FRP
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Guest Author - Dr. Taketo Uomoto

Professor Uomoto is a world-renowned researcher in the field of FRP reinforcement. He has published numerous papers related to material properties and deterioration mechanism of FRP from both physical and chemical aspects.

Guest Author: Dr. Taketo Uomoto Professor of Industrial Science University of Tokyo

Dr. Uomoto joined the Taisei Construction Company in 1971. He served the company until 1978. In the same year he joined the Institute of Industrial Science, at the University of Tokyo, and became Professor in 1982. He is a member of JCI, JNDI, ACI, RILEM, and IABSE. He is a fellow of JSCE. He has received awards for his excellent papers from the Japan Society of Civil Engineers, the Japan Concrete Institute and the Japan Cement Association.

Prof. Uomoto is highly active on FRP committees of the JSCE, JCI and ACI. He has been the Secretary of the JSCE committee on Continuous Fibre Reinforcing Materials, is the Chair of the Task Committee for FRPRCS-3, which will be held in October 1997 in Sapporo, Japan, and was co-chair of the Japan-Canada Workshop on Advance Composite Materials for Concrete Structures held on 17-19 July 1995 in Tsukuba, Japan.

Prof. Uomoto is also known for his research efforts on the properties of concrete, computer simulation of cement hydration, modelling of deterioration of concrete, steel and other materials, including FRP utilized in concrete, and evaluation of deteriorated concrete structures. He has already succeeded in developing a new quality control system for producing concrete in plants using neural networks and has clarified the mechanism and quantitative estimation method for alkali-silica reaction, fatigue failure of steel bars, strength reduction of GRC due to alkali, and deterioration mechanism of FRP reinforcements. The research includes computer simulation of cement hydration, to clarify the cause of deterioration of concretes.

In the field of non-destructive testing, Prof. Uomoto

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• American Concrete Institute • American Society of Civil Engineers • Canadian Society for Civil Engineering • • Composite Institute • Japan Concrete Institute • ACMBS Network of Canada •

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has developed new detection systems using thermography for both fresh concrete and hardened concrete. He has also perfected a radar technique for detection of voids and cracks, acoustic evaluation of deteriorated concrete structures and steel corrosion monitoring systems using computer and natural potential measurement. His research, Optimal Design Method of Structures, is currently in progress to develop a new design method for the use of new materials, such as fiber reinforced concrete in the main components of structures.

Research

ISIS - Canada Network of Centres of Excellence

On 5 July 1995, the Canadian Secretary of State for Science, Research and Development, Dr. Jon Gerrard announced the establishment of a new Network of Centres of Excellence (NCE) with headquarters at the University of Manitoba, Winnipeg, Manitoba, Canada. The network called "Intelligent Sensing for Innovative Structures (ISIS)," Figure (1), is lead by Dr. Sami Rizkalla.

Figure 1. ISIS Network Centre of Excellence

"I commend Dr. Rizkalla and his team from across the country for putting together this successful application. The Networks of Centres of Excellence Program is a unique Canadian initiative which puts Canada at the leading edge of multidisciplinary targeted research based on nationwide collaboration among universities, industries and government. In a world of ever increasing knowledge - intensive job and activities, it is more important than ever to encourage partnerships which connect key players in all sectors, both private and public" said Dr. Gerrard.

ISIS - Canada will develop innovative systems that combine advanced composite materials, new fiber-optic sensors and microchip technology for use in the design, reinforcement and repair of civil engineering structures. These structures will be classified as Smart by virtue of their integrated fiber-optic structural sensing systems and innovative through the use of advanced composite materials to make them light, yet strong, and non-corrosive. The wealth of sensing data generated from each structure, such as a bridge, will be intelligently processed and transmitted through phone or satellite links to a central monitoring station where it will be interpreted and the status of the structure evaluated. This central location will be able to remotely monitor the condition of hundreds of structures, thereby eliminating the need for many costly site inspections. Moreover, the extensive use

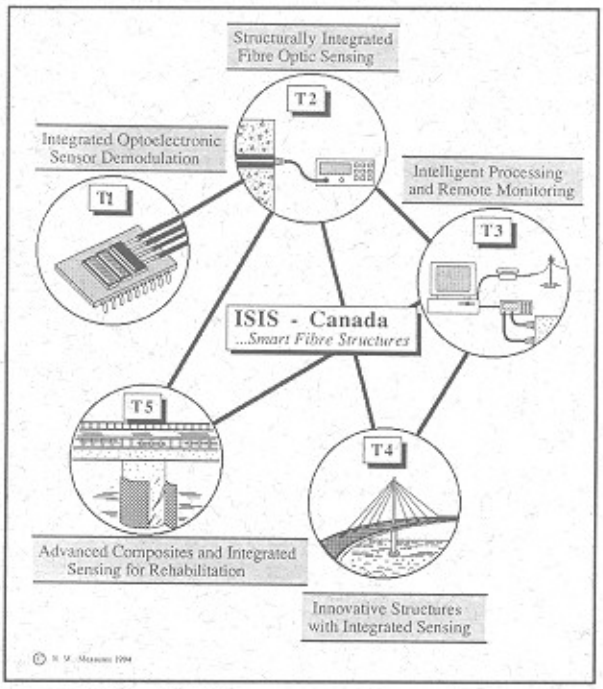

Figure 2. ISIS Canada NCE

of advanced composite materials will substantially reduce the long-term maintenance costs that have become a major source of frustration for the users as well as a significant burden to both private and government budgets.

The five themes of ISIS shown in Figure (2), which encompasses eighteen research projects, are:

Theme 1: "Integrated Optoelectronic Sensor Demodulation", led by Dr. J. Simmons of McMaster University.

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The theme has the goal of developing leading-edge optoelectronic chip technology that can be integrated with fiber-optic sensors to form a state-of-the-art sensor demodulation chip.

Theme 2: "Structurally Integrated Fibre-Optic Sensing", led by Dr. R. Measures of the University of Toronto.

The theme has as its goal, the development of fiber-optic structural sensing systems and their application to civil engineering. This work will involve improving the sensors range of capabilities and addressing structural integration issues.

Theme 3: "Intelligent Processing and Remote Monitoring", led by Dr. A.A. Mufti of the Technical University of Nova Scotia.

The theme has as its mandate the development of both our intelligent processing capability and the technology that will enable the flow of sensing data from remote sites to be transmitted by conventional phone and satellite links to a central monitoring station.

Theme 4: "Innovative Structures with Integrated Sensing", led by Dr. S.H. Rizkalla of the University of Manitoba.

The theme includes research and development to incorporate, in a structurally integrated manner, fiber-optic sensing into advanced composite materials and to use this technology for innovative civil engineering structures. A principal focus of the theme is to produce smart fiber reinforcements for bridge girders and innovative anchorage systems.

Theme 5: "Advanced Composites and Integrated Sensing for Rehabilitation", led by Dr. K. Neale of the Sherbrooke University.

The theme addresses the problem of deteriorating infrastructure and aims at developing an advanced intelligent sensing technology for structural rehabilitation, strengthening and monitoring.

ISIS - Network represents a unique opportunity to have these diverse disciplines working together in a highly focussed program. The total budget, from government and industrial sectors is over twenty million Canadian dollars. For further information, please contact Dr. S. Rizkalla, Fax: (204) 261-5465.

Applications

• ACM for Fender Systems

The Delaware River and Bay Authority "DRBA" owns and operates the Cape May-Lewes Ferry, which crosses the mouth of the Delaware River between Cape May, New Jersey, Lewes and Delaware. At the ferry terminals, timer pile clusters are used for pier fendering, vessel positioning and lead-in and turning dolphins. These timber pile clusters are subject to breakage and abrasion from vessel impacts and marine borer attack. Preservative treated piles are also coming under regulatory scrutiny. In 1993, the DRBA considered replacement of the timber clusters with modern, low maintenance fendering systems as a cost saving measure.

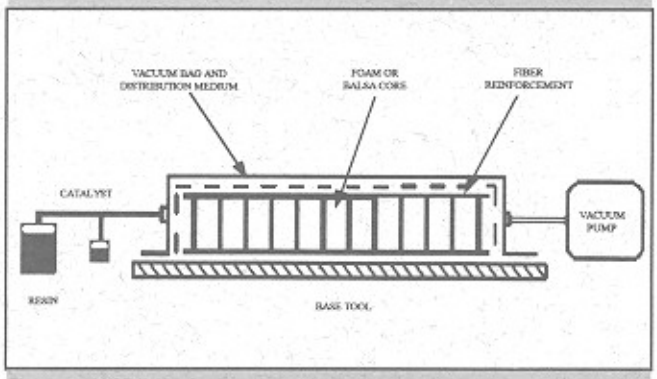

Figure 3. "SCRIMP" Composite Process

After consideration of several composite fabrication techniques, such as hand lay-up and prepreg processes, all were found to be labour intensive, messy and produce composites with highly unreliable properties. Hardcore Composites, manufacturer of composites targeting infrastructure application using the SCRIMP (Seeman Composite Resin Infusion Molding Process), were approached to produce a fendering design utilizing composites. In this manufacturing process, the reinforcing fabric and core are placed dry in a closed surface and compacted under a vacuum. Utilizing a patented distribution system, the resin is injected under vacuum and dispersed evenly through the liminate as shown in Figure (3). The SCRIMP process was found to be very effective in producing large, high-quality, cost-effective, consistent and reliable composite parts for infrastructure application.

The new fenders, shown in Figure (4) have an

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excellent corrosion resistance and are unaffected by salt water exposure. Ultra violet light degradation is prevented by using UV inhibitors and polyester surfacing veils. The relatively low elastic modulus of the composites was used to the advantage of the fendering application to elevate its capability to absorb more energy. For further information, please contact Rick Volk, Fax: (302) 571-6367.

Figure 4. Complete pier side installation of Hardcore Marine Fenders.

ACM Design Competition

The U.S. Army's Construction Engineering Research Laboratories (USACERL) in Champaign, IL, and Rutgers University along with the Composites Institute of the SPI has just issued an industrial design competition for marine/waterfront piling systems.

This design competition will be conducted as part of an FY94 Corps of Engineers Construction Productivity Enhancement Research (CPAR) program, "Development and Demonstration of Composite Piling Systems for Bearing, Fender and Sheet Piling (Bulkheading)." The CPAR will run for three years with a value of $2,554,000 (US) of which $1,600,000 comes in the form of in-kind contributions from industry through CI's Marine/Waterfront Task Group (MWTG). Funding for the program is not threatened by recent U.S. Congressional actions since CPAR programs are traditionally front-end funded.

The CPAR team has identified an envelope of performance targets for each type of piling system. A design competition package has been sent to CI member firms with proposals due by 15th August 1995. Proposers of design concepts are allowed to keep their intellectual property rights as participants in the program. Participants of record in the CPAR project will receive royalty-free licenses for products developed while non-participating organizations will pay royalties and/or licensing fees to be determined if they wish to use the resulting composite piling designs. Participation is limited to CI members, but teams of interested parties are being formed to pursue this opportunity.

An Advisory Board comprising five commercial ports authorities as well as three trade and professional organizations will provide oversight to the program. Focus will be on trying to expedite the evaluation, demonstration and commercialization stages of the project. Several composite waterfront piling products have already been introduced.

For further information please contact Composite Institute, Fax: (212) 370-1731.

Workshops

The First Israeli Workshop on Composite Materials for Civil Engineering Construction

On 29 May 1995 the National Building Research Institute hosted the First Israeli Workshop on Composite Materials for Civil Engineering Construction. The Workshop was attended by approximately 100 participants, including 11 speakers from abroad. Local participants included leading members of the Israeli construction and composites industries who joined the foreign guests on discussion panels that followed each technical session. The workshop was chaired by Dr. Lawrence Bank, a Visiting Professor at the Technion, and Dr. Mony Ben-Bassat of the NBRI.

The workshop was divided into four topic areas: the use of composite materials for the repair and retrofit of structures; the use of composite materials as reinforcements for concrete; the use of composite materials in prestressed concrete and composite material structures.

A book of the proceedings for the workshop was published by the NBRI and a limited number of copies are still available. For more information, please contact Dr. Ben-Bassat at the NBRI at Fax +972-4-324534.

• Japan/Canada Workshop

A Japan/Canada workshop on Codes using FRP materials was held in Japan from 17-20 July 1995. The workshop was held at the Creation Centre of Mitsubishi Kagaku Corporation in Tsukuba City, Isbaragi Prefecture, Japan. This Workshop is a continuation of discussions from the previous Canada/Japan Workshop which was held in 28-30 Ottawa 1993 and co-chaired by Dr. A.A. Mufti and Dr. T. Uomoto. The 1995 Japan/Canada Workshop, co-chaired by Dr. Uomoto and Dr. Mufti, covered the following four main subjects: the provisions in the Canadian Highway Bridge Design Code for fiber reinforcements, the Canadian Building Codes on the Use of ACM, ISCE Recommendations for Design and Construction of Concrete Structures Using Continuous Fibre Reinforcing Materials, and AIJ Recommendations for Building Using Continuous Fibre Reinforcing Materials. For further information please contact Dr. Uomoto, Fax: (03) 3470-0759.

Composite Structures

• First British Footbridge Reinforced with GFRP

The Village of Chalgrove in Oxfordshire is the location of the first footbridge in the UK, to be reinforced with FRP composite rods in place of the usual steel. It is one of the demonstration structures being built as part of Eurocrete, a pan European collaborative project to develop fibre composite reinforcement, with support from the EUREKA programme.

The bridge is a simple concrete slab, 5m long by 1.5m wide, with reinforcement on both the top and bottom faces as shown in Figure (5). The main design criteria were deflections and control of early thermal movements. The reinforcement, consisting of 13.5 mm diameter glass FRP bars in both directions, was made and assembled by GEC Reinforced Plastics. Vibrating wire gauges and thermocouples were fitted to the completed reinforcement cage before the concrete was cast. Trunking was fitted to the base of the mould into which fibre optic gauges were later fitted. The slab was installed in May 1995 and fitted with glass FRP handrails. The bridge will be load tested using dead weights to simulate 1.25 times the design loading. The load test will be repeated in 6 months and after one year.

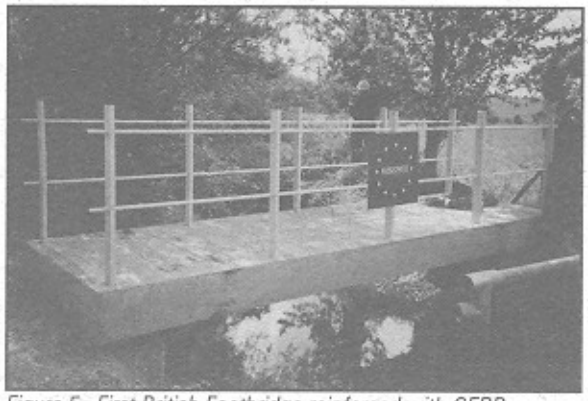

Figure 5. First British Footbridge reinforced with GFRP

The Eurocrete programme, started in December 1993, will run for four years and cover all aspects of the development of FRP reinforcements. The key topics to be covered include:

- selection of suitable resins and fibres
- selection of appropriate manufacturing techniques
- durability of composites exposed directly to aggressive environments
- durability of composite rods embedded in concrete, both under accelerated conditions in the laboratory and on exposure sites in the UK, Norway and the Arabian Gulf
- development of design methods
- cost analyses
- design, fabrication and monitoring of trial structures

For more information, please contact Dr. John L. Clark, Halcrow, Fax (+44) 171-603-0085.

• FRP Stairtower, A New Challenge

The 63-foot tall fibreglass stairtower at the US Naval Training Base in Fort Story, VA, presented some unique design challenges for MMFG. The Stairtower is probably one of the tallest FRP fabrications that has ever been attempted. Inverted V-bracing and specially designed connections were used to meet the design requirements for this job.

The stairtower shown in Figure (6) was designed to withstand column loading in excess of 90,000 lbs. and 130 lbs./sq. ft. wind loads (for hurricane winds of as much as 140 mph). The connections, which were the critical design element, were composed of fibreglass beams, reinforced with laminated FRP plates and stainless steel clip angles and bolts.

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The free-standing stairtower which is connected to the adjacent structure only at the floor platforms, gives access to a tower which doubles as a parachute drying facility and a rappelling training wall. Fibreglass was selected for the project to resist salt water corrosion from the nearby Chesapeake Bay and provide the long-term life cycle and low-maintenance required.

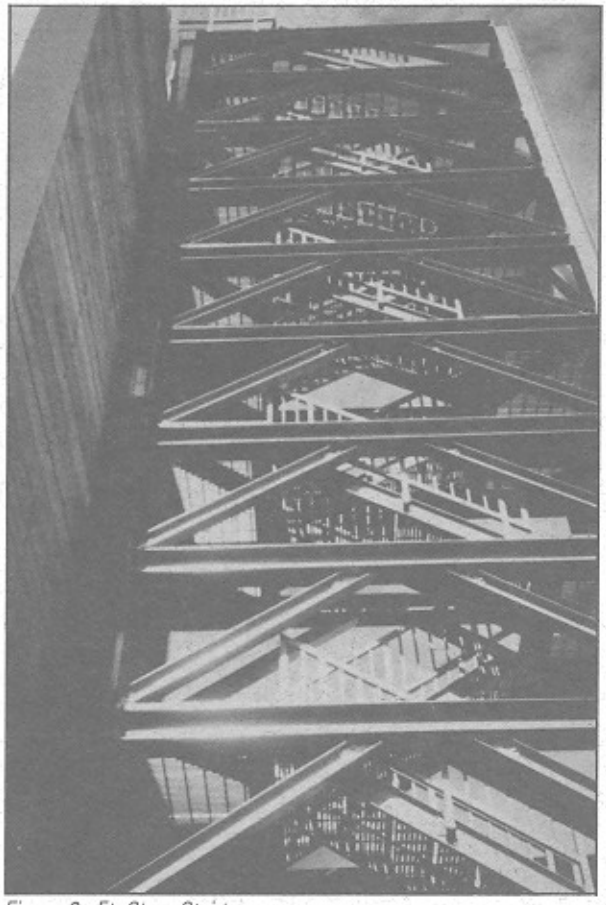

Figure 6. Ft. Story Stairtower

The architectural/engineering firm for the project was Hayes, Seay, Mattern & Mattern, Inc. Of Roanoke, VA. Shirley Construction was the general contractor for the job. For further information, please contact Vickie Clark, Fax: (703) 645-8132.

• Innovative Composite Cooling Tower

The innovative all-fibreglass cooling tower by Tower Tech Inc., Norman, Figure (7), introduced an innovative design of cooling towers. Designed to revolutionize the market, the composite cooling tower uses the largest commercially produced pultruded profiles for the structure, while mounting the fans at the bottom of the tower instead of the top.

The combined structural design, composite engineering and pultrusion processing expertise of Morrison Molded Fibre Glass Co. (MMFG) was necessary to produce the seven complex custom profiles that comprise the structure. Four interlocking sections, each nearly 4 foot wide profiles, are connected with custom-sized angles and gusset plates and supported by the custom leg shape.

The two largest components, a centre beam and bottom basin, are hollow profiles nearly 4 foot wide and up to 1 inch deep in sections. A specially designed pultrusion machine (one of the largest pultrusion machines in the world) was necessary to produce these profiles. For more information please contact Vickie Clark, Fax: (703) 645-8132.

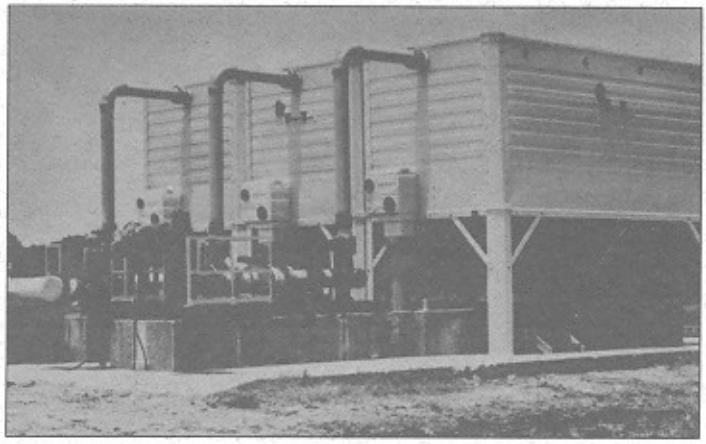

Figure 7. Fiberglass Cooling Tower

• Electronic World Observatory for the Millennium

Inspired by the Millennium celebrations, Globorama will take the traditional panoramic tower concept and extend the experience to include projected real time images from around the globe. This will be combined with direct interaction, using leading edge multimedia technology.

"Imagine looking out over a complete view of London one minute and then, say, Sydney the next." said Peter Head, Director of Maunsell Group, an international engineering company, who conceived the project. "People will not only be able to view placed from across the world in real time, as if they were there, they will actually be able to talk to people there and find out detailed information about the place. Telephone links, real time sound, simulated climate effects and local food will also be available, giving further sensory heightening of the illusion. Multimedia facilities will enable people to look back in time as well. There has been a lot of

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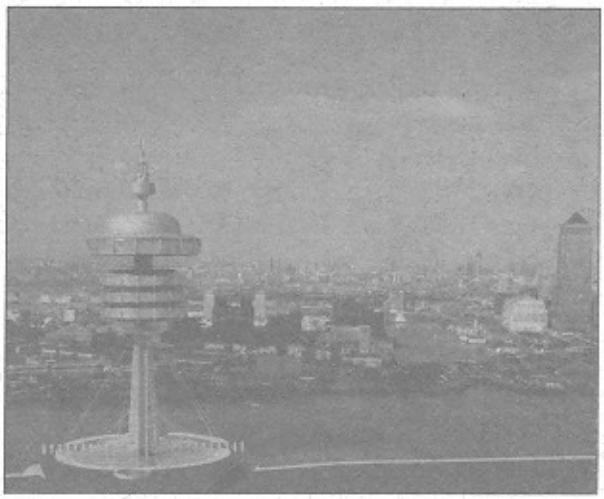

Figure 8. Design Concept for the World Observatory for the Millennium

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comment about the lack of imagination of millennium proposals; we believe Globorama has the vision to generate real excitement. And with all the expertise and knowledge coming from the UK, Globorama is set to become a symbol of British technological capabilities in the next century."

Globorama will be sited at Victoria Deep Water Terminal, a Thameside wharf on the Greenwich Meridian, the location from which all global time is measured. The multi-level facility shown in Figure (8) will provide a wide variety of real and illusory panoramic experiences, including a revolving restaurant. The area surrounding the tower will be completely redeveloped. The waterfront environment will be enhanced and the tradition of historic Greenwich reinforced.

The structure will be constructed using a number of different materials and will feature advanced composites for their versatility, maintainability, and lightweight properties. The materials will be used in the main structures housing the viewing screens and panoramic viewing areas. For further information please contact Peter Head, Maunsell Structural Plastics Ltd., Fax: +81-663-6723.

New Products

Carbon - Stress

NDI, known European prestressing steel producer since 1954, has developed a non-metallic high tech prestressing material called "Carbon - Stress". The product composed of special high strength carbon fibres embedded in an epoxy resin. This composite, supplied as wire, bar or strip, may be used for prestressing concrete structures, cable-stayed bridges, bander cables for suspension bridges, and, rock and ground anchors in aggressive subsoil and rocks. The product is produced in round wire shape, 5 to 7 mm diameter, flat wire 15 x 1.5 mm or 20 x 2 mm. The cables have tensile strength in the range of 2,200 to 2,400 MPa, elastic modulus of 160 GPa and total elongation of 1.6 percent. For additional information please contact Nederlandse Draadindustrie NDI BV, Fax: +31-77-873171.

Directory of FRP/FRC Applications

In March of 1994, the Advanced Composite Materials in Bridges and Srtructures (ACMBS) Network of Canada organized a think tank meeting. Leading experts from Canada and the U.S. identified opportunities for applications of ACM products in civil engineering. It was recommended that a directory of ACM products be developed to facilitate the exchange of information between users, manufacturers and researchers.

Plans are underway to publish a guide containing summaries of available applications, appended with a directory of products and manufacturers. The range of applications considered encompass both FRP and FRC.

Entries for manufacturers, researchers and expert practitioners around the world are now being accepted for inclusion in the directory. The target deadline for publishing is November 1995. Anyone interested in participating should send their mailing address to:

G. Gera, Director,
Research and Development Branch,
Ministry of Transportation of Ontario,
Room 331, Central Building,
1201 Wilson Avenue,
Downsview, Ontario, Canada
M3M 1J8
or Internet e-mail to GERAG2@EPO.GOV.ON.CA

All respondents will receive detailed instructions for brief entries.

Conferences

Second International Symposium on Non-Metallic (FRP) Reinforcement for Concrete Structures, Universiteit Ghent, Belgium, 23-25 August 1995. Contact: Dr. Luc Taerwe, Universiteit Ghent, Dept of Structural Eng'g. Technologiepark-Zwijnaarde 9, B-9052 Gent, Belgium, FAX: +32 (9) 264-5845, E-mail: beton@mecairis.rug.ac.be.

IABSE - Extending the Lifespan of Structures, San Francisco, CA, USA, 23-25 August 1995. Contact: IABSE Secretariat, ETH-H"nggerberg, CH-8093 Zurich, Switzerland, FAX: +41(1) 371-2131.

4th International Bridge Engineering Conference, St. Francis Hotel, San Francisco, CA. Sponsored by TRB & NRC. 28-30 August 1995. Contact C. Ballinger, FAX: (703) 938-1252

9th International Conference on Mechanics of Composite Materials, Riga, Latvia, Sweden, 17-20 October 1995. Contact: Secretariat, FAX: +46 (31) 772-2296.

The World of FRP in Corrosion and Construction 9th International Technical Conference & Exhibition, Caesar's Palace, Las Vegas, 18-21 September, 1995. Contact SPI Western Composites Institute, FAX (310) 420-9156.

ACI 95 Fall Convention, Montreal, Bonaventure Hilton & Radisson Gouverneurs, Quebec, Canada, 5-10 November 1995.

Second Symposium on High Temperature And Environmental Effects On Polymeric Composites, sponsored by ASTM Committee D-30, Norfolk, Virginia, 14-16 November 1995. Contact Dr. A. Zureick, FAX: (404) 894-0211.

International Conference on Fibre Reinforced Structural Plastics in Civil Engineering. Indian Institute of Technology, Madras, India. 18-20 December 1995.

The 75th Annual Transportation Research Board Meeting. Washington, DC. 7-11 January 1996. Abstracts for Synthetic Fiber Reinforced Concrete in Transportation Applications session are due by August 1, 1995. Contact Clifford MacDonald, FAX (612) 736-7496.

The First International Conference on Composites in Infrastructure (ICCI '96) Tucson, Arizona, USA. 15-17 January 1996. Contact Prof. M. Ehsani, University of Arizona, FAX:: (602) 621-1443; Dr. Saadatmanesh, FAX: (602) 621-2148. E-mail: baltes@bigdog.engr.arizona.edu.

2nd International Conference on the Use of Advanced Composite Materials for Bridges and Structures, Montreal, Quebec, Canada, 11-14 August 1996. Deadlines: Sept 15, 1995 for 300 word abstract. Contact: Dr. S. Rizkalla, Faculty of Engineering, University of Manitoba, Winnipeg, MB R3T 5V6 FAX: (204) 261-5465.

Third FRP International Symposium on Non-Metallic (FRP) Reinforcement for Concrete Structures, Sapporo, Japan, October 14-16, 1997. Deadlines for submission of abstract: October 1, 1996. Contact: Secretariat FRPRCS-3, Japan Concrete Institute, TBR - 708, 5-7 Kojimachim Chiyoda-ku, Tokyo 102, Japan.

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