest, to be held annually at the ACI Fall Convention, is to increase student awareness about the use of advanced composites with cement-based materials and to encourage fresh thinking on the utilization of new materials in infrastructure applications.

Tulane University hosted the competition, which received financial support from Owens-Corning and Reichold Chemicals. Marshall Industries Composites supplied the FRP reinforcement. The assistance of Professor John Niklaus of Tulane University, who coordinated testing arrangements and construction of the test rig, is gratefully acknowledged. The contest, which was organized by ACI Committee 440 on FRP Reinforcement, is open to all undergraduate students enrolled on a full or part-time basis at any college or university world-wide.

The seven schools which sent student teams to the competition were: University of Missouri-Rolla, University of New Hampshire, North Carolina State University, Pennsylvania State University, Université de Sherbrooke (Canada), University of South Florida and Winona State University. First place honors in the Highest Ultimate Load category went to North Carolina State University with student team members John Calvin, Jeremy Connell, Jonathon Godfrey, Maria Hedman-Swift, Tony Ledesma and Faculty Advisor, Dr. Neven Krstulovic-Opara. Université de Sherbrooke with student team members Genevieve Marchaho, Yanick Martin, Alexandre Meilleur, Frederic Michel and Faculty Advisor, Dr. Brahim Benmokrane, placed second, while Winona State University was third. Winona State's team consisted of Chad Jennings and Jeremy Schmoll, with Faculty Advisor, Dr. Beckry Abdel-Majid. The first, second and third prize winners in the Most Accurate Prediction Category were Université de Sherbrooke, see Figure (13), North Carolina State University and Winona State University. In addition to cash prizes the winners also received a trophy, award certificates, subscriptions to FRP International and CDA Magazine, and free admission to the 1997 Composites Institute Conference and Exposition.

The competition will be held again in November of 1997 in Atlanta as part of the student activities associated with the ACI Fall 1997 Convention. For further details, please contact Dr. Vicki L. Brown by telephone at 610-499-4607, by fax at 610-49-4059 or by e-mail at vicki.l.brown@widener.edu.

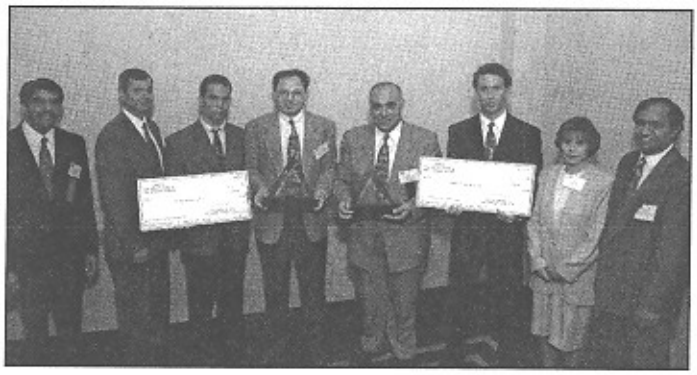

Figure 13. Université de Sherbrooke (Canada) along with organizers and sponsors.

University Theses

Tighiouart, B., 1997. Bond of Fibre Reinforced Polymer (FRP) Reinforcing Bars Embedded in Concrete (in French). Ph.D., Université de Sherbrooke, Sherbrooke, Québec, Canada. Supervisor: Dr. Brahim Benmokrane.

Chekired, M. 1996. Load Transfer Mechanisms of Instrumed Post-Tensioned Ground Anchors (in French). Ph.D., Université de Sherbrooke, Sherbrooke, Québec, Canada. Supervisor: Dr. Brahim Benmokrane.

Conferences

The National Seminar on Advanced Composite Material Bridges - Advancing FRP Bridges and Structures into the 21st Century, Washington, D.C., May 5 to 7, 1997. For further information, please contact Barbara Murdock in Washington at 202-289-8100.

42nd International SAMPE Symposium/Exhibition - Evolving Technologies for the Competitive Edge, Anaheim Convention Center, Anaheim, California, May 5 to 8, 1997. For further information, please fax 818-332-8929 or e-mail at 102022.3113@compuserve.com.

Canadian Society for Civil Engineering 25th Annual Conference, Sherbrooke, Québec, May 27 to 31, 1997. For further information, please contact the Department of Civil Engineering at the Université de Sherbrooke in Québec by fax at 819-821-7974.

1997 International Conference on Engineering Materials, Citadel Ottawa Hotel, Ottawa, Canada (covers repairs and rehabilitation materials and FRP materials), June 8 to 11, 1997. Please contact Akthem Al-Manaseer at Bradley University, Peoria, Illinois, U.S.A., by fax at 309-677-2867.

International Conference on Rehabilitation and Development of Civil Engineering Infrastructure Systems, Beirut, Lebanon, June 9 to 11, 1997. For further information, please contact the American University of Beirut by e-mail at mharajli@aub.edu.lb.

Fourth International Conference on Composites Engineering (ICCE/4), Khola Coast, Hawaii, July 6 to 11, 1997. For further information, please contact Dr. David Hui of the University of New Orleans by telephone at 504-280-6652, by fax at 504-280-5539 or by e-mail at dxhme@uno.edu.

The Seventh International Conference and Exhibition - Structural Faults and Repair '97, Edinburgh, Scotland, July 8 to 10, 1997. For further information, please fax 44-131-452-8596.

US-Canada-Europe Workshop on Bridge Engineering, Dubendorf and Zurich, Switzerland, July 14 and 15, 1997. For further information, please call +41-1-823-4200 or fax +41-1-821-62-44.

First Engineering Foundation Conference on High Strength Concrete, Kona, Hawaii, July 13 to 18, 1997. For further information, please contact the Engineering Foundation by telephone at 212-705-7836, by fax at 212-705-7441 or by e-mail at engfnd@aol.com.

The Fourth International Kerensky Conference - Structures in the New Millennium, Hong Kong, China, September 3 to 5, 1997. For further information, please contact the Conference Secretary by fax at 852-2559-5337 or e-mail at civilcom@hkucc.hku.hk.

International Conference on Composite Construction - Conventional and Innovative, Innsbruck, Austria, September 16 to 18, 1997. For further information, please call +41-1-633-2647 or fax +41-1-371-2131.

International Workshop on Structural Health Monitoring, Stanford University, Standford, California, United States, September 18 to 20, 1997. For further information, please contact Professor Fu-Kuo Chang by fax at 415-725-3377 or by e-mail at fkchang@eland.stanford.edu.

FRP in Corrosion and Construction 10th International Technical Conference and Exhibition, Caesar's Palace, Las Vegas, includes infrastructure and building, September 22 to 25, 1997. Contact SPI Western Composites Institute by fax at 714-261-6959 or by e-mail at dplummer@socplas.org.

Third FRP International Symposium on Non-Metallic (FRP) Reinforcement for Concrete Structures, Sapporo, Japan, October 14 to16, 1997. Contact: Secretariat FRPRCS-3, Japan Concrete Institute, TBR - 708, 5-7 Kojimachim Chiyoda-ku, Tokyo 102, Japan.

5th Japan International Sampe Symposium and Exhibition (JISSE-5), Tokyo, Japan, October 28 to 31, 1997. For further information, please contact Prof. M. Yamabe of the Kanazawa Institute of Technology by telephone at +81-762-94-6703, by fax at +81-762-94-0183 or by e-mail at yamabe@neptune.cisp.kanazawa-it.ac.jp.

Composites '97, jointly sponsored by the Composite Fabricators Association (CFA) and the Society for Advancement of Material and Process Engineering (SAMPE), October 29 to November 1, 1997, Orlando, Florida, United States. For further information, please contact the CFA at 703-610-9025.

Second International Conference on Composites in Infrastructure (ICCI'98), Tucson, Arizona, January 12 to 14, 1998. For further information, please visit their website at http://engr.arizona.edu/~ICCI.

8th European Conference on Composite Materials - Science, Technologies and Applications (ECCM-8), Naples, Italy, June 3 to 6, 1998. Deadline for abstracts is April 28, 1997. For further information, please contact Professor A. Langella by fax at +39-81-761-4212 or visit the conference internet site at http://www.eccm98.etruria.net.

Second International Conference on Concrete Under Severe Conditions, Tromsr, Norway, June 21 to 24, 1998. For further information, please contact professor O. E. Gjrrv of the Norwegian University of Science and Technology by telephone at +47-73-59-45-48, by fax at +47-73-59-45-51 or by e-mail at bml@bygg.ntnu.no.

The Structural Engineers World Congress (SEWC), San Francisco, July 18 to 23, 1998. For further information, please contact Dr. N. K. Srivastava by fax at 506-858-4082.

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