FRP
Fiber Reinforced Plastics
International
Summer, 1996 Volume IV, Issue 3

Society Profile – JCI

The Japan Concrete Institute (JCI) was established in July 1965 as the "Japan National Council on Concrete" after the formation of "Japan ACI", the Japan Chapter of the American Concrete Institute in 1962. The name of the organization was changed in May 1975 to the "Japan Concrete Institute". Membership includes both individuals and organizations. The total membership at present is approximately 7,500. The purposes of the Institute are to carry out investigation and research related to concrete, disseminate the results and promote the developments towards the advancement of concrete technology.

Research activities are carried out by sub-committees of the "Research Committee" for each research theme. The current research topics include; a) Repair methods for concrete structures, b) marketing of precast concrete structural members, c) Concrete modelling, d) Mechanical models of fresh concrete, e) Utilization of concrete sludge, f) Chemical reaction and process analysis, g) Ecological concrete, h) Autogenous shrinkage of concrete and, recently, in August 1995, a new research sub-committee on "Continuous Fiber Reinforced Concrete" chaired by Professor Kyuichi Maruyama.

The investigations by the subcommittees are published in the form of reports in the Institute's official publication, the "Concrete Journal", which is published monthly. Selected foreign publications are translated and published in the Institute journal. A convention is held annually in addition to various symposiums and seminars offered from time to time on the latest research topics. Outstanding research papers or construction reports that have contributed to the advancement of concrete engineering are honoured with the "Japan Concrete Institute Awards".

The main purpose of the Continuous Fiber Reinforced Concrete Sub-committee is to promote the use and development of FRP for concrete structures in Japan. The committee currently actively supports the Third International Conference to be held in Sapporo, Japan, October 14 to 16, 1997. The sub-committee is divided into three working groups with the following specific objectives:

WG1: To establish design code utilizing the current design guidelines currently available from the Japan Society of Civil Engineers (JSCE) and the Architectural Institute of Japan (AIJ).

WG2: To write the state-of-the-art report on repair and strengthening of concrete structures using FRP.

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• Composite Institute • Japan Concrete Institute • ACMBS Network of Canada • ISIS Canada •

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WG3: To study the effectiveness of using FRP for civil engineering applications.

JCI has exchange activities with many overseas organizations and has had a long close relationship with the ACI. The official publication, the "Concrete Journal" is the successor to the journal previously published by the Japan ACI Chapter. In the Japan-US joint seminars co-sponsored by the Japan Society for the Promotion of Science and the US National Science Foundation, JCI and ACI have served as the contact organizations for the respective countries when the theme is related to concrete. JCI is also a member of CEB (Comité Euro-International de Béton) since 1970 and an Associate Member of RILEM (International Union of Testing and Research Laboratories for Materials and Structures) since 1983.

For more information, please contact Associate Editor, Dr. H. Mutsuyoshi.

Applications

Aramid FRP Ground Anchor

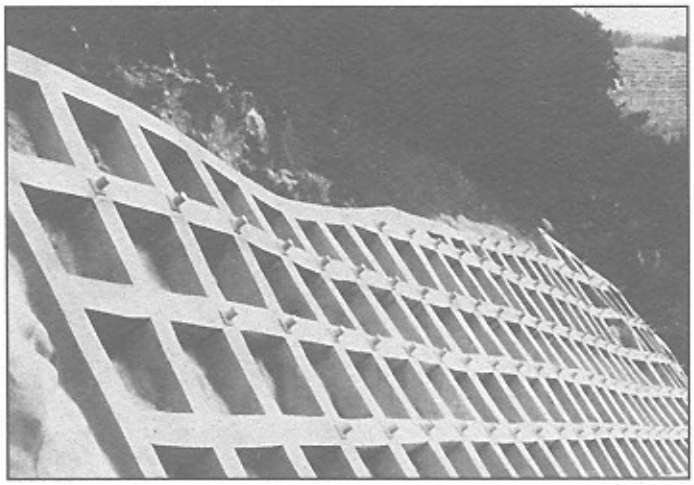

Figure 1. Aramid FRP for Ground Anchor

Technora® Aramid FRP ground anchor was certified last year by The Japanese Civil Engineering Research Center which is a certificating organization of the Construction Department in Japan. The first application of this technique was on the landslides of the slopes beside the Kawabe River in Kumamoto prefecture Japan, as shown in Figure 1. The anchors consist of 7.4 mm diameter Technora® rods, used as nine multicables for 7 to 10 meter lengths. Seamless bags, made by Technora® aramid fiber, were also used as a technique to prevent the outlfow of the grout cement paste into the rock cracks.

Fiber Optic Sensors in the PEI Fixed Link

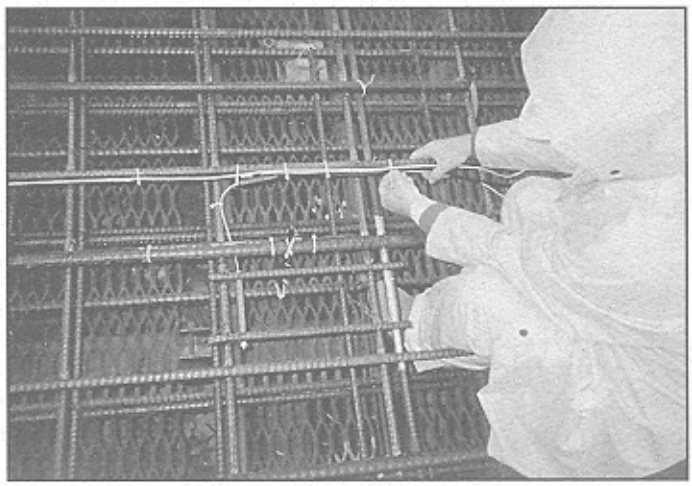

Figure 2(a). Fiber Optic Sensors Attached to Reinforcing Bars

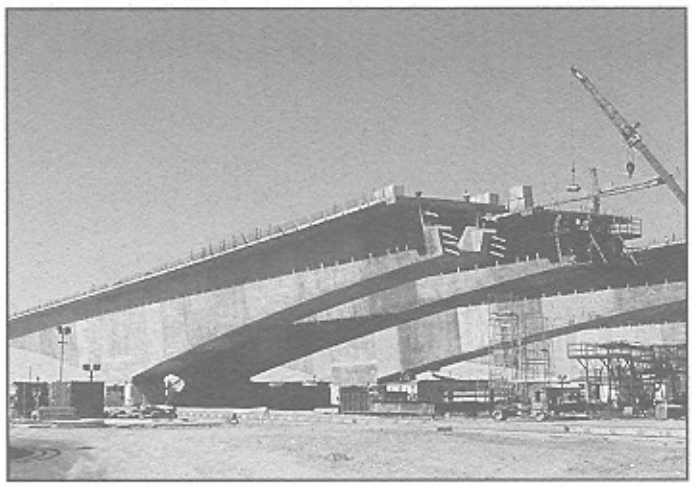

Figure 2(b). PEI Main Girders

Members of the ISIS Canada research team at the Technical University of Nova Scotia recently installed fiber optic strain sensors in one of the main girder segments of the PEI Fixed Link (Figure 2). Six fiber optic Bragg grating sensors were bonded to six pieces of 2.0 m long reinforcing bars. The sensors are used to measure strain in the concrete, with the reinforcing bar acting as the gauge length. The readings will be compared to values obtained from vibrating wire strain gauges in the same location. For more information, please contact Dr. Mufti by facsimile at 902-422-8380 (Canada).

Guideway for Yamanashi MAGLEV Test Line

MAGLEV (linear motor car, capable of travelling at a speed of 500 km/hr or higher) Test Line is now under construction. The total length of this test line is 43 km, with the first 18 km scheduled to open in the spring of 1997. NEFMAC C10 has been utilized as reinforcement for the beam-type guideways

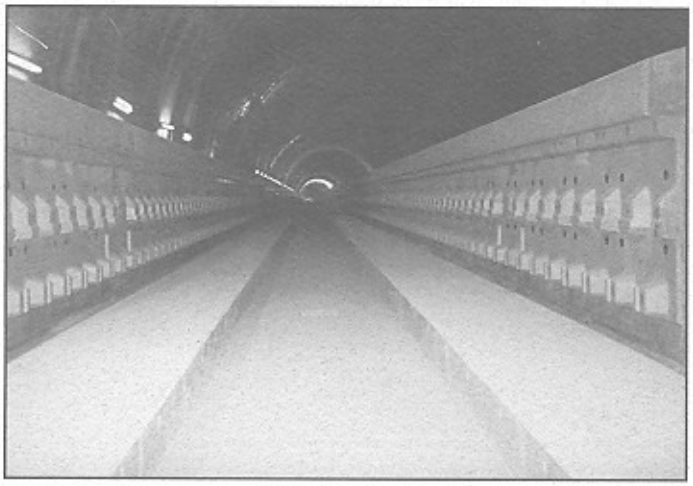

Figure 3. Guideway for Yamanashi MAGLEV Test Line

as shown in Figure 3. The decision to use NEFMAC was not only due to its non-magnetic property but for its simple and prefabricated form which simplifies construction, especially with these complicated forms. For more information, please contact Mr. Kenichi Sekine, Manager of NEFCOM Corporation, by fax at 81-3-3254-9210 (Japan).

Carbon Fiber Plates for Ohio Bridge

Figure 4.0 Carbon Fiber Plates for Ohio Bridge

Carbon fiber plates, originally developed for aerospace application, have been used for strengthening a concrete highway bridge in Butler Country, Ohio (Figure 4). The main purpose of this field demonstration is to assess the durability of this material under severe environmental conditions. The plates were applied using a vacuum bag system. For further information, please contact John Mistretta, Department of the Air Force, Wright Laboratory (AFMC), Wright-Patterson Airforce Base, Ohio or by fax at 513-476-4706 (USA).

Aramid Tape for Seismic Strengthening

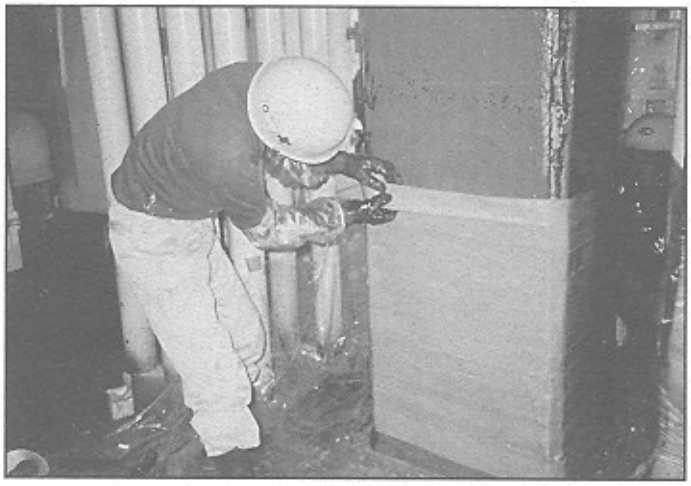

Figure 5. Winding of Aramid Fiber Tape

Mitsui Construction Company in Japan has developed FITS System for strengthening existing concrete structures spirally winding aramid tape around the columns. The method has been applied to more than ten retrofitting projects of old buildings. As an example, repair work to an old factory is shown in Figure 5. The installation was performed in a relatively tight space. The method makes use of the flexibility and the lightweight of the fibers and, therefore, has many advantages in comparison to the use of conventional welded steel plates. The technique does not also require any skilled welders or equipment to handle the materials. Test results conducted at Tokai University by Professor Tomoya Nagasaka indicated that this method also increased the column's shear capacity. This method is excellent in repairing deteriorated chimneys (Figure 6) due to the exposure of exhausted sulfurous acid gas. For further information, please contact Dr. T. Okamoto of Mitsui Construction by fax at 81-3-5821-7640 or by e-mail at ldx04053@niftyserve.or.jp (Japan).

Figure 6. Repair Work for Deteriorated Chimney

Supercover concrete

Figure 7. Supercover Concrete

Since 1994, researchers at London's South Bank University have been developing a new and patented technique for preventing corrosion of the reinforcements in concrete structures, based on using rods made of GFRP. The technique called supercover concrete involves using traditional steel reinforcement together with concrete covers of around 100 mm with a limited amount of GFRP at a nominal depth of 30 mm to control cracks in the concrete cover. The GFRP is attached to the main steel and offset with spacers.

The research team believes that this method holds many attractions for engineers since it only marginally increases the construction costs. Any deterioration of the GFRP is not expected to compromise the strength of the structure.

To demonstrate these aspects, a 17-foot long footbridge, shown in Figure 7, was recently designed and constructed in Oxfordshire using this system. The system is concealed in the slab which forms the bridge deck. Electrical strain gauges, resistivity probes and humidity and temperature sensors have been cast into the slab and connected to data loggers housed in a cabinet alongside the bridge. These will be used to continuously monitor the performance of the bridge over the next three years. This project will not only serve to illustrate the viability of this method but could also pave the way to the greater use of GFRP as a reinforcing agent for concrete. The GFRP rods used in this work were supplied by International Grating Inc. of Houston, Texas. For further information, please contact Dr. C. Arya, Division of Civil Engineering, South Bank University, Wandsworth Road, London, SW8 2JZ or by fax at 171-815-7399 (United Kingdom).

CRP Ground Anchors

CFRP Ground Anchors using Leadline were used for a slope stability project (Figure 8) authorized by the Kinki Regional Bureau of the Ministry of Construction. The ground anchors

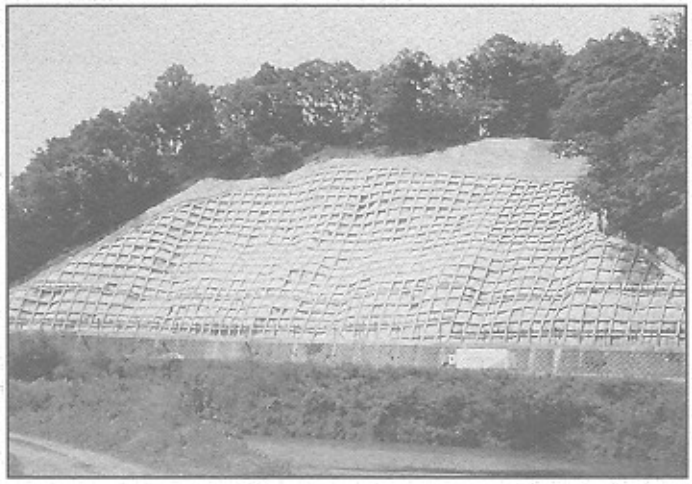

Figure 8. CFRP Ground Anchors

in this project were multiple tendons consisting of 2 x 8 mm diameter Leadline rods. Tendons were tensioned at 14 ton and the anchor length varied between 7.2 to 20 meters. A total length of 6,000 meters was used in this site. CFRP Ground Anchors were used in this project due to their lightweight and high tensile strength, which allowed the work to be completed smoothly on a high altitude site with limited space. For more information, please contact Mitsubishi Canada Limited, 2800 - 200 Granville Street, Vancouver, British Columbia, V6C 1G6, or by fax at 604-654-8222 (Canada).

Technora® for External Strengthening

Technora® deformed rods were used by the Japan Highway Public Corporation (JHPC) as external cables for the Amagawa Bridge No. 3 on the Himeji Bypass. The bridge was strengthened by converting the original simple girders into continuous girders (see Figure 9). The bridge consists of two simple span prestressed concrete T-girders each 23.4 m long and an effective width of 13.8 m. The technique adopted was developed jointly by the JHPC and Sumitomo

Figure 9. Anchor Blocks of Amagawa Bridge

Construction Co., Ltd. Six tendons, each consisting of 9 x 7.4 mm diameter, were used the for prestressing. The total length of Technora® rods used was 3,020 m. For more information, please contact Mr. Shinichiro Kumagai, Civil Engineering Division, Sumitomo Construction Co., Ltd., by fax at 81-3-3353-6656 (Japan).

Arapree for Concrete Floor

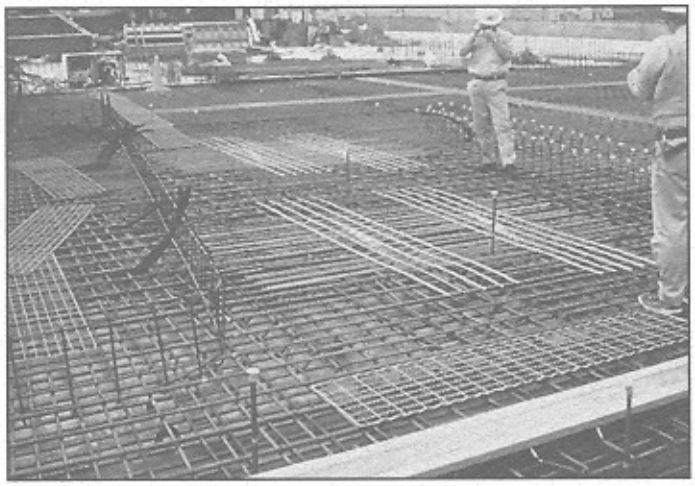

Figure 10. Arrangement of Arapree

Arapree was used to reinforce the concrete sections of the entrance and exit of the Kami ooka station (Keikyu Railway Co., Ltd.) multi-level parking structure at Yokohama in Japan (see Figure 10). Arapree consists of a parallel array of Twaron aramid fibers impregnated with vinyl ester resin. The unique properties of Arapree were useful for the installation of traffic sensors which are highly sensitive to detect the passage of motor vehicles. Four hundred and seventy meters of rectangle-shaped Arapree (2.8 x 14 mm) were used. For more information, please contact Mr. Matsuoka of Nitto Denko Corporation by fax at 81-5-9583-0749 (Japan).

Research

A new FRP hybrid composite I-Beam (shown in Figure 11) pultruded by MMFG, is part of a project sponsored by the Department of Defense, Advanced Research projects Agency (ARPA) to build and demonstrate a hybrid pedestrian foot bridge. The 24" x 7 1/2" x 3/4" I-beam composite was designed with carbon fibers in the top and bottom flanges to increase the stiffness over that of conventional FRP beams. The objectives of the project are to develop low-cost/high-volume manufacturing of high-performance composite material structures for infrastructure applications.

Researchers at the University of Kentucky (under the direction of Dr. Issam Harik) along with Great Lakes Composites

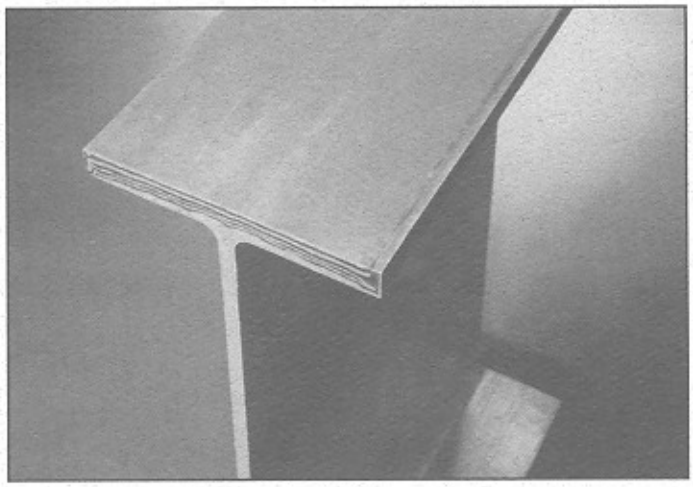

Figure 11. FRP hybrid composite I-Beam

Consortium, Wisconsin, and Basic Industry Research Laboratory (BIRL) at Northwestern University, Illinois, have been instrumental in the analysis, design and construction techniques of the composite components.

The glass and carbon fiber reinforced vinyl ester 24" depth pultruded I-beam was tested at the University of Kentucky engineering laboratory in May of this year (Figure 12). The hybrid beam demonstrated a modulus of elasticity much higher than the typical FRP beam without the additional carbon fibers.

A 60-foot pedestrian bridge for hikers in the Daniel Boone National Forest at Cave Run Lake in Bath County, Kentucky, will be constructed this summer with two of the 24" hybrid I-beams forming the support structure. Pultruded decking from MMFG's AFC Division will be used for the walkway. Fiberglass handrail and rods for post tensioning are also part of the design. The bridge will have a 60 foot clear span and a 6-foot width and will be 12 feet from mean high water in Cave Run Lake. For further information, please contact Dr. Issam Harik by fax at 606-257-1815 (USA).

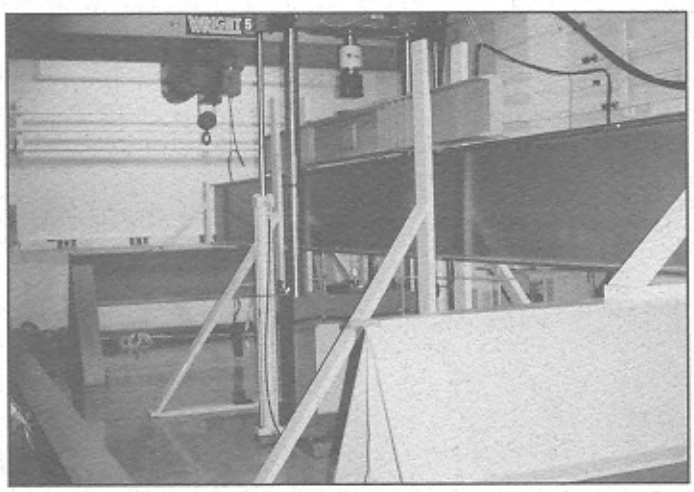

Figure 12. Testing of FRP Hybrid Composite I-Beam

New Products

SAFSTEP™ Fiberglass Gritted Plate

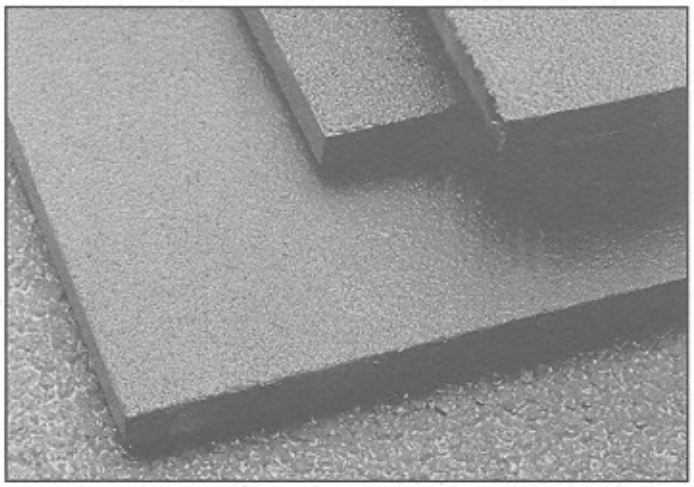

Figure 13. SAFSTEP™ fiberglass gritted plate

SAFSTEP™ fiberglass gritted plate (shown in Figure 13) is the newest product line for MMFG. A unique combination of pultruded fiberglass plate and epoxied anti-skid grit surface provides a textured solid sheet flooring that is corrosion and slip-resistant. Designed for use in applications where open floor grating isn't suitable, SAFSTEP™ is a durable, long-lasting solid surface with all the advantages of fiberglass, such as chemical and corrosion resistance, low maintenance, lightweight, electrically non-conductive, and high strength-to-weight ratio.

SAFSTEP™ is available in a solid plate or bonded to DURADEK® grating. Standard product will be available in 4' x 8' panels of gray EXTREN® Series 525 plate (fiberglass reinforced polyester with fire retardant) with a standard grit system of 30 to 50 mesh silica gradation. With design options in the grit surfaces, plate thickness, resin system, and color, SAFSTEP™ provides a wide variety of applications. Used in such areas as trench covers to contain vapors and fumes, or pedestrian bridge walkways for sure footings, SAFSTEP™ provides an alternative to steel plate for severe, corrosive environments. Other applications include walkways, overpasses, pool decks and splash walls. For further information, please contact Vickie Clark by fax at 540-645-8132.

Smart Technology

The world's first measurement of structural strain by an optoelectronic chip, the size of a pin head, is announced as an important ongoing research partnership including Intelligent Sensing for Innovative Structures (ISIS Canada), the Fiber Optic Smart Structures Laboratory (FOSSL) in the Institute for Aerospace Studies at the Faculty of Applied Science and Engineering in the University of Toronto, the Ontario Laser and Lightwave Research Centre (OLLRC) and the Centre for Electrophotonic materials and Devices (CEMD) at McMaster University.

This microsize quantum well chip, provided by Bell Laboratories Lucen Technologies, can detect signals transmitted through fiber optics from a Bragg grating. Precise information about the structural behavior caused by vehicle load, changing conditions and movement in bridges, overpasses, parkades and other structures can be transmitted through telephone lines or via satellite links from remote locations.

The integration of advanced composite materials and structural sensing systems is gaining momentum and application in Canada with examples of its use including the Beddington Trail Bridge in Calgary, the PEI Fixed Link, the Headingley Bridge in Manitoba, and the Salmon River Bridge in Nova Scotia. For further information, please contact Dr. Raymond Measures at FOSSL by telephone at 416-667-7721 or Ms. Jane Wilson at OLLRC by telephone at (415) 978-3923.

European Task Group

A CEB Task Group on the design of concrete structures reinforced, prestressed or strengthened with FRP, will be established. The aim is to elaborate design rules in accordance with the design format of Eurocode 2 or the CEB-FIP Model Code for Concrete Structures. Existing drafts of codes, state-of-the-art reports, technical papers and research data will be used. The results will be published in a "CEB Bulletin d'Information'. Persons interested to participate should contact, professor Luc Taerwe, University of Ghent, Magnel Laboratory for Concrete Research, Technologiepark-Zwinjnaarde 9, B-9052 Ghent, Belgium, by fax at 32-9-264-5845 or by e-mail at luc.taerwe@rug.ac.be.

Awards

Figure 14. ACMBS-II International Achievement Award Presented to Professor Urs Meier

The Second International Conference on Advanced Composite Material for bridges and Structures was held at the Marriott Le

Figure 15. ACMBS-II Canadian Achievement Award Presented to Dr. Leslie Jaeger

Chateau Camplain in Montreal, August 11 to 14, 1996. The conference was preceded by two workshops on Canada/USA codes and research in progress. The Honourable Jon Gerrard, Secretary of State for Science, Research and Technology Canada, was the Honourary Chair of the conference and delivered the opening, entitled "Advanced Material, Key to an Innovative Economy". The conference was chaired by Dr. Sami Rizkalla, President of ISIS Canada, and included 12 keynote speakers from Belgium, Canada, Switzerland, Japan, the United States and the United Kingdom. A total of 107 technical papers from 20 countries were presented and the conference was attended by approximately 300 delegates. The conference presented two awards for national and international achievements in recognition of outstanding contributions which have furthered the development of applications of advanced composite materials in bridges and structures. The awards were presented to Professor Urs Meier (Figure 14) for international achievement and Dr. Leslie Jaeger (Figure 15) and Dr. Aftab Mufti (Figure 16) for Canadian achievement. Copies of the conference proceedings may be ordered by contacting Ms. Leslie West, Executive Director, ACMBS Network of Canada, 2155 Guy Street, Suite 840, Montreal, Quebec, H3H 2R9 or by fax at (514) 933-3504.

Figure 16. ACMBS-II Canadian Achievement award Presented to Dr. Aftab Mufti

Innovation Award

Sumitomo Construction Co. Ltd., Teijin Ltd. and the Japan Highway Public Corporation have received the Charles Pankow Award for innovative application in recognition of developing new application for Aramid FRP rods (Figure 17). The award was established by the US Civil Engineering Research Foundation (CERF) in 1996. The purpose of the award is to support organizations in putting into practice innovative ideas in civil engineering.

Figure 17. Charles Pankow Award for innovative application

The 6th Technical Conference of ACC Club

The sixth technical conference of ACC Club of Japan was held in Osaka on February 19, 1996. The main theme was "Development of New Materials for Construction Field-Present state and Future of FRP Reinforcement". After declaring the conference opened, Mr. H. Yagishita, the Chair of the directors of ACC Club, made a presentation to promote the application of FRP reinforcement. Dr. A. Machida, a Professor at Saitama University and the Chair of the Japan Society of Civil Engineers Research Committee on Continuous Fiber Reinforcing Materials, delivered a special lecture on "Recommendation for Design and Construction of Continuous Fiber Reinforced Concrete" which will be published by JSCE.

Following this conference, the ACC Club introduced six topics of FRP reinforcements, and a few cases of applications as follows:

(1) a two-span simple slab bridge using CFCC at the Meihan Park Hills Country Club.
(2) a bracket for external cables using TECHNORA® tendon.
(3) use of FiBRA cable bolt for reinforcement of a tunnel face.
(4) use of LEADLINE for a suspension bridge is planned.
(5) use of LEADLINE for ground anchors.
(6) the latest applications of NEFMAC.

For more information, please contact Tatsuhiko Iwasaki, Secretariat of ACC Club, A.M. Engineering K.K., Furukawa Building, 2-3-14 Muromachi Nihonbashi Chuo-ku, Tokyo 103, Japan or by telephone at 81-3-3231-0690 or by fax 81-3-3242-7584.

Conferences

The Wilson Forum – East, two full days of papers, panel discussion, group discussion and exhibits, October 21 and 22, 1996, Holiday Inn Select, 480 King Street, Alexandria, Virginia. Please fax 916-989-1714 for further information.

Arquimacom '96, First International Conference on Composite Materials in Architecture and Building, Seville, Exhibition and Congress Center, Spain, October 25 to 26, 1996. For more information, please contact Dr. Arquitecto Don Manuel by fax at 34-54-55-6591.

ACI 1996 Fall Convention, New Orleans, Louisiana, November 3 to 8, 1996. Contact the American Concrete Institute, P.O. Box 19150, 22400 West Seven Mile Road, Detroit, Michigan, 45219 or by fax at 313-538-0655.

Fourth Materials Engineering Division Conference during ASCE Annual Convention, Washington, D.C., November 11 to 14, 1996. Please contact Dr. S. Iyer by fax at 605-394-5295 for further information.

76th Annual Transportation Research Board Meeting, Sheraton Washington Hotel and Omni-Shoreham Hotel, Washington, January 12 to 16, 1997. For ACM activities, please contact Craig Ballinger by fax at 703-938-1252.

The International Composites Expo – ICE '97, which is the new name of the Composite Institute's annual conference and exhibition, will be held at the Opryland Hotel Convention Centre in Nashville, Tennessee, January 27 to 29, 1997. For more information, please contact Peggy Stabach by fax at 212-370-1731 or by e-mail at pstabach@socplas.org.

Advanced Composites Conference and Exposition (ACCE '97), Westin Hotel, Renaissance Centre, Detroit, Michigan, April 7 to 10, 1997. Contact fax 810-355-1492 for further information.

JEC – Journees Europeenes des composites Conference and Exhibition, CNIT Center, La Defense, Paris, France, April 23 to 25, 1997. For further information, please fax 33-1-4059-8546.

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.

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, IL, USA, by fax at 309-677-2867.

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.

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 to 16, 1997. Contact: Secretariat FRPRCS-3, Japan Concrete Institute, TBR - 708, 5-7 Kojimachim Chiyoda-ku, Tokyo 102, Japan.

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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