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Research in Progress

Development of Composite Resin Matrix

Reactions of unsaturated polyester resin and 4, 4' diphenyl methane diisocyanate were carried out at different NCO/OH ratios in presence of catalysts to form the hybrid polymer networks. The curing of these networks was studied by a rigid body pendulum type (RPT) method in terms of reduced damping ratio and increased frequency. When isocyanate content increases, peak transition point in the curve of the resulting samples was moved to the higher temperature sides while the logarithmic damping ratio was moved to the lower sides. It is noted that before reaching the peak transition point, the size of network in the resin was small and also main chain structure of the resin was too soft. As a result, damping ratio increases and consequently, the stickiness occurs in the samples. This indicates a level of low curing probably due to the

movement of the physical networks. Above the peak transition point, the stickiness becomes small attributable to the creation and wider distribution of a large size networks following the temperature effects. It is noted that 10 wt % isocyanate addition to the unsaturated polyester resin (NCO/OH: 0.76) caused a significant reduction in the logarithmic damping ratio from 0.98 to 0.45 of the resulting system. The reduced logarithmic damping ratio and increased frequency favor a high level of curing in the hybrid polymer network compared with the unsaturated polyester. In order to enhance the toughness, chain extender was added to an optimized formulation of the hybrid polymer network (NCO/OH: 0.76). The tensile strength, elongation and energy to break of the hybrid polymer networks increased and tensile modulus decreased as the chain extender was added up to a level of 3 wt % only. An increase of 25% in tensile strength and 45% in elongation were observed over the hybrid network without chain extender. Above this level, the mechanical properties decreased especially after the phase separation of hard and soft domains.

AFM images of the hybrid polymer networks under phase contrast mode are shown in Fig. 1. The morphology of unsaturated polyester resin appears to be granular, rigid and heterogeneous in which both polyester and polystyrene coexist. The micro particle domains were emerged beyond the surface level. On the other hand, morphology of the hybrid polymer network was smooth, soft and particulate composite type in which urethane phase (dark area) was dispersed in the polyester matrix (bright area). When chain extender was added to the hybrid polymer network, morphology appeared to be relatively more soft and homogeneous. Under higher magnification, mat type microstructure was clearly visible. The phase contrast between the constituents was

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reduced due to the formation of polyester-urethane hybrid network phase as a continuous matrix. As a result, the tan delta peak of DMA was sharpened and moves towards lower temperatures due to dominant hybrid network phase.

The dynamic mechanical properties of the hybrid polymer networks were studied by constructing master curves of storage modulus and loss modulus versus frequency at a reference temperature of 80°C (Fig. 2). It is noted that storage modulus of all the samples were almost the same at higher frequencies, whereas at lower frequencies, the hybrid polymer networks exhibited high modulus values over the parent unsaturated polyester. The critical storage modulus of the hybrid network occurs at a frequency of

4×10^5 Hz as compared to 10^5 Hz for chain extended hybrid network and 10^5 Hz for unsaturated polyester resin showing its better time dependent response. The loss modulus of the samples also changes with the varying frequencies. It is observed that hybrid polymer network exhibited higher loss modulus than those of the other systems. Williams-Landel-Ferry equation (WLF) was used to describe the time-temperature behaviour of the hybrid polymer network at a reference temperature of 80°C.

$$\text{Log } a_T = \frac{C_1(T - T_0)}{C_2 + (T - T_0)}$$

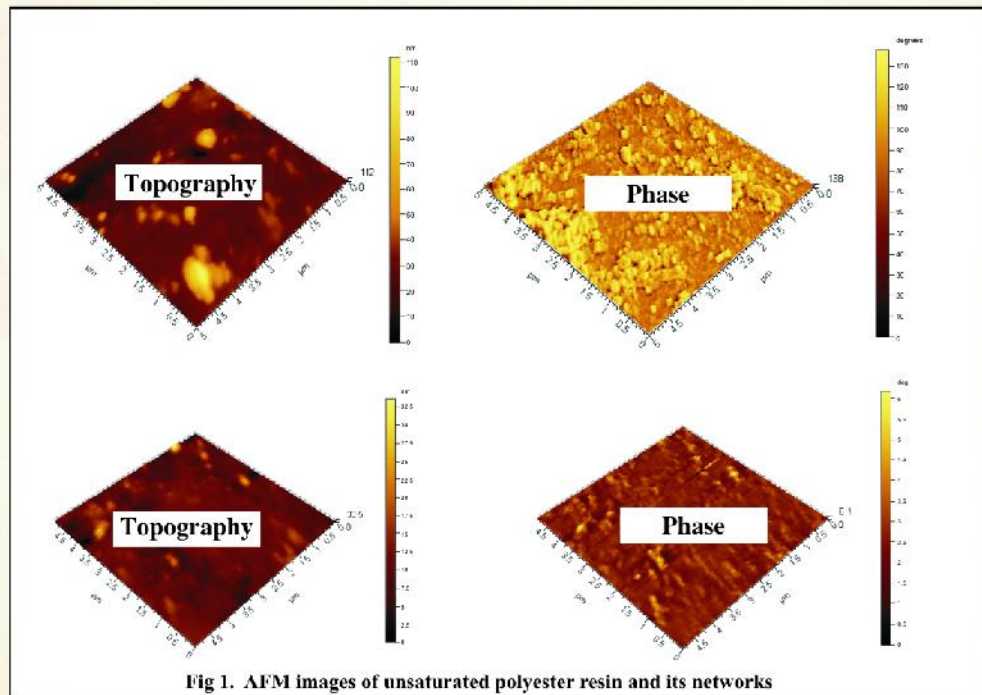


Fig 1. AFM images of unsaturated polyester resin and its networks

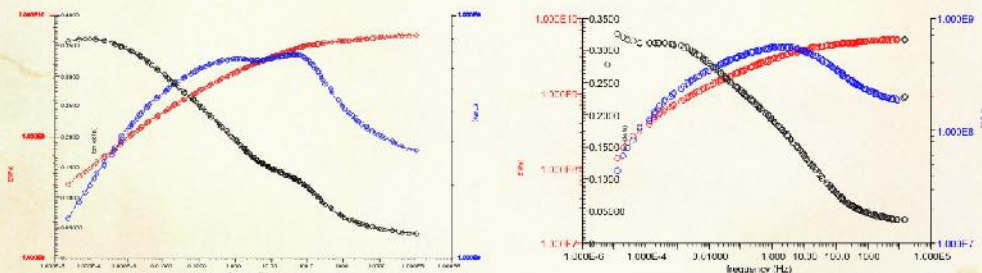


Fig 2. Time-temperature superposition curves of unsaturated polyester resin and its networks

Where a_T is the shift factor measuring how a material's frequency response changes with the variation of temperatures; T , the temperature (K or °C); T_0 the reference temperature (K or °C) and C_1 and C_2 , the experimental material constants. It is noticed that there was an acceptable resemblance between theoretical and measured shifts above the glass transition temperature. The material constants C_1 (65.26 K) and C_2 (432.2 K) for the hybrid polymer network were significantly higher than the C_1 (26.68 K) and C_2 (153.6 K) of the unsaturated polyester resin. When compared with the polyester resin, shift plot of the hybrid polymer network was less curved

showing its superior temperature resistance behavior. The hybrid polymer network incorporated with different percentage of chain extender exhibited variable material constants C_1 and C_2 in the range of 28.61 - 109.2K and 144.8 - 851.4 K respectively. The activation energy of the shift factor calculated by the Arrhenius equation at a reference temperature of 80°C was 356.7 KJ/mol for the hybrid polymer network and 455.3 KJ/mol for the unsaturated polyester resin. It is concluded that hybrid polymer network can be effectively used as a matrix for composite manufacturing.

B. Singh, M. Gupta and Anamika Randhawa (SIP-0029)

Performance Evaluation of Confined Masonry Buildings under Quasi-static Condition

The research attempts to comprehend seismic behaviour of confined masonry (CM) buildings through experimental investigation and thereon evolve design basis. During the period, the studies have been initiated on material characterisation of brick masonry & its constituents with different mortar proportions, numerical modelling of masonry walls together with mortar joints.

Experimental studies conducted on masonry for investigating the strength and elasticity of constituents of masonry i.e. bricks & mortar. The physical parameters i.e. the compressive strength, tensile strength, modulus of elasticity, Poisson's ratio and maximum compressive strain are measured for different

proportion for two kinds of mortars e.g. cement-sand mortar & cement-lime-sand mortar. The interaction between brick and mortar has also been studied through prism tests. Masonry prisms were also tested separately under cyclic loading for two stress conditions (i) loading normal to bed joints (stack bonded prism) (ii) loading parallel to bed joints. The tests are intended to examine strains at interface of masonry, in addition to the aforementioned parameters, which is subsequently being utilised for evolving analytical model of masonry walls/CM buildings. Table-1 presents structural properties while Fig. 3 shows stress – strain relationship for different grades of mortar.

Table-1: Structural Properties of Different Grade of Mortars

STRUCTURAL PROPERTIES	Cement-Sand Mortar (1:6)	Cement-Sand Mortar (1:8)	Cement-Lime-Sand Mortar (1:1:6)	Cement-Lime-Sand Mortar (1:1:8)
Density, (Kg/m ³)	1926.13	1905.41	2007.21	1983.76
Compressive Strength (MPa)	2.90	1.00	3.90	2.00
Tensile Strength (MPa)	0.95	0.31	1.05	0.34
Young's Modulus (MPa)	3696.85	4305.34	2627.25	3977.55
Poisson's Ratio	0.29	0.22	0.18	0.3
Ultimate Strain	0.0025	0.0021	0.0038	0.0035

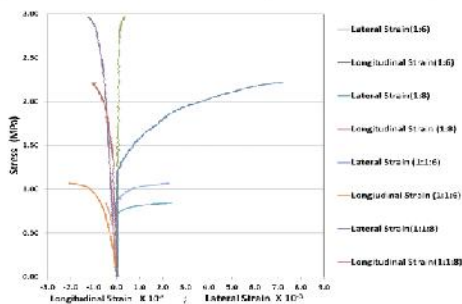


Fig. 3: Stress – Longitudinal Strain / Lateral Strain for different grades of mortar

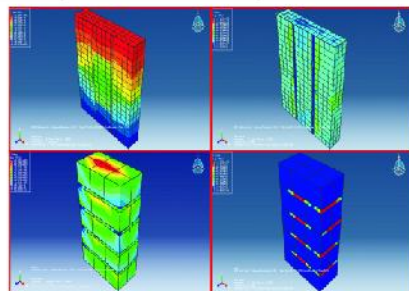


Fig. 4: Stress distribution for masonry prisms for loading parallel to bed joint and normal to bed joints.

The application of micro-modelling strategy for modelling in-plane masonry using the FE method requires use of continuum elements which are assumed to behave elastically and line interface elements displaying non-linear behaviour. The masonry has been modelled using 8-noded quadrilateral continuum element (C3D8I in ABAQUS) for bricks while mortar joints are being modelled using 8-

noded quadrilateral cohesive element (COH2D8). The interface behaviour has been simulated using traction separation mechanism assuming negligible constitutive thickness of mortar joints while inelastic properties were incorporated using modified Drucker-Prager model.

S K Bhattacharyya, Ajay Chourasia and Jalaj Parashar (OLP-0348)

Health Monitoring of Building Structures using Wireless Sensor Networks

The R&D assignment envisages to evolve a wireless system for capturing, transmitting and continuously monitor the physical parameters, which describes the health of building. Further, the research work proposes to develop numerical model using FE technique based on measured response, assess the health of building by performing modal updating and develop prognosis model to predict remaining useful life. The initial studies were conducted on eight-storied steel framed structure at CSIR-CBRI. Microstrain G-Link Wireless Accelerometer nodes and USB base-station with range extension has been used to collect data. The reliability of wireless communication in the present setup is being verified by placing nodes at different floors. Further, the structure will be excited at varying low frequency levels using Long-stroke shaker to study the response, and to evolve numerical model using FE technique, followed by model updating. Subsequently, additional sensors will be

introduced in the network to record other physical parameters like temperature, humidity, crack width, and corrosion. Once the activity is completed at laboratory level, field trials will be carried out on selected multi-storied buildings.

S K Bhattacharyya, Ajay Chourasia, S K Singh, Soju Alexander and Jalaj Parashar (OLP-350)



National Technology Day

The institute celebrated National Technology Day on May 11, 2011. Prof. S.C.Saxena, Director, IIT, Roorkee graced the occasion as Chief Guest and he delivered a lecture on Technological Innovation. In his lecture, Prof Saxena highlighted that May 11 is also the day when the indigenously developed Trishul missile was test fired and the indigenous aircraft Hansa-3 took to the air. Prof. S.K.Bhattacharyya, Director, CSIR-CBRI, Roorkee presided over the function. In his address Prof. Bhattacharyya welcomed the Guests and stressed that when science gets transformed into technology, it benefits the entire mankind in a big way. He further said that Technology day is celebrated to mark the many of technological achievements made by the country



especially CSIR in our context. This occasion reminds us to translate the research into technologies and business. Dr A K Mittal, Principal Scientist compered the function and also proposed the Vote of Thanks.

World Environment Day

In order to create awareness about protection of environment, trees were planted in the Institute by Prof. Prem Krishna, Chairman, Research Council, CSIR-CBRI on World Environment Day i.e on June 5, 2011. Shri Khalid Zahoor, Additional General Manager & Head, Pollution Control Research Institute, BHEL, Haridwar

said that clean environment is the concern of everyone and each one of us should contribute towards a healthy society by keeping the pollution level to the minimum. Prof S K Bhattacharyya, Director CBRI informed that this year, the United Nations Environment Programme (UNEP) has selected India as host of World Environment Day 2011

and the Environment Day 2011 slogan is 'Forest: Nature at your service'. Forests cover 1/3 of the earth's land mass and play a key role in our battle against climate change, and releasing oxygen into the atmosphere while storing carbon dioxide this is what the theme aims to reinforce. World Environment Day (WED) is observed on June 5 every year to promote awareness on the importance

of preserving our biodiversity, the need to identify problems related to the environment and ways to take corrective action. It was on this day in the year 1972 that the United Nations Conference on the Human Environment was formed. First celebrated in 1973, World Environment Day, also popularly known as Environment Day, is a means to tackle environmental challenges that include climate change, global warming, disasters and conflicts, harmful substances, environmental governance, ecosystem management and resource efficiency. Prof G J Chakrapani, IIT Roorkee delivered a talk on Rivers &



Environment. Dr A K Minocha, Sr Principal Scientist & Head EST compered the function and also proposed the Vote of Thanks.

Sadbhavna Diwas

The Institute observed Sadbhavna Diwas on August 19, 2011 with a view to promote harmony amongst people of all religions, languages and states and goodwill towards everyone.

Sri S G Dave, Chief Scientist, CBRI administered the Sadbhavna pledge to all the staff members of the Institute.

Independence Day



The Independence Day was celebrated at the Institute on August 15, 2011. Prof. Sriman Kumar Bhattacharyya, Director unfurled the National Flag and addressed the members of the staff. The CBRI staff club distributed sweets on the occasion. Students of Bal Vidya Mandir and CBRI Junior High School, Roorkee also participated in Cultural Programme.

Workshop-cum-Training Programme on Achieving Quality in Building Construction

A two days workshop cum training programme on Achieving Quality in Building Construction has been organized by CSIR - Central Building Research Institute, Roorkee (India) for engineering staff of Sarva Shiksha Abhiyan (SSA), Uttarakhand during 19-20th August, 2011 at CSIR-CBRI, Roorkee.

The training programme was inaugurated by Dr. N. M. Bhandari, Professor, Department of Civil Engineering, Indian Institute of Technology, Roorkee. He graced this

programme as a Guest of Honour. In the absence of Shri R.K. Sudhanshu, IAS, Secretary, Technical and Higher Education, Govt. of Uttarakhand and Chief Guest of the function, Dr. A.K. Mittal, Scientist, CBRI and Programme Coordinator read the message of the Chief Guest. The proceedings of the training programme was also released in the opening ceremony. Shri S. G. Dave, Chief Scientist, CBRI presided over the function.

The workshop was attended by forty-eight engineers from


Lighting of Lamp by the Dignitaries

Release of Course Proceedings

Demonstration of Concrete Block Construction

Closing Ceremony of the Course

Group Photo of Course Faculty & Participants

all the thirteen districts of Uttarakhand. Sh. S.G. Dave, Dr. B.K. Rao, Dr. A.K. Mittal, Sh. S.K. Negi, Sh. A.K. Sharma, Sh. Ajay Chourasia, Dr. L.P. Singh, Sh. Rajeev Kumar Sharma, Sh. Jajaj Parashar, Sh. I.A. Siddiqui and Sh. Deepak Dharmshaktu delivered lectures and shared their experiences. They discussed on the basics of earthquake engineering, latest construction

practices and achieving quality in building construction. A demonstration of reinforcement detailing and concreting was a part of the training programme. Some of the important lectures were on Basics of earthquake engineering and building design. Special soil and foundation systems, Precautions and quality control during concreting for small civil works, A glimpse on CBRI R&D for commercial/mass applications, Basic building materials, Construction practices and vernacular architecture in Uttarakhand, Inspection & testing plan for construction materials, Precautions during brick masonry construction, Achieving quality in construction – a challenge, Quality control strategy for Sarva Shiksha Abhiyan (SSA) school buildings, Demonstration of reinforcement detailing and concreting for building construction, Quality control in building construction using non-destructive testing etc.

The closing ceremony was held on 20th August, in which Prof. S. K. Bhattacharyya, Director, CBRI, Roorkee, presided over the function and distributed the certificates to Sh. Manish Mittal, Executive Engineer and his team of AEs and JEs. Dr. A. K. Mittal, Programme Coordinator proposed a vote of thanks. A feedback study was carried out by the organizers at the end of the event. Analysis of the feedback study suggests that this workshop cum training programme was highly appreciated, however, more time for demonstration was requested.

Workshop cum Training Programmes organised at U. S. Nagar & Nainital



Workshop cum training programmes were organised at Rudrapur, U.S.Nagar on 12th Sept., 2011, and at Haldwani, Nainital on 13th Sept., 2011. During the programmes, the lectures were delivered by the CBRI officials Ar. S. K. Negi & Sh. I. A. Siddiqui on the topics i.e. Achieving quality in construction, concept of earth-quake, earth-quake resistant design, architectural plans, Non-Destructive testing of RC components, and quality control programme. A questionnaire pertaining to QC practices was circulated to the participants. Tutorial & follow-Up session was also organised to answer the queries of the VECs, JEs and other participants at both the places. About 350 School Management Committee members, Sarva Shiksha Abhiyaan of U.S. Nagar & Nainital districts were benefited from these workshops.

Hindi Week

Hindi Week was celebrated in the institute during September 14-20, 2011. Dr. Yogendra Nath Sharma 'Arun', Member Rashtriya Sahitya Academy, New Delhi graced the occasion as Chief Guest of the Inauguration function on 14th September, 2011 & the celebration was presided over by the Director, CBRI, Prof. S.K. Bhattacharyya.

During Hindi Week, several competitions were organised. A two days Hindi Book Fair was also organized. S/Sri Arpan Maheshwari, Aman Kumar, Sudhir Kumar, Vishwas Tyagi, Sushil Kumar, Dr PKS Chauhan, Alok



Sharma, Satyarth Prakash, Sameer, Ajay Kumar Singh, Ajay Dwivedi, Shiv Kumar, Dr S. Sarkar, S.K. Senapati, Rajinder Kumar and Km Arti Garg won the prizes in various Hindi competitions.

On the valedictory function on 20th Sept., 2011, Prof. Mahavir Agarwal, Vice President, Uttarakhand Sanskrit Academy, Uttarakhand was the Chief Guest & the function was presided over by the Director, Prof. SK Bhattacharyya. The entire celebration of the Hindi Week was organised under the Chairmanship of Dr. B. Singh, Sr Principal Scientist & Convener Shri R.C. Saxena, Sr. Hindi Officer.



CSIR Foundation Day

The Institute celebrated CSIR Foundation Day on Monday 26th September, 2011 with great zeal and enthusiasm. Prof. Durg Singh Chauhan, Vice Chancellor, Uttarakhand Technical University, Dehradun graced the function as Chief Guest and Prof. S.K. Bhattacharyya, Director CSIR-CBRI, Roorkee presided over the function.

While speaking on the occasion, Prof. Chauhan, the chief guest, lauded the contribution of CSIR labs in varied areas of science and engineering and specially mentioned the contribution of Civil Engineering labs particularly that of CSIR-CBRI, Roorkee in resolving many housing problems encountered by the people residing in difficult and hilly regions, sea shore, poor and difficult soils areas etc. He further stressed that housing is a complex issue

encompassing many specialized areas of science and engineering and desired to have a strong collaboration and MoU between Uttarakhand Technical University and CSIR-CBRI for the benefit of the engineers of the future generation of the state of Uttarakhand.

Prof. S.K. Bhattacharyya, Director in his presidential address highlighted the ongoing programmes of the institute with special emphasis on the R&D programmes to be initiated in 12th Five Year Plan focusing towards a global impact in the area of civil engineering especially in housings. He further informed about PGRIPE and Doctoral programmes launched by the institute under the umbrella of recently approved Academy AcSIR by the parliament.

Earlier, Shri S.G. Dave, Chief Scientist and Chairman of the CSIR Foundation day function presented overview of CSIR institutions, their R&D activities and its reach from large industrial houses and corporate Industries to poor masses and villagers inhabited in far flung remote areas of the country. He further briefed on the glorious success of the CSIR and CBRI achievements and the importance of the celebration of the Foundation day of the CSIR. He also introduced both the Chief Guest and the Director to the invitees and audience gathering of around 500 city authorities, institutes past and present employees, school faculty & students of the town and senior faculty from IIT, CoER, NII, BE&G and other local institutions. The gathering was cheered with the presence of many senior





retired scientists & staff of CBRI on this important day recalling and exchanging with their old sweet memories.

The Chief Guest also gave away the prizes to the essay competition winning children of CSIR-CBRI employees who have secured Ist, IInd and IIIrd rank organised in two groups.

On this occasion, the Chief Guest presented mementoes (wrist watch) to the employees of the institute who had completed their twenty five years of service and a wrist watch, shawl and appreciation certificate to those who have retired in the previous year.



Two publications of the institute namely : PGRPE Brochure on Engineering of Infrastructure & Disaster Management and Proceedings of the Conference-Landslide Hazards: Consequences and Challenges were also released. Shri R.K. Garg, Chief Scientist proposed a vote of thanks.

The day was celebrated as an open day inviting school students and people of the town. An orientation programme was also arranged for 90 students from four schools and colleges of Roorkee namely, A S Arya Saraswati Vidhya Mandir, Kendriya Vidyalaya 1, DAV (PG) College and S.S.D.P.C. Girls degree College, under



the CSIR programme on Faculty Training and Motivation of Science Students and Adoption of School and Colleges. The students alongwith their faculty visited various labs of the institute and keenly interacted with the CBRI scientists.

In the afternoon, Prof. D.S. Chauhan delivered a special foundation day lecture on Management of R&D technologies and the traditional technologies.

The colourful evening celebration include a cultural programme beginning with Saraswati Vandana, film songs, Bhangra traditional, folk and modern dance and Music programme etc. The programmes were performed by the campus residents and the PGRPE students.

Research Publication

(a) Journal Publications

Arghya Deb & S.K. Bhattacharyya, (2010), An investigation into the effect of bonding of FRP wrapped cylindrical concrete columns, **Journal for Composites for Construction, ASCE**, available online 12 May 2010.

A.K. Pandey, (2010), Damage prediction of RC containment shell under impact and blast loading, **International Journal of Structural Engineering and Mechanics**, Vol. 36 (6), 729-744.

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of silica powder, **Applied Nanoscience**, **1**, 117-122.

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M. Gupta, Monika, Naseeba Khatoun and B. Singh, (2010), Composite boards from iso cyanate bonded pine needles, **J. Applied Polymer Science**, Vol. 118, 3477-3489, (USA).

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(b) Papers Published/Presented in Conference/Seminar/Workshop:

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V. Srinivasan, S.K. Singh and S.K. Negi, (2011), Green building challenges and assessment of building construction -An overview **National Energy Management in Buildings and Services**, organized by Chief Engineer Bareilly Zone, Bareilly, 4th Feb 2011.

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Y. Pandey and P.K.S. Chauhan, (2010), Strong ground motion data from Delhi region **14th Symposium on Earthquake Engineering**, IIT Roorkee, India, 17-19 Dec., 2010.

Colloquium

20th April 2011, Halogen-Free Fire Retardant EPS

Dr. Harpal Singh, Scientist, CBRI Roorkee

29th April 2011, An Automated Roof Top Organic Garden Design: An Approach for Land Utilization, Organic Crop Production and Environmental Abatement

Prof. B. C. Ghosh, Agricultural and Food Engineering Department, IIT, Kharagpur

4th May 2011, Tsunami - Surviving Nature's Fury through TER's,

Dr. Achal Kumar Mittal, Scientist, CBRI Roorkee

18th May 2011, Implementation of Suggestion Scheme in the Institute

Shri Ajay Singh, Principal Technical Officer, CBRI Roorkee

1st June 2011, Masonry Construction for Seismic Region: CBRI's Stride

Shri Ajay Chourasia, Scientist, CBRI Roorkee

8th June 2011, Fire Behaviour of Materials

Shri A.Ansari, Scientist, CBRI Roorkee

15th June 2011, The Right to Information Act, 2005

Shri S.G. Dave, Scientist, CBRI Roorkee and

Shri S.C. Tyagi, CoA, CBRI Roorkee

22nd June 2011, Wind Induced Damages on Structures and Mitigation

Dr. Amrit Kumar Roy, Scientist Fellow, CBRI Roorkee

29th June 2011, Utilization of Solid Industrial Wastes as Secondary Resource Materials in Building Sector (Part I)

Dr. A.K. Minocha, Scientist, CBRI Roorkee

6th July 2011, Fly Ash: From Waste to Wealth

Shri H.C. Arora, Scientist, CBRI Roorkee

13th July 2011, S&T Communication: Building of Innovation Culture

Dr. Anil Kumar Agarwal, Scientist, CBRI Roorkee

24th August 2011, Documentation of CBRI R&D Efforts, Dissemination and other Activities

Shri K.L. Chhabra, Principal Technical Officer, CBRI Roorkee

14th September 2011, Buyer Material Science Sustainable Solutions

Shri Isaac Emmanuel, Head, New Market Development (India)

21st September 2011, CSIR-CBRI Knowledge Resource Centre: Services and Latest Developments and Indian Author Productivity in Metrics: A Study (Paper in All India Conference on Library

Vision 2020)

Shri S. K. Senapati, Library Officer, CBRI Roorkee



Staff News

Honours/Awards



Dr. L.P. Singh, Senior Scientist has been awarded CSIR Raman Research Fellowship for the year 2011-12 to work at Northwestern University, Evanston, IL, USA in the area of Nanotechnology in Construction.



Smt. Gayatri Devi, Technical Asstt. has been awarded AMIE in Electronics & Communication Engineering from Institution of Engineers (India) in 2010-2011.



Shri Sudhir Sharma, Principal Technical Officer has been awarded AMIE in Computer Science & Engineering from Institution of Engineers (India) in 2011.

Transfer

CBRI Roorkee to SERC Chennai

V. Srinivasan Senior Scientist 21.04.2011

CBRI Roorkee to IIP Dehradun

B. B. Dimri Asstt. G (Gr-I) 01.07.2011

CBRI Roorkee from IMMT Bhubaneswar

S.P. Singh S&PO 04.08.2011

Superannuation

N.C. Yadav Daftri 30.04.2011

Suresh Giri Sr. Steno 31.05.2011

Janeshwar Prasad Tech. Gr-I 30.06.2011

Vikram Pal Daftri 30.06.2011

Bharat Singh Lab. Asstt. 31.07.2011

S.P. Vardhiya Sr. Tech. 31.07.2011

Shiv Kumar Sr. Tech. 31.08.2011

Ramesh Chandra S & PO 31.08.2011

Anand Prakash Sharma Sr. Tech. 01.09.2011
(VRS)

Obituary

*It is placed on record the sad and untimely demise of
Sh. Shyam Bir, Technician
on 10 April 2011.*

Promotion

Dr P K Bhargava	Chief Scientist	01.11.2009
Sh. R K Garg	Chief Scientist	27.11.2009
Dr. S P Agarwal	Chief Scientist	01.02.2010
Sh. Y Pandey	Chief Scientist	01.02.2010
Dr. (Smt.) Leena Chourasia	Senior Scientist	09.12.2009
Dr. Rajesh Deoliya	Principal Scientist	29.07.2009
Dr. Navjeev Saxena	Principal Scientist	01.01.2010
Sh. A.P. Chourasia	Principal Scientist	01.01.2010
Sh. S.K. Singh	Principal Scientist	01.01.2009
Dr. Sujit Kr. Saran	Principal Scientist	31.07.2009
Sh. S.K. Jain-IV	Principal Scientist	01.02.2010
Dr. A.K. Pandey	Sr. Principal Scientist	27.09.2009
Smt. Neeta S. Mittal	Sr. Principal Scientist	24.02.2010
Sh. Ashok Kumar	Sr. Principal Scientist	05.07.2009
Sh. Surendra Kumar Negi	Sr. Principal Scientist	09.07.2009
Dr. Shantanu Sarkar	Sr. Principal Scientist	25.07.2009
Dr. S.K. Agarwal	Sr. Principal Scientist	13.04.2009
Dr. (Smt.) Mridul Garg	Sr. Principal Scientist	01.08.2009
Sh. Suraj Pal Singh	Asstt. (F&A) Gr-I	01.04.2011
Sh. Khushpendra Arora	Pvt. Secy.	08.07.2011
Sh. Surendra Singh	Pvt. Secy.	11.07.2011

Editor

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Principal Scientist



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