



# newsletter

# SERC chennai

Vol. 25 No. 1 Structural Engineering Research Centre, Chennai January–March 2010

### VISIT OF DIGNITARIES

Dr. Kasturirangan, Member-Science, Planning Commission visited SERC and CMC on Friday, 29<sup>th</sup> January 2010. Dr. Nagesh R Iyer, Director, SERC and senior technical functionaries of SERC and CMC attended a briefing meeting chaired by Dr Kasturirangan on his arrival, from 1015 am to 1125 am at the Director's conference room. Director briefly welcomed Dr Kasturirangan, along with Shri A.K. Verma, Advisor, Planning Commission, and Dr. Mrs. Indrani Chandrasekharan, Advisor (E & F), Planning Commission. After a short self introduction of the scientists/officials present, Director made a power point presentation on the research and development activities and major achievements of SERC, highlighting initiatives and contributions of significant, innovative and strategic impact made by SERC over the years, leading up to the current scenario.

During the presentation of the Director, Dr. Kasturirangan sought clarification and further relevant information on several of the achievements/activities, such as, (i) Uniqueness of Madras Atomic Power Project contribution from SERC, (ii) Handbook of Machine Foundations, (iii) Aero-dynamical simulation capabilities on wind sensitive structures, and R & D on wind energy structures(iv) Remote health monitoring of railway bridges, (v) Major project on Green and Smart Approach for Sustainable Habitat and Infrastructure Systems, which will span the XI & XII Five Year Plan, etc.

(Cont. on page 2)



Dr. Kasturirangan shows keen interest in viewing product technology exhibits at SERC

### NATIONAL SCIENCE DAY CELEBRATIONS

The National Science Day was celebrated on the 26<sup>th</sup> February 2010 in the campus of the CSIR-Structural Engineering Research Centre and the CSIR Madras Complex, Chennai. The function was presided over by Dr. Nagesh R. Iyer, Director, CSIR-SERC and Coordinating Director, CMC, Chennai.

Director extended warm welcome to the Chief Guest, Dr. B. Gopalan, Chief Scientific Officer and Executive Director, Drug Discovery Research, Orchid Research Laboratories and also welcomed the gathering. Dr. Nagesh Iyer mentioned "in addition to remembering with gratitude the contributions of the renowned Nobel Laureate, C.V. Raman, the Government stands committed to inculcating a scientific temper in all so that overall development of society can be achieved. The basic objective of observation of National Science Day is to spread the message of importance of science and its application among the people". He further added that science has contributed a great deal to the human welfare. He said that it is widely accepted that only science and technology can offer solace amongst peril and chaos. Through the gospel of reason and experimental observation, by which it works, it has enabled man to acquire intellectual and mental excellence.

He also mentioned that presently we are concerned with the subject of climate change and that the Prime Minister has constituted eight mission mode programmes under the Action

(Cont. on page 2)



Dr. B Gopalan delivering the National Science Day Lecture (26 February 2010)

---

**(Cont. from page 1)****(Visit of Dignitaries)**

Dr Kasturirangan then visited the (a) Fatigue testing and research facility, (b) Process and product technology exhibits from the Advanced Concrete Testing and Evaluation as well as Advanced Materials Research groups, (c) the Advanced Seismic testing and research laboratory, and (d) the Wind Engineering Laboratory.

Subsequently, Dr Kasturirangan addressed all members of staff of SERC and CMC at the Vigyan Auditorium. He expressed that the visit was very fascinating, and that he found the scope and content of the R&D activities as so central to safety of life on earth. He congratulated the Institution and its Director. He indicated that scope existed for enhancing the interaction between SERC and ISRO, which could be beneficial to ISRO particularly for its ground systems/structures. He appreciated that SERC has already been entrusted with monitoring and analysis of 5 railway bridges. He exhorted the scientists to evolve "MEGA PROJECTS" on a scale to make an impact on the country. He was happy to see that SERC is restructuring itself to enable getting into multi-lab, multi-agency, and mega projects. Finally, he suggested that a three tier approach would be ideal for any R&D organizations:

- Do high-end R&D, world class publications –Individual spots of excellence
- Team level focus; build globally competitive capabilities / expertise
- Look across disciplines

In summary, he asked the scientists to look for opportunities to make national impact.

---

**EVENTS**

1. ISO 9001 Surveillance Audit-cum-Certification Team visited SERC on 6<sup>th</sup> & 7<sup>th</sup> January 2010 for review to recommend 2008 version certification.
2. Mr. Mike Jones, Instron Ltd., UK visited Fatigue & Fracture Lab, SERC on 19<sup>th</sup> January 2010.
3. Advanced Course on Transmission Line Towers has been organized at SERC, Chennai during 27<sup>th</sup> -29<sup>th</sup>, January 2010.
4. 22 Participants from African Countries of the Fifth International Training Course on "Wind Turbine Technology and Applications" at Centre for Wind Energy Technology visited SERC on 8<sup>th</sup> February 2010.
5. The first meeting of the reconstituted Management Council was held on 3<sup>rd</sup> March 2010.
6. The International Women's Day was celebrated on the 8<sup>th</sup> March 2010.
7. A Hindi Workshop was organized on 8<sup>th</sup> March 2010 for the administrative staff of SERC and CSIR (Madras) Complex for interaction with Mrs. Jayasurya Chellam, Senior Hindi Officer, BSNL, Chennai.
8. The Review Meeting of the CSIR Network Project was held on 19<sup>th</sup> March 2010.

---

**STAFF RETIREMENTS**

Shri J.A. Victor, Technical Assistant Gr.II(4), 31.01.2010, Retirement on superannuation.

Smt. A. Muniammal, Peon (ACP), 31.01.2010, Retirement on superannuation.

---

**(Cont. from page 1)****(National Science Day)**

Plan of Climate Change and that sustainable development and green concepts are a few of these approaches that CSIR campus is attempting to embark upon.

Dr. S. Arunachalam, Scientist G and Advisor (Management), SERC gave a brief introduction of the Chief Guest.

Dr. B. Gopalan delivered the National Science Day Lecture on 'Green Chemistry in Pharmaceutical & Chemical Industry'.

Dr. Gopalan began his lecture by touching upon basic strategies required for R&D in a general way. He stressed on the interplay of Creativity, Screening and Innovation; the different components of inputs – by way of ideas, day dreams, observations, and brainstorming; and those characteristics of outputs viz., results which are better, faster, cheaper, and aesthetic. He highlighted the research Infrastructure required for New Chemical Entity and New Biological Entity development. He cited examples of how Patenting is essential for out-licensing of innovative technologies. Cutting across disciplines, he emphasized the importance of Adherence to time line: Good documentation processes; Criteria for sustainability; Goal congruence.

Dr Gopalan further emphasized on the 12 Principles of Green Chemistry. He dwelt at length on the principle of "Atom Economy" wherein the attempt is to achieve maximum efficiency in process of synthesis of a drug molecule, in terms of the ratio of yield of desired (eco-friendly, non-hazardous) products to overall product outputs. He also mentioned about recent research into microwave energy induced and sonification induced synthesis routes. He concluded his talk outlining the Systems Biology approach to Drug Design and Discovery.

The programme ended with a Vote of Thanks by Dr. K.R. Sridharan.

---

**DEPUTATION****India:**

1. Mrs. R. Sreekala, Scientist participated in the 97<sup>th</sup> Indian Science Congress held during January 3-7, 2010 at Trivandrum.
2. Dr. M Saravanan and Ms. P. Prabha, Scientists attended the International Conference on Advances in Materials and Techniques (ICAMAT) in Civil Engineering held at VLB Janakiammal College of Engineering & Technology, Coimbatore, during January 7-9, 2010.
3. Shri G. Ramesh, Scientist attended the International Conference on Materials, Mechanics and Management at College of Engineering Trivandrum during January 14-16, 2010.
4. Shri K Kesavan and Shri A Rama Chandra Murthy, Scientists attended the Green and Intelligent Building Construction Technique held during January 21-22 at India Habitat Centre, New Delhi organized by Construction Industry Development Council.
5. Ms. R Lakshmi Poorna, Technical Assistant attended the 55<sup>th</sup> ILA National Conference on Library and Information Science in the digital Era during January 21-24, 2010 at BIMTECH, Greater Noida.
6. Shri K Kesavan, Scientist attended the 8<sup>th</sup> International Conference on Barkhausen Noise and Macromagnetic Testing (ICBM8) at IGCAR, Kalpakkam during 11<sup>th</sup> & 12<sup>th</sup> Feb. 2010.

**(Contd. on Page 7)**

## CSIR - SERC ACHIEVEMENTS IN ADVANCED MATERIALS RESEARCH

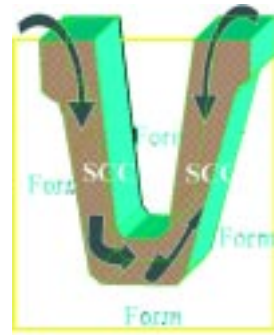
SERC, Chennai has carried out detailed R&D investigations and successfully developed and demonstrated many process / product technologies / knowhow covering advanced construction materials and repair and retrofitting schemes. The significant among these are briefly summarised below.

### Advanced Composite Construction Materials - Process Technologies Developed

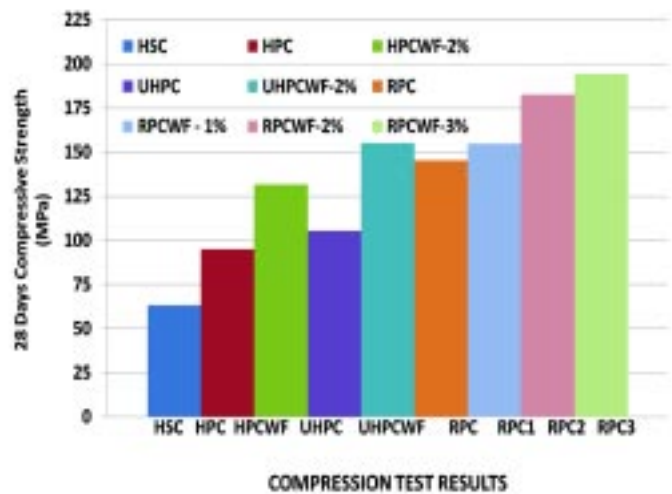
- **High Performance Concrete (HPC)**
  - Concrete mixes designed to meet specific performance requirements in terms of strength (30-80 MPa), workability and durability using appropriate combination of cement, supplementary cementitious materials and chemical admixtures
  - Applications: High rise buildings, long span bridges, pavements, tunnels, pipes and piles
- **Self Compacting Concrete (SCC)**
  - Concrete that readily flows into every corner of a formwork and gets compacted by gravity without the need for vibration
  - Applications: Structures with innovative geometries and congested reinforcements
- **Ultra High Performance Fibre Reinforced Concrete (UHPFRC) and Reactive Powder Concrete (RPC)**
  - Use optimized mix of ultra fine siliceous powders, selected fibres, special processing including pressure moulding and curing regime with heat treatment
  - High compressive strength (150-200 MPa), flexural strength of 30-40 MPa and fracture resistance –  $G_f$ -15-40 N/mm
  - Application: Long span bridges, precast sewers / culverts, pressure pipes (upto 20 MPa), cooling towers, facades / kerbs in aggressive environs, anchorage blocks, repair and retrofit, vibration control, machine components



Slump Flow of SCC Mix



Use of SCC for Casting of Complicated Shapes



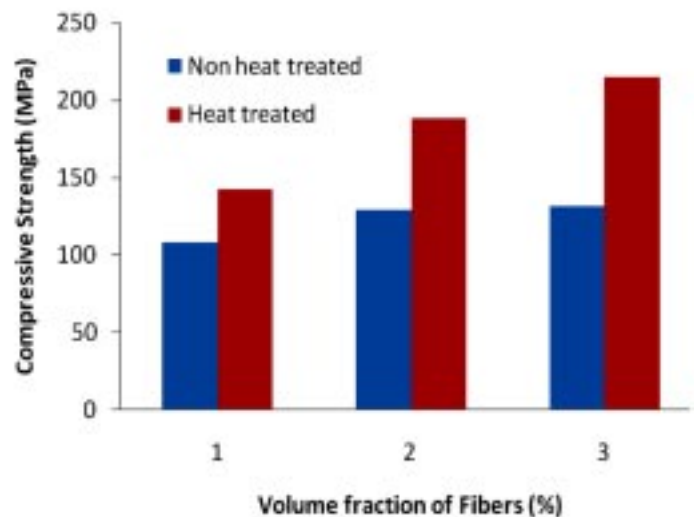
Compressive Strength for Various Types of Concrete



Spalling of Plain RPC Cylinder after failure



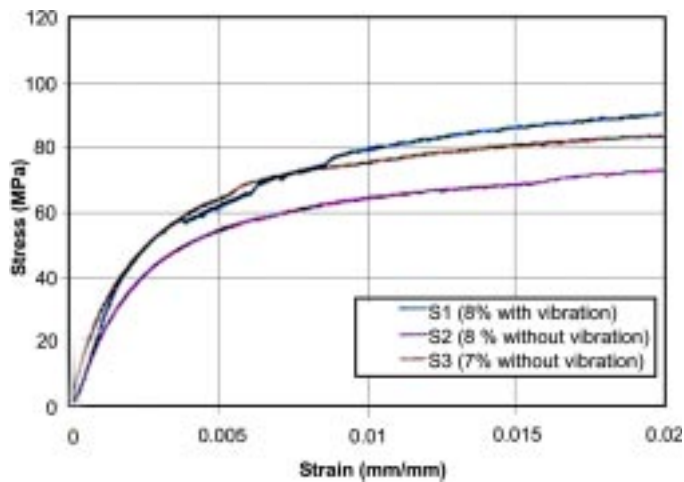
Crushing of Fibred RPC Cylinder without Spalling



Effect of Heat Treatment on the Compressive Strength of Fibred RPC

- **Slurry Infiltrated Fibrous Concrete (SIFCON)**

- High volume fibre Reinforced Concrete ( $V_f$  8-14%) with high tensile strength, strain hardening, ductility, energy absorption and Impact resistance
- Completely eliminates tensile reinforcement and reduces self weight
- Flexural Strength of 30-40 MPa, Compressive Strength of 60-70 MPa and Tensile Strain Capacity up to 2000 Micro strains
- Applications: Blast Resistant underground shelters, ammunition storage structures, Strong rooms overlays, armoured shield in lieu of steel shield, launch pads and retrofitting



*Stress- Strain Behaviour of SIFCON in Compression*

- **Structural Grade Geopolymer Concretes (GPC)**

- Use eco-friendly non-Portland cement binders based on alkali activated industrial wastes with ambient air / hydrothermal curing
- Strength, ductility and other structural parameters match these of structural grade OPC Concrete
- High rate of strength development, quick turnover time, increased production, cost effective and highly durable
- Applications: Cast insitu & precast structural components, building blocks, sewage pipes, chemical resistant overlays and floorings, temperature resistant lining



*GPC Specimens Intact Under H<sub>2</sub>SO<sub>4</sub> Attack*



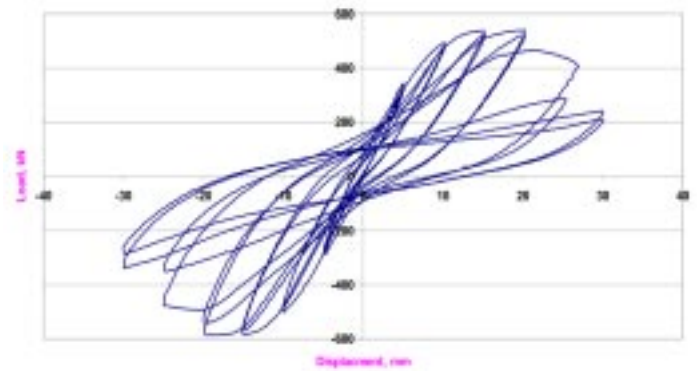
*Damaged OPC Concrete under H<sub>2</sub>SO<sub>4</sub> Attack*

- **Laced Reinforced Concrete (LRC)**

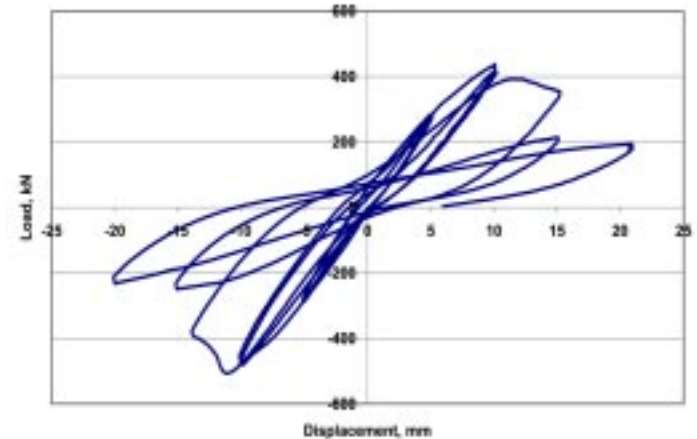
- LRC provides reinforcement in both strut and tie directions leading to large ductility
- Very high flexural rotation capacity (up to 8° without fibres)
- Suitable for blast resistant structures and explosives storage buildings
- Fibre Reinforced LRC provides excellent ductility and energy absorption under cyclic shear loading



*Laced Reinforcement for a RC Flexural Element*



*LRC with Fibre*



*LRC without Fibre*

*Performance of LRC Beams under Reverse Cyclic Loading*

### Advanced Construction Materials - Products Developed

- **Self Compacting Concrete Double Under-Reamed Piles**
  - Excellent surface finish, free from segregation, honey combs or voids
  - Well formed SCC pile shaft with two bulbs indicating easy flow of concrete into the bore hole
  - Ultrasonic pulse velocity > 4.2 km/s indicative of the excellent integrity of concrete

## Dimensions of Exhumed SCC Piles

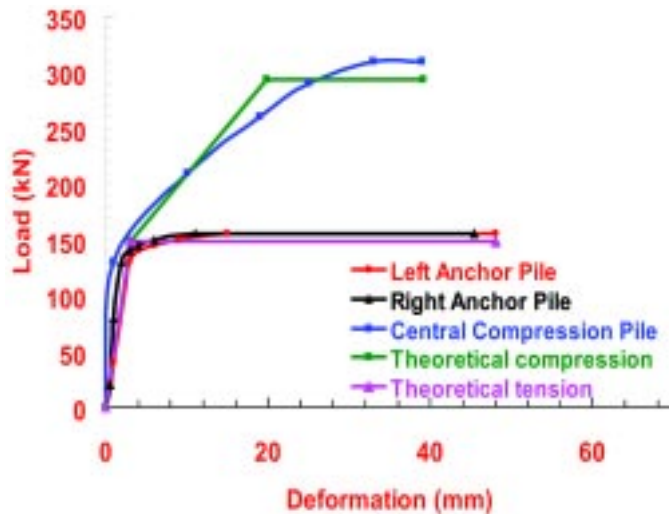
Type of Concrete	Top Bulb		Bottom Bulb	
	Distance	Height	Distance	Height
SCC	450-500 mm	210-300 mm	450-470 mm	200-300 mm
Conventional Vibrated Concrete	390-395 mm	150-165 mm	380-430 mm	135-170 mm



Exhumed Piles



Dynamic Test on Pile



Load-Deflection Plot of SCC Piles (Pullout Test)

### Fly Ash Aggregate

- Synthetic aggregate from industrial wastes in lieu of natural gravel/crushed stone aggregates produced by pelletization followed by sintering or hydro-thermal curing
- Light weight, low thermal conductivity, good sound insulation, suitable for use in structural concrete upto M40 grade



Fly Ash Pelletization



Fly Ash Aggregate of Different Sizes.

### Geopolymer Concrete Building Blocks/Pavers

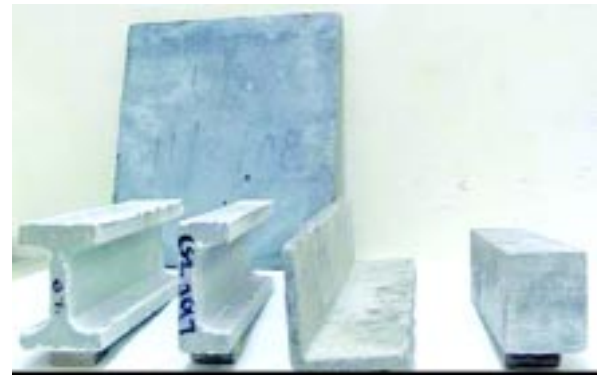
- M40 Grade blocks which utilize non-OPC binders produced by alkali activated industrial wastes
- Eco-friendly, fast setting, Turnover time-1day, no water curing, durable



Production of Geopolymer Building Blocks

### UHPFRC (Ultra High performance Fibre Reinforced Concrete) structural sections

- Very high compressive strength (200 MPa) and flexural strength (30-40MPa)
- Thin sections, light weight, high strength and ductility, conventional reinforcement eliminated by prestressing and /configurational design



UHPFRC Structural Sections

### SIFCON underground Shelters, ammunition storage structures, etc.

- Light weight, thin sections, no conventional tension rebars, high ductility and energy absorption



Performance Evaluation of Circular and Hairpin Shaped Models of SIFCON Underground Shelters

### FRC Manhole Covers

- Heavy duty, pilferage proof, impact resistant, high energy absorption
- Technology released through NRDC

## Techniques for Repair and Retrofitting of Concrete Structures using Non-metallic reinforcement

- Based on glass fibre reinforced polymer (GFRP) or carbon fibre reinforced polymer (CFRP)
- High Strength (500-1000 MPa), excellent durability in corrosive, alkaline and mild acidic environs
- Stiffness comparable or slightly less than that of steel
- Exhibit linear stress strain behaviour up to failure unlike the bilinear elastoplastic behavior of HSD rebars
- Ribbed GFRP/CFRP rebars exhibit excellent bond strength comparable to HSD and TMT rebars, while plain bars exhibit low bond strength



**Different Patterns of Using Carbon Fibre Wraps in Corrosion Damaged RC Slabs for strength Restoration**



**Performance Evaluation of CFRP Strengthened RC Compression and Flexural Elements**



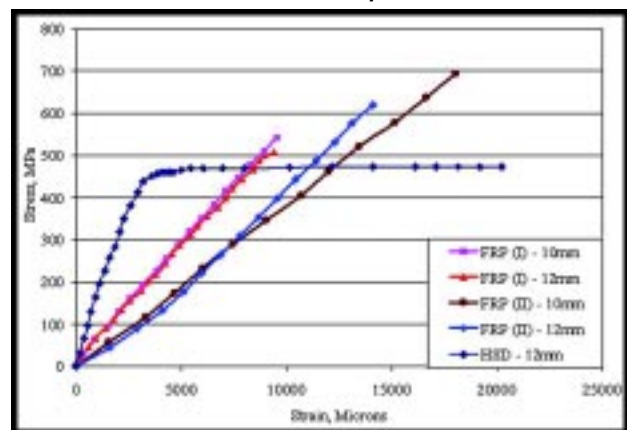
**GFRP Tension Test specimen**



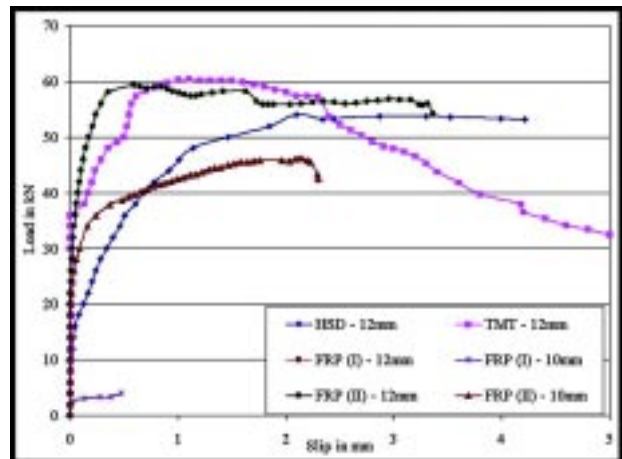
**GFRP Tension Test Set-up**



**Beam Bond Test Setup for Rebars**



**Stress Strain Behaviour of GFRP and HSD Rebars in Tension**



**Load Slip Behaviour for the GFRP Rebars and HSD Rebars**

For more details, please contact:

**Director**

**CSIR-Structural Engineering Research Centre  
(Council of Scientific and Industrial Research)**

CSIR Campus, Taramani, Chennai - 600 113

Phone: +91-44-22549201/22542139/22549151

E-mail: [director@sercm.org](mailto:director@sercm.org)

Web: <http://www.sercm.org>

---

**(Contd.... from Page 2)**

7. Shri K Sivasubramanian, Scientist attended the National Conference on emerging Trends in Civil Engineering (NCETCE-10) at KSR College of Engineering, Tiruchengode on 19<sup>th</sup> Feb. 2010.
8. Shri K Sivasubramanian, Shri S Sundar Kumar, Shri S Baskar, Shri Bhashya Vankudothu, R Manisekar and Mr. FA Olutoge, Scientists participated in the National Seminar on Advances in Construction Engineering Practice (ACEP-2010) at Annamalai University, Annamalainagar during 25<sup>th</sup> & 26<sup>th</sup> Feb. 2010.
9. S/Shri S Sundarkumar, Bhashya Vankudothu, A. Ramachandra Murthy, K.N. Lakshmikanthan, Dr. J.K. Dattatreya and Mrs. Smitha Gopinath, Scientists, attended the Short Term Training Programme on Fracture Mechanics of Concrete at IIT(M), Chennai during March 22-26, 2010.

**Abroad:**

Shri K. Sathish Kumar and Shri K.Kesavan, Scientists deputed to attend the 3<sup>rd</sup> International Earthquake Symposium at Dhaka, Bangladesh on 5<sup>th</sup> & 6<sup>th</sup> March 2010.

---

**SPECIAL LECTURES**

- Prof. Mahen Mahendran, Professor, Queensland University of Technology, Brisbane, Australia, delivered a lecture entitled, "Recent Advances in Cold Formed Steel Structures" on 4<sup>th</sup> January 2010.
- Ms. S.R.Uma, Earthquake Engineer, GNS Science, Lower Hutt, New Zealand, delivered a lecture on "Seismic Demands on Acceleration Sensitive Engineering Systems" on 13<sup>th</sup> January 2010.

---

**IN-HOUSE LECTURES BY SCIENTISTS**

**06.01.2010, Shri M. Saravanan**, Experimental investigations on composite slabs to evaluate longitudinal shear strength; **Shri J. Prabhakar**, Investigation of cement paste with mineral admixtures on engineering and durability properties – Study at Dundee University, UK.

**20.01.2010, Shri P. Harikrishna**, Experimental and Numerical Evaluation of Wind Induced Response of a Square Building; **Shri S. Gnanaprakasam**, Controller of Stores & Purchase, Current Purchase Procedures

**03.02.2010, Mrs. N. Anandavalli**, Flexural behaviour of LRC Beams; **Shri S. Gnanaprakasam**, Controller of Stores & Purchase, How to increase efficiency and how to get job satisfaction

**10.02.2010, Ms. P. Prabha**, Finite Element Simulation of connection behaviour of pallet racks; (ii) Evaluation of connection flexibility in cold formed steel racks; (iii) A polynomial equation for pallet rack boltless connections

**17.02.2010, Shri. S.R. Balasubramanian**, (i) Development of capacity curve for a typical two-storey reinforced brick masonry building; (ii) District-wise first order seismic loss estimation to the brick masonry Buildings in the States: UP, Uttarkhand, Punjab & Tamilnadu; **Ms. T. Priya, Project Assistant**, Occurrence of earthquakes in Southern India – A Bayesian approach

**24.02.2010, Shri B. Arun Sundaram**, (i) Strain monitoring in FRP strengthened concrete structures using fiber optic sensors; (ii) Technique for instrumentation and measurement of interfacial strains in FBG strengthened concrete structures

using FBG sensors; **Shri A. Abraham**, Full scale measurements of wind speed during a cyclonic storm

**03.03.2010, Dr. A. Rama Mohan Rao**, Structural parameter estimation combining domain decomposition techniques with immune algorithm; **Dr. Jolly Annie Peter**, A novel precise roofing scheme for affordable housing

**10.03.2010, Dr. A. Rama Mohan Rao**, Discrete hybrid PSO algorithm for design of laminate composites with multiple objectives; **Shri S. Parivallal**, Core drilling technique for in-situ stress evaluation in concrete structures; **Shri G. Ramesh**, Experimental studies on flexural behaviour of RC beams with corroded reinforcement

**17.03.2010, Dr. Arul Jayachandran**, (i) Comparative study on strength of cold formed lipped channel columns; (ii) Comparative study on the strength of cold formed tension members; **Shri K.N. Lakshmikanthan**, (i) Parametric studies on the behaviour of steel and composite space structures; (ii) Comparative study on steel and composite space structures

**24.03.2010, Shri V. Srinivas**, Comparative evaluation of longitudinal force on a railway bridge based on strain measurements – experimental and analytical investigations; **Shri J.Daniel Ronald Joseph**, Probabilistic analysis of imperfect steel columns designed using IS: 800-2007; **Mrs. R. Amourdhavally**, Technical Officer, Scenario analysis: A feasible planning technique for best practice of R&D – An Overview

---



*Mrs. Jayasurya Chellam, Senior Hindi Officer, BSNL, Chennai interacting with the administrative staff of SERC and CSIR (Madras) Complex, during the Hindi Workshop (8.3.2010)*



*Shri NV Raman, Former Director, SERC inaugurating the centralized Information Kiosk at SERC (18 March 2010)*

## International Women's Day Celebration

The International Women's Day was celebrated on the 8<sup>th</sup> March 2010. Mrs. Hema Gopal, Vice President, Tata Consultancy Services, Chennai was the Chief Guest. Mrs. Hema Gopal delivered a talk on "Woman as Role Model". On the occasion, Ms. P Prabha, Scientist, was awarded a Special Certificate for Excellence in Hindi for securing all India 4<sup>th</sup> rank in Prabodh, scoring a very high 92% marks during 2009. Mrs. Vani Satyanarayana, Hindi Officer (Technical), Knowledge Management Division, proposed a vote of thanks. □

## Visit of Shri N.V. Raman, Former Director, SERC

Shri N.V. Raman, Former Director, SERC, visited SERC on Thursday, 18<sup>th</sup> March 2010. He graced the ground-breaking ceremony of a new Dining Hall for PG Students and also of the proposed Entrepreneurship Development Centre (EDC) Building. He also inaugurated the centralized Information Kiosk, set up by the Knowledge Management Division at the entrance lounge of the Director's building and the Exhibits Park displaying various products/process technologies of SERC. He further inaugurated the newly acquired Material Handling Machinery and auxiliary equipment. He also interacted with project and infra-structure leaders at a meeting organised in the afternoon, presided over by Director, SERC. □

## Advanced Course on Transmission Line Towers

Advanced Course on Transmission Line Towers held during Jan.27-30, 2010 was attended by 50 participants. The topics covered in the Advanced Course included the following: An Overview of Design Requirements of Transmission Line Towers; Fibre Optic Sensors for Structural Health Monitoring of Towers; Reliability and Probabilistic Design Method; Conductor Loads on Transmission Line Towers; Steel Monopoles for Power Transmission and Lighting; Overview of Codes of Practices for Transmission Line Towers; Guyed Towers for Transmission Lines and Emergency Restoration System; Deep Foundations; Transmission Line Tower Failures during Testing; Prototype Testing of Towers; Tower Foundation Design; Introduction to Dynamic Analysis of Tower like Structures; Dynamic Wind Load Effects on Transmission Line and Communication Towers; Dynamic Analysis of Towers. □

## Augmentation of Material-handling facility

SERC has procured several material handling equipments to take care of day to-day material / store handling within the campus. These include an articulated Hydraulic mobile crane of 11 ton capacity with maximum operational height of 9 metres, a Forklift truck of 3 ton capacity and a battery operated four wheel industrial platform material-handling unit used for transportation of loads upto 2 tons on asphalt or smooth concrete, dry and trampled down road for short-haul services. In addition to these, SERC has added a few equipments to be used on the shop floor, such as 2 Nos. battery operated stackers of 2 ton capacity each, an electric pallet truck of 2.5 ton capacity and a manually operated hydraulic pallet truck. □

**Two-year Post-Graduate Research Programme  
on Engineering of Structures (PGRPE)**

**Commences Aug. / Sept. 2010**

**For application and further details, follow the link at  
<http://www.sercm.org>**



*Mrs. Hema Gopal, Vice President, TCS graces International Women's Day Celebrations at SERC as Chief Guest (08 March 2010)*



*Ground Breaking Ceremony of EDC Building at SERC (18 March 2010)*



*Participants of Advanced Course on Transmission Line Towers (27-29 January 2010)*



*Hydraulic mobile crane of 11 ton capacity procured at SERC*