वार्षिक प्रतिवेदन
Annual Report
2010-2011

सीएसआईआर–केन्द्रीय भवन अनुसंधान संस्थान
रुड़की

CSIR-Central Building Research Institute
(A Constituent Establishment of CSIR)

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ANNUAL REPORT 2010-2011

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सी एस आई आर – केन्द्रीय भवन अनुसंधान संस्थान रूड़की का वर्ष 2010–11 का वार्षिक प्रतिवेदन प्रस्तुत करते हुये मुझे अत्यन्त हर्ष का अनुभव हो रहा है। किसी भी समयावधि का महत्व उसके चिरस्थायी प्रभाव के परिप्रेक्ष्य में ही आंका जा सकता है। प्रौद्योगिकी के क्षेत्र में तीव्र गति से हो रही प्रगति अनुसंधानकर्ताओं को निरंतर सोचने पर विवश करती रहती है। इस अवधि के दौरान नवीन निर्माण सामग्रियों, ऊर्जा दक्ष भवनों एवं प्रणालियों, स्वास्थ्य प्रबोधन, पूरक सामग्रियॉ (रेट्रोफिटिंग्स) एवं आपदा प्रबन्धन के क्षेत्रो में महत्वपूर्ण उपलब्धियां रही है। सी एस आई आर नेटवर्क की तीन परियोजनाओं को सफलतापूर्वक जारी रखा गया। प्राकृतिक एवं अन्य आपदाओं में संरचना इंजीनियरी नामक नेटवर्क परियोजना में (जिसकी नोडल प्रयोगशाला सी एस आई आर– एस ई आर सी, चेन्नई है) हमारा लक्ष्य उत्तराखण्ड में ऋषिकेश उत्तरकाशी मार्ग (राष्ट्रीय राजमार्ग–94) पर संभावित भूस्खलनो पर भूस्खलन प्रबोधन योजना विकसित करना तथा इससे सम्बंधित उपचारात्मक उपाय ढूढना था। माप विज्ञान में प्रगति पर नेटवर्क परियोजना को जारी रखा गया तथा भवन सामग्रियों के परिप्रेक्ष्य में प्रमाणित संदर्भ सामग्रियों (सी आर एम) के विकास एवं प्रसार पर ध्यान केंद्रित किया गया। ग्रामीण जनता की आवास एवं रहन–सहन अवस्थाओं में सुधार लाने हेतु तथा स्थानीय कारीगरों एवं निर्माण मजदूरों के कौशल में वृद्धि करने के उद्देश्य से सुरक्षित, स्वास्थ्यकर एवं टिकाऊ आवास प्रौद्योगिकियों के प्रसार, प्रशिक्षण एवं निर्देशन पर सी एस आई आर–800: आर एस डब्ल्यू एन ई टी परियोजना जारी रखी गयी। देशभर में ग्रामीण क्षेत्रों में जनजागरूकता कार्यक्रमों, प्रशिक्षण कार्यक्रमों, स्थल (ऑन साइट) निर्देशनों तथा उद्यमशीलता विकास के माध्यम से इन लक्ष्यों को प्राप्त किया गया।

दीर्घकालिक (सुदृढ) भवन निर्माण हेतु उच्च निष्पादन सामग्री एवं निर्माण प्रौद्योगिकियों पर सुप्रा संस्थागत परियोजना के अंतर्गत कम्पोजिट रेजिन मैट्रिक्स, लिग्नो सैल्यूलोज पैनल उत्पादों हेतु रेजिन आसंजकों के विकास पर अध्ययन, रासायनिक पर्यावरण के अंतर्गत जियो पॉलीमर पेस्ट के टिकाऊपन का अध्ययन, अपरिष्कृत उड़नराख की पोजोलोना से प्रतिक्रियता, एम एस डब्ल्यू भस्मीकृत राख से सीमेंटीक बंधक, भवन ईंटों/पिंडो एवं यौगिको में उपयोग हेतु गैर परम्परागत सामग्रियों से अल्फा प्लास्टर तथा सीमेंटी बंधक का विकास, ब्लास्ट लोडिंग के परिप्रेक्ष्य में चिनाई दीवारों के प्रायोगिक एवं सैद्वांतिक अध्ययन जारी रखे गये। नूतन निर्माण प्रौद्योगिकियों के क्षेत्र में संस्थान का सुविख्यात योगदान रहा है। उड़न राख के उपयोग पर भी संस्थान में उल्लेखनीय कार्य किया गया है। नैनो सिलिका के संश्लेषण एवं वर्गीकरण तथा कैल्शियम–सिलिकेट–हाइड्रेट सिस्टम में इसके उपयोग पर अध्ययन स्पंज लौह अपशिष्ट से भवन घटकों का विकास, कचरा विहिनता (जीरो गार्बेज) हेतु नगर के ठोस अपशिष्ट के उपयोग एवं इसके प्रबंधन हेतु कारगर समाधान योजना, वन अपशिष्ट से जैवभंगुर (बायोडिग्रेडेबल) नर्सरी गमले तैयार करना, आदि पर अध्ययन जारी रहे। कार्बनिक भवन सामग्रियों के क्षेत्र में, उर्वरक उद्योगो हेतु सवंर्धित एपोक्सी रेजिन पर आधारित विलेपन प्रणाली के विकास, भवनों हेतु बहुउद्देश्यीय ताप विलेपनों के विकास पर अध्ययन किये जा रहे है।

उर्जा दक्ष भवनों तथा अन्य प्रणालियों के क्षेत्र में, देश की विविध भू जलवायु में इंदिरा आवास योजना के अंतर्गत इकाई लागत के संशोधन पर अध्ययन, पर्वतीय क्षेत्रों (उत्तराखण्ड) में ग्रामीण आवासों के अभिकल्पन एवं विकास की विधियों तथा शीत जलवायु वाले क्षेत्रों में भवन पर्यावरण में सुधार हेतु भवनों में सौर उर्जा के उपयोग पर अध्ययन प्रगति पर है।

स्वास्थ्य प्रबोधन एवं रेट्रोफिटिंग के क्षेत्र में, वायरलेस सेंसर नेटवर्क के उपयोग से भवन संरचनाओं के स्वास्थ्य प्रबोधन संबंधी गतिविधियां, एन टी पी सीमाद्री के कूलिंग टावर की मरम्मत हेतु स्वास्थ्य प्रबोधन एवं उपचारात्मक उपाय,

अर्ध स्थैतिक अवस्थाओं में परिरूद्ध चिनाई भवन के निष्पादन का मूल्यांकन, निकट में खुदाई के कारण अप्रत्यक्ष कारणो के अंतर्गत पाइल नीवों के निष्पादन का मूल्यांकन प्रगति पर है।

आपदा न्यूनीकरण के क्षेत्र में, सेलुलोजी सामग्रियों से अविषालु दहन उत्पाद एवं इनका न्यूनीकरण, जम्मू क्षेत्र हेतु भूकम्पीय अध्ययन गढवाल हिमालय में अलकनंदा द्याटी के ऊपरी क्षेत्र में भूस्खलन जोखिम निर्धारण एवं नियंत्रण उपायों हेतु दिशा निर्देशों का विकास, भूस्खलन संभाव्यता एवं मेसो स्केल पर जोखिम अनुक्षेत्र वर्गीकरण हेतु विधियों का विकास तथा उपचारात्मक उपायों के दिशा निर्देशों पर महत्वपूर्ण अध्ययन किये जा रहे हैं।

सी एस आई आर. द्वारा वर्ष 2009 में इंजीनियरी में स्नातकोत्तर अनुसंधान कार्यक्रम (पी जी आर पी ई) प्रारम्भ करने पर, हमें, अपनी सहयोगी प्रयोगशाला सी एस आई आर–सी आर आर आई, नई दिल्ली के साथ मिलकर, सी बी आर आई रूड़की में अगस्त 2010 से अवसंरचना एवं आपदा न्यूनीकरण इंजीनियरी (भवन/सड़क) पर दो वर्षीय पी जी आर पी ई कार्यक्रम आरम्भ करने का अवसर प्राप्त हुआ।

संस्थान द्वारा बहुत से लद्यु अवधि पाठ्यक्रम आयोजित किये गये, जैसे – कार्यरत इंजीनियरों हेतु भूकम्परोधी अभिकल्प एवं निर्माण युक्तियां (प्रेक्टिस), सी एस आई आर 800 के अंतर्गत कम लागत आवास प्रौद्योगिकियों पर उद्यमशीलता विकास कार्यक्रम। सितम्बर माह में संस्थान में हिन्दी सप्ताह मनाया गया। संस्थान ने आई आई टी एफ नई दिल्ली में सी एस आई आर टैक्नोफेस्ट 2010 (बदलते भारत के लिये विज्ञान एवं नवीकरण खोज) में सक्रिय रूप से भाग लिया। भवन संरचनाओं का भूकम्प एवं वायु प्रतिरोधी अभिकल्प पर कार्यगोष्ठी सह प्रशिक्षण पाठ्यक्रम, तत्पश्चात दिसम्बर 2010 में विज्ञान एवं कंक्रीट में नैनोटैक्नोलोजी पर इण्डो यूएस कार्यशाला, फरवरी माह 2011 में आयोजित "भूस्खलन संकट : परिणाम एवं चुनौतियां" विषय पर राष्ट्रीय सम्मेलन, 'भूमि सुधार तकनीकों में अपद्यटन प्रगति' विषय पर राष्ट्रीय सम्मेलन आयोजित किये गये जिनमें विश्व भर से शिक्षा एवं उद्योग जगत के प्रतिभागियों ने बड़ी संख्या में भाग लिया।

संस्थान की अनुसंधान एवं विकास गतिविधियों के विषय में छात्रों एवं आम जनता को जागरूक करने के उद्देश्य से संस्थान द्वारा राष्ट्रीय विज्ञान दिवस, पर्यावरण दिवस, प्रौद्योगिकी दिवस, सी एस आई आर स्थापना दिवस, सी एस आई आर–सी बी आर आई स्थापना दिवस को मुक्त दिवस के रूप में मनाया गया।

देश विदेश के लोगों के साथ निरंतर संवाद एवं संचार बनाये रखने की कड़ी में, संस्थान ने भवन एवं निर्माण क्षेत्र की विभिन्न समस्याओं के लगभग 2000 से अधिक पूछताछ संबंधी उत्तर दिये। भवन निर्माण के क्षेत्र में नये अनुसंधान एवं प्रौद्योगिकीयों के विषय में आम जनता के बीच जागरूकता पैदा करने के उद्देश्य से निर्देशन सह प्रशिक्षण कार्यक्रमों एवं तकनीकी प्रदर्शनियों आदि का आयोजन किया गया। संस्थान ने अपने दिल्ली स्थित प्रसार केन्द्र के साथ मिलकर, देश भर में केंद्रीय, राज्य, सार्वजनिक निजी क्षेत्रों के संगठनों के साथ संपर्क बनाये रखा।

इसके अतिरिक्त 12वीं पंचवर्षीय योजना के लिये एक महत्वाकांक्षी एवं केंद्रित अनुसंधान योजना बनाने के उद्देश्य से संस्थान में, एक सुविचारित रणनीति के अंतर्गत वैज्ञानिकों के बीच एक व्यापक अंतः प्रेरक विचार विमर्श आरम्भ किया गया है। यहां पर यह उल्लेख करना प्रासंगिक होगा कि ये कार्यक्रम, अपनी सहयोगी प्रयोगशालाओं की अनुसंधान एवं विकास क्षमताओं के साथ संयोजन करते हुए एक राष्ट्रीय मिशन के साथ तैयार किये जा रहे है।

उपर्युक्त सभी कार्य वैज्ञानिक साथियों, तकनीकी अधिकारियों तथा प्रशासनिक सहकर्मियों के कर्तव्यनिष्ठ तथा सच्चे प्रयासों के बिना संभव नहीं हो पाता, जिन्होने सौंपे गये कार्यों को सफलतापूर्वक पूरा करने के लिये कठोर परिश्रम किया है। मै उन सभी की हार्दिक प्रशंसा तथा उन्हे शुभकामनाएं देता हूं। हमारी अनुसंधान परिषद के अध्यक्ष, सदस्यगण, अपने अमूल्य परामर्श, मार्गदर्शन तथा सहायता के लिये विशेष धन्यवाद के पात्र हैं। मैं महानिदेशक, सी एस आई आर तथा सी एस आई आर मुख्यालय के अपने साथियों को, हमें सतत सहयोग एवं मार्गदर्शन प्रदान करते रहने के लिये सद्भावनापूर्वक धन्यवाद देता हूं।

मैं, आवश्यक सूचनाएं उपलब्ध कराने वाले सहकर्मियों तथा इस वार्षिक प्रतिवेदन की उत्तम प्रस्तुति के सम्पादक दल को भी धन्यवाद देता हूं। अन्त में, मैं अपने मूल्यवान ग्राहकों, प्रायोजकों, शुभचिन्तकों तथा सी एस आई आर–सी बी आर आई के सेवानिर्वृत्त स्टाफ सदस्यों के सहयोग तथा सहायता का स्मरण करना भी मेरे लिये प्रसन्नतादायक एवं महत्वपूर्ण पल है।

भवन निर्माण तथा अवसंरचनात्मक उद्योग में अभूतपूर्व वृद्धि के साथ हम उज्जवल भविष्य की ओर अग्रसर है।

एस.के भट्टाचार्य

दिनांकः 20 नवम्बर 2011

(श्रीमान कुमार भट्टाचार्य)

From the Director's Desk

It gives me immense pleasure to present the Annual Report of CSIR-Central Building Research Institute, Roorkee for the year 2010-11. Each period is characterized by its own value in terms of everlasting impact. Rapid advancements in the technology front have forced researchers to think otherwise always.

During the period, notable achievements have been made in the areas of Newer Construction Materials, Energy Efficient Buildings and other Systems, Health Monitoring & Retrofitting and Disaster Mitigation. Three CSIR Network Projects were successfully continued. In the Network Project on `Engineering of Structures against Natural and other Disasters' (nodal Lab was CSIR-SERC, Chennai), our main focus was on the development of Landslide Monitoring scheme and associated Remedial Measures of a potential landslide slope on Rishikesh-Uttarkashi Road (NH-94), Uttarakhand. The Network Project on `Advancement in Metrology' was continued and focused on preparation and dissemination of Certified Reference Material (CRM) with reference to building materials. CSIR-800-RSWNET project on Dissemination, Training and Demonstration of safe, healthy and durable housing technologies was continued with the aim to improve housing and living conditions of the rural masses and enhance the skills of local artisans and construction workers. These were achieved through mass awareness programmes, training programmes, on-site demonstration and entrepreneurship development in rural areas of the country.

Under the Supra Institutional Project on `High Performance Material and Construction Technologies for Sustainable Built Space' studies on development of composite resin matrix, resin-adhesives for ligno-cellulosic panel products, durability studies of geopolymer pastes under chemical environment, pozzolanic reactivity of coarse fly ash, cementitious binder from MSW incineration ash, development of alpha plaster & cementitious binder from non-traditional materials for use in building bricks/blocks and composites, experimental and theoretical study of masonry walls subjected to blast loading were continued. The contribution of the Institute in the area of Newer Construction Materials is well recognised. The Institute has done notable work on flyash utilization. Studies are going on synthesis and characterization of nano silica and its subsequent use in calcium-silicate-hydrate systems, development of building components from sponge iron waste, utilization and tangible solution for management of municipal solid wastes (including inert) towards Zero garbage, biodegradable nursery pots from forest waste etc. In the area of Organic Building Materials, studies on development of coating system based on modified epoxy resin for fertilizer industries, development of multifunctional thermal coatings for buildings are under progress.

In the area of Energy Efficient Buildings and other Systems, Studies on revision of unit cost under Indira Awas Yojana in various geo-climatic zones of the country, methodology for design and development of rural housing in hilly area (Uttarakhand), utilization of solar energy in buildings for improvement of built environment in cold climatic region are under progress.

In the area of Health Monitoring & Retrofitting, activities on health monitoring of building structures using wireless sensor networks, health assessment and remedial measures for the repair of cooling towers of NTPC, Simhadri, performance evaluation of confined masonry building under quasi-static conditions, performance assessment of pile foundation under indirect loading due to adjacent excavations are under progress.

In the area of Disaster Mitigation, studies on toxic combustion products from cellulosic materials & their minimization, seismic studies for Jammu region, landslide risk assessment in the upper reaches of Alaknanda Valley, Garhwal Himalaya and development of guidelines for control measures, development of methodology for landslide susceptibility and risk zonation on a meso-scale and guidelines for scheme of remedial measures are continued.

With the introduction of Post Graduate Research Programme in Engineering (PGRPE) by CSIR in the year 2009, we took this opportunity to launch a two years' PGRPE Programme on `Engineering of Infrastructure and Disaster Mitigation (Building/Roads)' from August 2010 at CSIR-CBRI, Roorkee in association with our sister laboratory CSIR-CRRI, New Delhi.

The Institute has organized various short term courses viz. Earthquake Resistant Design and Construction practices for practicing engineers, Entrepreneurship Development Programme on Low Cost Housing Technologies under CSIR-800. Institute has actively participated at CSIR-Technofest 2010 (Science & Innovation for Transforming India) at IITF, Workshops cum training course on 'Seismic and Wind Resistant design of building structures' followed by 'International Advance School (IAS 7) in Wind Engineering', INDO-US workshop on 'Nanotechnology in the Science and Concrete' in December 2010, National Conference on 'Landslide Hazard: Consequences and Challenges', National Conference on 'Recent Advances in Ground Improvement Techniques' in the month of February 2011 attracted large number of delegates from academia and industries from all over the world.

The Institute observed open days on the occasion of National Science Day, Environment Day, Technology Day, CSIR Foundation Day, CSIR-CBRI Foundation Day to make the students and general public aware with the R&D activities of the Institute. The Institute celebrated Hindi week in the month of September. To maintain regular interaction and communication with the people of India and abroad, the Institute attended about 2000 inquiries pertaining to various problems of Building and Construction sector. Demonstration cum training programmes, technical exhibitions etc. were organized to create awareness for general public about the new research and technologies in the field of building sector. The Institute along with its extension centre at Delhi continued to maintain liaison with Central, State, public/private sectors throughout the country.

Besides, the Institute has initiated extensive brainstorming discussions among its scientists to arrive at an ambitious and focused research plan for the XII Five Year period, with a well-thought out roadmap. It is pertinent to note that these programmes have been drafted with a National mission by combining the R&D capabilities of our sister laboratories.

All could not have been possible without the sincere and honest efforts made by fellow scientists, technical officers and administrative staff who worked hard in successfully completing the work assigned to them. I record my deep appreciation and best wishes to all of them. The Chairman and the Members of our Research Council deserve special thanks for their valuable advice, guidance and support. I extend my

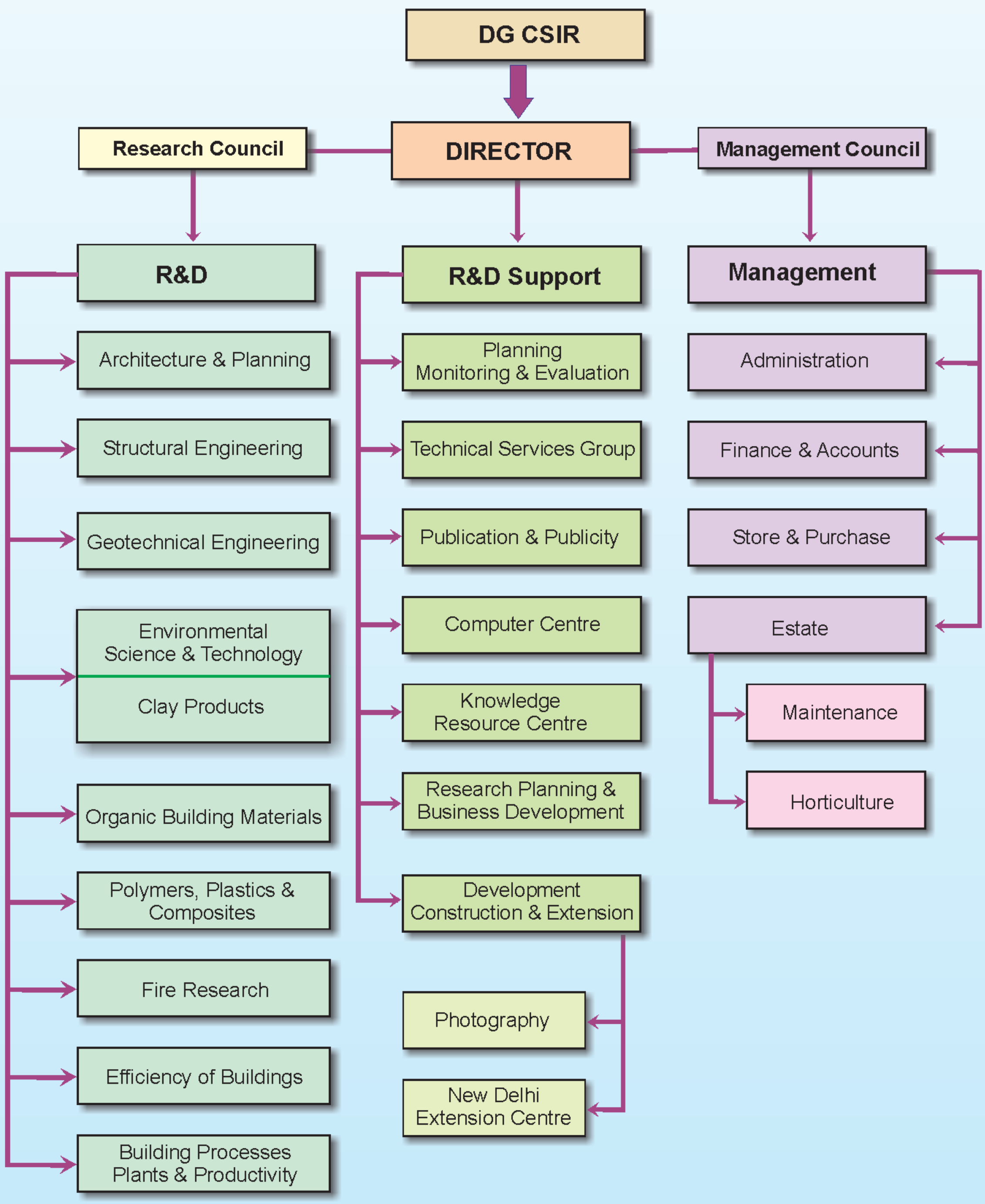
sincere thanks to the Director General, CSIR and other colleagues from CSIR Head quarters for their continued support and guidance. I thank my colleagues for providing the necessary inputs and editorial team for bringing out this annual report in an elegant manner. Last but not the least, it is a happy moment for me to remember the support and co-operation provided by our valued customers, sponsorers, well wishers and ex-staff members of CSIR-CBRI.

With the unprecedented growth in the building and infrastructure industry, we are looking forward to an exciting future.

Dated: November 20, 2011

(Prof. S. K. Bhattacharyya)

CSIR-CBRI ORGANOGRAM



Newer Construction Materials

Newer Construction Materials

Synthesis and Characterisation of Nanosilica and its Subsequent use in Calcium-Silicate Hydrate Systems (GAP-3017)

L. P. Singh and Team

Nanotechnology is gaining widespread attention and being applied in many fields to formulate materials with novel functions having unique physical and chemical properties. In the construction sector, nanotechnology is being used in a variety of ways to produce innovative materials. Using nanotechnology as a tool, it is possible to modify the nano/basic structure of the materials to improve the material's bulk properties such as mechanical performance, volume stability, durability and sustainability.

Dispersed, spherical particles of nano silica (n-SiO_2) with controllable size have been synthesised using a metal alkoxide, tetraethoxysilane, as starting material and ammonia as base catalyst by sol-gel method. The particle size of nano silica can be well controlled by adding non-ionic surfactants. Increase in chain length of surfactant resulted in decreasing particle size of silica nano particles (Fig 1).

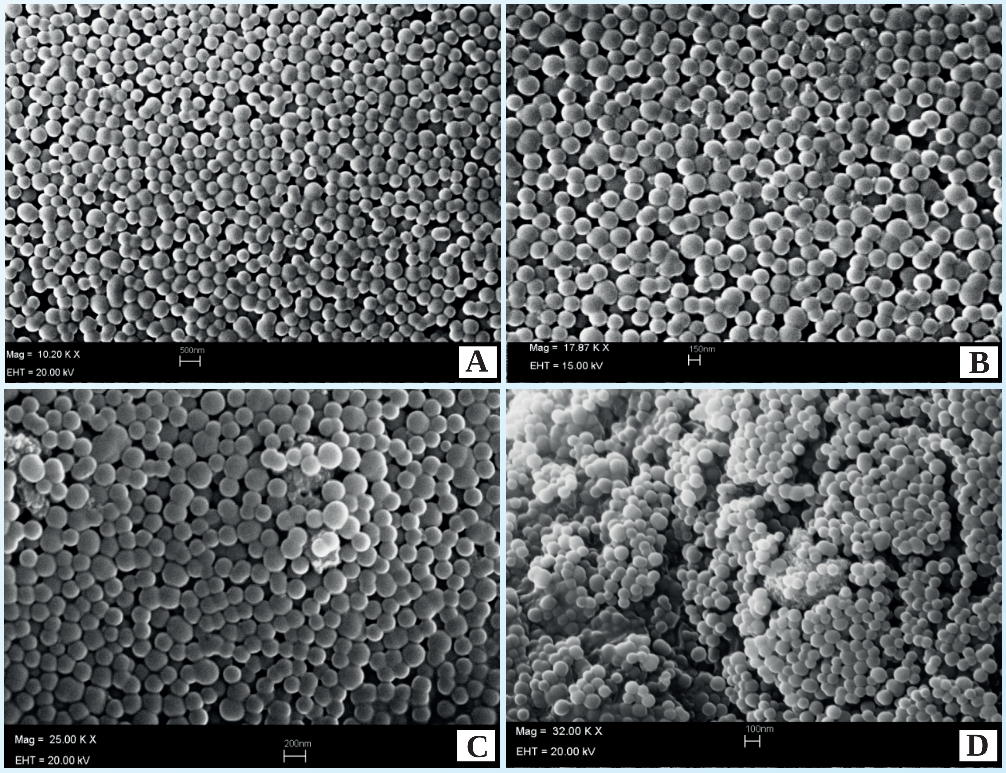


Fig 1: SEM micrograph of n-SiO_2 particles (80-200nm) prepared without surfactant (A), span 20 (B), span 40 (C) and span 60 (D)

Further, these nano-particles were incorporated in cement paste for compressive strength and calcium leaching resistant. The two silicate phases of cement, tricalcium silicate and dicalcium silicate, give calcium-silicate-hydrate (C-S-H) and calcium hydroxide (CH) as hydration products. The C-S-H gel being the main component of cement hydration is responsible for the strength and microstructure of the cement paste. The amount of CH formation in cement paste was evaluated by thermo gravimetric analysis (TGA) during hydration process. This was characterized by CH residue determination in cement paste admixture. Further, silica fume (SF) was also added to cement paste for comparison. TGA curves of pure, n-SiO_2 & SF incorporated cement pastes are shown in Fig 2 at 28 days of hydration. CH content in various cement paste during the hydration process is shown in Table 1. At early stage of hydration, plain cement paste has 4.4% of CH whereas SF incorporated cement paste has 2.3% and n-SiO_2 incorporated paste has only 0.5% CH content. During the hydration, CH forms and at 3, 7 and 28 days it amounts to 7.7%, 12.8% and 20.3%, respectively in plain cement paste. Whereas the CH content, in SF incorporated cement paste is upto 16.3% at 28 days. n-SiO_2 have much significant effect as compared to plain and SF incorporated cement paste and at 28 days of hydration only 8.5% CH content was observed.

XRD profiles of plain cement, n-SiO_2 and SF incorporated pastes 28 days of hydration are shown in Fig 3, respectively. It is evident from XRD profiles that the CH peak is completely disappeared with the addition of n-SiO_2; while the same is significantly present in plain and SF incorporated cement paste. It is therefore inferred from Fig 3 that addition of n-SiO_2, significantly consumes the CH produced during the hydration process. Therefore, the pozzolanic reactivity of n-SiO_2 at early stage of hydration is significantly high and increases compressive strength at early ages, thereby enhancing the durability and mechanical properties of the cementitious materials.

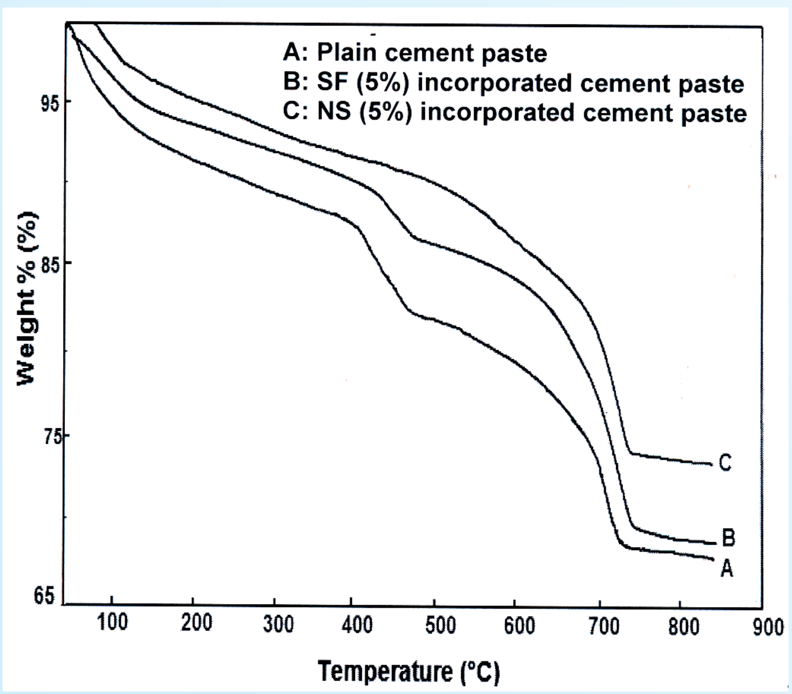


Fig 2: TG curves of cement pastes at 28 days of hydration

Table 1 : Calcium hydroxide content (%) in cement pastes

	CH content (%) at			
	1 day	3 days	7days	28 days
Plain cement paste	4.4	7.7	12.8	20.3
Cement + SF (5%)	2.3	5.7	9.8	16.3
Cement + n-SiO_2 (5%)	0.5	3.3	5.2	8.5

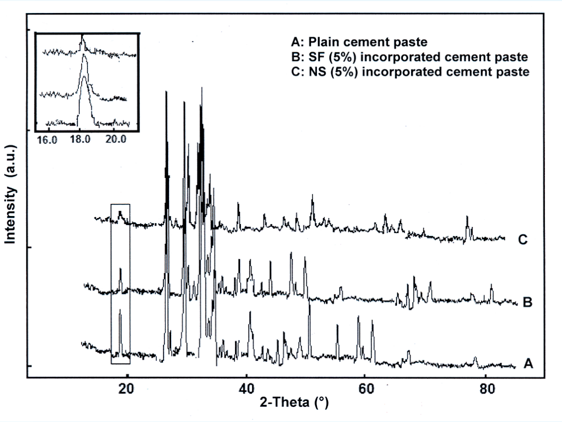


Fig 3: XRD patterns of cement pastes at 28 days of hydration

SEM micrographs of plain cement paste, SF and with n-SiO_2 (5%) at 28 days are shown in Fig 4. It was observed that in the microstructure of the plain cement paste and SF incorporated cement paste, the C-S-H gel existed along with needle and plate shaped hydrates of CH. The deposited CH around the C-S-H gel is uniformly distributed among the entire cement phase (Fig 4). However, the microstructure of the cement paste with the addition of n-SiO_2 revealed that the formation of hydration products was denser, becomes significantly different and showing absence of the needle shaped crystals of CH.

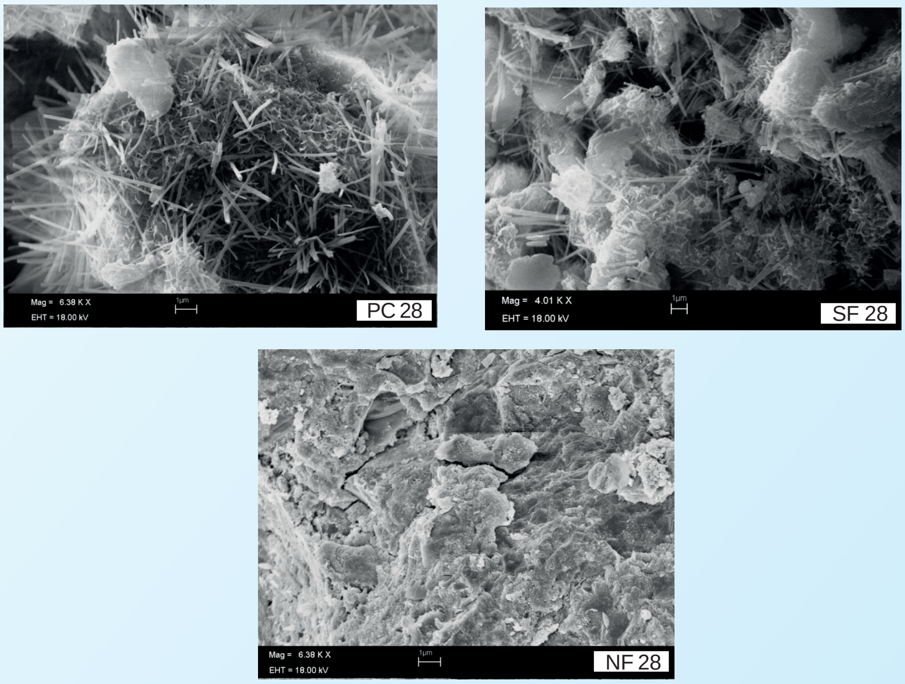


Fig 4: SEM micrographs of plain cement paste (PC28), silica fume incorporated cement paste (SF28) and nano silica incorporated cement pastes (NS28) at 28 days of hydration

The compressive strength of cement paste containing n-SiO_2 is shown in Table 2. The compressive strength of cement paste containing 5% n-SiO_2 is 64% higher at 1 day & 35% at 28 days than that of control cement paste. The difference in the strength development of the paste is attributed to the pozzolanic reaction of n-SiO_2 with CH and forming additional C-S-H.

Table 2: Mix proportions, compressive strengths of cement pastes

S.No.	nSiO_2(~100nm) in cement (%w/w)	Compressive strength (kg/cm^2)			
		1d	3d	7d	28d
1.	0.0	244	392	417	548
2.	0.2	269	433	482	585
3.	0.5	358	436	527	589
4.	1.0	364	459	535	592
5.	2.5	371	465	562	680
6.	5.0	401	528	581	741

It was observed from SEM, XRD and TGA studies that addition of n-SiO_2 to cement reduced CH leaching by reacting at early stage of hydration and forming additional C-S-H gel and enhanced the mechanical strength. It was found that, CH content in n-SiO_2 incorporated cement paste reduced 90% at 1 day and upto 59% at 28 days. Therefore, addition of nanoparticles significantly improves the engineering properties of the cementitious materials.

Capacity Enhancement Programme on Flyash Utilisation (GAP-3522)

L.P. Singh and Team

In order to enhance the utilization of flyash, the Ministry of Environment and Forests (MoEF) has identified CSIR-CBRI to collect, collate and disseminate information relevant to flyash generation and utilization in the country. As a result, CBRI ENVIS Centre was established in the year 2003 and a website was launched from the Centre in the year 2004. A frame based structure (Fig. 1) has been developed in English language and the front page is as below:

Fig. 1: Front page of the URL www.cbrienvis.nic.in on fly ash

The home page of the website has been designed in such a way that the visitors clearly know the theme and the contents of the website within seconds after opening it. The website is also available in Hindi language so as to reach to the maximum community.

Fig. 2: Webpage view in Hindi

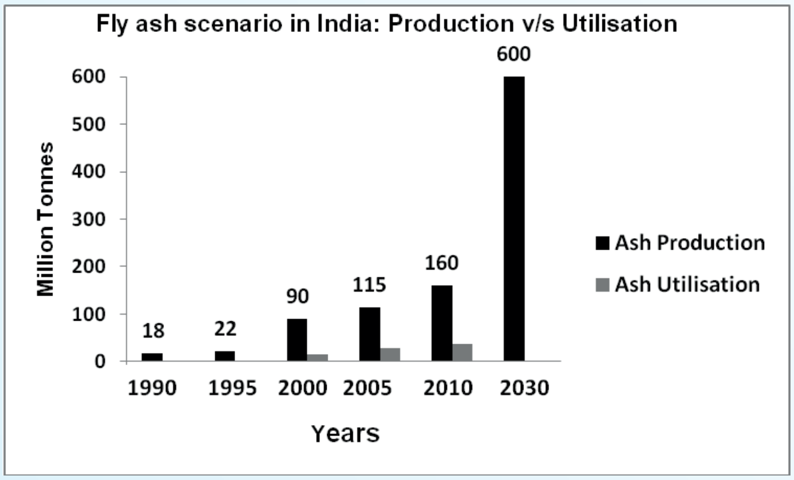


Fig.3: Fly ash generation vis-à-vis Utilisation

The newsletter "***The Built Environ***" on the subject area "FLY ASH" is also being published periodically under the scope of the project activity. So far 14 issues have been published on the following themes:

- Global warming and climate change
- Energy savings in the manufacture of building materials through use of fly ash
- Sustainable cements and concrete for the climate change era
- Railways experiment with cost effective fly ash sleepers
- Making it happen a climate friendly industry
- Sustainability of concrete construction in Indian context
- Fly Ash: A sustainable construction solution

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The Built Environ

Newsletter from CBRI ENVIS Centre on Fly Ash

CSIR-CENTRAL BUILDING RESEARCH INSTITUTE (CBRI), ROORKEE

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CBRI ENVIS

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Building green out of grey matter

As economies grow and get wealthier, the demand for construction materials such as cement and concrete is booming. This is particularly visible in emerging economies. The global cement industry is facing the challenge to sustain its business while decreasing its carbon intensity, from production processes, fuel uses and its product end use. Science tells us that the world must reduce its emissions of greenhouse gases by at least 80 per cent below 1990 levels by 2050. The big greenhouse gas emission savings lie firstly in reducing the volume of cement needed to make high strength concrete. Fly ash, a pozzolanic material produced as a byproduct of coal burning at utility plants, has great potential to lower green house gas emissions by decreased mining activities and reducing carbon dioxide production during manufacture of materials that can be substituted by fly ash. It can also be used in Portland cement concrete to enhance the performance of the concrete. Portland cement is manufactured with calcium oxide, some of which is released in a free state during hydration. As much as 20 pounds of free lime is released during the hydration of 100 pounds of cement. This liberated lime forms the necessary ingredients for reaction with fly ash silicates to form strong and durable cementing compounds thus improving many of the properties of concrete. Replacement of cement with flyash results in net reduction in energy use and green house gas and other emissions.

CBRI ENVIS...

Energy Savings in the Manufacture of Building Materials through Use of Fly Ash

Building Material	Composition	Material Compared	Energy savings (%)
Portland pozzolana cement	75% Ordinary Portland cement 25% Fly Ash	100% Ordinary Portland Cement	20
Lime-pozzolana mixture	25% Acetylene gas lime 75% Fly Ash	25% Lime 75% Calcined brick	75
Calcium silicate brick	90% Fly Ash tailings 10% lime (waste source)	Burnt Clay brick	40
Burnt brick	75% Clay 25% Fly Ash	Burnt Clay brick	15

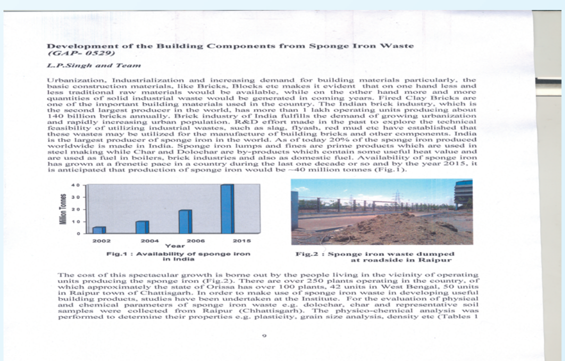
Source: Article "Fly Ash utilization in India" by Dr. Yashpal Singh (www.wealthywaste.com)

Fig 4: Snapshot of latest newsletter Issue (1&2) (Jan-June)

Development of the Building Components from Sponge Iron Waste (GAP-0529)

L.P. Singh and Team

Urbanization, Industrialization and increasing demand for building materials particularly, the basic construction materials, like Bricks, Blocks etc makes it evident that on one hand less and less traditional raw materials would be available, while on the other hand more and more quantities of solid industrial waste would be generated in coming years. Fired Clay Bricks are one of the important building materials used in the country. The Indian brick industry, which is the second largest producer in the world, has more than 1 lakh operating units producing about 140 billion bricks annually. Brick industry of India fulfills the demand of growing urbanization and rapidly increasing urban population. R&D effort made in the past to explore the technical feasibility of utilizing industrial wastes, such as slag, flyash, red mud etc have established that these wastes may be utilized for the manufacture of building bricks and other components. India is the largest producer of sponge iron in the world. As of today 20% of the sponge iron produced worldwide is made in India. Sponge iron lumps and fines are prime products which are used in steel making while Char and Dolochar are by-products which contain some useful heat value and are used as fuel in boilers, brick industries and also as domestic fuel. Availability of sponge iron has grown at a frenetic pace in a country during the last one decade or so and by the year 2015, it is anticipated that production of sponge iron would be in the range of 40 million tonnes (Fig.1).


Development of the Building Components from Sponge Iron Waste (GAP- 0529)

L.P.Singh and Team

Urbanization, Industrialization and increasing demand for building materials particularly, the basic construction materials, like Bricks, Blocks etc makes it evident that on one hand less and less traditional raw materials would be available, while on the other hand more and more quantities of solid industrial waste would be generated in coming years. Fired Clay Bricks are one of the important building materials used in the country. The Indian brick industry, which is the second largest producer in the world, has more than 1 lakh operating units producing about 140 billion bricks annually. Brick industry of India fulfills the demand of growing urbanization and rapidly increasing urban population. R&D effort made in the past to explore the technical feasibility of utilizing industrial wastes, such as slag, flyash, red mud etc have established that these wastes may be utilized for the manufacture of building bricks and other components. India is the largest producer of sponge iron in the world. As of today 20% of the sponge iron produced worldwide is made in India. Sponge iron lumps and fines are prime products which are used in steel making while Char and Dolochar are by-products which contain some useful heat value and are used as fuel in boilers, brick industries and also as domestic fuel. Availability of sponge iron has grown at a frenetic pace in a country during the last one decade or so and by the year 2015, it is anticipated that production of sponge iron would be ~40 million tonnes (Fig.1).

Fig.1 : Availability of sponge iron in India

Fig.2 : Sponge iron waste dumped at roadside in Raipur

The cost of this spectacular growth is borne out by the people living in the vicinity of operating units producing the sponge iron (Fig.2). There are over 250 plants operating in the country, of which approximately the state of Orissa has over 100 plants, 42 units in West Bengal, 50 units in Raipur town of Chattisgarh. In order to make use of sponge iron waste in developing useful building products, studies have been undertaken at the Institute. For the evaluation of physical and chemical parameters of sponge iron waste e.g. dolochar, char and representative soil samples were collected from Raipur (Chhattisgarh). The physico-chemical analysis was performed to determine their properties e.g. plasticity, grain size analysis, density etc (Tables 1

9

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Table 1 : Physical and chemical properties of soil sample

Properties	Raipur Soil
A. Mech. Composition	
Clay, %	57
Total fines, %	43
B. Plasticity properties	
Liquid Limit	45.2
Plastic Index	23.9
Activity coefficient	0.06
Soil group	CL-ML
C. Chemical Properties	
pH	7.6
$CaCO_3$,%	7.0
Soluble salts,%	0.13
Organic matter,%	0.56

Table 2: Physical and chemical properties of Sponge iron waste

Properties	Dolochar	Char
A. Physical properties		
Loss on ignition, %	43	16.4
Bulk density, (gm/cc)	0.83	-
B. Chemical Properties		
pH	8.3	9.9
SiO_2,%	49.3	56.5
$R_2O_3(Al_2O_3+ Fe_2O_3)$,%	25.2	29.8
CaO,%	3.0	1.2
MgO,%	1.7	2.3
Soluble salts,%	0.07	0.25

For mineralogy of the soil and sponge iron waste samples, powder X-ray diffraction (XRD) studies were carried out on a Rigaku, Japan make XRD instrument. The XRD profiles of the samples as shown in Fig.3 indicate that the soil contains quartz and other associated clay minerals and the same quartz peak was also observed in dolochar sample. Thermal analysis (TG/DTA) of the samples was also performed on Perkin Elmer, Fig.4 indicates that due to the presence of higher percentage of carbon in dolochar more weight loss was observed as compared to soil sample. Experimental briquettes (Fig.5) were manually prepared with Raipur soil and different composition of sponge iron waste i.e. dolochar, char. These briquettes were then air dried and fired in an electric furnace at 950, 1000, 1050ºC. Engineering properties of these samples were evaluated for compressive strength, water absorption and presented in Table 3. Further, work on full size bricks and evaluation of their engineering properties is in progress.

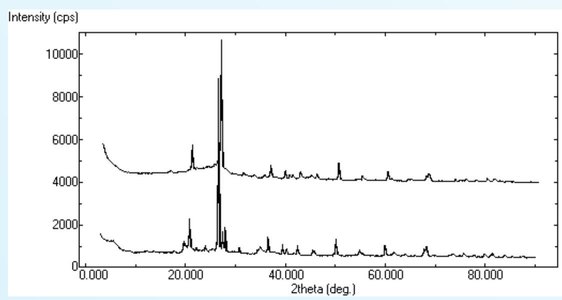


Fig.3 : XRD profile of Raipur soil & dolochar

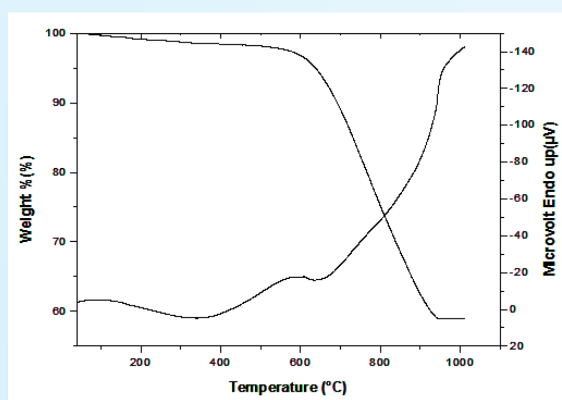


Fig.4 : TG/DTA of Dolochar

Fig.5 : Experimental briquette samples (7.5×5.0×3.5cm) prepared using Raipur soil & Sponge iron waste

Table 3 : Mix composition of Raipur soil & Sponge iron waste and their engineering properties

S.No	Briquettes		Temp.(°C)	C.S.(Kg/cm2)	W.A. (%)
	Soil (%)	Dolochar (%)			
1.	100	-	950	352	7.9
2.	90	10	950	233	13.2
3.	80	20	950	183	16.3
4.	70	30	950	98	22.7
5.	100	-	1000	523	9.5
6.	90	10	1000	253	14.6
7.	80	20	1000	195	18.0
8.	70	30	1000	96	24.3
9.	100	-	1050	397	8.3
10.	90	10	1050	230	12.7
11.	80	20	1050	167	17.0
12.	70	30	1050	84	24.6

Utilization and Tangible Solution for Management of Municipal Solid Waste (including inert) towards Zero Garbage Achievement (GAP-0210)

Neeraj Jain and Team

CPCB has conceived a strategy of "Zero Garbage" in MSW Management aiming towards complete recycling of MSW and to address the issues of municipal solid waste management in concurrence to the MSW rules for effective management. Indian MSW exhibits: 51% organic waste, 17% recyclables and 21% inert and this estimates corresponds to generation of 0.292 million MT/d of organic waste which could be processed and not allowing it to go for land filing. Waste minimization can be achieved in an efficient way by focusing on the 4R's, "reduce", followed by "reuse" and then "recycle" and finally "recover".

MSW processing plant of M/s A2Z Infrastructure Pvt. Ltd., Kanpur was visited for mass balancing studies. Results of mass balancing shows that out of 1000 Tonnes of waste processed per day, 350 Tonnes is lost as moisture during various processing. 180 Tonnes of compost and 200 Tonnes of RDF/fuel are manufactured from the compostable and non compostable material respectively. Balance 270 Tonnes is the recyclables, inert and reject materials. About 50 Tonnes of inert material (debris) is used for land filling for power plant project, 50 Tonnes of innert material (brick and stone waste) is used for making building component like road pavers and blocks. 50 Tonnes of the inert waste (recyclable plastic) is stored for making laminated plastic boards in future as plastic recycling unit has not been installed so far. Rest 120 Tonnes of reject material will be dumped in sanitary land fill liner. The Fig. 1 also shows the quantity of waste processed per day at each section along with the quantity of finish product and fate of reject material.

1000 TPD MSW Processed = 180 TPD compost
+ 350 TPD moisture loss
+ 50 TPD recyclables
+ 120 TPD in sanitary landfill
+ 200 TPD RDF
+ 50 TPD in brick manufacturing
+ 50 TPD in land filling

Samples of inert waste (brick and stones) collected from the plant were successfully used for making low cost value added construction and building components like road paving blocks, chequered and Terrazo tiles and masonary blocks. Recycling and utilization of inert waste collected from the MSW processing plant effectively shows the feasibility of the technology.

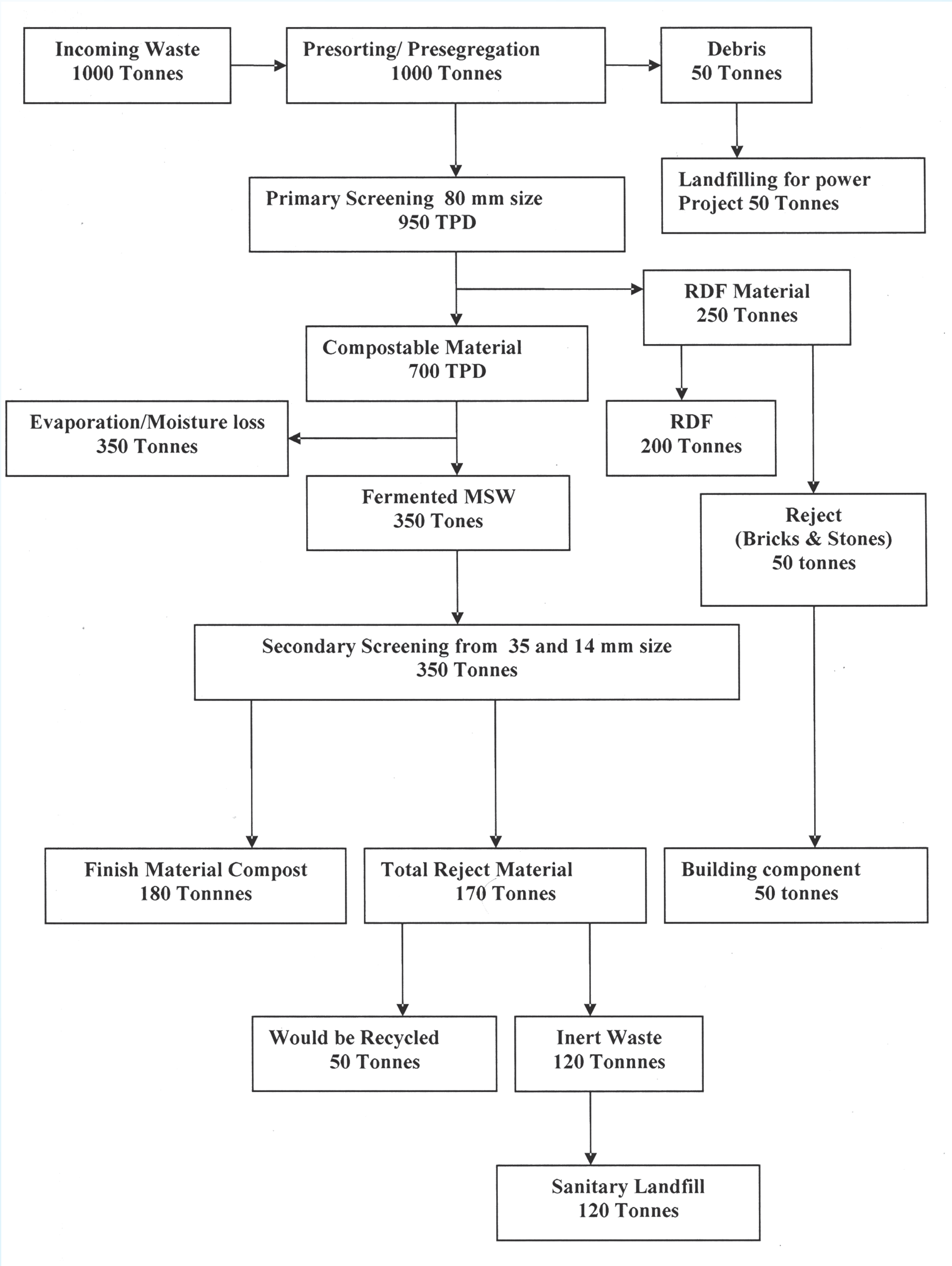


Fig. 1: Mass Balancing and Life Cycle Assessment of MSW

Development of Physical Barrier for Termite Management in Buildings (OLP-0331)

B. S. Rawat and Team

Termite is a well known structural pest throughout the world. Once the pathway of termite into buildings is established, it starts attacking all types of cellulosic and some non-cellulosic materials also such as paper, books, wood works, plastic, synthetic fibre, polyurethane foam, thermocole and even thin sheet of soft metal of lead or copper, asphalt, rubber, creosote and mortars etc. There are four types of termites found, out of them subterranean termites are most destructive to buildings. More than 95% damage is caused by this termite alone. They infest structures by tunneling through the soil. It enters into buildings at ground level from the foundations. Protection of buildings from termites is conventionally achieved by creating chemical barriers inside as well as outside of buildings. A typical "anti-termite treatment" may involve application of thousands of litres of toxic pesticidal solution. This technique is quite effective. However, the pesticides used for the purpose are toxic and are sources of environmental pollution. Pesticides approved by Govt. of India (in IS:6313, Part-3, 2001) are already banned in foreign countries. The new pesticides, which are coming up as alternative are considered comparatively safe but relatively short-lived and require multiple re-applications. Therefore, there is an urgent need to develop long-lasting and environment friendly alternative of toxic pesticides.

In the present project, extensive studies and experimental work was carried out on various types of inert-materials to develop "Physical Barrier" for termite management in buildings. Different types of waste materials like- granite waste, glass waste, fly ash, ceramic waste and available sand (Badarpur and Solani) were identified for the purpose. Ceramic waste was in the form of de-shaped, damaged and broken sanitary ware etc. Except fly ash, all the materials were washed, dried and crushed with machine. Particle size ranging from 0.5mm to 3.0 mm were prepared and sieved with standard test sieves (IS:460,BSS,ASTM)

Experimentation:

A laboratory level experiment was carried out using various particle sizes of different material to determine penetration behaviour of termites. *Microcerotermes beesoni* (Snyder) species of termite was used for the study. Major active workers were sorted out. Soil of *Odontotermes obesus* species was collected from the upper parts of mounds with uniform texture and pH ranging from 6.7 to 7.0. The soil was air dried, moistened with distilled water up to 15-20% moisture content. Round bottom transparent glass jars (capacity 2500 ml) with plastic lids were used for the study. Lower portion of experimental jar is filled with the material and upper part was filled with termite culture medium. A wooden test block (*Mangifera indica*) was kept in the bottom with material. Three replica of each material and control were prepared. The experiments were maintained in the laboratory at 28 ± 5 degree Celsius and 80 % RH (Fig.1). Laboratory trial of material is completed and field trial is in progress.

Results obtained so far are encouraging. It was observed that test termites were unable to penetrate through the specific particle sizes/combinations of some material. The wooden test blocks kept in effective material remained intact till the end of experimental period. However, termite can easily penetrate through the particle size less than 0.5mm and above 3.0 mm of all the material including sand

and fly-ash. The activities of termites started within two weeks in all the experimental jars and the test blocks kept in controlled experimental jars were observed to be affected totally (Fig.1).

Fig.1: Laboratory level experiment with various grades of material

Laboratory experiments have shown excellent results. However, yield from the waste is 30% to 40%. Field trial of finally prepared material has been started using Barrier Testing Stations (B.T.S.). Each B.T.S. is prepared in the laboratory using 20-24 kg of material (Fig.2) and basic principles are shown in Fig. 3.

Fig.2: Barrier Testing Stations (B.T.S.) ready for field trial

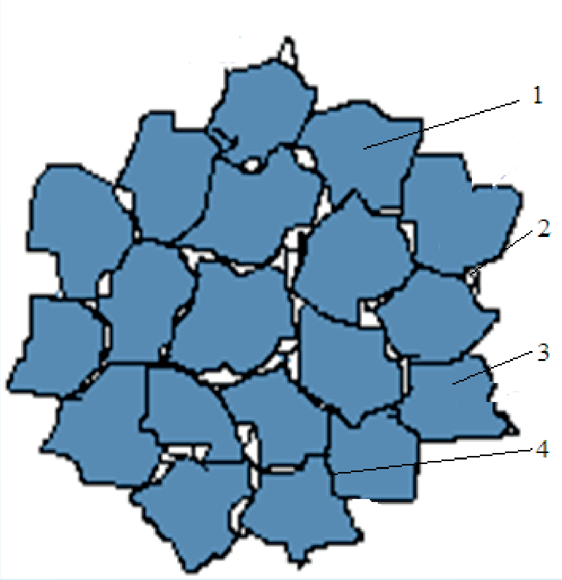


Fig.3: The basic principles on which developed material works. 1. Termite cannot chew the hard material, 2. Termite cannot cross through the narrow spaces, 3. Termite cannot take away large and heavy particles, 4. Sharp edges of particles prevents movement of termites

Salient features of developed material:

- Completely eco-friendly. No environmental pollution and ground water contamination.
- Completely pesticide free.
- Effective life is much more than the conventional anti-termite treatment.
- One time application.
- Neither degrades nor decomposes.
- Applicable during pre-constructional stages of buildings.

Infrastructure Creation and Development of Expertise in the Area of Cathodic Protection (CP) for RCC Structures (CLP-0110)

S.R. Karade

Presently cathodic protection (CP) of concrete structures is not used much in India and therefore the nation is lacking in expertise and skilled manpower in this area. In developed countries, it has been applied on various concrete structures successfully for more than last 30 years. Some of the critical components of the CP system such as anodes are not widely available in India. The imported anodes are very costly and therefore need to be replaced with some cost effective alternative materials. The main objectives of the project are to identify and install the required infrastructure/ equipment for CP; to conduct studies for identifying the design parameters; to verify the efficiency of various anode materials and to examine the utility of CP technology and its cost effectiveness with respect to the conventional repair methods for RCC structures.

In this effort BDS Project Pvt. Ltd., Mumbai, who has collaboration with 'Vector Corrosion Technologies' shown interest to support this project and provide necessary instruments and anode materials to start the work. An agreement was signed between CSIR-CBRI and BDS Project Pvt. Ltd., Mumbai on 20th October, 2010. After it, the instruments and necessary software etc. have been installed. More than 36 reinforced concrete specimens have been cast as shown in Fig.1 as per ASTM G109 and put for 28 days curing (Fig. 1-4). Six of these samples have been provided with Galvashield XP anodes and will be compared with the specimens treated using other corrosion control methods and with those without any treatment (control). The effectiveness is being measured by continuously monitoring the change in potential and current between the reinforcing steel bars. Further work on other type of specimens and impressed current method is in progress.

On completion of this study efforts will be made to increase awareness of CP system among the Civil Engineers/ Contractors in India through short term courses.

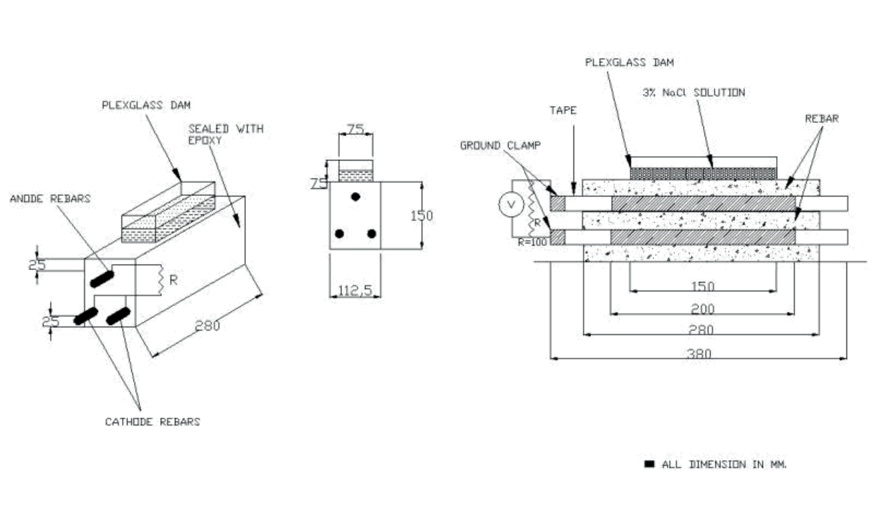


Fig. 1: Details of the RCC specimens

Fig. 2: Casting of RCC specimens

Fig. 3: Attachment of Galvashield XP anode and connectivity checking

Fig. 4: RCC samples for curing

Bio-Degradable Nursery Pots from Forest Waste (GAP-0579)

S. P. Agrawal & Rajni Lakhani

There is direct relation of environmental problem and depletion of natural resources of the forests. Forests are very important resources in any region and play a very significant role in the process of economic development. Forests serve as a primary resource base along with cultivable land in every state. They are source for fodder, fuel and timber, which affect the entire economic activities and social life of the people. The first and foremost challenge in its development is the problem associated with the degraded environment and ecological imbalance. Further R&D work is needed to develop other product using different forest waste resources. According to forest policy, depletion of forest is strictly prohibited due to ecological reasons. Huge forest wealth is being destroyed every year due to forest fire besides many other factors. Major reason for these fires is dried forest litter and bio-mass itself. To save our forest, there is a need to develop appropriate technologies which can utilize these forest wastes and convert it into value added products. This will not only provide employment to the people but also help in the development of region and disposal of hazardous waste material.

A project has been undertaken under the support of Ministry of Environment & Forest (RE Division) vide their letter no. 19-49/2008-RE dated 7 August 2009. The work was started in the month of October 2009.

The forest waste procured from Karnataka Forest Department is shown in Figure 1a, Waste was first tried to be converted into pulp without using any chemical in order to minimize the use of water by mechanical means. The transformed forms thus obtained are shown in Figs. 1b and 1c. Fig.-1b shows the product obtained as such after ball milling while Figure-1c shows the sieved product.

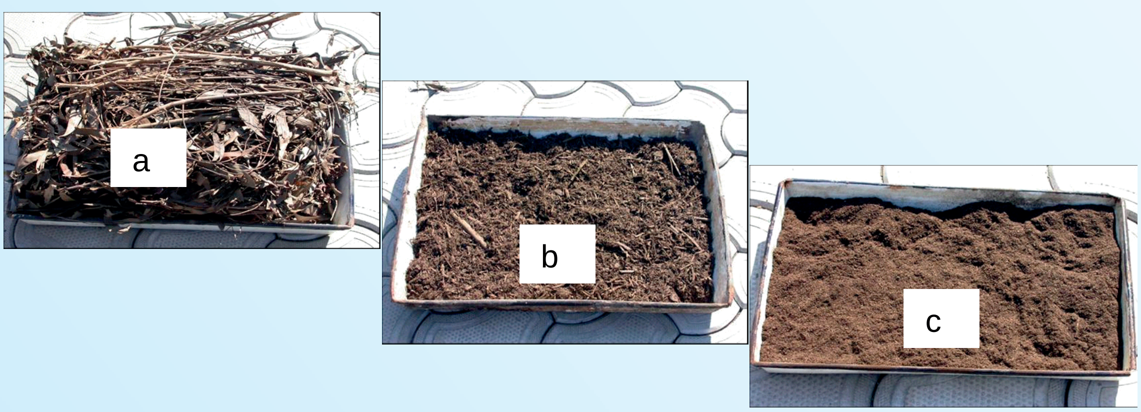


Fig. 1: Forest Waste from Karnataka State Forest

This sieved product was used for making the pots initially. A specifically designed and fabricated mould was used for making the pots. The mould is shown in Fig. 2.

De-Assembled

Assembled

Fig. 2: Mould for making Nursery Pots

Two routs were tried to make the pot from forest waste. The routs are shown in Figure 3 and 4 respectively.

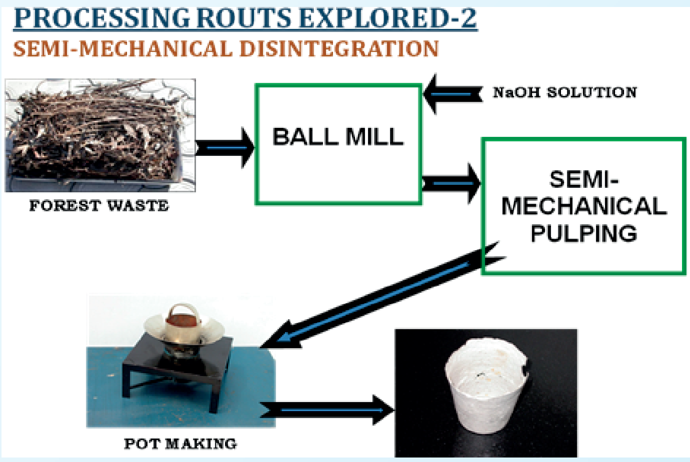


Fig. 3: Pot making using semi-mechanical Pulping

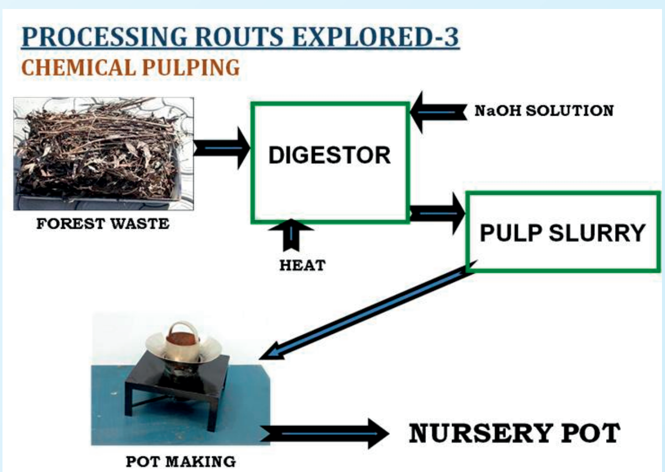


Fig. 4: Pot making using semi-mechanical Pulping

Other mould used for designed, fabricated and used for making other type of pots are shown in Fig. 5 and Fig. 6 respectively and the product developed are shown in Fig. 6 and other shapes are shown in Fig. 7.

Fig. 5: Views of two other moulds used for making pots

Fig. 6: Bio-degradable pots using forest waste

Fig. 7: Other shapes of Bio-degradable pot using forest waste

These two shapes of pots as shown in Fig. 7 are under optimization.

To study the Behaviour of Consolidants for Strengthening Stone Surface and Weak Jointing Mortar (OLP-0346)

Rajni Lakhani

The objectives of this project are to assess the behavior of different consolidants/ water repellents for their performance on weak mortar and stone surface.

In most of the old buildings, basic structures were built by using stone, jointing mortars etc. Due to vagaries of weather, mortar loses their basic properties and becomes the weakest link in the structure and easily reacts with the pollutants and other deteriorating agencies available in the environment. These pollutants convert the mortar into wet mass and fragments of deteriorated mortar with little or no cohesive, compressive and adhesive strength. Due to this, in most of the cases it has been observed that this deteriorated mortar absorbs water which attracts microorganisms, insects, biological growth etc (Fig. 1). Keeping this in view, this project was started with the objectives to assess the behaviour of different consolidants/water repellents for their performance on weak mortar as well as on stone surfaces.

(a) (b)

Fig. 1: Showing biological growth from jointing mortar
(a) Showing vegetable growth from jointing mortar, and
(b) Cracks development due to biological growth

This is the initial stage for the deterioration of nearby materials. Weathering action of water is mainly dependent upon the hygroscopic nature of the mortar and extent of its ingress into the mortar and their retention.

It has been observed that surface protection of building by protective treatment is an essential requirement to control the weathering action of water and other related factors. Consolidants and water repellent treatments are being used for this purpose.

In CSIR-CBRI, studies have been started to assess the effectiveness, efficacy, and durability of the consolidants and water repellents on jointing mortar and stone surface in the laboratory under simulated environment. In this project, Weak mortar samples has been prepared and subjected for curing. Surface preparation of cured mortar samples and sand stone samples followed by drying of samples has been done prior applying the treatment. Different diluted formulations of Consolidant-Polyurethane resin. Polyester Resin, Poly-methyl-methacrylate, Polyvinyl alcohol, Polyvinyl acetate and epoxy resin for treatment has been prepared. The treated and untreated mortar and stone samples were subjected to different experimental tests- Water absorption by total immersion; Capillary Water absorption; Liquid Water Penetration, Depth of Penetration and Compressive Strength test (Figs. 2-4).

Fig.2: Water absorption set up

Fig.3: Drying index set up

Fig.4: Liquid water penetration

Data have been collected. Alkali Immersion Test of the treated and untreated samples is in progress. Long term performance studies of all the samples from end use application point of view will be performed. The generated data will help in providing some guide-lines in selection of different treatments for specific surface protection along with specific exposure conditions.

Development of Coating System based on Modified Epoxy Resin for Fertilizer industries (OLP-0325)

P.C. Thapliyal & S.R. Karade

The work was initiated with the objective to prepare a coating system for concrete surfaces based on modified epoxy resin. The task was divided in two parts. Part 1 included development of modified epoxy coating system (formulations).

Data have been generated for a newly developed three component coating system and comprising of cardanol modified virgin/pigmented epoxy and polyurethane. In total four coating systems have been studied. The developed coating system showed remarkable performance in terms of bond strength and immersion studies under laboratory and accelerated conditions and hence can be used on concrete structures exposed to aggressive environments. The coating properties of the system were investigated for their physico-mechanical and corrosion resistance. Compositions of four coating systems are as follows:

1. System A = Unmodified epoxy + Pigmented epoxy + Pigmented epoxy
2. System B= Unmodified epoxy + Pigmented epoxy + Polyurethane
3. System C= Modified epoxy + Pigmented epoxy + Pigmented epoxy
4. System D= Modified epoxy + Pigmented epoxy + Polyurethane

In this part of work on comparison to virgin resin, it is observed that bond strength increased for the modified systems C and D although tensile strength decreased but is still significant. Also water vapour transmission decreased for modified systems and which is good property for coatings (Table 1 & 2).

Table 1: Physico-mechanical properties

System	Bond strength (N/mm^2)	Tensile strength (N/mm^2)	Water vapour transmission ($mg/cm^2/24$ hr)
A	3.2	23.0	0.6
B	3.7	10.3	1.8
C	5.6	8.5	0.5
D	6.0	19.0	1.1

Table 2: Results of immersion tests

System	Water	Sodium chloride (5%) soln.	Urea solution	Hydrochloric acid (20%)
A	No signs of failure	No signs of failure	No signs of failure	Few small blisters
B	No signs of failure	No signs of failure	No signs of failure	No signs of failure
C	No signs of failure	No signs of failure	No signs of failure	No signs of failure
D	Small blisters throughout the panels	No signs of failure	No signs of failure	Few small blisters

Development of coating for areas exposed to higher temperature is covered in part 2 of the work. In the second part formulation for coatings suitable for areas exposed to higher temperature were attempted. The coatings were developed using modified epoxy with flake type additive. Commercially available epoxy resin was used as such. Formulated coatings were labeled as A and B, with or without inorganic flake type mineral filler respectively. The initial studies showed more work are needed to establish their efficacy. The coating also did not showed any damage in heat resistance test even after 120 days. So it can be concluded that the results are promising and it has the potential to be developed into a good coating system for areas exposed to high temperature. More studies need to be done.

Conclusions have been drawn that the data generated on three coat system under part 1 of the work showed that modified epoxy based coating system can be used for aggressive environment especially fertilizer industries. Future work is planned to establish its efficacy in areas exposed to high temperature. Four papers in International Conferences have already been published and one paper has also been accepted in international journal 'Composite Interface'.

Development of Multifunctional Thermal Coatings for Buildings (OLP-0344)

P.C. Thapliyal

Most of the thermal coatings available commercially are meant for single end user application. Very few multifunctional thermal coatings are commercially available in the market having more than one property such as anti corrosion, thermal resistance, water proofing etc. Hence, the work on development of indigenous multifunctional thermal coatings was initiated in this project with the objective to develop as well as characterize the multifunctional thermal coating. Studies on addition of nano-materials on the coating behaviour is also included.

Fig. 1: Determination of Bond Strength of Coating using DYNA Pull Out Adhesion Tester

Four coating formulations are prepared and studied. The formulations are based on acrylic resin and modified epoxy and have non volatile content around 60% of the total volume. The coating properties of the formulations are investigated for their physico-mechanical behavior, which include bond strength with substrate and tensile strength. Initial studies showed encouraging results. Further work to establish their efficacy is in progress and effect of nano-additives on coatings will be studied before arriving at final conclusions.

Cost Effective Thermal Insulated Tiles for Insulation Purpose (GAP-0509)

Rajni Lakhani & S. P. Agrawal

This project was supported by BMTPC, New Delhi. Thermal insulation in buildings is an important factor for achieving thermal comfort for its occupants. Insulation reduces unwanted heat loss or gain and can decrease the energy demands of heating & cooling systems. It is known that vermiculite[$(Mg,Fe^{++},Al)_3(Al,Si)_4O_{10}(OH)_2 \cdot 4(H_2O)$] is an excellent material characterized by high thermal insulation parameters which make it useful for many purposes, including those for manufacturing different kinds of fire proofing materials as well as production of boards. The name "vermiculite" is derived from the Latin word for worm, a reference to the wormy threads of material which form when vermiculite is exfoliated.

Table 1: Properties of exfoliated Vermiculite

Bulk density	100-120 Kg/m^3
pH (in water)	6.8-7.6
Melting point	1300oC -1380°C
Combustibility	Non combustible
Water holding capacity	78% by wt. in 1 hr.
Moisture	78% by wt. in 1 hr.
Degree of expansion	25-30%

The powdered waste produced during exfoliation of vermiculite is used for converting into a value added product for building applications. Vermiculite, being a granular expanded aggregate with numerous air voids, when mixed with a suitable binder develops thermal insulating properties. Under this work roofing tiles for thermal insulation is developed using cement as binder with high pressure compaction technique. Different mix proportions are tried. A prototype thermal insulation tile using exfoliated vermiculite waste is shown in Fig. 1.

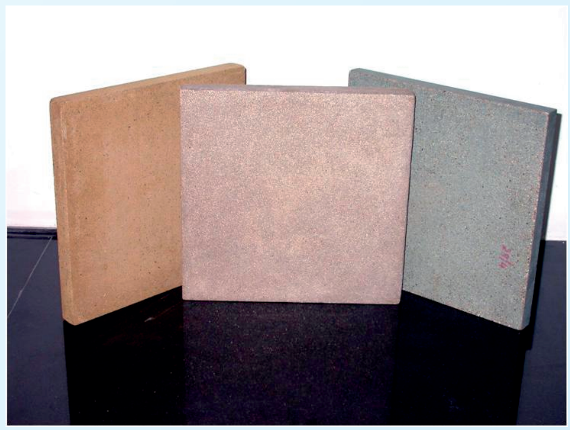
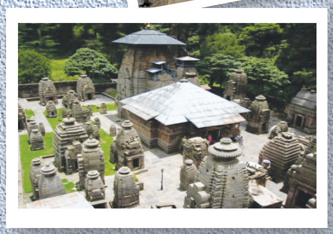


Fig. 1: Prototype Thermal Insulation Tiles

The developed tiles are characterized for density, water absorption, compressive strength, flexural strength and thermal conductivity.

Application: These tiles are suitable for heat insulation for roof in residential as well as commercial buildings as it will help in cutting down the electricity cost along with the environment.



Energy Efficient Buildings & other Systems

Energy Efficient Buildings & other Systems

Study on Revision of Unit Cost under Indira Awaas Yojana (IAY) in various Geo-Climatic Zones of the Country (SSP-0548)

R.K. Garg and Team

The project has been undertaken considering the importance of rural housing in the development of the country, sponsored by Ministry of Rural Development (Rural Housing Division), Government of India.

Rural housing has been an important area and there have been attempts for formulation and implementation of government rural housing programmes. Considering the complexity of the social fabric of the rural India, it is difficult to implement the schemes. A number of factors including an incomplete understanding of the problem, limited flow of funds, low affordability, inadequate infrastructure, access to materials and ability to use local resources efficiently, awareness about the new and innovative building construction technologies for building disaster resistant, safe houses are some of the factors responsible for making housing problem more critical in the rural areas.

The work in this project has been attempted on the following:

(i) To study the existing typology of rural housing and to record changes undergone in last three years;

(ii) To assess the role and need of cost-effective and environment-friendly technology;

(iii) To assess the need for structural intervention in rural housing vis-à-vis disaster zones in the country;

(iv) To suggest the unit cost of construction for an IAY house of plinth area 20 sqm for the various geo-climatic conditions, soil condition, availability of local materials and cultural factors;

(v) To assess the availability and requirement of capacity among skilled and unskilled workers for construction of rural houses;

(vi) To assess the availability and requirement of technical capacity among the govt. personnel responsible for implementing rural housing program and to decide minimum size of the house.

A survey proforma was evolved in consultation with the Ministry, and a sample survey of Haridwar district was carried out prior to finalization of the survey proforma. The survey results were discussed with the Ministry officials and the proforma was finalized with the inputs from the officials. Detailed study of thirty two districts, covering entire country in different geo-climatic conditions viz. Jaipur, Jodhpur, Jaisalmer (Rajasthan); Shivpuri & Jabalpur (Madhya Pradesh); Mahaboobnagar & Ananthapuram (Andhra Pradesh); Hawrah & South 24 Parganas (West Bengal); Saharanpur & Basti (Uttar Pradesh); Muzaffarpur, Gaya & Madhubani (Bihar); Cuttak, Bhubaneshwar (Orissa); Goa; Raipur (Chhattisgarh); Pune, Ahmadnagar, Aurangabad (Maharashtra);Yamuna Nagar, Rohtak (Haryana); Bathinda, Amritsar (Punjab); Pithoragarh (Uttarakhand); Kinnaur (Himachal Pradesh); Mysore, Dharwad, Belgaon (Karnataka) and Meghalaya (E.K.Hills) was carried out covering all the five climatic zones of the country.

The survey carried out in different parts of the country form the basis of the typology of housing, materials and construction technologies used in foundations, walls and roofs. Data through questionnaire was collected for about 800 houses through field survey. The major foundation, walling and roofing materials and technologies adopted in IAY & a few non - IAY houses were studied and analyzed. Two types of recommendations are proposed for the construction of IAY houses: (a) mandatory, to be adopted uniformly across the country and (b) desirable, which may change according to the local area requirements. Type design of the houses with varying specifications has been proposed with the cost estimates.

AN IAY HOUSE - SAHARANPUR DISTRICT, UP

TYPICAL IAY HOUSE - E.K.HILLS, MEGHLAYA

TYPICAL IAY HOUSE - SOUTH 24 PARGANAS DISTRICT, W. BENGAL

AN IAY HOUSE - JODHPUR DISTRICT, RAJSTHAN

TYPICAL IAY HOUSE - SHIV PURI DISTRICT, M.P

AN IAY HOUSE - MADHUBANI DISTRICT, BIHAR

This study attempts to provide the magnitude and variety of the rural housing processes in the backdrop of nation-wide trends and seeks to ground the development of rural housing under IAY in these realities. While improved designs and technologies will assist in fulfillment of the felt needs of the communities, the appreciation of the housing process will be successful in developing and disseminating the technology. Besides serving as a useful guide and source of information, the report will also be valuable to architects engineers and professionals engaged in the rural housing.

Methodology for Design & Development of Rural Housing in Hilly Area (Uttarakhand) (OLP-0343, Part - A)

S.K. Negi and Team

Objective of the project is to develop a methodology for design and development of economically viable and self-sustained rural housing in hilly area of Uttarakhand. Serious challenges exist in the hilly regions including scarcity of public services, market social inequalities in habitat conditions, social and spatial segregation, inequity, poverty, unemployment and increased vulnerability for natural disasters. Majority of rural population don't have access to the basic amenities like drinking water; toilet, bath and sewer line etc in the houses. There is a need to address affordability, quality and safety for rural housing using appropriate construction technology in hilly area of Uttarakhand.

The Traditional Building Typologies in Uttarakhand have been studied and the factors that govern the popularity of the vernacular architecture in the state have been identified as: Climate; Material

A typical hill settlement of Uttarakhand

A Traditional double story house using Random Rubble masonry, wood and slates


Typical building structures of Uttarakhand using Coarsed/un-coarsed Random Rubble masonry with wooden logs

& Construction Techniques; Affordability; Safety; Living habits; Socio cultural factors; Environmental considerations and architectural features. The gaps in the existing study and practice have been identified. Based on this value addition in the existing (traditional) construction technologies has been proposed. The design and technology package with guidelines for rural housing in hilly region of Uttarkashi region has been proposed.

Utilization of Solar Energy in Buildings for Improvement of Built Environment in Cold Climatic Region (OLP-034, Part-B)

Neeta Mittal , B.M. Suman & Team

The study has been undertaken with the objective to develop methodology for utilization of solar energy for improved environment in and around residential buildings in cold climatic region. The study will provide the framework for utilization of solar energy in buildings for maintaining comfort and for infrastructure development in Indian conditions.

Energy conservation has emerged as one of the central issues in India in recent years. The sun is an inexhaustible source of energy. India receives solar energy in most of its part throughout the year. Utilization of this Solar energy can reduce energy consumption in buildings through efficient designing in cold climatic places and increase the comfort inside the building. Two major methods for solar energy utilization are Thermal and Photovoltaic.

Identified the systems through which solar energy can be utilized for thermal comfort in residential buildings. Design parameter have been identified and the important parameters are :

- Orientation and type of the roofs
- Aspect ratio

- Site location
- Solar insulation in term of total & defuse solar radiation
- Glazing and day light availability

Experimental study has been conducted to know the performance of heat absorbing glazing through solar cooker. In winter season through solar cooker, solar data has been collected in different direction during day hours for study of temp. variation and shown in Fig-1 (a) & (b) Also, visited the URJA park Dehradun and studied the various use of solar energy including passive systems in buildings.

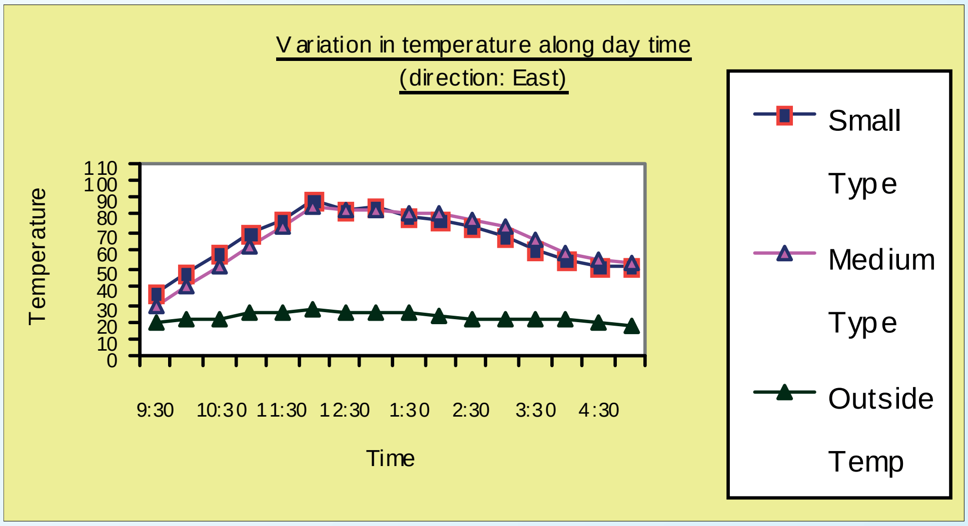


Fig. 1 (a): Performance of heat absorbing glazing through solar cooker (direction:East)

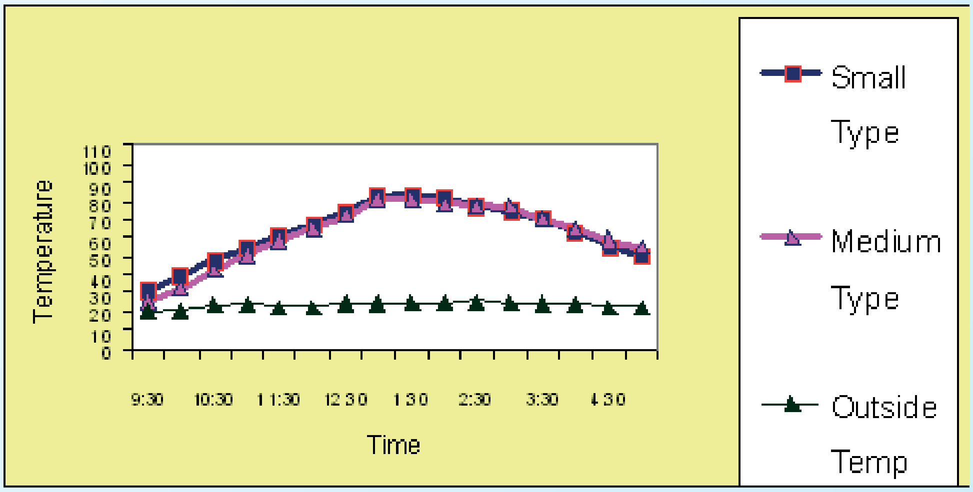


Fig. 1 (b): Performance of heat absorbing glazing through solar cooker (direction:SE)

Development of a Framework to Reduce the Carbon - Footprint and Enhance the Energy Efficiency in Buildings (OLP-0343, Part-C)

Ashok Kumar, R.K. Garg, B.M. Suman, V.K. Sharma, Rajesh Deoliya and Team

The objective of the project includes quantification of parameters including climate responsive building envelopes for making buildings energy efficient; development of strategies to reduce the carbon footprint of existing and new buildings and design guidelines for energy efficient residential & office buildings in composite climate.

Building symbolizes unrestrained consumption of energy and other natural resources, with a consequent negative environment impact. During a life cycle of a building, energy is consumed in the following ways: (i) manufacturing of the building materials (embodied energy); (ii) transport of the building materials (grey energy); (iii) construction of the building (induced energy); (iv) operation of the building (operational energy). Embodied energy of the building varies significantly depending on the choice of building materials and building techniques.

The study of important parameters from energy conservation point of view of a building has been carried. They are: thermal resistance, overall thermal transmission co-efficient, building elements influencing the transmission of heat loads such as orientation, walling and roofing materials, percentage glazing, height of building, L/B ratio, thermal comfort, air quality & air - tightness, selection of glazing including U-value, daylighting and heat loss through windows, etc.

Computation of thermal resistance and over all heat transfer coefficients have been carried out for 112 combinations of roof and wall sections. The conventional roof section is considered as RCC (100, 120, and 150 mm thickness) along with mud phuska, brick tile and with various thicknesses of thermal insulating materials for determination of R and U - values. Out of the total 38 combinations of roof sections, U- values of 14 sections satisfy the ECBC requirements

Similarly in wall section, various thicknesses of insulation materials combined with basic conventional

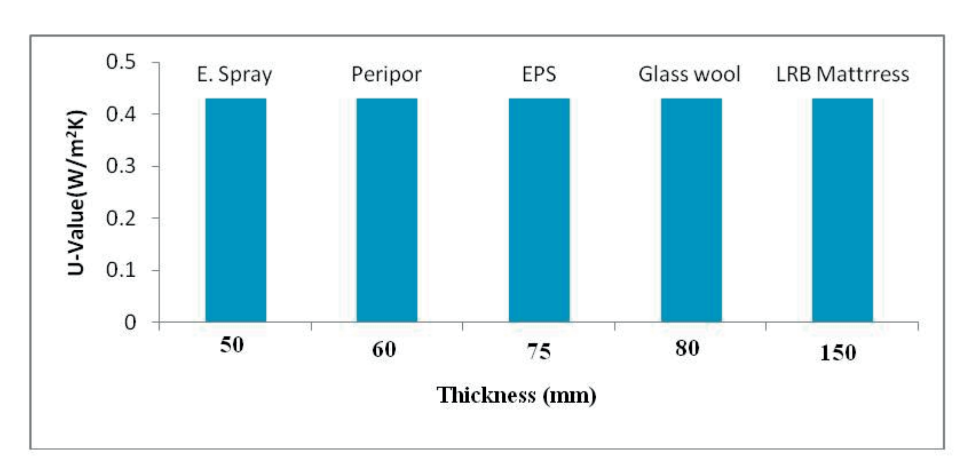


Fig. 1: Thickness of different thermal insulation materials used in same wall section to satisfy the minimum U-value as per ECBC.

wall section (230mm brick with 12.5 mm thick cement plaster on both sides) were studied. Out of total 74 combinations of wall sections, 28 sections satisfy the ECBC requirement of U-value. The insulation materials are Perlite Concrete, EPE, Neopor, Peripor, Isoboard, Styropor, Elastopor, EPS, Fiberglass, Foam concrete and EPS concretre taken for computation. Thicknesses of different thermal insulation used in same wall and roof section to satisfy the minimum U-value as per ECBC are shown in Figs. 1 and 2 respectively.

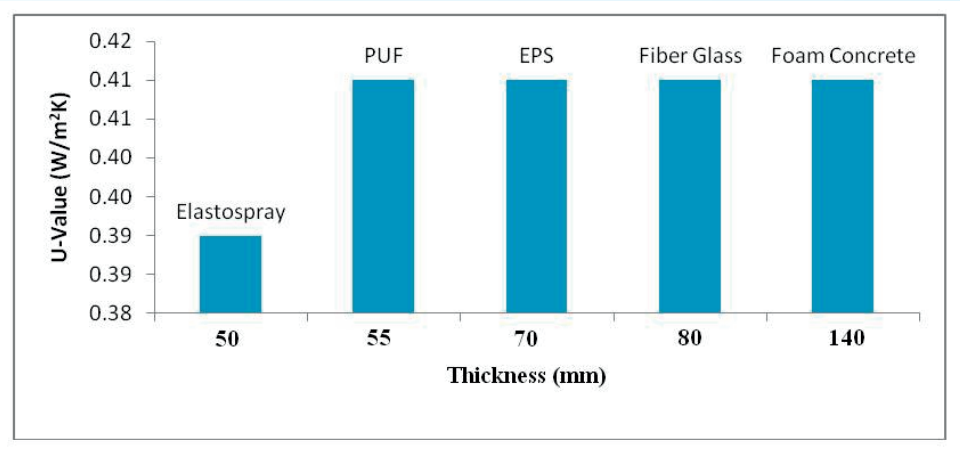


Fig. 2: Thickness of different thermal insulation materials used in same roof section to satisfy the minimum U-value as per ECBC.

Architectural Design of Cyclone Resistant Roofing System (OLP-O353)

P. K. Bhargava & Amrit Kumar Roy

The coastal belt of peninsular India, especially the east coast is very much affected by cyclone taking number of lives and livestock and causing damages to the residential housings and industrial buildings. Some guidelines for design and construction of buildings and structures in cyclone-prone areas are available. Post disaster surveys of cyclone affected areas carried out in India and abroad revealed that hipped roof structures stand better chances of survival as compared to pitch roof structures. It was also observed that damage caused to symmetrical type of structures was comparatively less than the asymmetrical type of structures.

It was conceived earlier at CBRI that a square shape structure with pyramidal type of roof is one of the probable design that would be suitable for cyclone prone areas. Pressure coefficient values for different wind incident angles (i.e. 0°, 15°, 30° and 45°) and with varying roof inclination (i.e. 0°, 5°, 7.5°, 15°, 20° and 30°) on pyramidal shaped buildings are available through Wind Tunnel studies carried out at CBRI.

This research work is consisting of wind tunnel study of pyramidal roofed buildings and then CFD (Computational Fluid Dynamics) analysis with the wind tunnel data for further evaluation of wind pressure on building structures. The Indian Code suggests values of pressure coefficients for Gable roof with various roof angles and wind incident angles. Some foreign code like ASCE/SEI 7-05, AS/

NZS.1170.2:2002 and Eurocode 1(prEN 1991-1-4:2004) etc. have given some pressure values for designing gable and hipped roof buildings. Present work of wind tunnel tests on rigid models of pyramidal roofed building in a simulated flow conditions provides detailed information about wind loads on the effect of roof angle with different wind incident angles. The details of experimental setup in wind tunnel and pressure points location with wind direction considered for experimental purpose are shown in Fig. 1 and Fig. 2 respectively.

Fig. 1: Experimental setup for wind tunnel

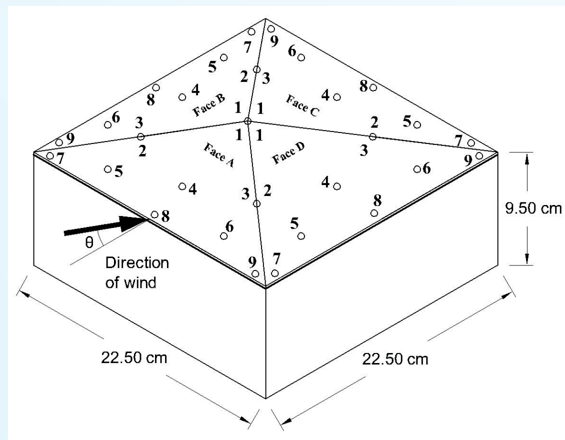


Fig. 2: Location of points of observation on pyramidal type of roof

The variation of maximum area averaged suction pressure values for different roof slopes of pyramidal building model with varying wind incident angles are shown in Fig. 3. Suction is minimum for most of the angle of incident wind on roof surface of the pyramidal building with the range of roof slopes between 7.5° and 20°. The typical area averaged pressure coefficient values for pyramidal building with roof slope 7.5° are shown in Fig. 4 for safe design of roofing elements.

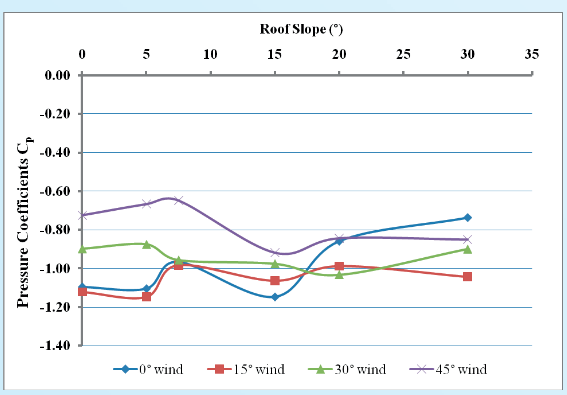


Fig. 3: Maximum weighted area average pressure coefficient on roof surfaces for different roof slopes and wind incident angles

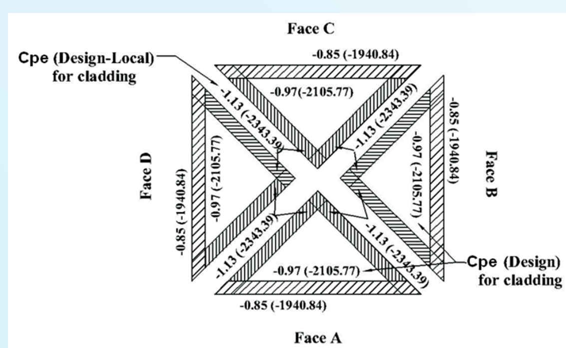


Fig.4: Design for cladding of pyramidal type roof building with roof slope 7.5°

Computational Fluid Dynamics (CFD) is now a days, a very good second alternative to the solution of wind related problems. CFD simulation along with the experimental study has been carried out to compare wind tunnel data with CFD model. A commercial code, CFX-12 (ANSYS 12) is used as part of the solution method deployed in this research. Some of the results of CFD simulation are shown in Fig. 5.

It has been observed that experimental results are very much similar to the CFD results. The contour lines of pressure coefficients are also of matching with the experimental studies.

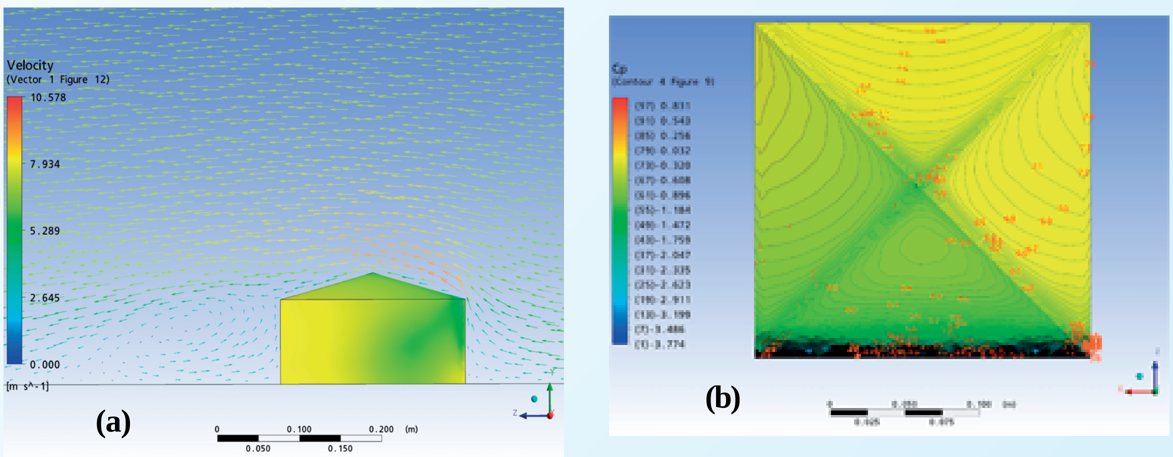


Fig. 5: (a) Velocity vectors of wind flow and (b) variation of pressure coefficients (Cp) on roof surface of the pyramidal building with roof slope 15° with wind incident angle 0°.

Determination of Temperature Profile and Energy Load on Computer Model for three Composite Buildings and Validation of Thermal Properties of BASF Products (SSP-0439)

B. M. Suman and V. K. Sharma

In this project roof and wall insulation has been applied in buildings to assess its energy saving potential by the computer model, TRNSYS, versatile software, in air conditioned building and reduction in indoor air temperature to be achieved in unconditioned building during summer season. In this software heat conduction transfer functions or response factor methodology to predict the thermal history of multi-layer slabs, developed by Mitalas, Stephenson and Arseneault have been used for the calculation of transient heat transfer through walls and roof of building. The most important factor for thermal simulation study of the building design is the climatic condition outdoor. The study on thermal behavior has been made for the building assuming to be located at New Delhi which falls in the composite climatic zone of India. The solar radiation and climatic data of this station is available in the desired format i.e. TMY2 (New Typical Meteorological Year) as required in TRNSYS Software. In the case under study no adjacent or internal wall is considered as all the four walls are external wall, each made of non negligible mass. The untreated base case has conventional construction material used. The walls are 0.230m thick brick wall plastered on both side with cement mortar of 0.013m thickness. The total thickness of each of four walls is 0.256m and its U-value is 2.376w/m^{2}K. The solar absorbance of the walls is 0.6 on the front side and 0.6 on the back side. The convective heat transfer coefficient of wall are 11 kJ/hm^{2}K on the front side (inside surface) h_i and 64 kJ/hm^{2}K on the back side (outside surface) h_o. Roof is 0.150m thick heavy reinforced concrete slab plastered inside with thickness of 0.013m. The total thickness of each of roof is 0.163m and its U-value is 4.023w/m^{2}K. The floor of the building is made of marble stone of 0.025m thick laid over heavy concrete of 0.100m, and clay-soil of at least 0.100m thickness. The total thickness of the floor is 0.255m and its U-value is 3.290w/m^{2}K. The treatment such as application of various layers of insulation material on roof as recommended practice followed by BASF India using different insulation materials have been considered in various treated case. Applications of wall insulation along with roof insulation have also been considered. The insulated system of wall and roof are depicted in Fig. 1.

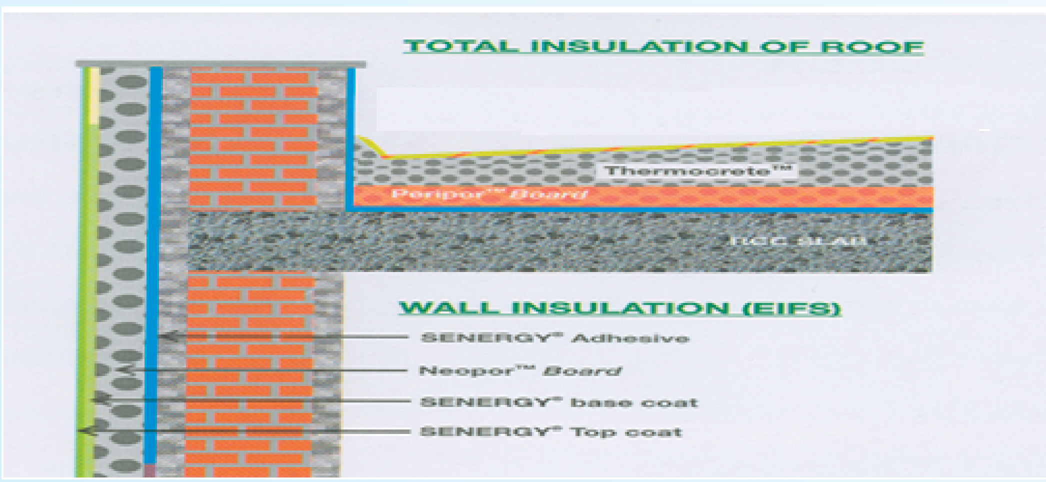


Fig. 1: Insulated system of wall and roof

All thermo-physical and construction parameters for different cases along with corresponding overall thermal transmittance are given below in the tabulated form.

CONVENTIONAL CONSTRUCTION (UNTREATED)

CASE 1. Wall Specification (U-Value=2.376 W/m^{2}K)

Layers	Thickness (m)	Thermal conductivity (W/mK)	Thermal capacity (K joule/KgK)	Density (Kg/m^3)
Cement plaster	0.013	1.07	0.84	2000
Brick	0.230	0.85	0.84	1750
Cement plaster	0.013	1.07	0.84	2000

Roof specification (U-Value=4.023 W/m²K)

Layers	Thickness (m)	Thermal conductivity (W/mK)	Thermal capacity (K joule/KgK)	Density Kg/m³
Cement plaster	0.013	1.07	0.84	2000
Heavy Reinforced Conc.	0.150	1.89	0.84	2400

Floor specification (U-Value=3.290 W/m²K)

Layers	Thickness (m)	Thermal conductivity (W/mK)	Thermal capacity (K joule/KgK)	Density Kg/m³
Marble	0.025	2.52	0.84	2550
Heavy Concrete	0.100	1.46	0.84	2200
Soil	0.100	1.29	1.80	1500

The other five treated cases have been described here. The main thermal insulation has been changed in all five cases keeping basic building materials same.

CASE 2. Roof Specification (U-Value=0.425 W/m²K), (with same Wall and Floor specification)

Layers	Thickness (m)	Thermal conductivity (W/mK)	Thermal capacity (K joule/KgK)	Density Kg/m³
Cement plaster	0.013	1.070	0.84	2000
Heavy reinforced conc.	0.150	1.890	0.84	2400
Elastopor	0.050	0.0249	0.84	44.32
Thermocrete	0.100	0.230	0.84	752
China Mosaic	0.003	1.030	1.00	2000

In the case 3, case 4, case 5 and case 6, only thermal insulation Elastopor has been replaced by Styropor, Neopor, Elastospray and Peripor respectively and their overall thermal transmittance values are found to be 0.511, 0.508, 0.401 and 0.536 W/m²K respectively. Cooling load with and without insulation treatment of AC room can be seen in Fig. 2.

Fig. 2: Cooling load in KWh for different cases

Calcination of Gypsum for producing Plaster of Paris utilizing Solar Energy as partial replacement of Heat Energy (OLP-0327)

S.K. Saini

Gypsum is the sulphate of calcium ($CaSO_4$. $2H_2O$). The different types of gypsum available in the market can be grouped into three main classes based on their mode of origin - quarry gypsum, marine gypsum and by product phospho gypsum. India is rich in the deposits of quarry gypsum and the mines are located mainly in Rajasthan, Gujarat, Jammu & Kashmir, Andhra Pradesh and Uttar Pradesh. About 90% of annual production of quarry gypsum is from Rajasthan alone. Marine gypsum is produced during separation of ordinary salt from seawater when the latter is evaporated in shallow pits. Huge quantity of phospho gypsum is produced from phosphoric acid plants as by-product of the wet process of phosphoric acid manufactured by acidulation of rock phosphate with sulphuric acid.

Gypsum as such does not posses proper setting and binding properties. Industrial importance of gypsum is attributed to its dehydrating ability on heating. Manufacturing of gypsum plaster of different grades like surgical, building and pottery grades requires the gypsum to be calcined to hemi-hydrate commonly called plaster of Paris. On heating at 120^0C -170^0C, gypsum releases one and a half molecules of water of crystallization forming hemihydrate. This dissolves on addition of water and its saturated solution precipitates needle shaped crystals which later set into a hard and strong mass. It is this property of gypsum which is utilized in the production of pottery, terra cotta and many other building components and ceramic products. Since its market use is mostly in the form of plaster of Paris, the conversion of gypsum into plaster of Paris through calcinations becomes a significant industrial operation and which consume lot conventional energy.

At present all the energy requirement for calcinations of gypsum is fulfilled with conventional fuels. The energy required for producing 1 kg of gypsum plaster from gypsum having 10% free moisture is about 1.04 MJ. As the tending extinction of the fossile fuels, oil and natural gas, which are deplitable sources, has mounted the pressure to explore other renewable sources of energy. The only possible solution at the moment is the Solar Energy, which is available in abundance in tropical countries like India. India is a sunny country with most parts receiving about 4 to 7 kilowatt hours of solar radiation per square metre per day with 250 - 300 sunny days in a year. This makes solar energy a very attractive option for generating both power and heat. There is scope to design a calcinator, which shall replace partial energy requirement for calcining the gypsum with solar energy.

Thermal Energy Required For Calcining Gypsum

- Heat required for bringing gypsum to its calcination temperature 20°C to 130°C excluding energy required for evaporation of water(14.4%).
- Heat required to evaporate the free moisture content in the gypsum charge taking the free moisture as 10 % (32.4%).
- Heat required to decompose gypsum for conversion into gypsum plaster (10.8%).
- Heat required to evaporate water molecules released in decomposition gypsum (38.4%).
- Heat required for bringing temperature of gypsum & plaster of paris to its calcination 130°C to 160°C (4.0%).

Designed Calcinator

A cylindrical pan has been designed having concave shape bottom welded to cylinder shell. The pan has an insulated jacket for circulating hot thermic fluid heated by solar energy for heating the gypsum powder fed in to the pan for calcination as shown in Fig.1. An insulated fluid tank has also been designed and connected to the jacketed pan by the pipe line for circulating hot fluid heated by solar energy with a fluid pump. The quality and the rate of setting is considerably depend upon calcination temperature employed and churning of charge in the pan. The need for careful control in the calcination of gypsum is therefore manifest; indeed, an unduly hurried calcination with bad distribution of heat may easily result in an unwelcome mixture of several calcined products plus some unaltered gypsum.

The temperature require careful control and also relative uniformity of temperature has to be achieved by constant mechanical churning of the gypsum charge during calcination. Therefore, a churning mechanism has been designed for providing adequate agitation in the charge during calcination process having 15 RPM. The temperature of the gypsum charge and thermic fluid are monitored using several thermocouples as shown in Fig. 1, during calcination at different locations inside the pan, fluid tank and pipe line. This monitoring helps for maintaining the requisite temperature of the gypsum in different sections of the charge in the pan by regulating the thermic fluid supply to the jacket. The work of fabrication of the calcination system is in process.

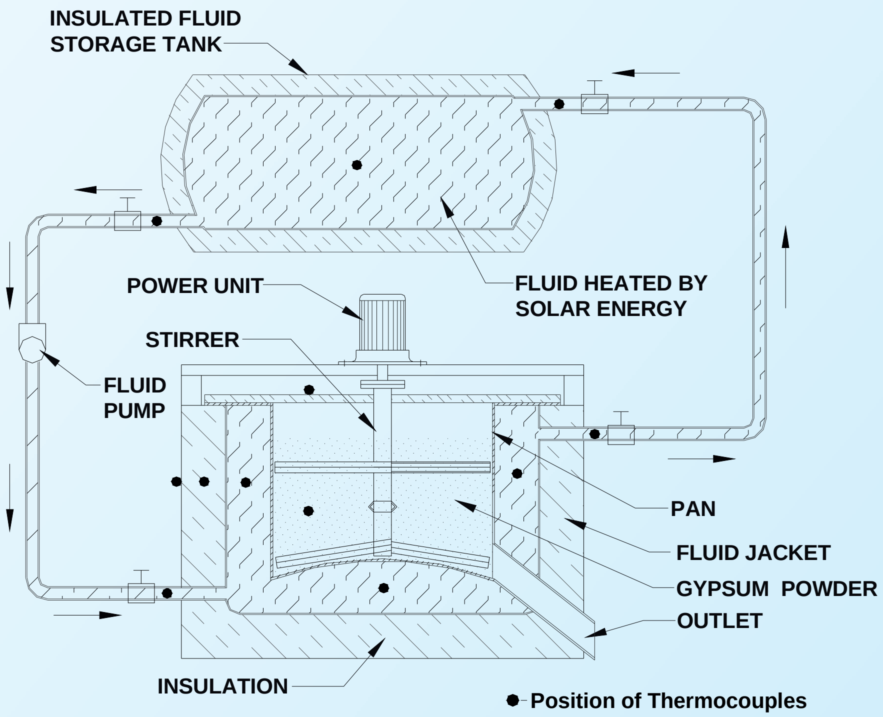


Fig. 1:Sectional view of Gypsum Calcinator



Health Monitoring & Retrofitting

Health Monitoring & Retrofitting

Performance Assessment of Pile Foundations under Indirect Loading due to Adjacent Excavations (OLP-0338)

S. Karthigeyan & Team

Pile foundations are extensively used to support various structures built on loose/soft soils, where shallow foundations would undergo excessive settlements or shear failure. The present day state of art provides guidelines for design of pile foundations subjected to axial as well as lateral loads, which are active in nature, i.e., directly applied at the pile cap level. But, with the increased construction activity in the form of excavations, road embankments, tunneling etc., the piles situated nearby these activities are also subjected to indirect loads from induced ground movements, which impart additional stresses on the piles by increasing the strains and displacements thereby causing distress to the structures. Besides, the use of piles to stabilize moving soils is also becoming popular in the recent times. One of the main design constraints in all the above mentioned cases are to prevent or minimize damages to the nearby pile supported buildings due to indirect loadings. Although, procedures are available (IS 2911 - Part I/ Sec. 1 to 4 -1979) for designing the piles under direct loading, there are still many unanswered questions about this design technique, especially the pile designed for direct loading is safe against indirect loading or not.

Based on the review of literature, the following important gaps were identified in this area. Numerical analyses have performed by assuming that the induced lateral ground movements on the piles due to various practical cases are uniform in nature. But, in real field situations the induced ground movements in the piles due to various cases are non-uniform in nature. Also, analyses have performed in two stages i.e. prediction of ground movement due to excavation in first stage and incorporating the predicted ground movement for pile analysis separately in the second stage. However, in reality these two analyses are always coupled in nature. In view of the above, this project is mainly aimed to investigate the behaviour assessment of pile foundations under indirect loading due to adjacent excavations (Fig.1) through a numerical/experimental investigation by arriving at an improved design procedure.

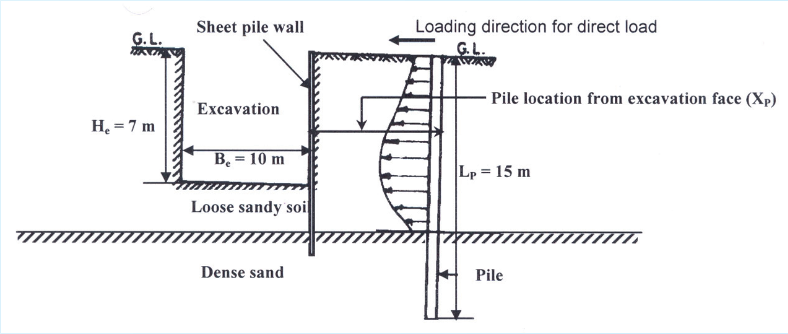


Fig. 1 :Pile adjacent to a supported excavation

The 3-d FEM based PLAXIS3D Foundation software has been used to analyze soil-pile interaction under indirect loading. In the analysis, the pile is assumed to be linear elastic and the soil is treated as an elasto-plastic material, obeying Mohr-Coulomb failure criterion. The sheet pile wall is assumed to be linear isotropic material. The finite element mesh has been generated by using 15-noded wedge element for soil continuum, volume pile for the pile and vertical wall element for the sheet pile wall. The indirect loads on the piles are represented as a function of some of the key parameters like normalized depth of excavation (H_e/B_e) and pile location (Xp) from the excavation face. Numerical analyses have been carried out initially by start with self weight analysis to generate the in-situ stresses in the soil mass. Further analyses have been carried out in two phases. In the first phase, the piles were subjected to combined vertical and lateral loads than the sheet pile wall was installed. In the second phase, direct loading was remains constant while the soil layers were excavated from top to bottom in various steps with each step involves the removal of 1m and continued until the desired depth of excavation was achieved. Fig. 2(a) and 2(b) shows the 2-d and 3-d finite element discretization of the problem.

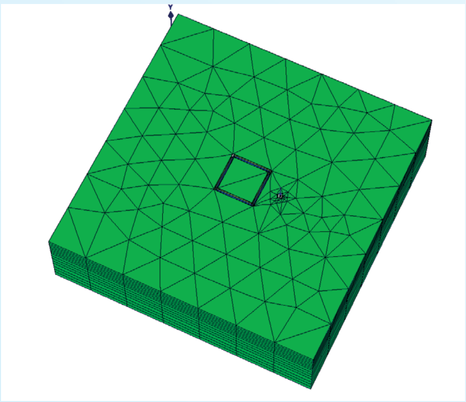


Fig. 2(a): 2-d finite element discretization of the problem

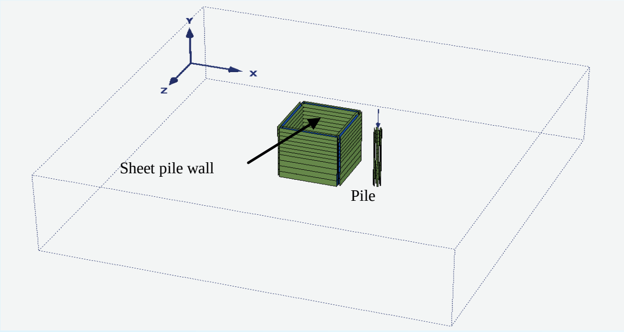


Fig. 2(b): 3-d view of the pile adjacent to an excavation

A series of 3-d finite element analyses have been carried out to investigate the response of piles under indirect loads by placing the pile at different distances away from the excavations. Although an excavation will cause both vertical and lateral soil movements, lateral soil movement is considered to be more critical, as piles are usually designed to sustain significant vertical loads. In view of this, the effect of indirect load on the lateral response of piles has been analyzed. The numerical results in terms of lateral deflections and maximum bending moments in the pile sections due to the effect of indirect loads are investigated in the project, which are of prime interest to designers. Figs.3 and 4 shows a typical lateral deflection and bending moment profiles along length of the pile due to both a direct load of 150 kN and indirect loads with respect to different depths of excavations. The pile deflection profiles as presented in the figure are pertaining to a pile located at a distance of 1m away from the excavation. It can be seen from the Fig. 3 that the maximum lateral deflections are occurring at top head of the pile in all the cases. Further, the maximum induced lateral deflections in the pile section due to indirect loads are increasing with increase in normalized depth of the excavations (H_e/B_e). Also, it is to be noticed that the lateral deflection profiles for piles under indirect loads are almost in line with the pile under direct lateral load for a shallow depth of excavations. However, it is different in the case of a deep depth of excavations say i.e. beyond 0.3.

It can be seen from the fig.4 that the trends of bending moment profiles are almost same for the pile under both direct and indirect lateral loads. The maximum bending moment induced in the pile section is observed to be increased with increase in normalized depth of the excavation (H_e/B_e). The depth at which maximum bending moment occurred was observed to be at a depth of 2.1 m from the top pile head for all the cases. It indicates that the effect of indirect loads on the depth at which occurrence of the maximum bending moment is less significant. It can also be noticed that the point of zero bending moment is slightly moved down with increasing depth of excavations.

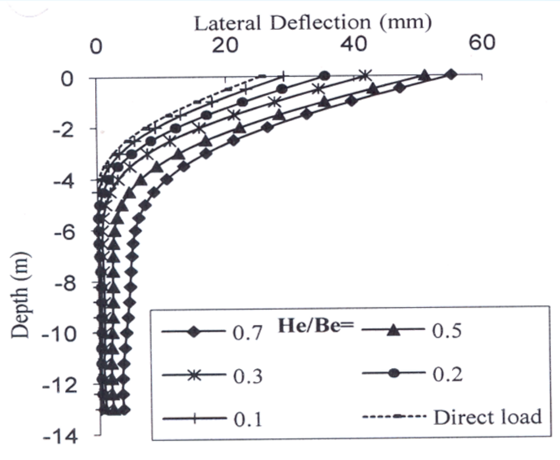


Fig. 3: Lateral deflection along the length of pile under direct and indirect loads

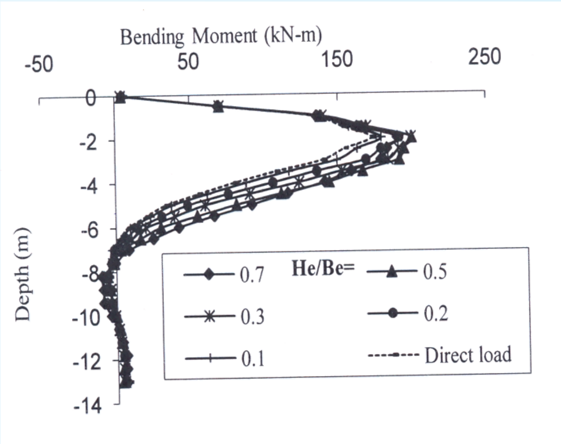


Fig. 4: Bending moment along the length of pile under direct and indirect lateral loads

Table 1 : Location of piles beyond which the pile designed for direct loading is safe against indirect loads

Normalized depth of excavation (H_e/B_e)	Safe limit of pile location (Xp) based on allowable deflection criteria	
	5mm	10mm
0.1	1.5	0.0
0.2	2	0.0
0.3	4	1.75
0.4	5	2.5
0.5	>25	3
0.7	>25	6.25

Further, in order to quantify the influence of indirect loading, the safe location of pile from the excavation face is estimated based on deflection criteria and are presented in Table 1. From the table, it is to be interpreted that if a pile under direct load is designed for an allowable lateral deflection of 10 mm, the design is safe up to an excavation height (H_e/B_e) of 0.2 even if the source is at very close vicinity (zero distance). However, if depth of the excavation (H_e/B_e) increases to 0.3 and above, the design is safe only if the pile located beyond at a distance of 6.25 m away from the excavation face. In contrast, if the pile is designed for an allowable lateral deflection of only 5 mm than the effect of indirect loading is significant even at shallow depth of excavation. It is clear from the table that the design is safe if the pile located beyond at a distance of 5 m away from the excavation face for H_e/B_e up to 0.4. However, if the depth of excavation increases to 0.5 and above than the design is safe only if the pile located at distances beyond 25 m from the excavation face. Thus, it is essential to take precautionary measures to avoid any kinds of structural failure than the piles should be designed by incorporating the effects due to possible indirect lateral loads. The results similar to those in Table 1 could be generated for particular cases in order to assess the sensitivity of a given pile to adjacent excavations.

The project is in progress, the outcome from the study would leads to new understanding of the behaviour of piles under indirect loading. Also, in view of increasing in construction activities, particularly in the urban areas, it would be useful for the development of new design guidelines of piles to modify the current practices for accounting the effect of possible indirect loads due to excavations.

Behaviour of Shallow Foundation on Randomly Distributed Fibre Reinforced Flyash (RDFF) (OLP-0341)

Sujit Kumar Saran

Objective: To increase the strength and stiffness of flyash by mixing it randomly with commercially available synthetic fibres so that flyash deposits become competent to support various engineering structures.

The behaviour of footing resting on fibre reinforced flyash by performing model tests is under progress.

Some typical results are given in Table 1.

Table 1: Effect of fibre content (fc) on bearing capacity and settlement of footing

quo =1450kN/m2	Increase in Bearing Capacity qu (%)		Reduction in settlement at qu/3 (%)	
	fc=0.5%	fc=1.0%	fc=0.5%	fc=1.0%
RW = B, RD = B	14%	19%	20%	40%
RW=2B,RD= 2B	17%	23%	30%	51%
RW=3B,RD= 2B	23%	31%	41%	60%

From the model tests carried out so far, the following conclusion has been drawn:

- With increase in fibre content, overall pressure-settlement curve improved and shifted upward. Significant improvement in bearing capacity and reduction in settlement of footing resting on RDFF was observed.
- By providing RDFF in a depth of 2B and width of 3B below, the footing was found very effective and economical. In this case bearing capacity gets increased by 31% for 1% fibre content (fc).

Performance Evaluation of Confined Masonry Buildings under Quasi-static Condition (OLP-0348)

S K Bhattacharyya, Ajay Chourasia and Jalaj Parashar

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. 1 shows stress - strain relationship for different grades of mortar.

Table 1: Structural Properties of Different Grades of Mortar

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	0.33
Ultimate Strain	0.0025	0.0021	0.0038	0.0035

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 (COH3D8). 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. Fig. 2 shows stress distribution for masonry prisms for loading parallel to bed joint and normal to bed joints.

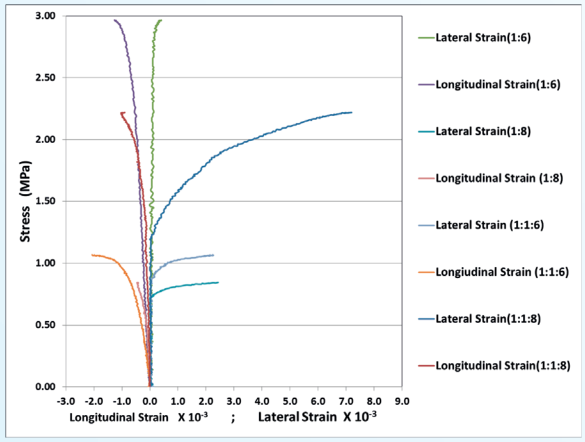


Fig.1: Stress - Longitudinal Strain / Lateral Strain for different grades of mortar

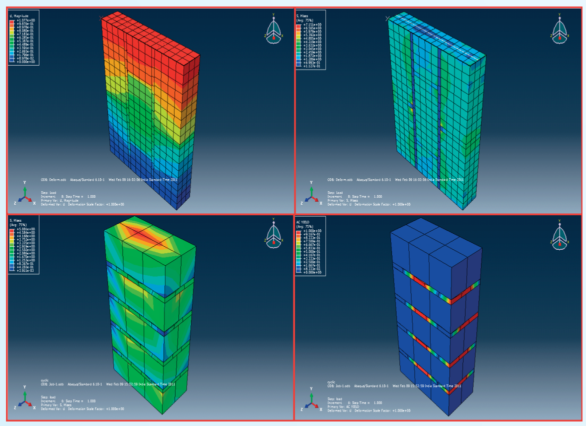


Fig. 2: Stress distribution for masonry prisms for loading parallel to bed joint and normal to bed joints.

Health Monitoring of Building Structures using Wireless Sensor Networks (OLP-0350)

S K Bhattacharyya, Ajay Chourasia, S K Singh, Soju Alexander and Jalaj Parashar

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 model updating and develop prognosis model to predict remaining useful life. The initial studies were conducted on eight-storied steel framed structure at 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-storeyed buildings.

Fig.1: Schematic of structural health monitoring data flow using wireless sensor network

Evaluation of 3-S Prefabricated Systems to Establish Behaviour of various Joints under all Design loads on full scale two Storied Building (SSP-6437)

Ajay Chourasia, S K Singh and Jalaj Parashar

The project was undertaken with the objective to ascertain behaviour of joints and connections of 3S Prefabricated building system under lateral loads. The full-scale experimental investigation on two storied building constructed at SE lab has been tested under cyclic lateral loads. The displacement-controlled loading is applied at two slab levels through steel grillage mechanism firmly connected with a rigid frame at two opposite faces of building. The model is instrumented with LVDTs to capture the deformations and strains using strain gauges at critical locations through data acquisition system.

Fig. 1: Test setup for full scale testing of '3-S' Model under quasi-static condition

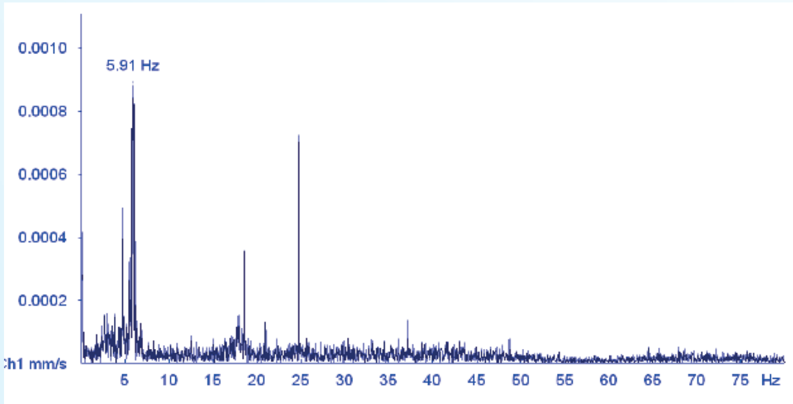


Fig. 2: FFT analysis of vibration signature for 3S system

Important conclusions drawn from the study are: (i) The maximum applied cyclic lateral load corresponds to 440 kN (lateral displacement cycle of ±49 mm) as against the seismic load of 64.8 kN (0.24 g). Thus, the structure withstood 6.79 times more cyclic lateral load corresponding to Maximum Credible Earthquake value for Seismic Zone IV. (ii) Even at this loading; no collapse mechanism was observed and the structure responded in elastic range which indicates that the '3-S' prefab structure having light-weight autoclaved cellular reinforced concrete slabs has a large ductility and can withstand even more lateral load. (iii) The diaphragm comprising of panels of autoclaved reinforced cellular lightweight concrete having 40mm thick nominally reinforced in-situ deck concrete was effective in cyclic lateral load transfer mechanism and no opening of panel joints were observed. (iv) The detailing for the '3-S' prefab structural elements and connections conforms to the performance requirements; as revealed from the experiment.

To assess stiffness degradation of structure, vibration monitoring of structure before and after the cyclic loading was also carried out. The frequencies before cyclic loading, at 1st and 2nd slab level were observed as 8.54 & 8.42 Hz respectively, whereas the corresponding frequencies after loading were 5.91 & 5.88 Hz, indicating considerable stiffness degradation. The comparison of experimental results has also been carried out with analytical model, which were in good agreement.

Studies on Durability of FRP Wrapped Concrete Structures in Marine Exposure Conditions (OLP-0349, Part-C)

Harish Chandra Arora and B.K.Rao

As cities across the world revise their master plans to permit higher floor-area ratios and join the trend towards vertical growth, architects and engineers are faced with new challenges in the strengthening and repair of concrete structures.

Until recently, the accepted methods of strengthening were concrete jacketing, guniting or steel-plate bonding, all cumbersome, labor intensive and problematic. These techniques add to the size of members and increase deadweight. Composite fibre wrapping is one of the most popular techniques in use today. This novel technique of rehabilitation is very effective and fast for earthquake effected structures and retrofitting of structures against possible earthquakes. Globally, composite technology and its applications have made tremendous progress during the last two decades or so. A serious matter relating to the use of FRP's/FRC's in civil applications is the lack of design codes and specifications. For nearly a decade now, researchers from Canada, Europe, and Japan have been collaborating their efforts in hope of developing such documents to provide guidance for engineers designing FRP structures as well as their utilization in repair and rehabilitation projects all over the world.

Armed with a wide gamut of advantages, composites have a key role to play in the growing market in India. Composites have made an entry into diverse end-use segments and the developmental efforts for finding newer composites for existing & novel applications is an area of top priority. Applications of FRP in India are getting momentum of late. One of the major applications has been in rehabilitation works in Gujarat earthquake damaged structures. There is a huge potential of application of this technique in India and the future prospects for the composite industry in India appear to be very bright.

Different structural characteristics of the confined/wrapped concrete using fibre reinforced composites has already been studied in the past considering various parameters such as varying concrete strength, corner radius, thickness and number of layers, orientation of fibres, percentage of longitudinal and shear reinforcement etc.

In varied civil engineering uses such as infrastructure renewal applications, offshore platforms, oil development-related structural facilities and marine infrastructure, the FRP composite is exposed to moisture coupled with other chemicals. The deterioration that occurs in FRP during the service life in general, is linked to the level of moisture that is absorbed. Undesirable structural changes within the fiber reinforcement and the matrix or the interface between the two can occur in the presence of moisture coupled with salt affecting the structural and durability performance of rehabilitated structure.

Durability of repaired/ rehabilitated structures is a crucial element governing the life-cycle cost of FRP-rehabilitated reinforced concrete structures. The research into durability-related aspects of FRP strengthening and repair is a relatively new field, and the information currently available is consequently rather limited. Considering this fact the present in-house R & D project was initiated which will indeed be beneficial for construction and repair society. Test results of a new extensive research program investigating the effects of different parameters on the durability aspects of FRP repaired concrete structural elements will be attempted to be presented in this research program. Moreover, the research on durability of FRP, considering its optimum use (cost aspect), becomes particularly important for the country like India.

The main objectives of the current investigation are as follows

- To study the durability behavior of FRP wrapped concrete elements under marine exposure conditions
- Structural and durability characterization of FRP retrofitted/ repaired RC structures for its efficacy to be used in future national retrofitting and rehabilitation programs
- Investigations for viability of using FRP repairs to extend the service life of damaged concrete structures
- Generation of useful data for formulating the design guidelines compatible with the existing IS codes and thus to enrich this comparatively new field of research
- Dissemination of S&T knowledge on the subject through research publications

So far in this research program, a detailed literature review has been carried out with the output in the form of a comprehensive state of the art report on the subject area. A sustained loading setup for the testing/ investigation and monitoring purpose, has been planned, designed, fabricated and installed for different sizes of beam specimens. The system works on level arm system where reaction force acts as external loading on beam. The installed system is shown in Fig. 1. The calibration process for the sustained loading setup has been completed for two sizes of beam specimens. Different corrosion durability studies are in process on the specimens with the experimental setup.

Fig 1: Sustained loading system

Health Assessment and Remedial Measures for the Repair of Cooling Towers of NTPC Simhadri (CNP-030)

S.R. Karade & A.K. Mittal

NTPC's Thermal Power Station at Simhadri (AP) has two units of 500 MW each, which were commissioned in the year 2002. The power station has two natural draught cooling towers (NDCT) constructed using steel reinforced concrete. For the water cooling system sea-water is being used. In the beginning of the year 2009, the NTPC engineers noticed spalling of the concrete, exposure and corrosion of reinforcement at several parts of these cooling towers. Besides these defects corrosion was also observed in the steel components like ladders, railings, doors and fittings installed on these cooling towers. In view of the deterioration in several parts of the cooling towers, NTPC requested CSIR-CBRI to undertake an investigation work for health assessment of these cooling towers and suggest suitable remedial measures for repair. Accordingly, CSIR-CBRI teams made several visits to the site and various tests such as visual observations, rebound hammer, ultrasonic pulse velocity measurement, half cell potential and resistivity measurement were conducted (Fig. 1). Help of an NTPC hired agency was also taken during the investigation work. Besides these tests, 44 concrete core samples (Fig. 2) were extracted from these cooling towers for various laboratory tests such as: visual observations, compressive strength, pH, carbonation depth, chloride penetration and sulphate content.

The investigation revealed that columns and core concrete in shell are still in good condition, but the reinforced concrete in the shell of the cooling towers is deteriorating at a faster rate due to corrosion of the steel and an urgent intervention is required for restoration. Appropriate repair schemes for various parts have been suggested.

(a)

(b)

Fig.1: Delamination of concrete cover due to corrosion of reinforcement in Cooling Towers

Fig. 2: Concrete core samples extracted from the Cooling Towers

Disaster Mitigation

Disaster Mitigation

Landslide Risk Assessment in the Upper Reaches of Alaknanda Valley, Garhwal Himalaya and Development of Guidelines for Control Measures (OLP-0339, Part-A)

S. Sarkar and D.P. Kanungo

Existing and potential landslides were spotted through field investigation and satellite image interpretation along Chamoli-Badrinath road (NH-58) in the upper reaches of Alaknanda valley, Garhwal Himalaya. A few hazard zones were identified as most potential zones, where number of landslides is affecting the traffic and thereby posing threats to lives. Various landslides of different natures were identified in these hazard zones. Landslides identified are broadly classified into debris slide, debris flow, rock fall and rock slide (Figure 1).

Fig. 1: Landslides of different types along Chamoli-Joshimath Road

The most threatening landslides in this area are of rock fall and debris slide types. These landslides were mapped on the CARTOSAT I Remote sensing image having 2.5 m resolution. The river, major streams, roads and landslides were mapped from satellite data in GIS environment (Fig. 2). The area coverage of these landslides was determined from the GIS maps.

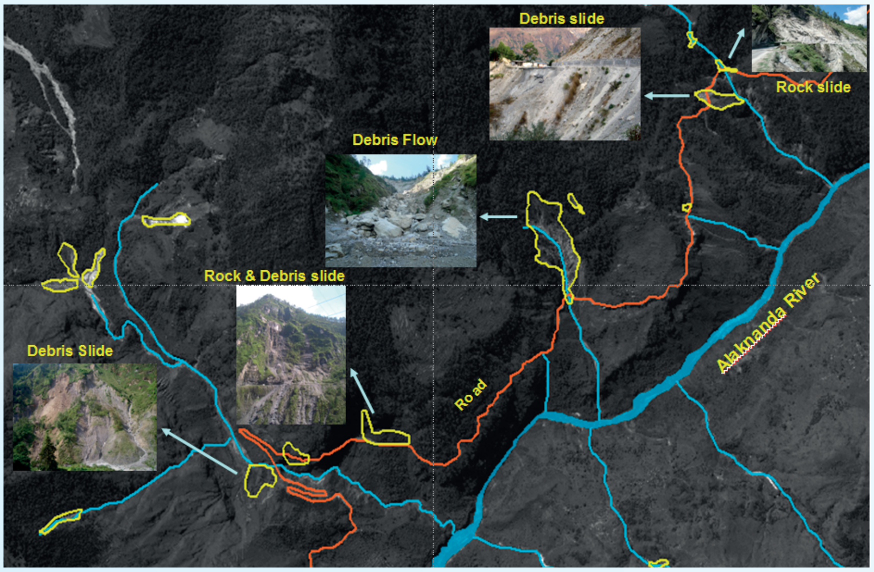


Fig. 2 : Landslides of different types mapped in GIS are shown on satellite image

The thickness of debris material and dimension of rock blocks were estimated in the field. These data gave a fair estimation of landslide volume, which may trigger in future. The volume range obtained was suitably classified into four classes.

Volume Classes (m3)

♦ <1000	Low
♦ 1000-10,000	Medium
♦ 10,000 - 1,00,000	High
♦ >1,00,000	Very High

To define the landslide velocity, different types of landslides were considered and a nominal velocity scale was defined.

♦ Rock Fall	Very High
♦ Rock Slide	High
♦ Debris Flow	High
♦ Debris slide	Moderate
♦ Rotational Slip	Low

Based on landslide volume and velocity, landslide intensity was defined to estimate the hazard.

Landslide Volume	Landslide Velocity	Landslide Intensity
Very high	High	Very high
Very high	Moderate	High
High	High	Very high
High	Moderate	Medium
High	Slow	Low
Medium	Moderate	Medium
Medium	High	High
Low	Very high	High

Considering the intensity of the impending landslide, the degree of hazard can be estimated. The study is continuing for hazard assessment, so that landslide risk and future landslide scenario in the area can be assessed.

Development of Methodology for Landslide Susceptibility and Risk Zonation on a Meso-Scale and Guidelines for Scheme of Remedial Measures (OLP-339,Part-B)

D.P. Kanungo and S. Sarkar

The study area comprises mainly the uphill slopes and partly downhill slopes along a road stretch of 1.5 km at a distance of 9 km from Pipalkoti on Chamoli-Badrinath highway (NH-58). A contour map on 1:1000 scale with 2m contour interval of the area has been prepared based on field survey. The study area has been divided into different zones based on field survey and the hill shade developed through GIS analysis (Fig.1). In different zones along the road stretch, the landslide scars are mapped along with other geological and morphological features. The area is affected mostly by shallow debris slides/flows except few rockslides. One landslide (Zone 1) in the study area has been mapped in detail through field investigation. The field investigation includes mapping of different features on the landslide body, information about the materials on the slope and also collection of soil samples from different levels of the landslide body and surrounding areas.

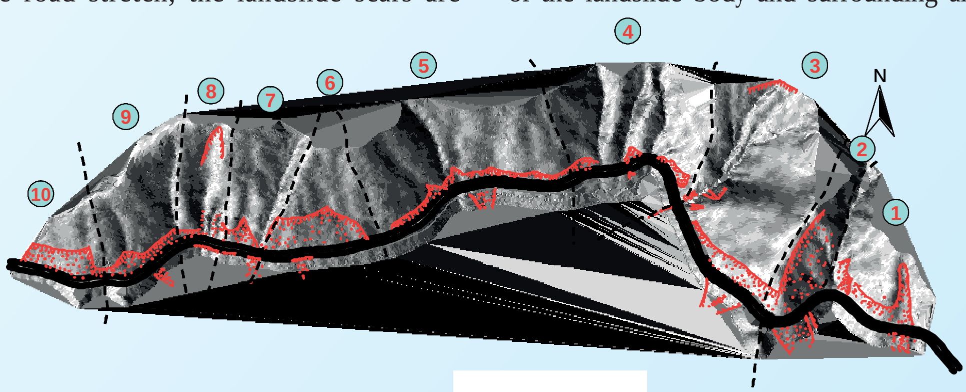


Fig.1 Zoning of Slopes based on Hill-shade and field information

Landslide Description & Field Observation

This is a debris slide of progressive nature (Fig.2) which is encompassed by two natural streams joining the Alaknanda River at the downhill side below road level. The landslide is spread over a length of 112m in total at the road level with two active stretches on left and right flanks having spread lengths of about 57m and 15m respectively. Initially, the debris slide along a narrow channel on the left flank and at the excavated height at road level was initiated, may be due to the road widening process. Due to heavy precipitation during the monsoon season (specifically August-September) of 2010, this slide got extended towards its right side and is also progressing towards uphill slope. This has been clearly observed in the field.

Fig.2: A panoramic view of the landslide

At present, the slide has the main scar on the uphill slope and a number of minor (secondary) scars developed along the radial transverse tension cracks (Fig.3) all over the landslide body. There is a clear indication of detachment and displacement of the order of 0.5m to 1.0m along all these tension cracks which indicates the progressive nature of sliding activity. Only one longitudinal tension crack is observed just right side to the narrow channel of debris slide on the left flank with a visible depth of 0.3m and 0.3m to 0.4m wide.

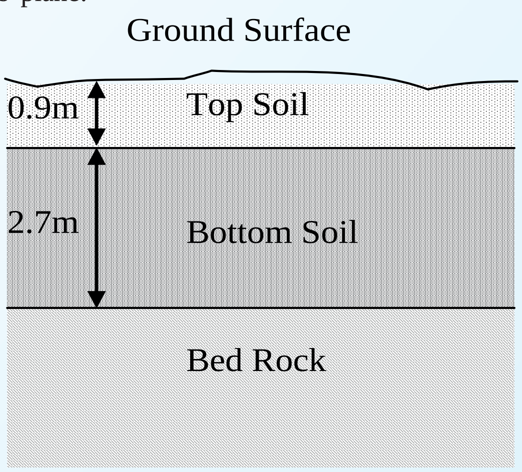
Fig. 3: Tension cracks on the slide body at different locations

Slope - Slope angle is 56° in general towards a direction of N320°.

Base rock - Dolostone (Dolomitic limestone)

Joints/Discontinuities - The unfavourable discontinuity has a dip of about 45°-55° with a dip direction of N330°. It has a dip-slope relationship with respect to the slope direction which makes this discontinuity plane favourable for sliding along this plane.

Soil/Debris overburden - The soil overburden is about 3.6m thick with two distinct layers (Fig.4). The top soil layer appears to be clayey, fine grained and brown in colour with about 0.9m thick. The second soil layer appears to be formed by weathered disintegrated parent rock, grey in colour with about 2.7m thick. Below this soil layer, the in-situ rocks are present as observed in the field.



Soil as observed visually appears to be clayey, fine grained & brown in colour. Roots of the pine trees are normally confined to this soil. layer.

Soil as observed visually appears to be coarse grained, gray in colour & formed by weathered disintegrated bed rock. Soil as observed visually appears to be coarse grained, gray in colour & formed by weathered

Dolostone. As observed in the field, the bedding plane is acting as the surface of sliding of overlying debris/soil overburden.

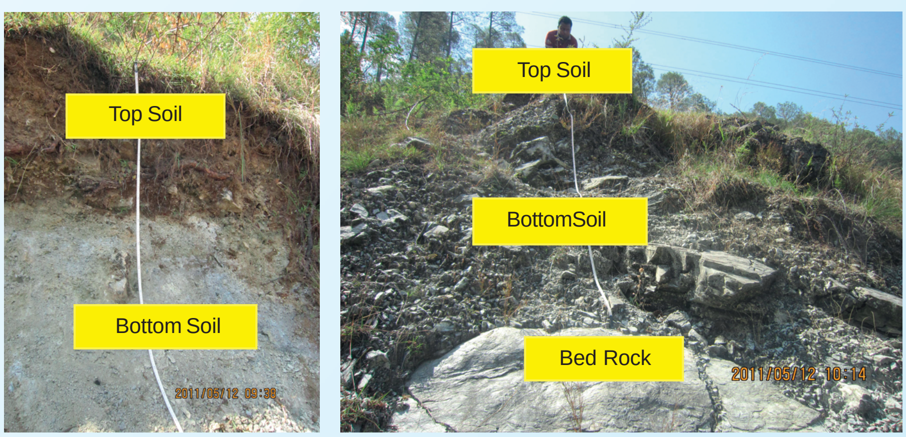


Fig. 4: Sketch and field photographs showing soil layers

Four soil samples were collected from different locations at different levels of the landslide body (Fig.5) and will be tested in the laboratory. The soils collected belong to the top soil, bottom soil horizons and also the displaced and accumulated slide mass at road level. Undisturbed soil samples could not be collected from the site. The laboratory investigation of these soil samples will reflect more on the material characteristics and their variation along the landslide body and also may be on the sliding mechanism.

Based on the field information, the landslide map on the contour map has been prepared in GIS (Fig.5).

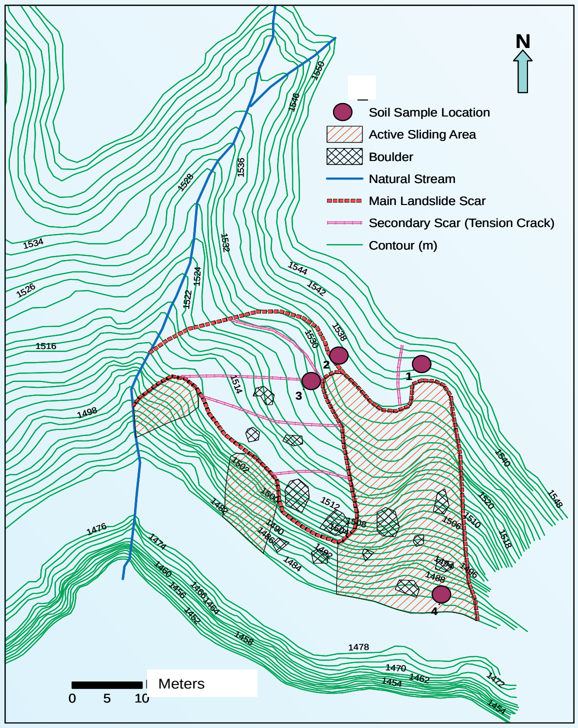


Fig.5: Field information based map of the landslide slope

Inferred Landslide Failure Process

- The slide started at road level due to excavation and road widening activity.
- The extension of sliding uphill and its progressive nature may be attributed to lack of proper toe support at road level and subsequent heavy precipitation in last monsoon (Year 2010).
- The infiltration of rain water along all the longitudinal and radial transverse tension cracks increases the saturation level and builds the pore water pressure above the plane of sliding.
- The unfavourable discontinuity with dip-slope relation at a depth of about 4m acts as the plane of sliding surface.
- The varying thickness and characteristics of top and bottom soil layers are probably helping to the sliding activities. This will be more clarified with the results of the laboratory testing of the soil samples.
- Above all, the topography of the hill slope is very much favourable for sliding to occur.

Evaluation of Seismic Ground Motion Parameters of Jammu City (OLP-0340, Part A)

Abha Mittal, S. Karthigeyan, P.K.S. Chauhan and Team

Jammu Situated on a sub hilly area between 32°44'N and 74°55'E at an altitude of 400 m above mean sea level. The city's sprawl is on both the banks of the River Tawi, which is a tributary of River Chenab. The old city is confined to the right bank; whereas the later expansions of the city have largely taken place on the left bank. Jammu, the winter capital of J&K state, is a city of temples, symbol of ancient values and has a distinct image due to its heritage, location and linkages. Large scale urbanization and industrialization has given rise to the siesmic hazard assessment of the area as it comes under seismic zone IV. This zone is called the High Damage Risk Zone and covers areas liable to MSK VIII. The IS code assigns zone factor of 0.24 for Zone 4.

Around the Jammu, a number of moderate to major earthquakes have occurred repeatedly (Fig. 1). Seismic hazard analysis of this region play important role in the sustainable development of the city like Jammu.

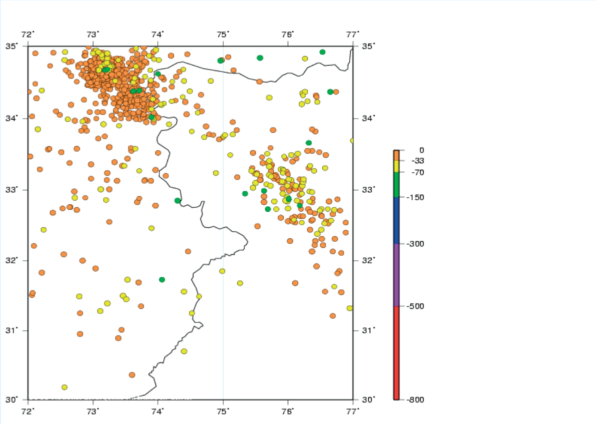


Fig. 1: Earthquake Locations in and around Jammu

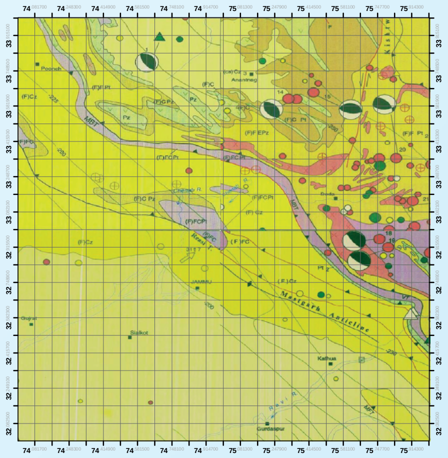


Fig. 2: Study Area with Log. 74°-76° and Lat. 32°- 34°

Statistical/Probabilistic Analysis used

Different researchers have used several statistical techniques like principal component analysis, factor analysis and cluster analysis. In the present work Pattern Recognition Technique, which is gaining importance in earthquake prediction studies has been used. In this technique the region is subdivided into smaller no. of grids (Fig. 2). The data on nine parameters like no. of epicenters, no. of major thrust passing, perpendicular distance from the major thrust, soil type etc in each of the grid has been collected. The data is divided into two groups based on one of the nine parameters.The discriminant values (Table 1) under these two groups, were used in discriminant analysis to find the discriminant scores for each of the grid. Discriminant scores were than projected on a discriminant function line (Fig. 3) and there is clear separation of grids on the basis of number of faults & thrust passing through the grid.

Results of the Discriminant Analysis

MAHALANOBIS D2 = 92.46 where D2 is the difference between the means of two groups.

R1 = 13.0287 ; RO = -33.2003 ; R2 = -79.4293

Where RO is exactly half way between the centres of the groups. R1 and R2 are the centres of the two original groups.

Table 1 : Discriminant Scores for Nine Variables

VARIABLE	CONSTANT(v's)	PRCT. ADDED
1.	.2207	-.0001
2.	.0209	-.0710
3.	-84.6548	97.9297
4.	.0591	2.0707
5.	.1342	.0542
6.	-.0646	-.2910
7.	2.3251	-.1936
8.	2.5507	.3848
9.	-.1188	.1163

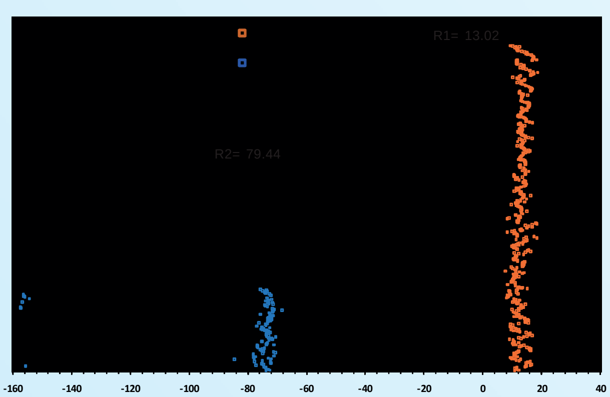


Fig. 3: Distribution of epicentres on Discriminant function line

First order Seismic Microzonation of Jammu City using Strong Motion Data(OLP-0340, Part B)

P.K.S. Chauhan, Y. Pandey, Abha Mittal, S. Karthigeyan and Team

Himalayan region is one of the most active seismic zone of the world. Jammu is very important city and winter capital of the State J&K. Jammu is situated on the bank of river Tawi in the southern part of J&K state. It is a fast growing city located in foothill zones of Himalaya. Jammu city lies in between Himalayan Frontal Thrust (HFT) and Main Boundary thrust (MBT). As such Jammu city lies in Zone IV on Seismic zoning map of India. It has been rocked by 23 major earthquakes in between 1828 to 2005 of magnitude 6.0 or more. These includes the earthquakes 1552 (Ms 7.5); 1554 (Ms 7.7); 1662 (Ms 7.5); 1784 (Ms 7.3); 1778 (Ms 7.7); 1884 (Ms 7.3); 1885 (Ms 7.0); 1905 (Ms 7.8) Kangra earthquake and recent one 2005 (Ms 7.6) of Muzaffarabad, Pakistan. During Muzaffarabad Earthquake 8th October 2005 (magnitude 7.6) Jammu City and the adjoining area has suffered major damage to the Buildings. These include Heritage Buildings as well as other structures including few buildings of Jammu University. Before the commencement of the project, no Strong Motion Network was placed in the Jammu city.

Fig. 1: Locations of SMA stations in Jammu

Seismic microzonation is an exercise carried out on hazard or risk estimation on smaller spatial scales like city blocks. For the preparation of the seismic microzonation map for the Jammu city it is very much required that we should have a good understanding of neotectonic activity, seismicity and site characteristics of this region. These are some of the inputs for the preparation of seismic microzonation map. Microzonation provides the basis for site-specific risk analysis, which can assist in the mitigation of earthquake damages. In most general terms, seismic microzonation is the process of estimating the response of soil layers under earthquake excitations and thus the variation of earthquake characteristics on the ground surface.

For site characteristics studies in the region we are using strong motion accelerographs. This study has to be conducted at different pre selected sites in Jammu City. The entire region has been divided into small regular grids and the data has been collected at these grid points. This data has to be processed using spectral techniques (Nakamura, 1989). In the first year we have established four station network in Jammu City (Fig. 1). During this period few earthquakes have been recorded by the SMA network (Fig. 2). The microtremor data has been collected from some locations and analysed for computation of natural ground frequency and amplification.

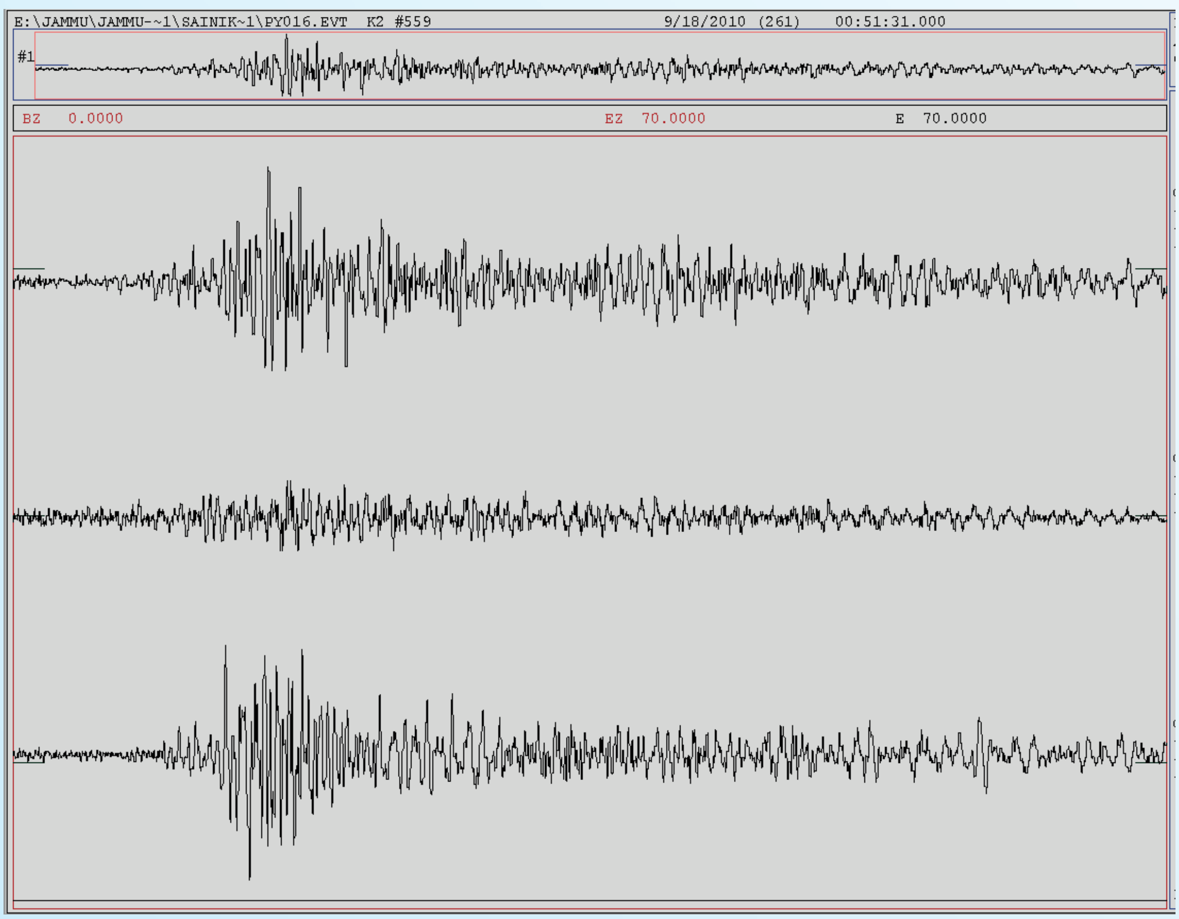


Fig. 2: Hindukush Earthquake, Date: 18 September 2010 Mw=6.2, Source: GS-NEIC

Investigation-Characterization & Slope Stability Analysis of Landslide on Chamoli-Joshimath Road for Development of Early Warning System (EWS) (GAP-0069)

Y. Pandey, D.P. Kanungo, P.K.S. Chauhan and S. Sarkar

This Project was a collaborative project between CBRI & Defence Terrain Research Laboratory (DTRL), Delhi, a DRDO Institute. The basic objective of the project was to understand the composition of the slope and triggering mechanism of the landslide in case of intense rains.

Under this study, an attempt was made to interpret the surface behaviour/movement patterns of Tangni landslide, near Garudganga on Rishikesh-Badrinath highway, based on Total Station data. The precise geographic location of the landslide is Lat 30° 27' 54.3" N and Long 79° 27' 26.3", at an elevation of 1524 m (Fig.1).

Fig.1: Tangni Landslide on Chamoli Joshimath Road

The rocks in the landslide area mainly comprise of dolomites. The rocks are well jointed with bedding planes dipping 35° towards North. The present landslide is a rock slide with planar mode of failure at the right flank and debris slide along a drain on the left flank with respect to the direction of landslide.

A contour map was prepared on 1:500 scale with 1 m contour interval to know the topography/morphology of the slide area so that the locations of observation markers and permanent station for total station monitoring could be planned. 100 numbers of Observation Markers were installed to monitor the surface movements periodically from a Permanent Station. Automatic Rain Gauge was installed on the roof top of a nearby house for continuous rainfall data collection. Monthly rainfall data is shown in Fig.2.

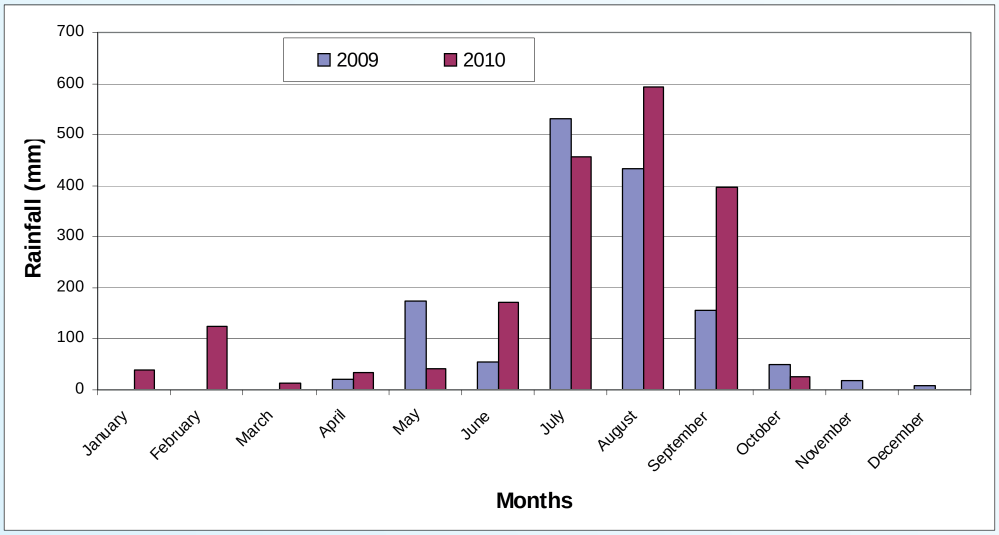


Fig.2: Monthly Rainfall at the Landslide site during 2009-2010

The daily rainfall data during August and September 2010 confirmed that there was a cloud burst with heavy precipitation (121.4 mm) in the area during 17th-18th September, 2010.

The surface movements of the 100 Observation Markers on the landslide body were monitored during July -November 2010. Considering July 2010 as the reference observation, the change in sloping distance of each Observation Marker with respect to the Permanent Station was analysed (Fig.3). It was observed that the maximum extent of surface movement occurred during July-September as compared to that during September-November. Further, by analyzing the surface movement along individual Observation Marker, a zone could be identified on the landslide body where there was considerable extent of surface movement during the study period (Fig.4).

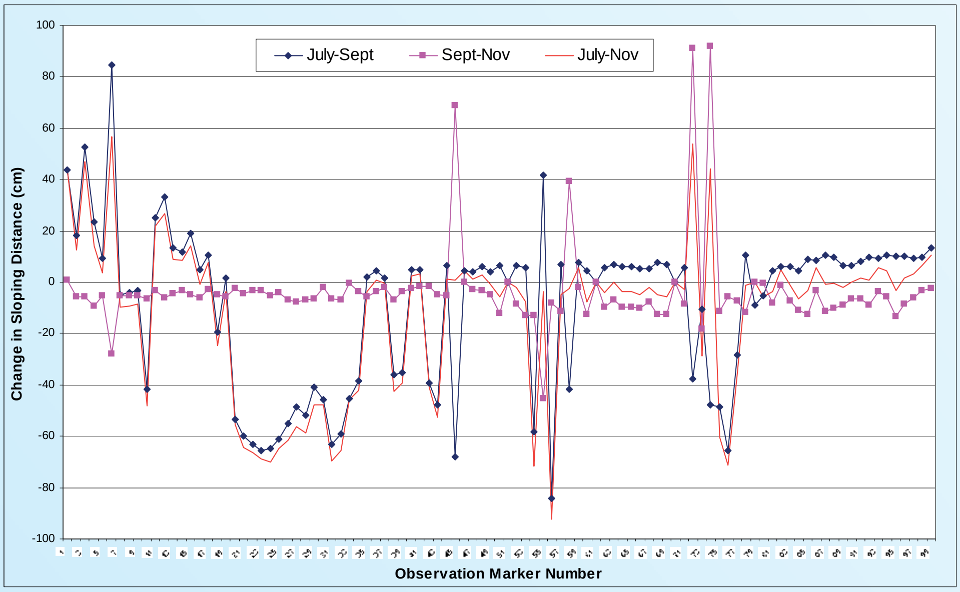


Fig.3: Surface Movement Data Recorded at the Landslide during July-November 2010

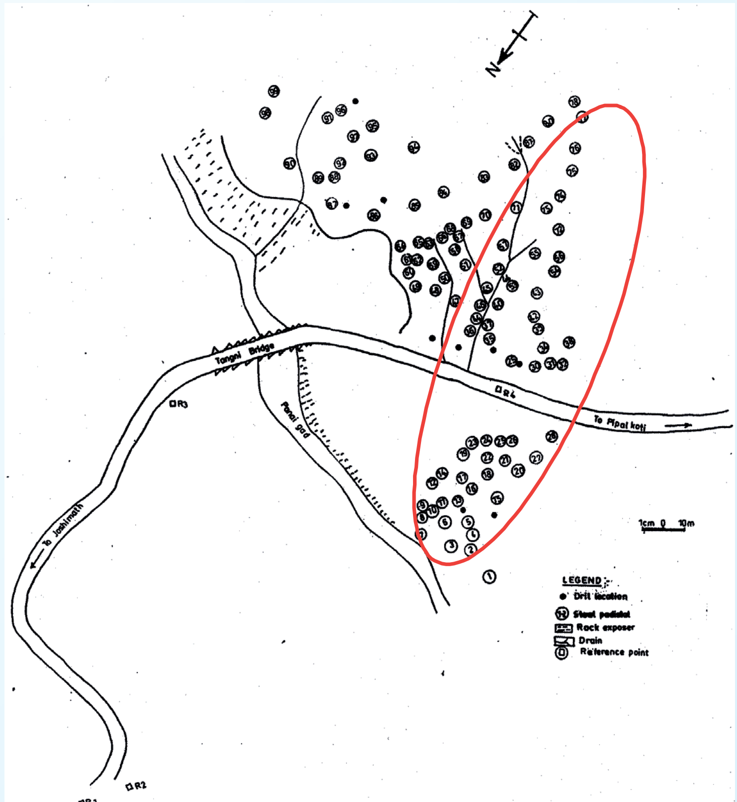


Fig.4: Zone of Considerable Surface Movement

Fire Retardant Compositions for Building Materials

Toxic Combustion Products from Cellulosic Materials and their Minimization (OLP-334, Part-A)

N.K. Saxena and Team

Various natural and synthetic polymer lining materials such as cellulose and its derivative, PVC, Polyurethane foam, laminates and composite etc. are used in building for diverse applications. In the event of fire these materials produce copious amount of smoke and toxic combustion gases causing hindrance in protecting life due to physical in capacity and reduced visibility. It is well known that most of fire deaths are caused by suffocation and in hailing of toxic combustion products. To achieve fire retardancy different compositions based on organophosphorous and halogenated compounds are reported in literature. A few of them exhibit good fire retardancy; however, they enhance generation of smoke and toxic combustion products.

To reduce burning characteristics of cellulosic lining materials, few fire retardant chemical compositions based on inorganic phosphate, borates, and amides are studied. Specimens of fiber boards, cotton fabrics and particle boards were treated with these compositions. Effect of ratio of ingredients, chemical retention, reaction temperature and duration of reaction on fire performance was studied.

Burning characteristics such as flame spread, after glow combustion, smoke generation, and heat release rate of treated and untreated specimens were evaluated using international standards. The evaluation of different combustion products such as Carbon dioxide, Carbon monoxide, Formaldehyde, Nitrogen oxide, Hydrogen cyanide, Acrylonitrile, Phosgene, Sulphur dioxide Hydrogen sulphide, Hydrogen chloride, Ammonia, Hydrogen fluoride, Hydrogen bromide and Phenol were determined with different compositions. The toxicity index of treated and untreated specimens was determined following standard procedure.

It is observed that few studied compositions are found quite effective in reducing the burning behavior of specimens, preventing smoke and toxic combustion products. Results are given in Tables 1-3.

Table 1: Burning Studies on Cotton Fabrics

Standard Method used	BS:3119			ASTM E-662	NES-713
Compositions	After Flame, (Sec.)	After Glow, (Sec.)	Char Length, (Cm)	Specific Density of Smoke	Toxicity Index
Phosphate-Borate	0	0	4.80	22.5	1.816
Phosphate-Amide	0	0	5.60	28.2	1.849
Phosphate-Amide-UF-Resin	0	0	5.20	30.8	1.868
Phosphate-Copolymer	0	0	4.6	230	2.327
Control	6 - 8	280 - 300	31.0	148	2.160

Table 2: Fire performance of Fiberboard as per ASTM D 1360

Compositions	After Flame,Sec.	After Glow,sec.	Char Vol.,cc
1. Phosphate-Boron Salts	0	0	32.60
2. Phosphate-Zinc-Boron Salts	0	0	40.20
3. DAP-Amide-DMDHEU	0	0	36.50
4. Untreated	16	Contd.	540

Table 3: Fire performance of coatings on Fiber Board

Standard Method used	ASTMD1360			ASTM E-662	NES 713
Compositions	After Flame Sec.	After Glow, sec.	Char Volume cc	Max. Spec. Optical Density, Dm	Toxity Index
Non intumescent Coating	0	0	51.20	172.4	3.453
Intumescent Coating	0	0	NIL	46.0	1.982
Control	16	Contd.	540	310	3.448

Rigid Foam Insulation Boards with Reduced Combustion Products (OLP-334, Part-B)

Harpal Singh and Sunil K. Sharma

Insulation boards are also very much used to keep buildings heating and cooling in check. Several insulation boards such as mineral wool, cork, wood fiber, softwood etc. are available but rigid foam insulation boards are superior due to its attractive properties such as high insulation value, insensitivity to moisture, ease of mounting and maintenance as well as neat general appearance. However, on burning rigid foam insulation boards undergo thermal decomposition and produce dense smoke containing highly toxic gases such as carbon monoxide and hydrogen cyanide. One of the surest ways of minimizing smoke and toxic combustion products is to render rigid foam insulation boards fire retardant.

A chemical formulation for rigid foam insulation board was prepared based on the polyether polyol and diisocyanate along with catalyst, surfactant, chain extender and blowing agents. Nitrogen (ME), phosphorus (TPP) based and carbon rich (EG) fire retardant additives alone and in combinations were incorporated during its preparation. The additives optimum loadings are presented in Table 1. The density of control and additives filled insulation boards was measured according to ASTM D1622. Specimens were conditioned at 25°C and 55% relative humidity for 48 hours prior to their density measurement. The average value of five specimens per sample is shown in Fig. 1. The density of the samples increases as the loading of the fire retardant additives increases. The morphology of control and additives filled samples was observed with scanning electron microscopy (SEM). The samples were cryogenically fractured in order to expose the fresh cells which remain unaltered by the cutting process and gold coated to render them conductive prior putting under scanning observation. During scanning 15-kv accelerating voltage was used to avoid the degradation of the samples. Micrographs of control and additives filled samples are shown in Fig. 2 (a,b,c) which show the spherical and polyhedral closed cell structure. Micrographs of ME-TPP and EG-TPP filled samples show that ME particles and EG flakes are properly dispersed and intercalated into the matrix respectively. Elemental analysis was carried out with CHNS analyzer and EDX to detect the qualitative and quantitative presence of elements introduced into the matrix of the samples by the additives incorporation. The elemental analysis results of control sample shows the presence of Carbon, oxygen, hydrogen and nitrogen which are part of the backbone. Additives filled samples exhibit the introduction of phosphorus and increased nitrogen and carbon percentages. The elemental analysis results are presented in Table 2. Thus the introduction of phosphorus and enhanced percentage of nitrogen and carbon show that samples are properly filled with above additives. The fire performance of additives added rigid foam boards and comparison with control samples was carried out as per BS: 4735 and ASTM D2863. The results show that EG-TPP combination is very effective to render rigid foam boards fire retardant. EG-TPP combination is more effective than ME, ME-TPP and EG. The overall results are shown in Table 3. Smoke density was measured as per ASTM E662 in flaming and non-flaming mode. Samples incorporated with EG generate less smoke in non-flaming mode than flaming mode. The results show the significant reduction in the smoke generation of rigid foam boards filled with ME, ME-TPP, EG and EG-TPP than the control samples under flaming and non-flaming mode. The results of control and additives added rigid foam boards under flaming and non-flaming mode are presented in Table 4.

Table 1: Fire retardant additives and optimum loadings

Fire retardant additives	Optimum loading, (%)
ME	40
ME-TPP	60-10
EG	30
EG-TPP	40-10

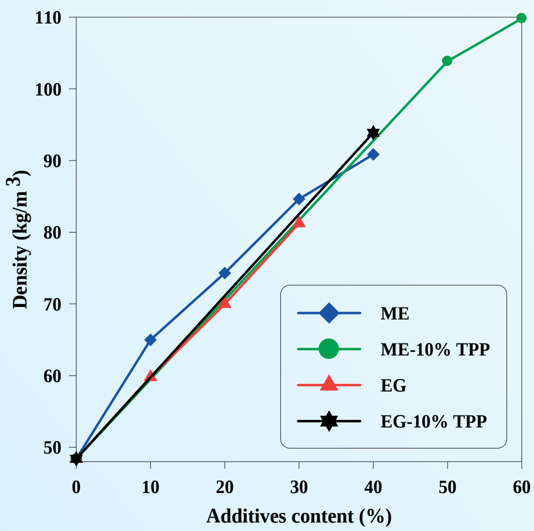


Fig.1: Effect of additives loading on the density of rigid foam board

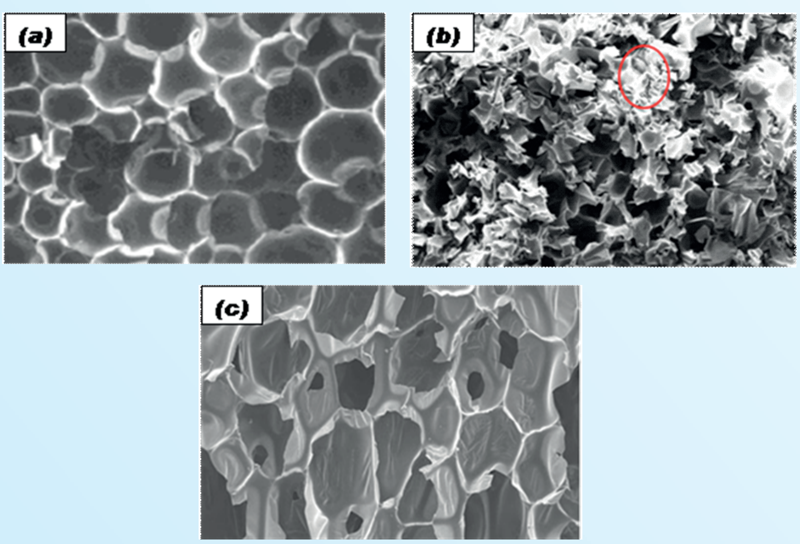


Fig.2: Micrographs of rigid foam boards: (a) Control, (b) ME-TPP filled, (c) EG-TPP filled

Table 2: Elemental analysis of control and additives added rigid foam boards

Sample codes	C(%)	H(%)	O(%)	N(%)	P(%)
RFB-C	55.15	5.67	34.14	5.05	-
RFB-ME	53.05	5.94	10.04	30.97	-
RFB-ME-TPP	44.78	4.87	17.98	24.13	8.24
RFB-EG	80.65	5.20	9.35	4.80	-
RFB-EG-TPP	76.18	4.11	6.87	4.01	8.83

Table 3: Fire performance of control and additives added rigid foam boards

Samples	Optimum loading, (%)	Extent burnt, (mm)	Burning rate, (mm/s)	Mass loss, (%)	Oxygen Index, (%)
RFB-Control	-	125	2.23	100	17.8
RFB-M	40	24	0.30	5.91	24.6
RFB-M-TPP	60-10	15	0.20	5.10	26.1
RFB-EG	30	11	0.18	4.80	26.9
RFB-EG-TPP	40-10	9	0.15	4.20	27.2

Table 4: Smoke generation of control and additives added rigid foam boards under flaming and non flaming mode

Smoke Density (Ds)	Maximum smoke time (min)	Control	ME	ME-TPP	EG	EG-TPP
Flaming mode						
	8	34.82				
	19				14.19	17.02
	20		19.87	25.39		
Non-flaming mode						
	7	5.98				
	18				2.48	
	20		3.15	3.82		2.99

Fire Retardant Compositions for Reduced Heat release from Lining Materials (OLP-0334, Part-C)

A.A. Ansari

Generally wood and wood based materials are combustible, easily ignitable, can propagate heat and flame spread, produce dense smoke in fires. These materials can be used in buildings as lining materials in spite of their inferior behavior in fire. To render them flame retardant, we studied & prepared a new Fire retardant (FR) chemical coating which not only improves the flame retardancy of these materials but also makes them the product with low heat release.

A fire can basically be split into three phases, the initiating fire, the fully developed fire and the decreasing fire. The fire starts with an ignition source setting combustible material on fire. The fire spreads, heats up the surroundings and once the materials in the room have formed enough flammable gases and are sufficiently hot, flashover takes place and the whole room is engulfed in the fire. This is the start of the fully developed fire. The fire will later decrease as the available fire load is consumed by the fire or if the fire occurs in a totally closed room the fire can decay because of oxygen deficiency.

The fundamental parameters governing a fire are:

Combustibility: Will a material burn?

Ignitability: If it is easily ignitable, how and when will it ignite?

Spread of flame: Once ignited, how quickly will the flames spread over the surface?

Heat release/ Fire Propagation Index: What will be the rate and total amount of heat released or how much is contribution of heat towards development and propagation of fire in terms of Fire Propagation Index?

Smoke generation: Smoke development and visibility reduction which hinders escape in case of smoke filled fire.

FIRE RETARDANT TREATMENT

Chemical FR coatings are chemicals which are added to combustible materials to render them more resistant to ignition. They are designed to minimize the risk of a fire starting in case of contact with a small ignition source. If the flame retarded material or an adjacent material has ignited, the flame retardant will slow down combustion and often prevent the fire from spreading to other items. Flame retardants are necessary to ensure the fire safety of a wide range of materials including wood products. These materials are e.g. used in parts of buildings as false ceiling, wall linings, partitions and building components.

Chemical FR coating can be applied to many different combustible materials to prevent a fire or to delay its start and propagation by interrupting or hindering the combustion process. They thus protect lives, property and the environment.

Chemical FR coatings contribute to meeting high fire safety requirements for combustible materials and finished products prescribed in regulations and tests.

By chemical and/or physical action, flame retardants will inhibit or even suppress the combustion process. They interfere with combustion during a particular stage of this process, e.g. during heating, decomposition, ignition or flame spread.

The most effective chemical action may take place by:

Reaction in the gas phase: The radical gas phase combustion process is interrupted by the flame retardant, resulting in cooling of the system, reducing and eventually suppressing the supply of flammable gases.

Reaction in the solid phase: The flame retardant builds up a char layer and shields the material against oxygen and provides a barrier against the heat source (flame).

The less effective physical action may take place by:

Cooling: Energy absorbing (Endothermic) processes triggered by additives and/or the chemical release of water cool the substrate to a temperature below that required for sustaining the combustion process.

Formation of a protective layer (coating): The material is shielded with a solid or gaseous protective layer and protected from heat and oxygen necessary for the combustion process.

Dilution: Inert substances (fillers) and additives evolving non-combustible gases dilute the fuel in the solid and gaseous phases.

CHEMICAL FR COATING

Wood and wood based lining materials, has a wide range of applications as a construction material as it is or in the form of Plywood, medium density fibre board, pulp board, paper board, fiber board, chip board, wood wool board etc. Among the wood based boards, plywood are considered to be the "combustible" boards mainly due to their low density. Untreated insulating plywood do not fulfill the requirement of minimum fire safe requirements for these boards in wall and ceiling applications.

A chemical FR coating was prepared using amine, amide and aldehyde solution in certain molar ratio.

The specimens samples of 12 mm thick Plywood were coated by brush on the surface and cured at 60°C in an oven and finally in the sun light to characterize them for Heat release studies. The formulation gives a clear finish after treatment and curing and provides a shine to the surface. The dry loading after the treatment was 0.3 Kg/m^2 for 12 mm thick Plywood.

HEAT RELEASE (ISO: 5660)

Heat Release studies carried out on untreated Plywood specimens and FR Plywood treated with chemical FR coatings by using Dual Cone Calorimeter as shown in Fig.1. Oxygen-consumption-principle-based cone calorimeter testing is a useful small-scale test capable of determining most of the important parameters for identifying fire hazard. In this study, tests were conducted on the cone calorimeter according to the ISO5660 standard test method. The specimens of untreated Plywood and FR Plywood are exposed to an incident radiant flux of 30 kW/m^2. Directly measured properties include; Heat Release Rate, Time to Ignition, Mass Loss Rates, Smoke Release Rates, Effective Heat of Combustion, Rate of Release of Toxic Gases(e. g. carbon monoxide, carbon dioxide).

The specimens of Untreated Plywood and FR Plywood are exposed to Dual Cone Calorimeter as per standard condition. The view of the Untreated Plywood and FR Plywood before and after exposure to Dual Cone Calorimeter are shown in Fig 2 & 3. The time-heat release rate curves for untreated Plywood and specimens of FR Plywood are shown in Fig 4.

The heat release rate (HRR) for the specimens of untreated Plywood obtained is 144.510 kW/m^2 while for FR Plywood is 25.925 kW/m^2, which shows that the reduction in heat release rate is 82 % less than that for untreated Plywood. Also the total heat release and mass loss rate reduced to 76 % & 41 % respectively while total smoke release is reduced to 77 %. Hence the FR coating applied to Plywood is effective in making the product of low heat release.

Fig. 1: Dual Cone Calorimeter

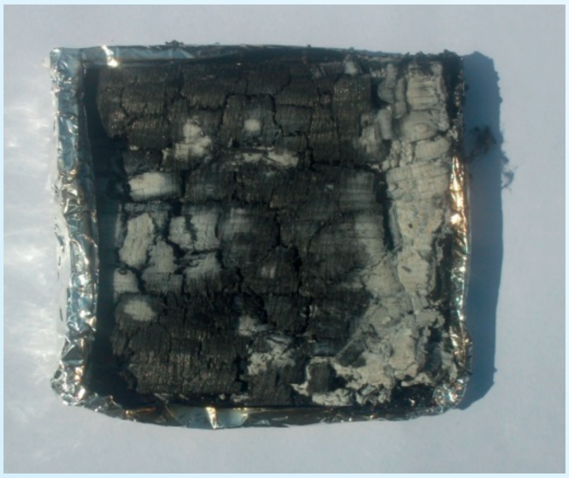
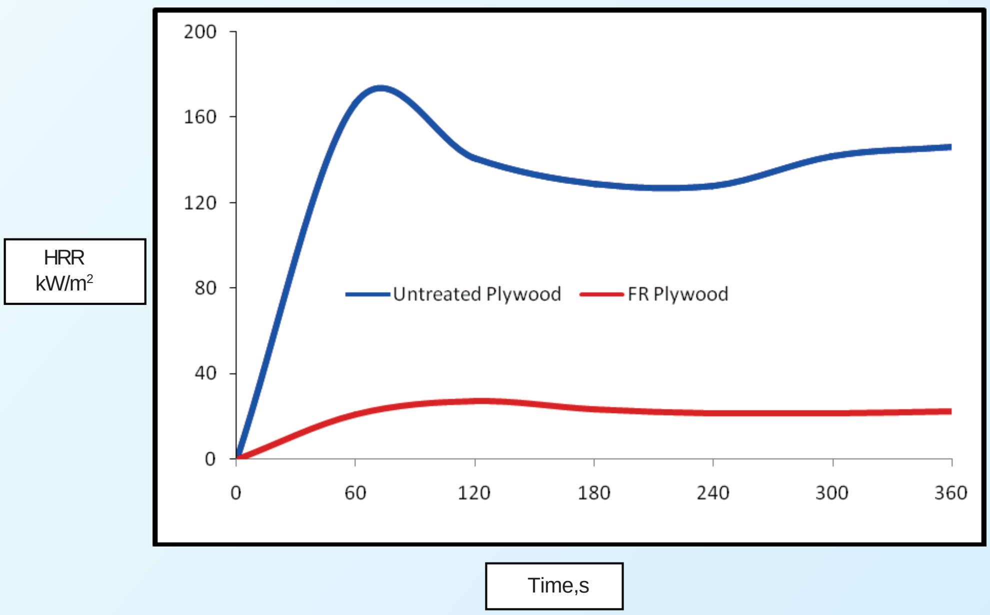


Fig. 2: Untreated Plywood before & after exposure to Cone Calorimeter

Fig. 3: FR Plywood before & after exposure to Cone Calorimeter



Network Projects

Network Projects

Engineering of Structures against Natural and Other Disasters-Area - Landslide Monitoring and Remedial Measures of a Potential Landslide Slope on Rishikesh-Uttarkashi Road (NH 94), Uttarakhand Himalaya (NWP-039)

A. Ghosh, S. Sarkar, D.P. Kanungo, S.K. Jain, Dalip Kumar and Zameer Ahmad

An unstable slope situated at Agrakhal along Rishikesh - Uttarkashi highway (NH 94) having few houses, which were under distress, was studied to arrive at suitable control measures. The slope has undergone subsidence at the road level and there are few houses down the road level which have developed major cracks. The study was focused on identification of causes, assessment of slope stability and suggestions for control measures. The study involved geological and geotechnical investigations, slope stability analysis and monitoring of movements.

Slope Monitoring

There are six houses on the slope which have shown distress manifested by development of cracks on the walls and floor subsidence. A monitoring scheme was planned to monitor the horizontal and vertical movements of these houses using Total station from a far distance outside the unstable zone. Fixed points were installed as observation points on roof top of the six houses. A stable zone based on field observation was identified at a distance of 800 m from the unstable slope. The reference point was made at this location from where all the observation points could be seen without any hindrance (Fig. 1). The movement data were collected for the period August 2009 to June 2011. The horizontal and vertical movements of the observation points were calculated from the periodic monitoring data. The movement data is shown in the Fig. 2. An automatic rain gauge was installed at the site to collect rainfall data. The monthly rainfall data is shown in the Figure 3. The rainfall data shows that in the monsoon period of 2009, the maximum rainfall was only 232 mm in the month of September. While in the year 2010

(a)

(b)

Fig. 1: (a)Houses being monitored and (b)position of Total Station and target

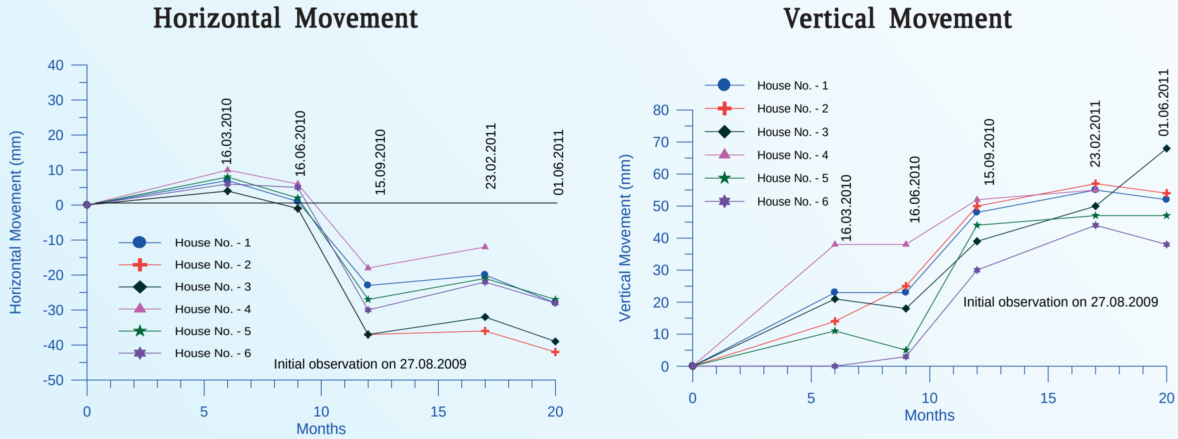


Fig. 2: Horizontal and vertical movements

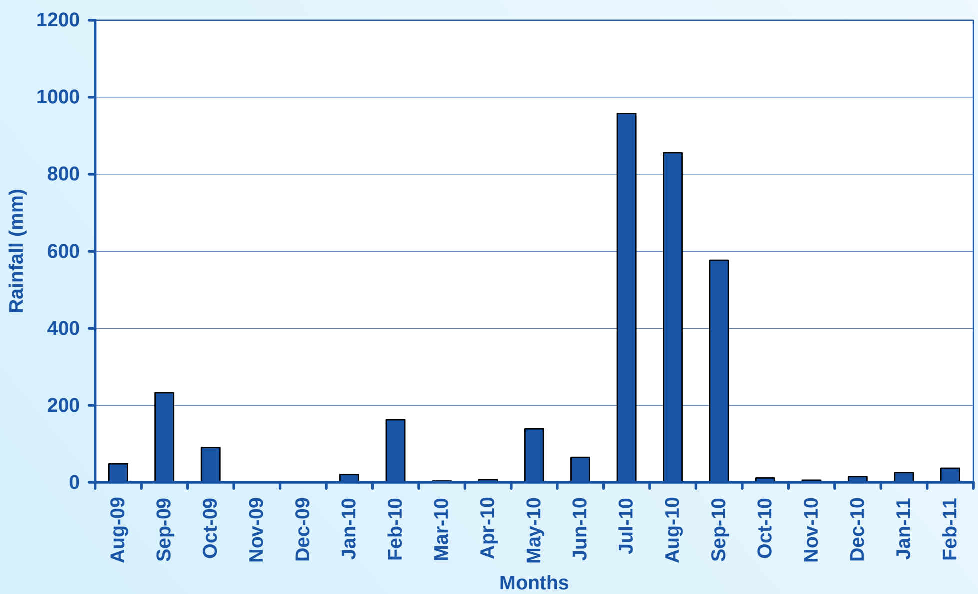


Fig. 3: Monthly rainfall data

there was a heavy rainfall during July to Sept. and rainfall of 950 mm was recorded for the month of July only.

The observation points of the six houses show varied vertical and horizontal movements. In case of vertical movement, the house no 4 shows a vertical movement of 40 mm from August 2009 to March 2010 while the house no 6 shows negligible vertical movement during that period. There is no considerable movement during March 2010 to June 2010. A considerable movement varying from 15 mm to 35 mm is shown by all the houses during June 2010 to September 2010. The movement data when compared with the rainfall data, it was found that the sudden increase of vertical movement during June to September 2010 can be well explained by the heavy rainfall during that period. During September 2010 to February 2011 there is not much movement. However, it can be inferred from the figure that all the houses have shown movements of a similar trend. When considering the horizontal movement the total maximum movement of 40 mm during the total monitoring period is shown by the house no 2. The house no 4 has shown the least horizontal movement of 18 mm. In this case also maximum movement was observed during the heavy rainfall period of June 2010 to September 2010. Hence, the movement monitoring data of the last two years has shown a cumulative vertical movement of 38-68 mm and cumulative horizontal movement of 20 to 40 mm. The monitoring study is being continued to assess the vulnerability of these houses against the slope instability.

Control Measures

A detailed geological and geotechnical study was carried out to arrive at a suitable control measures. Since the prime cause of the slope instability is the sub-surface water seepage and the local geological condition, drainage measures was suggested. The general observation of the site revealed that the movement of the slope so far observed is mostly restricted during the rainy season, it is felt that proper drainage network is desired to be made to divert the surface flow of water to the central drain through the proposed radial drains. This will reduce the generation of excess pore pressure in the slope and consequently the effect of subsurface saturation manifested as slope movement will also reduce. In nutshell the slope will be stabilised against heavy rainfall at site. Along with drainage measures few retaining walls were also suggested to provide support at active portion of the slope. The scheme of landslide measures is shown in the Fig. 4.

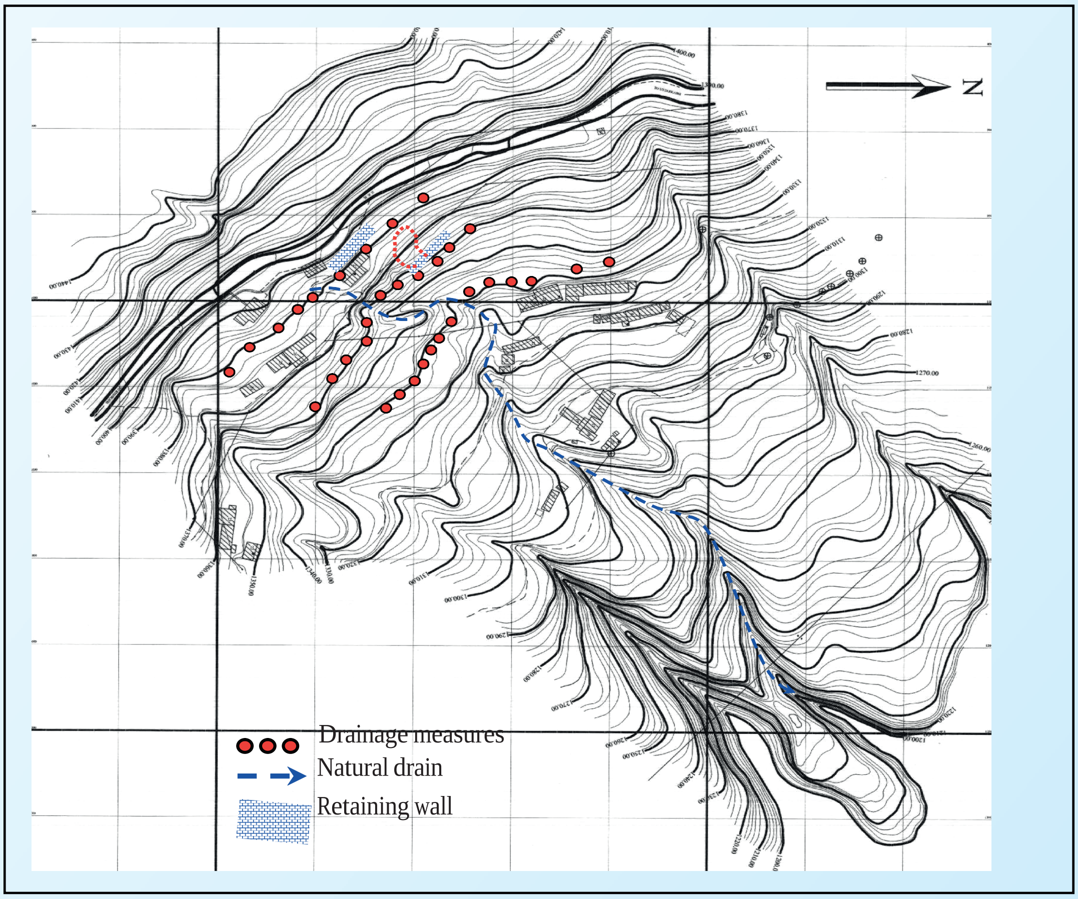


Fig. 4: Scheme of suggested control measures

Advancement in Metrology (NWP-0045)

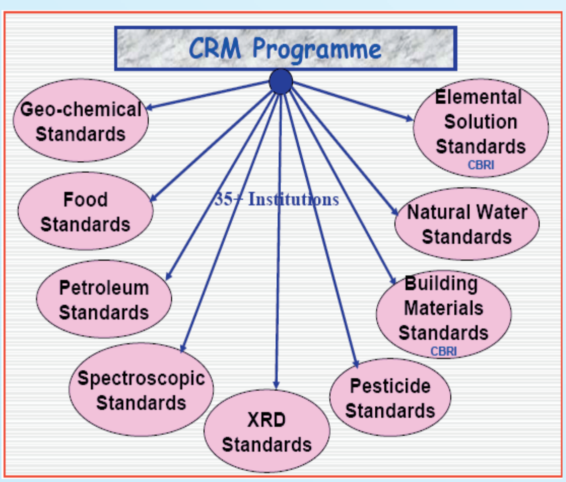
A.K. Minocha, Jaswinder Singh and Vivek Sood

Indian Priorities in Chemical Metrology

In the present scenario of globalization of economy, use of Certified Reference Materials (CRMs) in measurements has become essential for global acceptance of products and test reports. Use of certified reference materials ensure high quality in measurements and provide trace ability to the analytical measurements with national/ international measurement system (SI unit). These fulfill a mandatory requirement of all international level quality systems (ISO/IEC guide 17025 and ISO 9000) including our national accreditation body. National Accreditation Board for Testing and Calibration Laboratories (NABL).

A large number of certified reference materials are being required in India for quality control in industries and accredited laboratories. National Accreditation Board for Testing and Calibration Laboratories (NABL), India is granting accreditation to the laboratories in various areas including chemical testing as per ISO.IEC 17025 guidelines. Demand of the CRMs in the country is increasing tremendously due to increase of the awareness of quality system in the country and the activity of the NABL A national inter laboratory programme on preparation and dissemination of certified reference materials is being coordinated by National Physical Laboratory to meet the demand of CRMs in the country. A network of the 20 reputed laboratories of the country had been created to prepare the CRMs required in various sectors including environment, health, power and industries. Certified reference Materials prepared under this programme are christened as Bharatiya Nirdeshak Dravyas or Indian Reference Materials or BNDs in short.

Presently, these BNDs are being widely used in the all sectors of science and technology including environment, health, agriculture and industries for quality assurance. Various analytical equipments e.g. atomic absorption spectrometers, inductively coupled plasma emission spectrometers, inductively coupled plasma mass spectrometers, ion chromatographs, gas chromatographs, HPLC, UV visible spectrometers etc are being calibrated and analytical methods are also being validated by their use to generate precise and accurance measurement data.



Bharatiya Nirdeshak Dravyas

Mono-elemental Solutions

S.No.	Code No.	Material and Certified Concentration	Unit
1.	BND 101.03	Lead in water : 1.00 ± 0.02 mg/l	60 ml
2.	BND 102.03	Lead in water : 2.01 ± 0.02 mg/l	60 ml
3.	BND 201.03	Cadmium in water : 1.00 ± 0.02 mg/l	60 ml
4.	BND 301.02	Arsenic in water : 1.00 ± 0.02 mg/l	60 ml
5.	BND 401.02	Chromium in water: 1.00 ± 0.02 mg/l	60 ml
6.	BND 402.02	Chromium in water : 2.0 ± 0.02 mg/l	60 ml
7.	BND 601.02	Mercury in water :1.00 ± 0.02 mg/l	60 ml
8.	BND 701.02	Selenium in water : 1.00 ± 0.02 mg/l	60 ml
9.	BND 801.02	Fluoride in water :1.00 ± 0.02 mg/l	60 ml
10.	BND 901	Nitrate in water :49.94 ± 0.48 mg/l	60 ml
11.	BND 1001.02	Nickel in water : 1.01± 0.02 mg/l	60 ml
12.	BND 1201	Zinc in water : 1.01 ± 0.02 mg/l	60 ml
13.	BND 1301	Iron in water :1.00 ± 0.02 mg/l:	60 ml
14.	BND 1401	Copper in water : 1.01 ± 0.02 mg/l	60 ml
15.	BND 1801	Calcium in water : 50.24 ± 0.42 mg/l	60 ml
16.	BND 1901	Manganese in water :1.01 ± 0.02 mg/l	60 ml

CSIR Techno Fest 2010

The CRMs prepared under this task will be easily available to the Indian users at a reasonable cost for improvement of the quality of measurement and products.

CSIR-800 RSWNET Project on Dissemination, Training and Demonstration of Rural Housing Technologies (RSP-0003)

S.G. Dave and Team

The CSIR- Central Building Research Institute (CBRI), Roorkee implemented a CSIR- 800-RSWNET Project on 'Dissemination, Training and Demonstration of safe, healthy and durable housing technologies so as to improve housing and living conditions of the rural masses and enhance the skills of local artisans and construction workers through mass awareness programmes, training programmes, on-site demonstrations and entrepreneurship development in rural areas of the country.

The Project activities were mainly focused on 4 A's:

- **Awareness:** through **Exhibitions, Get-to-gathers, Seminars,**
- **Acceptance:** for building confidence of the rural masses, artisans and field engineers through **live demonstrations and on-site model constructions.**
- **Application:** through promotion of entrepreneurs, production centers & NGOs and by developing trained & skilled manpower and artisans locally and
- **Absorption:** supporting Mass Scale Construction by adoption of innovative materials and durable technologies.

During this period, the training and live demonstration programmes were mainly focused in Himalayan region imparting training to Block and field Engineers, and skilled construction workers. While the activities for Mass Awareness, Dissemination and Exhibitions were aimed to reach to as many people as possible and were widely spread over the vast geographic areas of the country.

The technologies were discussed and presented on many platforms of Workshops, Seminars and Conferences and taken further down among the Professionals, Industrialists and Entrepreneurs. Technical exposure, Group visits and Vocational trainings were arranged for the consultants, professionals and technical students who represent new generation of engineers.

In the year 2010-2011, the institute organized

- 2 Trainings cum Demonstration programmes one at Sundernagar and another at Solan in the state of Himachal Pradesh
- 1 Entrepreneurship Development programme at Roorkee
- 1 Orientation programmes for the participants of Lok Avas Yatra beginning from Roorkee and undertaken in Northern region

Trainings cum Demonstrations programmes

The 2 trainings on Earthquake Resistant Rural Housings were jointly organized with Himachal Pradesh Council of Science, Technology and Environment, (HPCST&E) Shimla, organized for the rural and Panchayat Engineers and Mason artisans representing about 50 Blocks of the 2 commission division Mandi and Shimla of the Himachal Pradesh.

The training programmes were specifically designed keeping the requirement of hill housing in mind. Field level Block Engineers, Construction supervisors, practitioners and artisan masons were benefited from the trainings which mainly include topics like:

- Earthquake Resistant Technologies
- Prefabricated walling and Roofing elements
- Innovative Building Materials using local resources and wastes.
- Quality control in Housing constructions
- Improved mud and Sanitation Technologies
- Rain Water Harvesting etc.

Live Demonstration includes:

- Correct method of providing vertical steel bars in brick masonry,
- Laying earthquake bands in buildings and mud houses,
- Bonds at corners and junctions of walls,
- Rattrap bond brick masonry,
- Fire and rain resistant thatch roof,
- C-brick machine and process,
- Precast RC plank and Brick panel systems of roofing,
- Concrete & stone masonry blocks and
- Two pit rural latrine & rural waste water disposal System.

Supra Institutional Project

Supra Institutional Project

High Performance Material and Construction Technologies for Sustainable Built Space (SIP-0029)

Development of Composite Resin Matrix

B. Singh, M. Gupta and Anamika Randhawa

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 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 $4x10^5$ Hz as compared to 10^7 Hz for chain extended hybrid network and 10^6 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.

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

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.

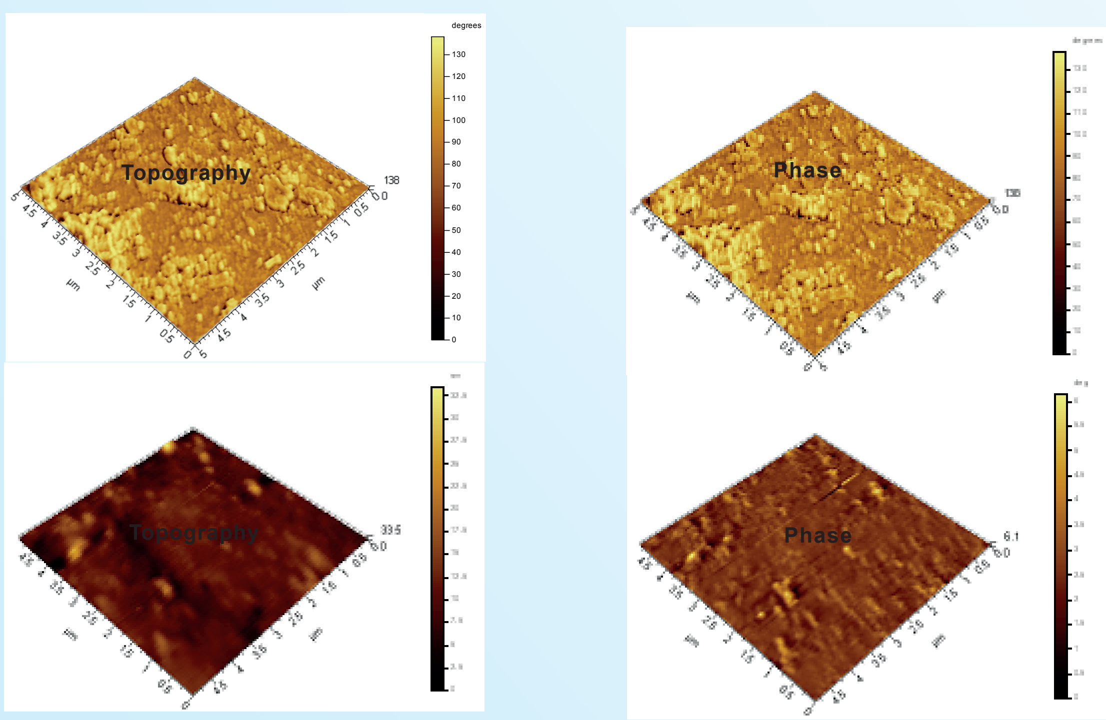
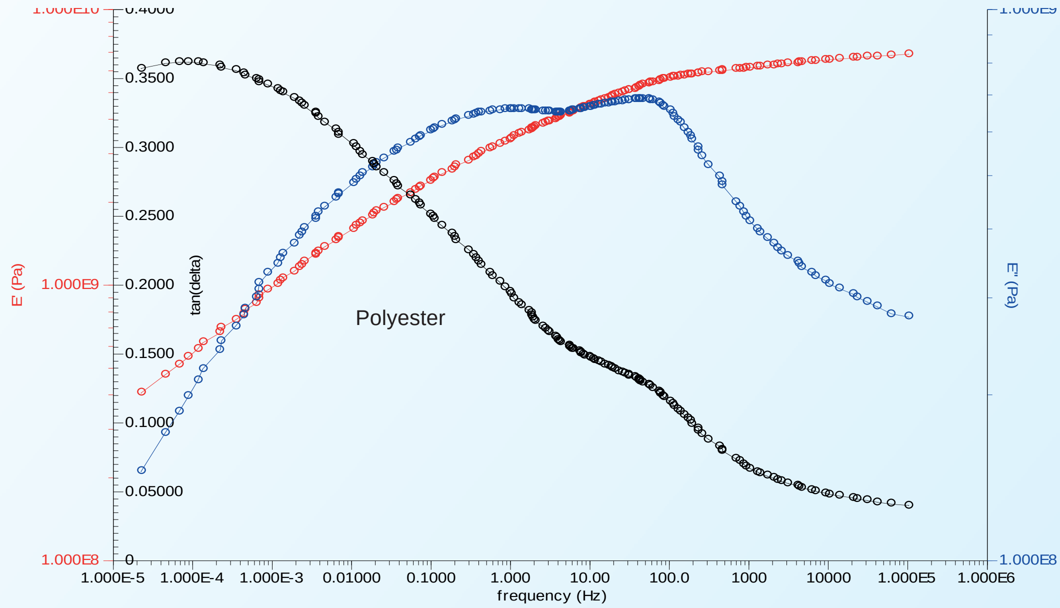


Fig 1: AFM images of unsaturated polyester resin and its networks



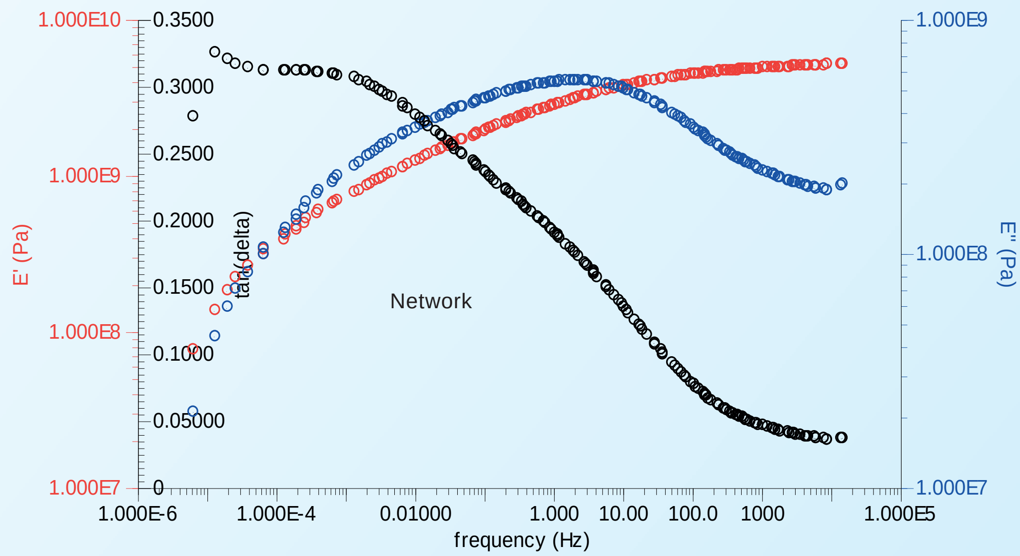


Fig 2. Time-temperature superposition curves of unsaturated polyester resin and its networks

Resin-Adhesives for Ligno-cellulosic Panel Products

Monika, Deepak Agarwal, Jeet Singh and M. Gupta

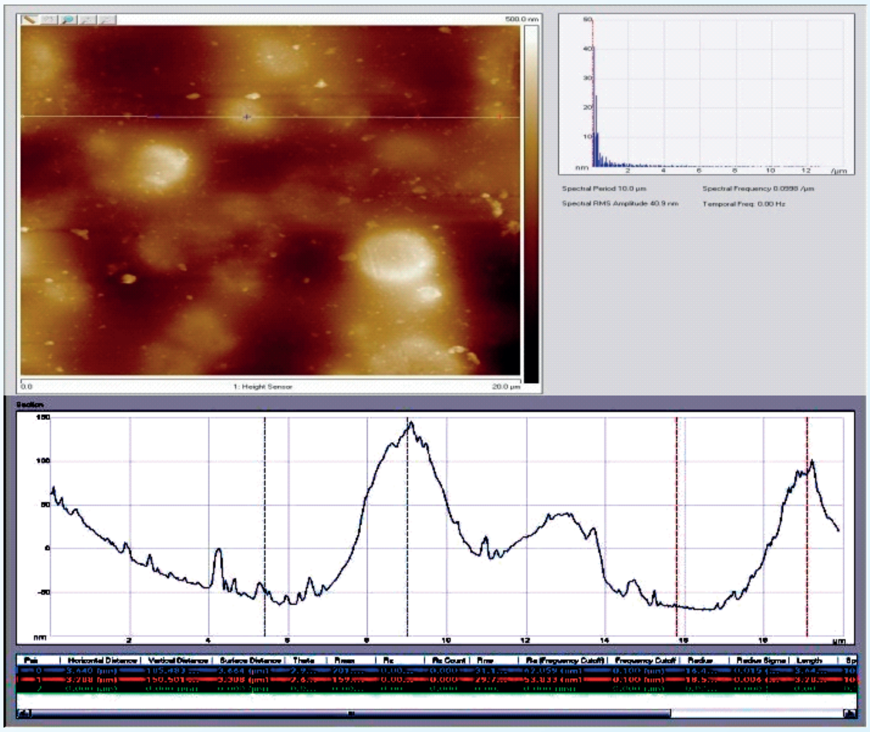
Isocyanate prepolymer (NCO content: 12-15%) was synthesized in the laboratory using 4-4'-diphenyl methane diisocyanate and polyols of different molecular weight aiming at to improve bonding with moisture containing ligno-cellulosics. It is expected that the developed adhesive can be used as an alternative to formaldehyde based resins in terms of its high resin spread, low dosage and good penetration into cell wall. An adhesive recipe was formulated with the help of synthesized prepolymer, bio-polymer, adhesion promoter and additives. Viscosity result indicates that difference in the flow behavior of various adhesive formulations at higher temperature was marginal showing their processing benefits during board pressing. The contact angle decreased with the increase of biopolymer concentration showing its superior wettability behavior. The polar component of surface-free energy of the developed adhesive (up to 20% biopolymer) was lower than the control supportive of its better compatibility with the substrate. Under peel adhesion, lattice squares are intact satisfying 5B criteria of ASTM D 3359. The pull off adhesive test was two times more than the parent system. Lap joint shear strength of the newly formulated adhesive was higher (17.13 MPa) than the basic resin adhesives (12.99 MPa). However, under wet condition, the reduction in shear strength was more in the case of modified adhesives Table 1.

Phase miscibility of constituents in the adhesives was examined for phases by AFM under topography and phase imaging mode (Fig. 1). The parent resin showed presence of white large sphere particles in the isocyanate matrix. Adding biopolymer in the isocyanate prepolymer results in an uniform surface morphology. Above 10%, the presence of large particle size of biopolymer was clearly seen showing existence of heterogeneous system. The sample was also examined under force-peak mode. The initial elastic modulus of sample was 2159 MPa while adhesion was 203 nN. Addition of biopolymer reduces adhesion to 99 nN at 5% level while elastic modulus was almost same. Subsequent increase of biopolymer at 20% level increases elastic modulus (2528 MPa) and adhesion (609 nN) substantially of the resulting adhesives system due to smaller grain size. The phase miscibility in the adhesive was also examined as a function of reaction time. As the reaction time increased, the grain size distribution becomes uniform. The height of grain substantially reduced from 185 nm for control to 27-50nm for newly formulated adhesives. The roughness of samples was also decreased from 52.9 nm for control to 7.37 nm for newly formulated adhesive.

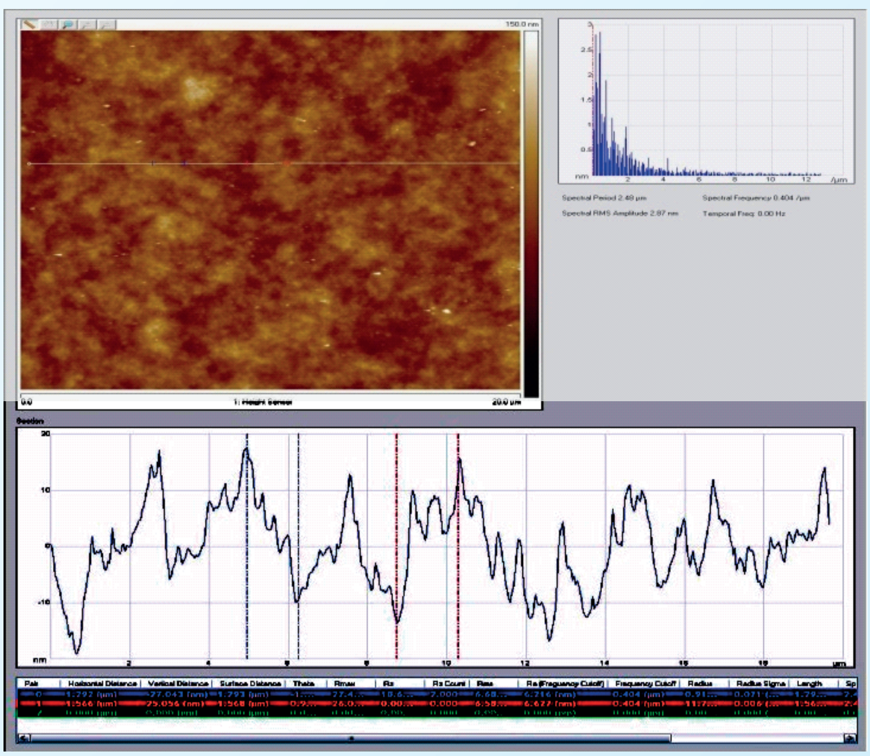
The composite boards made from processed pine needle furnishes and isocyanate prepolymer adhesive (3-7wt.%) were evaluated for their dimensional stability, flammability characteristics, biological resistance and thermo-acoustic properties. It was found that thickness swelling and linear expansion of the composite boards

Table 1: Properties of isocyanate based prepolymer adhesives

Biopolymer content (%)	Contact angle (0)	Surface free energy (mJ/m^2) Polar component	Peel adhesion (ASTM D3359)	Pull off adhesive strength (MPa) (ASTM D 4541)	Single-lap joint shear strength (MPa) (ASTM D1002)	
					Dry	% Strength reduction in wet condition
0	86.60	12.1	5B	2.31	12.99	4.77
3	82.30	9.5	5B	3.25	14.86	9.60
5	77.9	7.6	5B	4.64	17.13	13.30
10	73.2	11.1	5B	3.64	15.53	18.50
20	70.0	8.2	5B	3.52	13.20	35.83



Isocyanate prepolymer



Isocyanate Adhesive

Fig 1: AFM image of isocyanate prepolymer and its adhesive affected significantly by adhesive bond quality and recovery of compression sets under wet/dry cycle and humid condition for longer periods. Cone calorimeter results indicate that optimum flammability characteristics of needle furnish was obtained at the retention of 7.48 kg/m^3 fire retardant additive (~ 20 wt.%). When the board was tested as per BS 476, fire propagation index was 17.52 only indicatives of its slow growth of fire and the samples also belong to class I category according to surface spread of flame test. During natural decay test for 8 weeks, the composite boards treated with wood preservatives exhibited 4-8% weight loss compared to 9-13% for the untreated boards. The existence of low fungal hyphae and retention of treatments on the treated samples was confirmed by FESEM-EDAX. The loss of internal bond strength in both the treated and untreated samples exposed to fungus culture was in the range of 35 - 60% only. Termites caused ~6% less weight loss in the treated samples than the untreated samples showing their moderate resistance behavior. The thermal conductivity and sound transmission loss of samples were 0.13 W/mK and 26.51dB respectively showing their adequate insulation properties. Based on these results, it is concluded that pine needle composite boards with 5-7 % resin adhesive can be suitably used as wood particle boards/ panels in buildings.

Durability Studies of Geopolymer Pastes under Chemical Environment

Sarika Sharma, Deepak Agarwal, B. Singh and S.K. Bhattacharyya

Geopolymers have emerged as important engineering materials with the potential to form a substantial element of an environmentally sustainable construction and building products industry. With sufficient knowledge and understanding of raw material reactivity and chemistry, it is possible to tailor the products to attain combinations of the properties like high compressive strength, low shrinkage, good fire and acid resistance in optimization of both cost and technical performance.

The durability of geopolymeric pastes was studied under acid and sulphate environments in terms of microstructural evolution and strength properties. The paste was prepared from fly ash (80% passing on 45 µm sieve) and activator at different molar concentrations. The samples were immersed in 5% acid solutions (HCl and H_2SO_4), 5% sulphate solutions (Na_2SO_4, $MgSO_4$ and their combination) and also in deionized water for 120 days. The microstructure of the control samples exhibited smaller pore size (24.8 nm) and pore volume (8.83 x 10^{-3} cm3 / gm). The pore size distribution of pastes at different concentration is given in Fig.1. The alumino silicate gel was segregated above the optimized ratio resulting in the formation of cracks and fissures as viewed in the back scattered electron images. The unreacted ash particles were embedded in the gel structures. When samples exposed in sulphate solution, the color become darker and the weight change of the samples increases up to 90 days immersion and then slightly decreases with the subsequent exposures. It is found that compressive strength increased initially after 7 days immersion in $MgSO_4$ and Na_2SO_4 solutions possibly due to the modification of network structure by migration of cations from the solution. Upon subsequent exposure, the compressive strength decreases with the increase of exposure time. The loss in compressive strength of the samples was

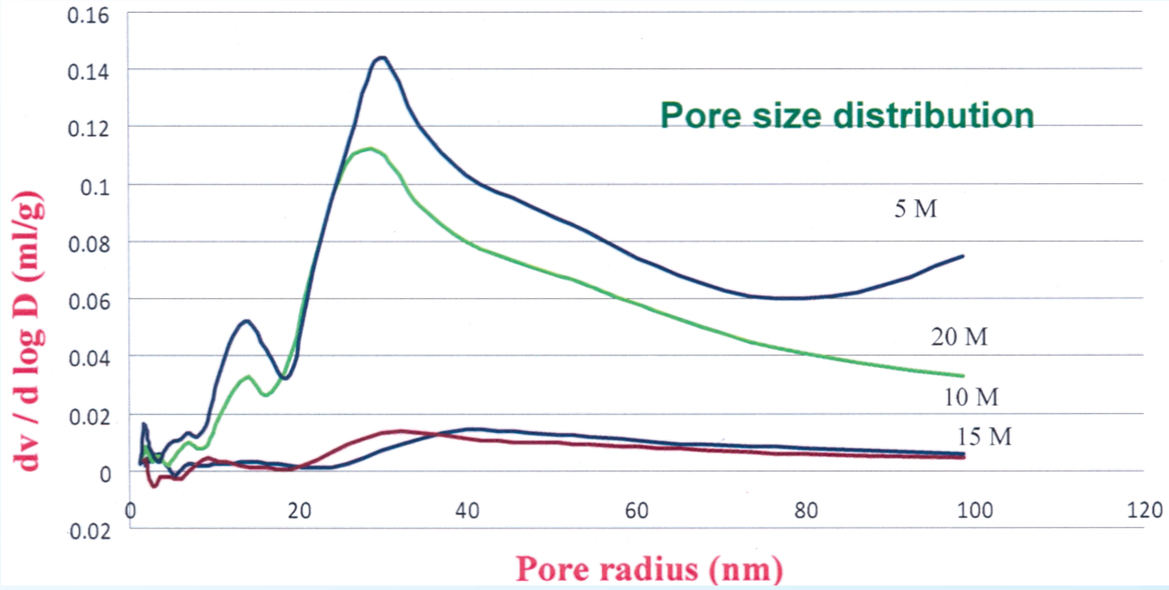


Fig.1. Pore size distribution in geopolymer pastes

26% in Na_2SO_4 and 50% in $MgSO_4$ solutions while samples cracked in the mix sulphate solution. The cracking in the samples was occurred mainly due to the leaching of sodium ions and the formation of large sized crystalline zeolites. AFM images show that porosity in the samples decreased when exposed in the sulphate environment. Granular rough surface was observed with respect to control samples (Fig. 2). SEM images indicate that the exposed samples exhibited entirely different microstructures to the fresh sample. In the case of samples exposed to Na_2SO_4 solution, deposition of large amount of precipitates was observed in the pores of gels. Sodium ion heavily leached into solution and its concentration reduces from 3.42% (control) to 0.82% in the exposed samples. The presence of sulphate ion (0.3 - 0.6%) in the aluminosilicate matrix was also noticed. Na / Al ratio reduced significantly from 0.23 for the fresh sample to 0.06 for the exposed samples. In $MgSO_4$ solution, the samples exhibited porous structure along with micro-fissures. The magnesium ion (0.5 to 0.95%) migrated from the solution into the aluminosilicate gel. Si/Al ratio in the exposed samples increased (3.6-4.6) with respect to 2.4 for the control. The concentration of sodium ion was reduced drastically to 0.3 - 0.5% from 3.42% of the control due to its leaching in the solution. On the other hand, the samples exposed in the mix sulphate solution shows the existence of vertical cracks in the aluminosilicate gel, disintegrated small particles, dealumination and pores in the microstructures. Migration of sodium ion into solution and presence of large crystalline zeolitic phase were noticed as observed in the case of samples exposed in both Na_2SO_4 and $MgSO_4$ solutions.

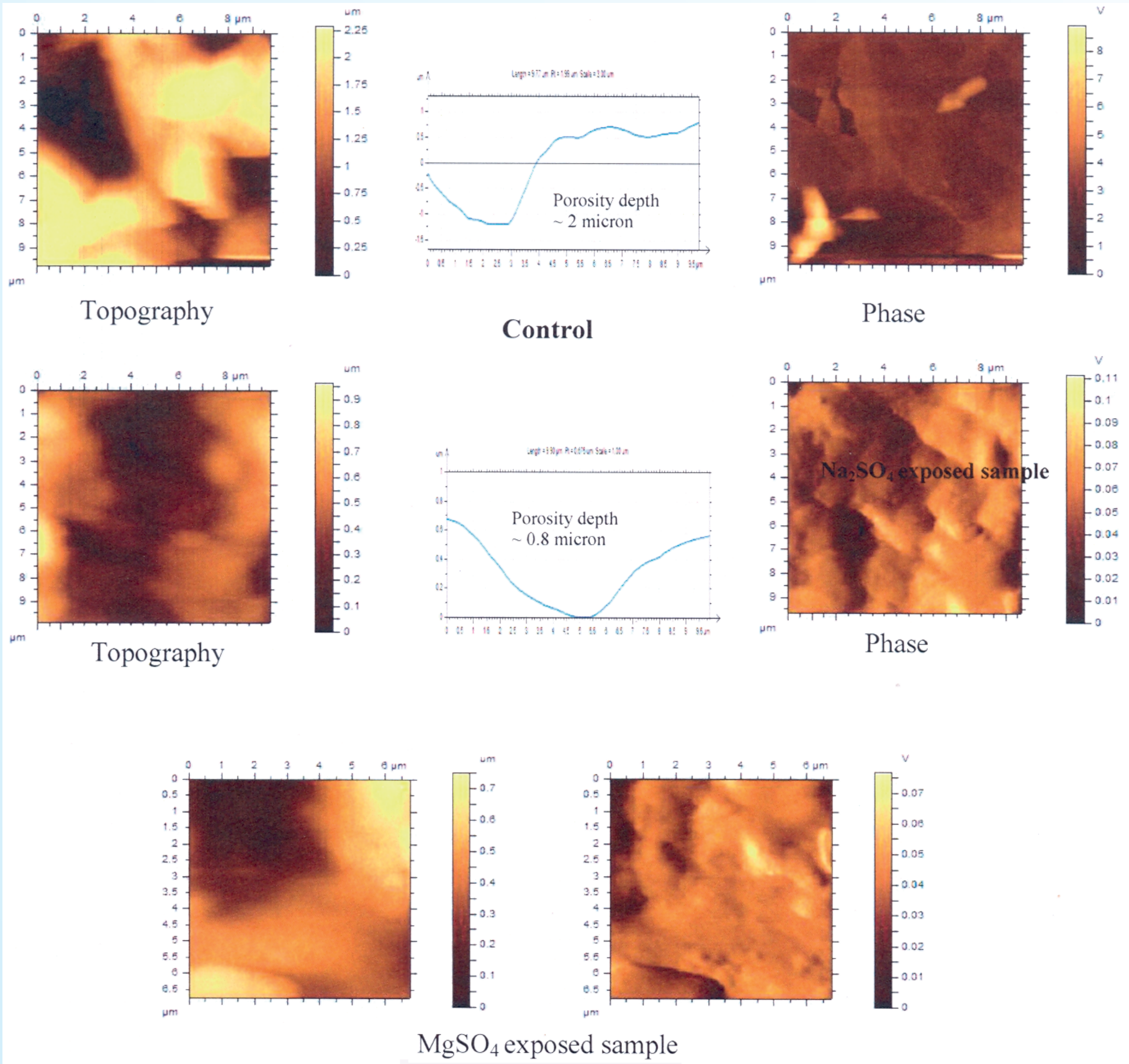


Fig. 2: Atomic force microscopic images of fresh and exposed geopolymer pastes

Pozzolanic Reactivity of Coarse Fly Ash

Simmi Tyagi, M. Gupta, B. Singh and S.K. Bhattacharyya

Fly ash is an accepted beneficial ingredient in the construction industry and widely used in the blended cements and concrete. However, as far the coarse ash is concerned, the previous reports indicated its weak pozzolanic behaviour due to its larger size and existence of major unreactive phases. In the present study, the coarse fly ash was used in the experiment (particle retained on a 45 μm sieve:

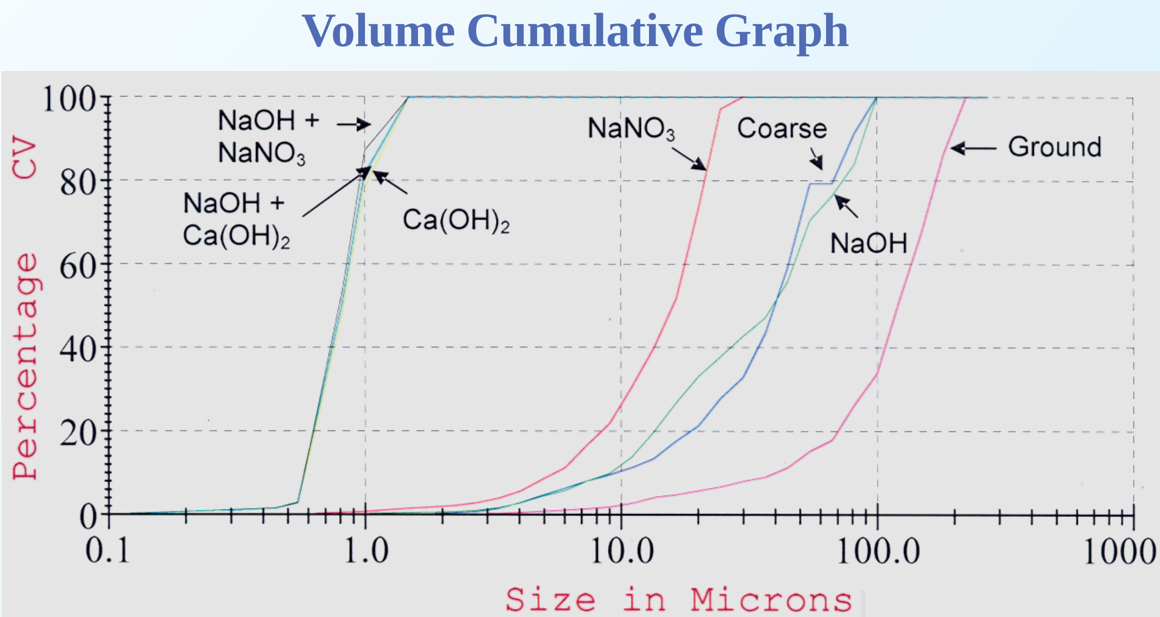


Fig. 1: Particle size distribution of coarse and treated ashes

45%; loss on ignition 1.8%; Blaine surface area 160 m^2/kg). The ash was subjected for mechno-chemical activation with single and binary activators. Figure 1 shows volume cumulative particle size distribution of the coarse and activated fly ashes. It can be seen that the coarse ash contains particle size ranges between 3.2 to 300 µm and its mean particle size (D50) was 120.29 µm. Upon mechano-chemical activation, the ash exhibited particle size distribution ranging between 0.1 and 200 µm with the mean particle size between 0.5 and 16 µm. The percentage of large size particles (D90) was also less in the activated ash. It is noted that the coarse ash treated with a binary activator imparted smaller particle size than the ash treated with single activator. The BET specific surface area has increased in the range of 8.3 to 17.67 m^2/g from 7.29 m^2/g for the coarse ash. The total pore volume on the particles also increased (4.2-8.9 m^2/kg) with respect to the coarse ash (3.7 m^2/kg). The higher surface area of the activated ashes would expect to increase their pozzolanic activity. These values were in the range to that of the ordinary Portland cement (12.64 m^2/g; pore volume: 6.4 m^2/kg).

FE-SEM images of the coarse and activated fly ashes are shown in Figure 2. The ash particles are mostly smooth and spherical in shape having varying particle sizes. [Fig. 2 (a)] When the ash was subjected to mechano-chemical treatment, its spherical structure was destroyed. The particles are smaller in size, irregular in shape and spongy in the appearance. The presence of zeolitic precursor phase in the ash treated with NaOH and NaOH + $NaNO_3$ and C-S-H phase developed onto ash surface upon $Ca(OH)_2$ treatment supportive of their reactivity when used in the cementitious binders [Fig. 2 (b-f)]. The compositional changes in the activated ash were also seen during EDAX mapping. The Si/Al ratio in the coarse ash increased from 1.63 to 1.76-2.44 while Al/Fe ratio decreased from 3.74 to 2.87-3.63 after mechano-chemical treatment except in the case of NaOH. After processing, the sodium and magnesium

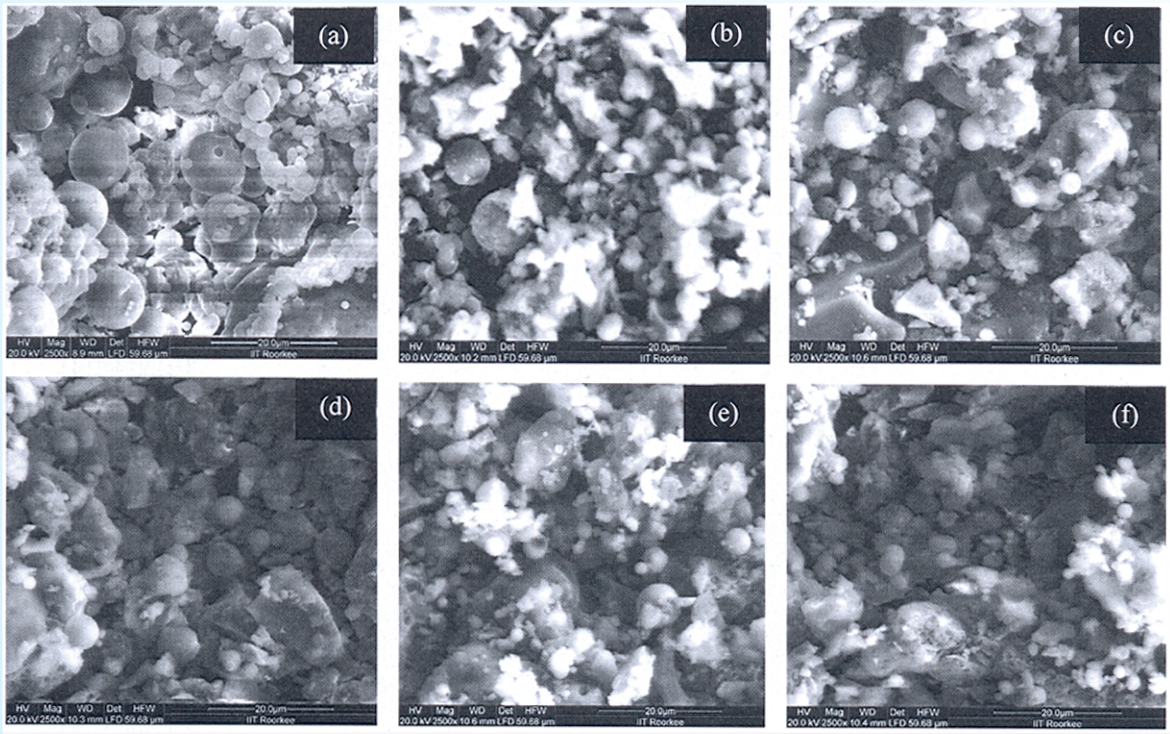


Fig. 2: FE-SEM images of fly ashes: (a) Coarse; (b) $NaNO_3$; (c) NaOH; (d) Ca $(OH)_2$; (e) NaOH + $NaNO_3$; (f) NaOH + $Ca(OH)_2$

contents in the coarse ash decreased from 1.31 to 0.031-0.23 wt % and 1.43 to 0.18-0.55 wt % respectively. The coarse ash treated with the binary activator exhibited low Si and Al contents compared with the other activators. This indicates that glass surface no longer keeps its original stable state; the incomplete coordinated Si^{4+} is likely to be exposed on the particle surface, so that the surface free energy of ash is increased which makes it more reactive.

Figure 3 shows lime solubility curves of the coarse and activated ashes plotted as per EN 196 (British Standard (2005)) between CaO concentration and hydroxyl ion concentration at 40ºC. It is found that values for the coarse and NaOH treated ashes produced points directly on the line of saturation curve showing their zero pozzolanic activity. It is believed that the optimum concentration of activator is necessary to break the glassy layer of ash particles. On the other hand, other activators showed points below the line of curve indicating a removal of calcium ions from the solution attributable to their pozzalanic activity. The CaO reduction obtained from the difference between the theoretical and experimental values was 32% for the binary activator and 4-14% for single activators. After assessing the effectiveness, the optimum concentration of the binary activator was finalized in terms of its lime removal. The values below the line of lime solubility curve are an indicative of their pozzolanicity. The maximum lime removal (73.46%) of the activated ash was obtained at 1N solution. EDAX analysis indicates that Si/Al ratio in the activated ash reduced to 1.95 compared with the 2.44 for the ground ash. The surface area calculated by particle size analyzer and BET method was 7.69 m^2/g and 17.67 m^2/g with pore volume 8.9 m^2/kg respectively. However, it is noted that higher concentration (2-3 N) of the binary activation results in more specific surface area in BET method contrary to the results of particle size analysis.

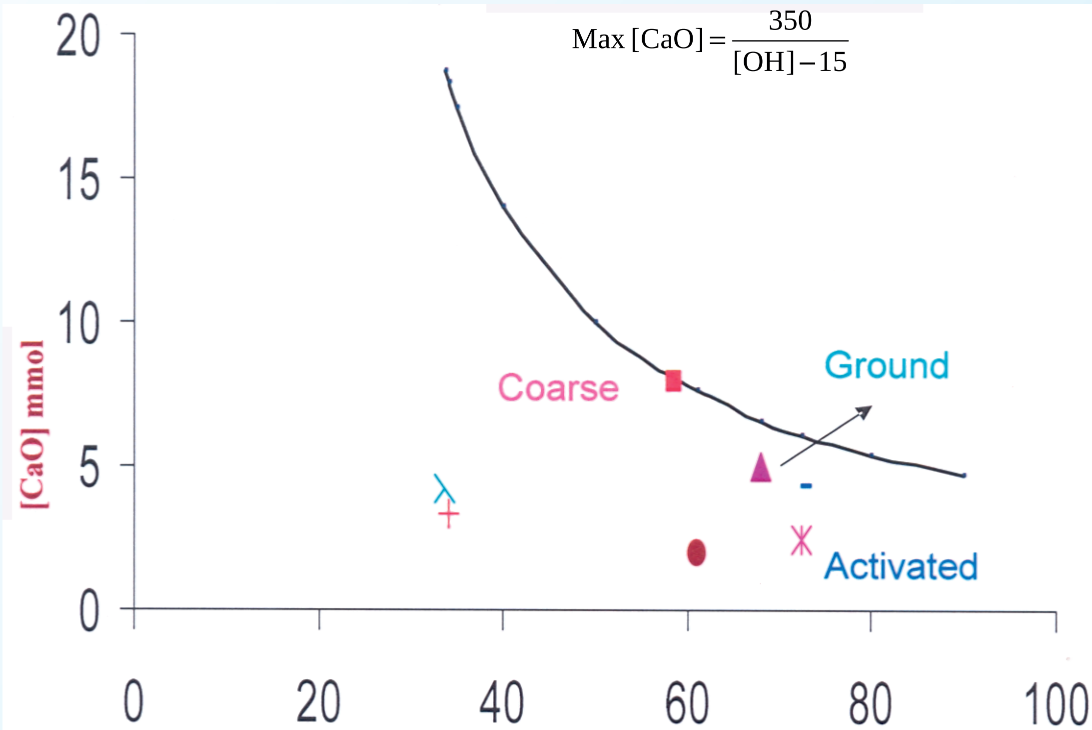


Fig. 3: Frattini test of coarse and activated ash

Cementitious Binder from MSW Incineration Ash

Shilpa Agarwal, M. Gupta and B. Singh

The disposal of municipal solid waste ash has become a significant economic and environmental issue. Recent investigations of MSW ash have focused more on environmental issues such as the leaching of heavy metals and other toxicological concern such as dioxins, but its resource is not utilized. The present research takes into a account both aspects which determined whether the cementitious binders can be used as a building material, and environmental aspects that may limit its use.

MSW incineration ash was ground to a sieve size of 170 μm for fly ash and 600 μm for bottom ash. The toxic elements such as mercury, chromium and cadmium in the fly ash and bottom ash were estimated by ICP - MS method. It is found that toxic elements in the fly ash are more than the bottom ash and also above the permissible limit of EPA. Removal of toxic elements was studied by washing with distill water for the period ranging from 5 min to 5 hrs. The pH is independent of the washing. Leaching of cadmium, lead, copper and chromium increased with increasing washing time. In acid wash, hydrochloric acid is more effective than sulphuric and nitric acid under hydrothermal treatment. At 100°C, leaching of heavy metals are higher than at room temperature. TCLP analysis of fly ash and bottom ash was also carried out using water and HCl at 20°C and 100°C.

It is found that acid wash at 100°C removed nearly almost Cr, Cd, Cu and K.

TGA analysis shows that weight loss in the fly ash and bottom ash is ~ 13% at 120°C and ~ 23% at 150°C indicating presence of organic / low volatile contents. XRD indicates presence of hump between 15 - 25.2-theta for fly ash whereas in this region there is no hump for bottom ash. SEM of fly ash and bottom ash was also carried out to know their surface morphology. Fly/bottom ash particles seems to be amorphous, irregular shape exhibiting deposition of substances contrary to the fly ash obtained from thermal power stations. After acid wash, particle seems to be smaller and rod shaped crystals are dominant in the microstructure.

A cementitious composition comprised of lime stone, calcium carbonate, MSW incineration ash, and small additives was prepared and fired at different temperatures (1250, 1350, 1400°C). The resulting mass was ground in a planetary ball mill. XRD results shows that the composition prepared at 1400°C exhibited nearly similar phases as cement (Fig.1). Prior to this, chemical and physical composition of MSW fly ash and bottom ash was carried out. The ash contains CaO 24.57%, Al_2O_3 6.26%, Fe_2O_3 3.57%, SiO_2 35.51%, MgO 3.31% and SO_3 0.75%. The loss of ignition was 19%. ICP analysis indicates that bottom ash has several heavy metals such as Cr 92.36 mg/kg, Cd 0.37 mg/kg, Pb 40.25 mg/kg, K 17550 mg/kg. The chemical analysis of cementing materials was analyzed by XRF. The prepared binder has CaO content 55-60%, SiO_2 20-22%, Al_2O_3 6-7%, $Fe_2O_3$4-4.71%, MgO 2.8-3.51%, $SO_3$1.3-1.5%. The lime saturation factor was in the range of 0.75-0.88, Silica ratio 0.58-2, Alumina ratio 1.44-2.29, C_3S 34%, C_2S 33.57%, C_3A 9.25% and C_4AF 13.18%. It is found that C_4AF and C_2S were higher than the prescribed limit mentioned in the IS: 269. SEM micrographs also show presence of various phases (Fig. 2). The lime solubility curve indicates that the points are well below the line of saturation curve. Various cubes were also cast for measurement of their compressive strength. The properties of prepared binders were also compared with OPC. Work is under progress.

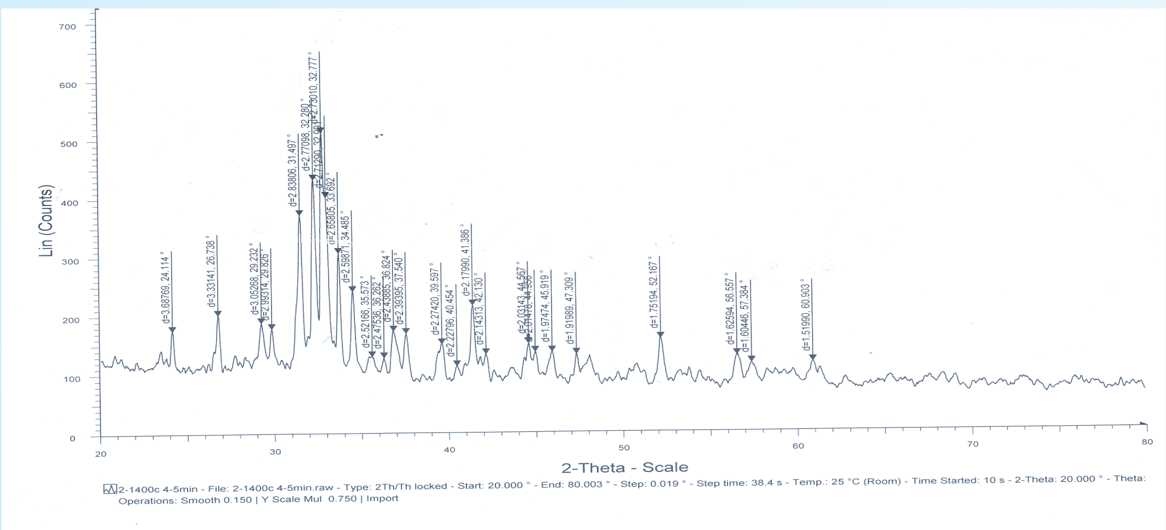
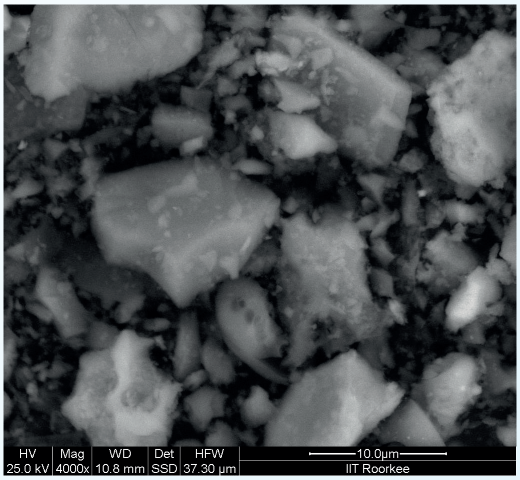
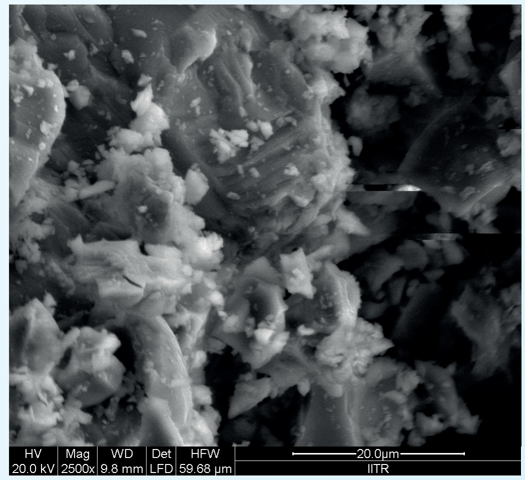


Fig. 1: XRD of cementitious binder based on MSW incineration ash



(a) MSW incineration ash



(b) MSW based binder

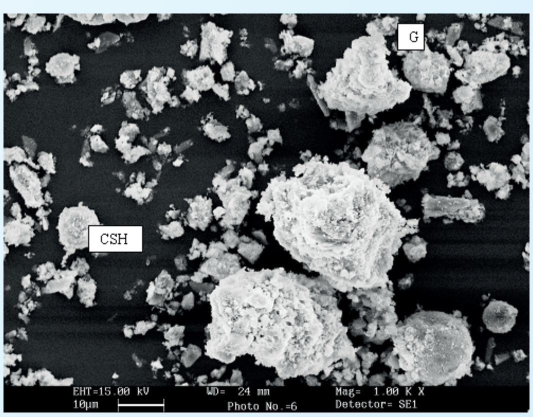
Fig.2: Cementitious binder from MSW incineration ash

Development of Alpha Plaster & Cementitious Binder from Non -Traditional Materials for Use in Building Bricks/Blocks and Composites (SIP 029)

Mridul Garg and Team

Alpha Gypsum Binder

The water-resistant α-gypsum binder was made by blending α-gypsum plaster (20-25%) with granulated blast furnace slag (50%), marble dust, hydrated lime and activators followed by grinding to a fineness of 350 m^2/kg and tested as per IS: 4031-1991 and IS 6909-1973. The results show that α-gypsum binder has compressive strength 32 MPa, setting time (min.): initial: 20; final:50, water absorption: 4-6% and porosity 7-8 and soundness 3mm and complied the requirements as given in standards. SEM and DTA [Fig.1(a)&(b)] studies showed that strength development of binder takes place through formation of ettringite, CSH and C_4AH_{13}.



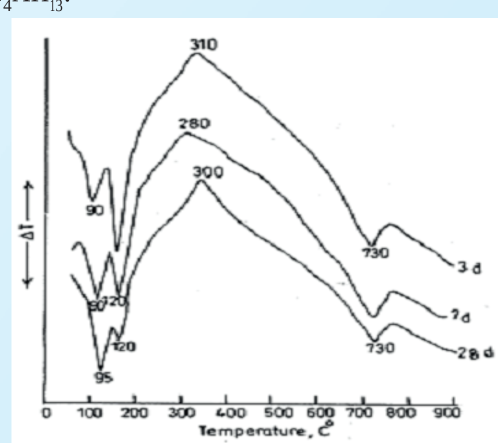


Fig.1 (a) Micrograph of Cementitious Binder; (b) DTA of Hydrated Cementitious Binder

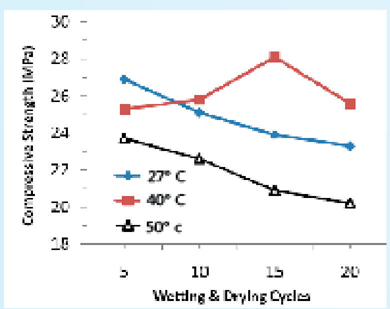
Durability of the alpha gypsum binder has been studied by its performance in water, and by accelerated aging i.e. alternate wetting and drying and heating and cooling cycles at temperatures at 27, 40 and 500C.

Performance in water

The cubes of binder hardened for 28 days were dried and then immersed in water to measure their water absorption, porosity and strength after different periods. Results show the absence of leaching and better stability of the binder than the plain plaster

Wetting and Drying Cycles

During alternate wetting and drying cycles, maximum strength was achieved at 40°C and weight loss increased with cycle and temperature as shown in Fig. 2.



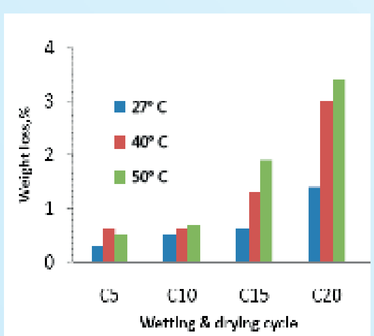
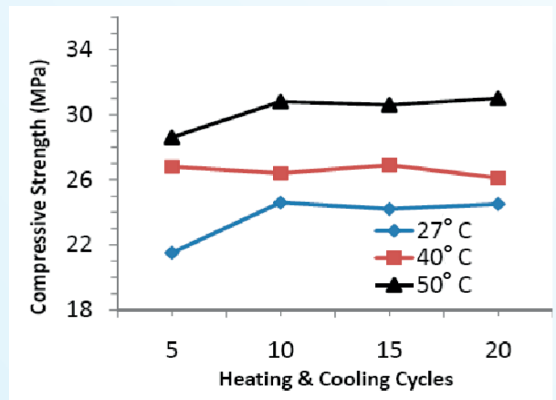


Fig.2: Effect of alternate wetting and drying cycles on Compressive strength and weight loss at different temperatures

Heating and Cooling Cycles

In alternate heating and cooling cycles, the strength increased with increase in temperature up to 10 cycles & than no change in strength. At 27° C no weight loss was observed whereas at 40 & 50°C weight loss increased with cycles as shown in Fig. 3.



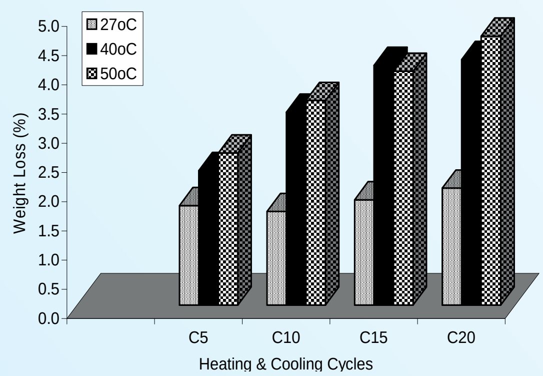


Fig.3: Effect of alternate wetting and drying cycles on Compressive strength and weight loss at different temperatures

Salient features

- Low Heat, durable & environmental friendly.
- Suitable for Prefabricated component like bricks/ blocks and fiber reinforced composites.

Experimental and Theoretical Study of Masonry Walls Subjected to Blast Loading

A.K.Pandey

Objectives of this project is to study masonry properties required for constitutive modelling for blast loading and perform parametric studies for behaviour of confined masonry under blast loading using nonlinear finite element analysis. This is also aimed in the project to study retrofitting techniques to enhance the performance of brick masonry under blast loading. IS-4991-1968 requires that a building may be designed for a bare charge of 100kg at distance of 40 m for residential building, 30 m for community buildings and 20 m for buildings housing services. Calculations for blast pressures and positive phase duration have been made using developed software for blast of 100 kg at a detonation distance of 20, 30 and 40m.

Masonry walls are the weakest link in a framed structure in resisting the forces during a blast event. Masonry is very weak in tension because it is composed of two different materials distributed at regular intervals and the bond between them is weak. Therefore, masonry is normally provided and expected to resist only the compressive forces. The uniaxial monotonic compressive behaviour and other characteristics of masonry prisms and wallettes and its constituents, viz. clay brick and mortar, have been studied by laboratory tests. Bricks were also tested for splitting tensile strength test as per ASTM standards (Fig. 1).

Fig. 1: Testing of Bricks for splitting tensile strength test as per ASTM standards

It is found that for the bricks and mortar of comparable strength, the compressive strength of masonry is less than both of its constituents. Based on the results and observations of the comprehensive experimental study, nonlinear stress-strain curves have been obtained for masonry. Poisson's ratio has been obtained and it is found that final failure of masonry specimens in compression mostly occurred by vertical splitting of bricks. **Splitting Tensile strength of bricks has been found to be 6.8% of its compressive strength.** Vertical splitting failure of bricks in masonry compression and splitting tensile strength of brick has been related to explain the failure mechanism.

During blast loading flexural strength of brick masonry is an important parameter and flexural strength test of the brick masonry panels (1:3, 1:4.5 and 1:6 mortar) has been determined as per ASTM standards. The failure of the masonry panels indicate that bond failure occurs during the flexural test. The results indicate that **average flexural bond strength for 1:6, 1:4.5 and 1:3 mortar brick masonry are 0.16, .0.19 and 0.26 MPa respectively.** As flexural strength of the brick masonry panel is very little and it is an important parameter for blast resistance, retrofitting techniques for improving the flexural strength will help in blast resistant performance and these are being studied experimentally.

It is concluded from the linear analysis of confined masonry panels for the blast loading that boundary conditions have impact on the response as the behaviour may change from impulsive to dynamic. The flexural stresses are higher indicating requirement of nonlinear analysis. The study of the confined brick masonry has been made with elasto-plastic strain hardening models using Mohr- Coulomb yield and failure criterion and contact algorithm for the boundary conditions. The nonlinear analysis indicate that for blast pressure of 1.02 kg/cm^2 of duration 18 ms (surface blast of 100 kg TNT at distance of 30 m) by changing contact friction between RC beam/column and masonry from 0.0 to 0.3 and 0.5 the peak deflection reduces from 4.1 cm to 2.8 and 2.5 cm respectively and peak velocity reduces from 1.7 to 1.4 and 1.25 m/sec.

Information, Extension & Project Management

Publication

The Publication Group continued to serve as the nerve center of the Institute conducting and co-ordinating multifarious activities, such as, collection, storage and dissemination of R&D information; handling scientific and technical enquiries; publicity and public relations. Compilation, editing and publication of Annual Report to meet the inter and intra-institutional information needs, editing and publication of CSIR-CBRI Newsletter and Bhavnika periodically, publication of Building Research Notes, Project Profile, Technical and Divisional Brochures etc., preparation of other scientific/technical reports and filling up of questionnaires and performae received from various departments/organizations; providing inputs for CSIR Annual Report as well as for CSIR News and CSIR Samachar; reporting of the scientific and technical work carried out at the Institute in Hindi and English and publicity of the Institute's R&D capabilities through print Media.

Knowledge Resource Centre

CBRI Knowledge Resource Centre (KRC), is actively engaged in acquisition, technical processing and updating the collection and providing the platform for e-access of information sources to expand the horizon of information base to the scientific community.

Acquisition: Books: The library added 337 numbers of books. Journals: The library has subscribed 104 (61 foreign & 43 Indian) journals. 138 volumes of journals were got bound.

Library Statistics: The present position of library collection: Books including reports; standards; conference proceedings; theses & maps: 43464; Bound Periodicals: 19738

Institutional Membership: KRC continued to renew the membership of learned national/ international professional societies and received their publications against the membership.

National (India): Indian Building Congress (IBC), Delhi; Indian Geotechnical Society (IGS), Delhi; Institute for Steel Development and Growth (INSDAG), Kolkata

International / Foreign : International Council for Research & Innovation in Building and Construction (CIB), Rotterdam, The Netherlands; International Union of Laboratories & Experts in Construction Materials, Systems and Structures (RILEM), Bagneux, France, International Federation for Structural Concrete (fib), Lausanne, Switzerland.

Exchange of Publications : Besides membership, the library received Annual Reports; Newsletters; Technical Reports; Reprints and other materials in exchange from National and International Organizations.

Resource Sharing and Local Networking: Maintaining continuously good relationship with the libraries located in Roorkee viz. Indian Institute of Technology; National Institute of Hydrology; Irrigation Research Institute; Bengal Engineering Group library and so on; providing resource sharing through inter library loan. Besides the local network, KRC is maintaining the liaison with the KRC's of CSIR Laboratories and other academic/ research institutions.

Services: KRC is playing a coordinating role between users and the literature, providing personal Information service through Current Awareness (CAS) and Selective Dissemination of Information (SDI) using modern information technology. Besides the day to day circulation, reference and xeroxing services, KRC is also rendering the following specific services:

- **Documentation:** Paper clipping service is continued through scanning eight no. of newspapers in English and Hindi version. The topics of the interest of the institute under eleven major heads like-Building Materials; Structure & Foundation; Disaster Management: earthquake & landslides; Shelter Planning & Policy; Environment Science & Technology; Fire Research; CSIR/ CBRI etc. The paper clipping are kept in classified order for providing current awareness service to users.
- **List of Latest Addition:** Library is bringing out a quarterly list of latest arrivals of books for the general awareness of library users.
- **Bibliographic Service:** Library is providing bibliographic service to users on demand on the subject of interest from in house data base as well as international databases.
- **Web-OPAC Search:** Library has created a bibliographic database of documents and providing search facility through computer. Users can search any document through any access point like author, class no., subject, title, keyword and combination of search (Boolean search).
- **CD-ROM:** CD-ROMs are available in KRC viz. CIB Conference Proceedings, ACI Manual, Patestate: a database of CSIR patents and heritage buildings and sites.
- **In-house Database:** KRC is maintaining in-house bibliographic database of books and bound volumes of journals.
- **Internet Facility & Access of E-Journals:** Access to over 3000 full text of e-journals of leading S&T publishers, full text of Indian & ASTM Standards as well science & patent databases are available online under National Knowledge Consortium (NKRC-CSIR-DSTE-journals Consortium).

Development, Construction & Extension

CSIR-CBRI implemented a major social programme of CSIR 800-RSWNET, RSP-0003, on Dissemination, Training and Demonstration of safe, healthy and durable housing technologies so as to improve housing and living conditions of the rural masses and enhance the skills of local artisans and construction workers through mass awareness programmes, training programmes, on-site demonstrations and entrepreneurship development in rural areas of the country. The group also thrived for successful extension, technology utilization and implementation of the institute's R&D and especially its technological achievement of Supra Institutional Project (SIP 029).

(I) Training & Demonstration

The institute organized 3 Training & Demonstration programmes at Sundernagar and Solan (Himachal Pradesh) and Roorkee (Uttarakhand) imparting training to over 150 Engineers, 200 Construction workers and 500 of local population.

S.No.	Training and Venue	Date	Partner Agencies	No. and Details of Trainees
1	Training on Appropriate EQ Resistance Rural Housing Technologies at ATC centre, Sunder Nagar (H.P.)	14-15 May, 2010	Himachal Pradesh Council of Science, Technology and Environment (HPCST&E) Shimla Appropriate Technology Centre, Sundernagar	• 50 Block/ DRDA engineers and NGO's. • 60 Construction workers, volunteers, and masons from various block/ villages.
2	Earthquake Resistant Rural Housing at Dr.YS Parmar University of Horticulture & Forestry, Nauni, Solan, (H. P.)	17-18 February 2011	Himachal Pradesh Council of Science, Technology and Environment (HPCST&E) Shimla	• 60 Block Engineers and NGO's. • 50 Construction workers and masons from various blocks/ villages.
3	Technical Entrepreneurship Development Programme at CBRI Roorkee, Uttarakhand	05-09 July 2010	Entrepreneurship Development Institute of India, Ahemdabad	• 25 Polytechnic students.

(II) Exhibitions organized / participated

Sl. No	Theme	Date and Venue	Organizing Agency/ Department	Witnessed/ Interaction
1	Exhibition on Rural Housing Technologies	14 -15 May, 2010; Sundernagar, H.P.	CSIR- CBRI	Trainee Participants and engineering students
2	CSIR-Technofest – 2010	14 – 27 Nov 2010; IITF , Pragati Maidan, New Delhi	CSIR & India International Trade Fair Authority,	Over 5 lakhs people
3	Achievements of CBRI	14 – 15 Dec. 2010; CBRI , Roorkee	CBRI during Indo-US workshop on Nano Technology in Concrete.	Delegates of the Workshop

Sl. No	Theme	Date and Venue	Organizing Agency/ Department	Witnessed /Interaction
4	Rural Technology Mela	2 – 5, Feb. 2011, Hyderabad	National Institute of Rural Development, Hyderabad	5,000 village development agencies , builders, engineers, senior delegates , NGO's and students
5	Exhibition on 'Disaster Resistant Rural Housing Technologies'.	17-18 Feb.2011 at Nauni , Solan , H.P	CSIR- CBRI and Trainee HPCSTE, Shimla	Trainee Participants, College faculty and students
6	Exhibition on Appropriate Technologies for Rural Development during North Zone Regional Agriculture Fair,	23-26 February, 2011, NIT, Hamirpur, Himachal Pradesh	Himachal Pradesh Government ; HPCSTE, Shimla	Thousands of farmers and professionals
7	Exhibition on Innovative Building Materials & Processes	28 Feb., 2011 on National Science Day, CBRI, Roorkee	CSIR – CBRI	200 Nos. including RC members, CBRI Scientists and Science Students of local Colleges
8	Innovative Building Materials & Technologies	4 – 5 March , 2011, Raj Bhawan, Dehradun	Lok Nirman Vibhag , Uttrakhand Govt.	Hundreds of Govt. officials and others
9	COGNIZANCE 2011	March 11 – 13, 2011, Roorkee	IIT, Roorkee	Hundreds of IITs Students & Faculty members

Planning, Monitoring and Evaluation

Planning, Monitoring and Evaluation Group coordinates the activities related to In-house R&D projects, Sponsored Projects, Grant-in-aid Projects, Consultancy projects, Project budgeting, costing & accounting and other S&T services. Important documents like annual plan document of the institute, manpower deployment document, and R&D agenda for the Research Council are also delt with by PME Group

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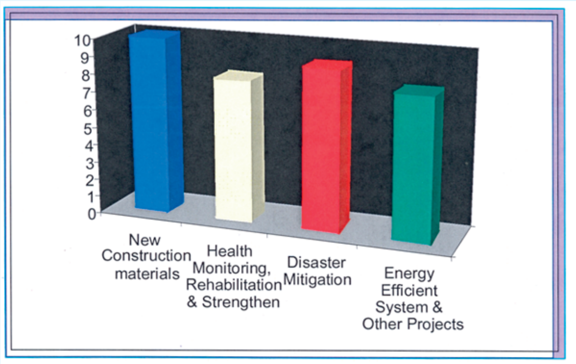
In-house R&D Projects

For selecting of new R&D projects and to monitor the progress of ongoing projects, Internal divisional review meetings, and External experts meeting were organized. Follow up actions were taken before placing the projects in the Research Council. 35 In-house R&D projects were processed under four R&D Areas of Institute as new and ongoing.

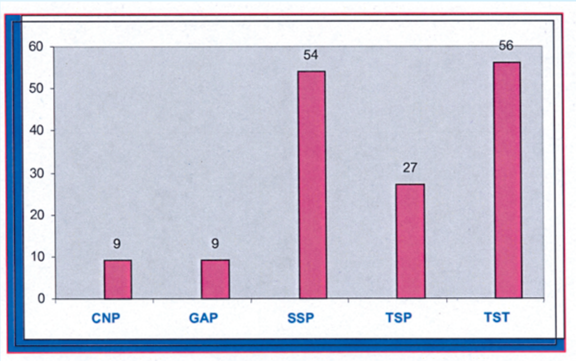


Research Council Agenda

Agenda for 42nd and 43rd Research Council meetings were prepared which covered the progress of the ongoing R&D projects, new proposals, projects seeking extension of time. Views/ suggestions given by the experts, direction and guidelines provided by the Research Council were passed on to respective project leaders for incorporation in the R&D programmes of institute.

Externally Funded Projects

There were 09 of Consultancy Projects, 54 Sponsored Projects and 09 of Grant-in-Aid projects, 27 Testing projects and 56 Technical Services projects during this year. A Database on the externally funded projects is being maintained. Necessary records and receipt against consultancy/ test projects were maintained and submitted for service tax to the designated authorities.



Manpower Planning & Deployment Document

Manpower planning & deployment document was prepared for the year 2010-2011 to provide the division wise deployment of institute's manpower against various R&D projects as well as activities. This document also shows the reporting & reviewing officer of each staff member.

Project Evaluation

Project evaluation of in-house R&D/Externally funded projects was conducted during 2010-11. Projects from different disciplines were presented and discussed. PME coordinated the scheduling of the presentations & interacted with the project leaders for putting up related documents. Follow up actions were taken for in-corporating the suggestion & recommendations in the project proposal.

Monthly Report/Research Utilization Data/Quartertly

PME compiled monthly progress reports, etc of the Institute and communicated the same to CSIR on regular basis. Quarterly Progress Report and RUD for the year 2010-2011 were also compiled and sent to CSIR as per schedule.

Management Council Agenda & Other Documents

Prepared agenda items related to externally funded projects and action taken for 35th & 36th MC meeting

PME also coordinated replies to audit (CAG & CSIR) memos & parliamentary Queries.

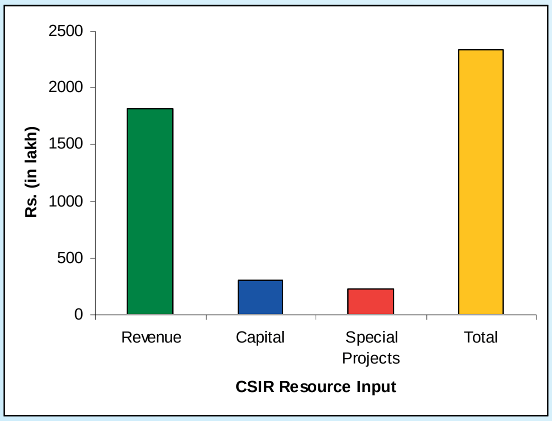
Budget and ECF

CSIR Resource Input

Revenue	1817.595 Lakh
Capital	300.500 Lakh
Special Projects	223.250 Lakh
Total	**2341.345 Lakh**

ECF

Private	73.715 Lakh
Govt.	274.589 Lakh
Testing	145.736 Lakh



Special Events Organised

• *Entrepreneurship Development Programme on Low Cost Housing Technologies under CSIR 800 : RSWNET*

CSIR-CBRI, Roorkee organized one week Technical Training for Entrepreneurship Development on Low Cost Housing Technologies from 5th to 9th July, 2010 for the 25 trainee students of diploma in civil engineering who had registered for six weeks EDP training with National Entrepreneurship Development Institute (EDI), Roorkee

The programme was inaugurated by Prof. S.K. Bhattacharyya, Director, CBRI, Roorkee and attended by Sh. Chanchal K. Singh, Project officer & Sh. S. Sharma (EDI, Roorkee), Er. S.G. Dave, Scientist 'G' & Course Coordinator and other fellow Scientists of CBRI, Roorkee. In the inaugural remarks, Director, CBRI apprised the contribution of CBRI in R&D on housing technologies & also expressed that such training will help the students to improve their skill and also in better understanding of newer technologies for proper implementation in field and escalation in Entrepreneurship opportunities.

Er. S.G. Dave, the course coordinator informed the trainees about CBRI R&D achievements & highlighted the technologies successfully exploited at commercial level. He also briefed on mission CSIR:800 and its objectives and achievements so far.

Sh. Chanchal K. Singh briefed on objectives of the Training cum Entrepreneurship Development Program as to develop skilled & trained manpower confident of implementing the low cost construction technologies in field and also to promote development, production, and large-scale application of cost-effective innovative building materials and construction technologies in housing construction. He hoped that such training programme will encourage the engineers to become entrepreneurs and establishing production units in their regions.

CBRI Faculty included Er. S.G Dave, Ar. R.K. Garg, Er. S.K. Singh, Er. Ajay Chourasia, Dr. L.P. Singh, Sh. Nadeem Ahmad, Scientists and Sh. K.L. Chhabra & Shri Rajeev, Tech. Officers for presentation & demonstration of several technologies including Low Cost Housing and Sanitation Technologies, Improved Brick Production Technologies, Prefabricated Building Technologies, Disaster Resistant Housing Technologies, Ferro-cement Products & Application and Quality Assurance Control and Technologies available for commercial exploitation by the entrepreneurs.

In a problem solving session open discussion among trainees and faculty took place as trainees were quite enthusiastic and exchanged several queries from the CBRI Scientists. The trainees sought full details on various areas of appropriate technologies, disaster resistant housing, entrepreneurship opportunities and other related construction problems on seepage, water proofing, ventilation, prefabrication, etc.

In concluding session, Er. S.G. Dave informed that future of Civil Engineers is bright in both entrepreneurship and service sector. The engineer entrepreneurs can serve the nation, his family and a society by creating good employment opportunities in the region and also by making significant contribution in making construction of good quality, economy, durability using optimal resources and appropriate technologies. The organizers extended their thanks to the Director & faculty members of CBRI and praised for their devotion of their time for this noble cause.

• CBRI launched POST GRADUATE COURSE on Engineering of Infrastructure and Disaster Mitigation (Buildings/ Roads)

In consonance with the approval of the Govt. of India accorded to Council of Scientific and Industrial Research (CSIR) for setting up an Academy named 'Academy of Scientific and Innovative Research (AcSIR)' for conducting Post Graduate courses to award Masters degree, the Central Building research Institute (CBRI) along with the Central Road Research Institute (CRRI) launched a two years long Post Graduate course on "Engineering of Infrastructure (Buildings/Roads) and Disaster Mitigation" (EIDM) on 9th August 2010 at CBRI Roorkee campus.

The course is appropriate, relevant and timely because of the growing demand in the area of Disaster Mitigation. The course is designed to address effects of earthquake, landslide, cyclone and fire disasters on infrastructural systems and the remedial measures.

In addition, the course focuses on the engineering of basic infrastructure e,g Building and Road. In view of the huge shortage of housing in the country and the growth in the surface transportation sector, the course is appropriate and will help in developing the required kind of human resources to address the complex problems of disaster mitigation and engineering of basic infrastructure. The course is so designed that it is unique and no other Institutions in the country offer such programmes. The programme will benefit immensely because of the available facilities and expertise in the two laboratories of CSIR, namely CBRI and CRR!.

Eight students from different corners of the country have joined the programme. The orientation programme for the students was held on 9th August 2010. The basic philosophy of launching the Post Graduate Research Programme in Engineering (PGRPE) by CSIR and the course on EIDM by CBRI was elaborated by the Director of the Institute, Prof. S. K. Bhattacharyya. While welcoming the students in the campus, he reminded them about their duties and responsibilities. A brief about the Institute was presented by Mr. A. Ghosh, Dean of the PG Programme and subsequently the divisional activities were presented by the Scientist Co-coordinators of different divisions. Scientists from the Central Road Research Institute (CRRI), New Delhi joined the orientation programme through video conferencing. The presentations were followed by laboratory visit and an interactive session with the students.

The day long programme was concluded in the evening and the regular classes have commenced from 10th August 2010.

• Independence Day

The Independence Day was celebrated at the Institute on August 15, 2010. 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.

• Sadbhawna Diwas

The Institute observed Sadbhavna Diwas on August 20, 2010 with a view to promote harmony amongst people of all religions, languages and states and goodwill towards everyone.

Prof. S. K. Bhattacharyya, Director, CBRI administered the Sadbhavna pledge to all the staff members of the Institute.

• Hindi Week-2010

Hindi Week was organized in CBRI, Roorkee during 8-14 Sept. 2010. Dr. Sudha Rani Pandey, Vice Chancellor , Uttarakhand Sanskrit University, Haridwar graced the occasion as Chief Guest on Inauguration & the Celeberation was presided over by the Director, CBRI, Prof. S.K. Bhattacharyya.

During the Hindi Week, on 9th September, Hindi Noting & Drafting Competition was held and another competition of Hindi Essay Writing on the subject "Rajbhasha: Hindi Hi Kyon" on 10th of Sept. In the series of competitions, Hindi Vocabulary & Usages of Hindi Words competititon was organized. Shri Aman Kuman, Alok Sharma, Arpan Maheshwari, HC Madan, PKS Chauhan, Sudhir Kumar, S.K. Senapati & Rajinder Kumar won the prizes in these Hindi Competitions.

On 14th Sept., 2010, the concluding day of the Hindi Week, VC of GKV, Prof. Col. Swatantera Kumar was the Chief Guest & the function was Chaired by the Director, Prof. SK Bhattacharyya. The entire celeberation of the Hindi Week was very successfully organised under the Chairmanship of Dr. B. Singh, Scientist F & Convener Shri R.C. Saxena, Sr. Hindi Officer.

- ## *Short-Term Course on Earthquake Resistant Design & Construction Practices*

Natural disasters in the form of earthquake have become a global phenomenon, and there is a need to safeguard our building structures against such calamities. As a reactive society, need is felt to inculcate earthquake education to the practicing engineers and CSIR-Central Building Research Institute (CBRI) in association with The Institution of Engineers (I), Roorkee Centre jointly organized a course on Ear thquake Resistant Design & Construction Practices during 21-24 September, 2010 at Roorkee. The course in all had 28 technical lectures covering wide spectrum of topics related to earthquake engineering right from Engineering seismology; soil and structural dynamics, earthquake resistant design principles & philosophy; performance based design, seismic qualification, geo tech-earthquake engineering, seismic up-gradation, sustainable precast construction, quality control in construction and failure analysis with case studies. The course was attended by 48 participants from various government, public & private sector organizations.

While welcoming the Chief Guest, Guest of honour and participants, Prof. V.K. Agarwal, Chairman, IE(I) highlighted the importance of the course. Prof. S.K. Bhattacharyya, Director, CBRI, Roorkee, in his presidential address emphasized the need to propagate the awareness and message of seismic resistance to all structural designers/architect so that while conceiving the project they ensure that the measures are adopted during construction so as to save lives & properties in future earthquakes. He also mentioned that it needs whole hearted support of all stake holders namely, the owner, the planner, the designers and the builders, which can be achieved by systematic initiatives to change the mindset of professionals and generate awareness regarding earthquake preparedness & mitigation, while highlighting the contribution of CBRI towards the subject. The Chief Guest of the inaugural function Shri P. G. Dhar Chakrabarti, Director, NIDM, New Delhi stressed the need on synergizing the theoretical concepts on earthquake engineering with practice by organizing such kind of courses. The short-term course of four days duration was organized in a highly scientific & professional manner. Participants, very actively interacted with faculty during the entire programme. Faculty members drawn mainly from CBRI, Roorkee and IIT Roorkee includes Prof. S.K. Bhattacharyya, Prof. D.K. Paul, Prof. Swami Saran, Dr. Yogendra Singh, Prof. M.L. Sharma, Prof. A K. Jain, Dr. B.K. Maheshwari, Dr. Satyendra Mittal, Er. Ajay

Chourasia, Er. Sanjeew K. Singh, Dr. Achal Mittal, Dr. Shantanu Sarkar & Dr. A.K. Pandey. The renowned experts from field Dr. Shailesh Agarwal, Executive Director, BMTPC, New Delhi and Mr. Yogesh Kajle, Executive (Planning & Design), B.G. Shirke Construction Technology, Pune also shared their experiences.

- *CSIR Foundation Day*

The Institute observed Open Day on 26 Sept. 2010 to commemorate the Foundation Day of Council of Scientific and Industrial Research. The Institute was kept open to the public and invitations were sent to schools to send their children to interact freely with the scientists of the Institute.

Padam Shree Prof. K.L. Chopra, Former Director, IIT Kharagpur graced the occasion as Chief Guest and congratulated scientists and staff members of the Institute for carrying out various R&D programmes concerned with the Building Science & Technology. The R&D work of CBRI has benefited the society, particularly the rural people of the country. He emphasized that the research should be in consultation with the need of masses and environmental friendly. He also showed his concern towards the ethical values diminishing in the area of scientific research. Prof. Prem Krishna, Chairman, Research Council, CBRI, Roorkee graced the occasion as Guest of Honour and drew attention on the problem of Global Warming. He also emphasized that the scientists in the Institute should choose a few areas and work towards excellence in those.

In his Presidential address, Prof. S.K. Bhattacharyya, Director, CBRI welcomed the Chief Guest and Guest of Honour and highlighted the Institute's R&D activities after explaining the importance of CSIR in the Country's need since its inception. He mentioned that our former leader had envisioned the need of scientific research and several scientific research establishments were established in the country including CSIR. He informed that a PGRPE course on "Engineering of Infrastructure and Disaster Mitigation (Buildings/Roads)" has started from this year in the Institute and eight students have been enrolled.

Prof. S.K. Bhattacharyya apprised that the Scientist of CBRI and other CSIR labs are facing a great challenge to keep pace with the development in different parts of the globe and it is indeed a matter of great satisfaction that our country is now considered as one of the greatest resources of the world market as the Scientists of this country have proved their worth. CBRI is one of those labs which is directly concerned and connected with the upliftment of common man because shelter is considered as one of the basic needs. CBRI has always played a vital role in finding appropriate solutions for providing houses and buildings to meet the aspirations of the people of this country.

On this occasion the citations were distributed to the persons who retired during the year and the employees who have completed 25 years service in CSIR. The meritorious wards of CBRI staff were rewarded. An essay competition for CBRI wards was organized in different groups and the selected ones were awarded. The prizes were also given to the winners of different events organized for Foundation Day.

The programme was anchored by Shri Y. Pandey, Scientist 'F' and the vote of thanks was proposed by Controller of Administration, Shri S C Tyagi.

At a later session, Prof. K. L. Chopra delivered the first lecture of the Distinguished Institute Lecture Series on 'Application of Solar-Photovoltaic in Buildings'. The lecture was attended by CBRI staff and others and was well appreciated. In the evening a Cultural Programme was also organized in the Institute auditorium, in which the PGRPE students, scientists, staff and the wards of CBRI family participated

• *Vigilance Awareness Period*

The Institute celebrated Vigilance Awareness Period during 25 October to 01 November 2010. Different programmes which include special lectures, poster competition for school children of staff wards, debate competition for staff members etc. have been organized during the week. The valedictory function was organized in the Institute's auditorium on November 01, 2010. Prof. S.K. Bhattacharyya, Director CBRI presided over the function and gave away the prizes to the winners of the different competitions. Dr. S.K. Saini, Scientist 'F', Chairman, Organizing Committee presented a brief of the programme organized during the week and the function was concluded by a vote of thanks presented by Shri S.C. Tyagi, Vigilance Officer and Controller of Administration.

• *CBRI at CSIR-Technofest 2010 (Science and Innovation for Transforming India)*

CSIR-Central Building Research Institute, Roorkee enthusiastically participated in CSIR-Technofest 2010 at India International Trade Fair (IITF) during 14-27 November, 2010 at Pragati Maidan, New Delhi.

The impressive and useful R&D of the CBRI, Roorkee on Innovative Housing Technologies having an impact on user masses and building industry in the R&D areas like :

- High Performance Materials and Composites
- Energy Efficient Green Housing,
- Cleaner and Environment Friendly Technologies,
- Health Monitoring & Rehabilitation of Structures and
- Disaster Mitigation

were showcased under four theme areas namely :

- **Mining, Minerals & Materials :** Rice Husk Plastic Wood, Pine Needle Composites, Geo-polymer Bonded Bricks, Energy Efficient Gypsum Calcinator, Brick Making Machine and Improved Brick Production Technologies.
- **CSIR-800 :** Innovative Technologies for Rural Housing, Precast Roofing Systems, Low Cost Fire Extinguisher and Disaster Resistant Shelter.
- **Strategic Sector :** Early Warning System for Landslide in Chamoli.
- **Ecology & Environment:** Improved Brick Technologies and R&D on Flyash Utilization.

Shri Kapil Sibal, Hon'ble Union Minister, HRD and Science & Technology accompanied by DGCSIR, Lab Directors & Sr. Scientists, while taking a round of technofest soon after the inaugural opening of the CSIR-Technofest Pavilion on 14th Nov. 2010, was received at CSIR-800 theme pavilion by Dr. P.G. Rao, Director, NEIST Jorhat and theme coordinator along with Sri S.G. Dave, Dr. A.K. Kundaliya and Senior Scientists of other participating labs.

CSIR Technofest 2010 is the first of its kind event organized by CSIR to showcase its contributions in driving forward the competitive industrial growth coupled with sustainable inclusive growth towards improving the quality of living of the common masses were mainly exhibited in the technolofest. The event is a part of the India International Trade Fair (IITF) held every year at Pragati Maidan, New Delhi. This fair throws light on the potpourri of the industrial competence and cultural diversity of India, hence appealing to an drawing in millions of people from across the world, a large number of whom are also important stakeholders of CSIR.

The DG CSIR while narrating about the Technofest informed that the exhibition showcases CSIR's expertise in the field of science & technology through 15 theme pavilions. This mega event envisages to strengthen CSIR linkage with existing and potential industry partners and to effectively disseminate the benefits of knowledgebase to the masses. It also showcases CSIR's R&D competence, the technologies or products successfully used by the industry and made available for commercialization, and many more achievements of CSIR. The added attractions of the mega event are special talks, business-to-business meetings and interactive sessions with captains of the industry, leading technoprenures and academicians. This exhibition lies not so much in the exhibition itself but the spirit in which it was conceived as the industries benefited from the CSIR's knowledgebase have displayed their success ventures in the exhibition on behalf of CSIR. It is an acknowledgement of all that CSIR has contributed to the national cause.

The industry partners participated in Technofest as CBRI associates includes :

- Adlakha Associates Pvt. Ltd.
- Civil Engineering Technology Development Centre, SATI and IIHRD Vidisha
- Shivaye Namah Manufacturing Company Pvt. Ltd., New Delhi

On, the theme day of Mining, Minerals & Materials, 17th Nov.,2010 Shri Bhupesh Khanna, M.D. M/s Shivaye Namah Manufacturing Company (SNMC) Pvt. Ltd. spoke on successful transfer and absorption of the technology and appreciated the efforts of CBRI scientists in inventing the wonderful product and its successful extension to his industry.

Shri Pramod Adalakha, M/s Adalakha Associates Pvt. Ltd., New Delhi spoke on 22nd November, 2010, the theme day of CSIR-800, on his recently completed housing projects of about 15,000 housing units in Delhi using CBRI developed materials and prefab technologies like machine made Clay Bricks, Flyash Bricks, Under Ream Pile Foundation, RCC Planks & Joists Roofing units etc.

Large number of VIPs, entrepreneurs, professionals, students and common visitors keenly observed the CBRI display and exchanged their views with the Scientists. The live display of timber substitute products from industry partner, **wood without trees**, was one of the main attractions for all visitors including VIP's. Many visitors were found discussing in the crowd talking about this recent innovation of wood substitute, materials about its worth potential in preservation of the forests, ecology and nature.

The CBRI team led by the Director Prof. S.K. Bhattacharyya alongwith Shri S.G. Dave, Sc.'G', & Nodal Officer and colleagues S/Shri Rajeev, Dr. Pradeep Yadav, Dr. Sunil Sharma, Nadeem Ahmed, Rajeev Kumar Sharma explained the R&D technologies to the VIP's and large number of visitors. Shri H.K. Jain and Shri K.L. Chabbra supported in updating and making matter of the display charts in the presentable form.

The institute has now plan to further interact and pursue the interested pavilion visitors, entrepreneurs and NGO's to take up production of innovative building materials and promote their use in construction of mass housing projects so as to take the benefit of R&D to the grass root level for use of the common people.

Miracle Wood

Now Saves Trees

An interesting feature of the theme pavilion 'Mining, Minerals and Materials' in CSIR Technofest 2010 is a product ***Wood Without Trees****, based on the technology developed by CSIR-CBRI. Central Building Research Institute (CBRI), Roorkee has developed this technology using natural fiber derived from agricultural waste like husk and straws in combination with recycled plastics. The license for manufacturing products based on this technology has been given to M/s. Shivaye Namah Manufacturing Co. Pvt. Ltd. Doors, wood sheets, chairs, benches and some other furniture items made using this miracle wood was on display at the pavilion.*

• *Workshop cum Training Course on Seismic and Wind Resistant Design of Building Structures followed by International Advance School in Wind Engineering (IAS 7)*

A six days workshop cum training course jointly organized by CSIR-Central Building Research Institute (CBRI), Roorkee, and Indian Society for Wind Engineering (ISWE), Roorkee at CSIR Science Centre, New Delhi during Dec. 3-8, 2010.

The course on **Seismic and Wind Resistant Design of Building Structures** was inaugurated on 3rd Dec. 2010 by Prof. Michael Kasperski, Ruhr University, Bucham, Germany (Chief Guest), Prof. S. K. Bhattacharyya, Director, CBRI, Roorkee, India was the Guest of Honor. Dr. A.K. Mittal, Course Coordinator and Hon. Sec., ISWE presented an overview of the course and the activities of ISWE. The proceedings of introductory course were also released during the opening ceremony.

Eminent speakers like Prof. Prem Krishna, Prof. S.K. Bhattacharyya, Prof. P.D. Porey, Dr. N. Lakshmanan, Dr. S. Arunachalam, Prof. P.K. Pande, Prof. D.K. Paul, Prof. Abhay Gupta, Prof. Y. Singh, Dr. Naveen Kwatra and Dr. Achal Mittal delivered lectures on the following topics:

- Dynamics of structures
- Basic nature of wind
- Bluff body aerodynamics
- Wind loading on tall buildings with their codal provisions
- Wind loading on low rise buildings with their codal provisions
- Use of wind tunnels
- Seismic codes of India
- Structural health monitoring
- Commonalities and contradictions between wind and earthquake
- Tutorials and examples covering analysis of buildings

A large number of delegates from Govt. and private sectors were benefited from this workshop. Round table discussions also took place during the workshop. Engineers/Professionals from many organizations like Consulting Engineering Services, Mahagun India Pvt. Ltd., Mehro consultants, Construction Catalysers Pvt. Ltd., NTPC, Jaypee Associates Ltd., RWDI Consulting Engineers, HUDCO and CBRI attended the programme. Faculty members from IIT Kanpur, IT-BHU Varanasi, NIT Trichy, NIT Surathkal, NIT Durgapur and research scholars also participated in this course.

A training programme I**nternational Advance School in Wind Engineering (IAS 7)** jointly organized by CBRI, Roorkee and ISWE, Roorkee from 6th December onwards was also organized with the support of Global Centre of Excellence, Tokyo Polytechnic University, Japan.

The programme was inaugurated by Prof. Yukio Tamura, Tokyo Polytechnic University, Japan. Prof. Prem Krishna, Vice President, INAE & Chairman RC, CBRI, Roorkee, India graced the occasion and presented his views on the state of Wind Engineering in India. Prof. S. K. Bhattacharyya, Director, CBRI, Roorkee, India presided over the function. Dr. A. K. Mittal, Course Coordinator presented an overview of the activities of ISWE being carried out. The dignitaries released the lecture notes proceedings also. Experts in Wind Engineering from different parts of the world including Prof. Yukio Tamura, Japan, Prof. Michael Kasperski, Germany, Prof. YouLin Xu, Hong Kong, Prof Chii Ming Cheng, Taiwan, Prof Chris Letchford, Australia, Prof. Ted Stathopoulos, Canada, Prof. Partha Sarkar, USA, Prof. Prem Krishna, India, were invited to discuss the new areas of research that are being taken up in their respective countries and also to address the issues concerning the Indian designers and practice engineers. The ongoing areas of research and development are as follows:

- Aerodynamic database and wind resistant design of tall buildings
- e-wind: An integrated engineering solution package for wind sensitive buildings
- Wind loads on component and cladding of low rise buildings
- Test methods to assess performance of components and cladding under wind loads
- Efficient observation of random fields - meaning of POD and points to note
- Windborne debris and application to impact testing
- Climatology of extreme winds,
- Interference effect of surrounding buildings on wind loads
- Rain-wind induced and dry cable vibration of stay cables
- Damping in buildings and estimation techniques
- Aerodynamic load and response of slender structures in time domain
- Typhoon wind simulation
- Monitoring of long span bridges
- Estimation of design wind speed
- Identification of effective pressure distribution

The closing ceremony was held on 8th December, in which Prof. Yukio Tamura, Tokyo Polytechnic University, Japan, distributed the certificates to the participants. Prof. P.D. Porey, President, ISWE presided over the function and emphasized the need of similar activities in future also. Dr. Achal Kr. Mittal, Course coordinator and scientist, CBRI, Roorkee conducted the event and proposed a vote of thanks.

A feedback study was carried out by the organizers at the end of the event. From the feedback study of the participants, it was found that this workshop cum training course was highly appreciated. Suggestions for improvement were also given.

The recommendations of the workshop on the basis of feedback study are:

* The experts and the participants feel that there should be more of such courses dealing with the multi-hazard approach especially in earthquake and wind engineering.
* At present, there are very less number of wind tunnel facilities in India to cater for

the growing demand in view of extraordinary infrastructural growth. So there is a strong need for establishment of more wind tunnels in government sector (eg,. CBRI, IITs, etc,.) and also in private sector.

* International collaborative activities in the form of projects, visits, workshops, seminars, conferences, etc, should be rigorously pursued.

• CSIR-CBRI, Roorkee Flag off Lok Awaas Yatra (A CSIR-800 RSWNET Programme)

CSIR - Central Building Research Institute, Roorkee flagged off Lok Awaas Yatra of Northern Region from the Institute Technology Park, Roorkee on 6th December 2010, a programme of Basin South Asia and Development Alternatives. The main focus of the Lok Awaas Yatra programme is to spread the message and create awareness on :

* Low Carbon Construction Technologies
* Habitat infrastructure promoting use of local artisans & skills.
* Habitat based livelihoods supporting free livelihoods.
* Renewable Energy Technologies
* Water and Sanitation Technologies including rain water harvesting for ecohabitat
* Social Housing targeting government habitat schemes and
* Disaster safe durable construction

Lok Awaas Yatra is a journey to celebrate the achievements of select initiatives in rural habitat development that have improved the quality of life without environmental losses. The Yatra has been initiated for exploring pathways towards eco-habitat. Most importantly, it promotes learning from the experiences of those villages and settlements that are more sustainable, disaster resistant and most suited to the needs of the people in rural India.

The 5 regional yatras have been planned to undertake one each in Southern, Northern, Eastern, Western and Central regions across the country with overall thrust on environmental sustainability promoting towards Social Equity, Risk Reduction and People's participation.

The Northern Region yatra having about 25 participants including young Engineers and Architects, NGO representatives and students are expected to visit few recently completed model habitat projects of Uttarakhand and Himachal Pradesh and share their experiences finally with other yatra volunteers in Lok Awaas Karmi Sammelan at the National level workshop.

Many CBRI R&D achievement and construction technologies have been prominently included in a technology booklet of the yarta for generating awareness among the rural masses. Some of these includes : C-Brick, Clay Flyash Board, COIR-Cement Board, Sisalana Panels, IPN-CON Coating, IPN-RB Coating, EPS Door Shutter, Gypsum Binder, Brick Making Machine, High Draught Kiln, Vertical Shaft Lime Kiln, Sand Lime Brick Plant, Concrete Block Making Machine, Burnt Clay Fly ash Bricks and Construction Technologies like Stone Masonry Blocks, Solid Concrete Blocks, Precast Roofing Technologies, Under Ream Piles etc.

The Yatra is partnered and supported by the institutes namely BMTPC, BSHF, UCRS catholic Relief Services, National Housing Bank, oneworld.net, Dusty Foot, Department of Planning and Development, Government of Bihar, Knowledge Works, Basin South Asia Secretariat and the Key NGO organizations associated with the Northern Region Yatra includes - Technology and Research Network Welfare Society (Tarn) Dehradun, HESCO, Dehradun and Centre for Sustainable Development, Sundernagar, H.P.

At CBRI, the yatra participants were given a technical exposure on CBRI developed materials and construction technologies, their use in model habitat projects and the ongoing CSIR-800 RSWNET programme. They were also given a few handouts/brochures recently brought out by the institute and the live demonstration of technologies at Rural Technology Park of the institute.

After the flag off function, the yatra further began its march to Dehradun to visit other habitat demonstration projects in Uttarakhand. Subsequently, the Yatra visited Sundernagar, Himachal Pradesh to march and share with their experiences.

The yarta is a new beginning, may be the first of its kind, towards the joint effort with related partner stake holders to reach and extend appropriate rural eco-habitat technologies by sharing mutual experience of associated agencies all across the country as a part of an activity under CSIR-800 RSWNET programme at CBRI, Roorkee.

• *INDO-US Workshop on Nanotechnology in the Science of Concrete*

The INDO-US Workshop on **Nanotechnology in the Science of Concrete** was held at CSIR-CBRI, Roorkee during 14-15 December 2010. The workshop was jointly organized by CSIR-CBRI and INDO-US Science & Technology Forum (IUSSTF), New Delhi. Uttarakhand State Council for Science and Technology (UCOST), Dehradun also supported the workshop. The objective of the workshop was to arrive at appropriate direction of research in the area of concrete and possible collaborative activities between Indian and US institutions with industrial support in the area of concrete research with impetus on Nanotechnology.

Distinguished speakers from US and India participated and deliberated in the workshop with their thought provoking presentations and deliberations. Eminent speakers from US side included, Prof. S.P. Shah, Director, Centre for Advanced Cement Based Materials, Northwestern University, Illinois; Dr. Paramita Mondal, University of Illinois, Urbana Champaign; Dr. N. Neithalath, Clarkson University; Dr. Zachary C. Grasley, Texas A&M University and Prof. R. Panneer Selvam, University of Arkansas. From Indian side, Prof. B. Bhattacharjee, IIT, Delhi; Prof. Ananth Ramaswamy, IISc, Bangalore; Prof. Ravindra Gettu, IIT, Madras; Prof. Sudhir Mishra, IIT, Kanpur; Dr. Absar Ahmad, Scientist, CSIR-NCL, Pune; Dr. Rakesh Kumar, Scientist, CSIR-CRRI, New Delhi, Dr. Umesh Sharma, IIT, Roorkee and from industry side Dr. Subrato Chowdhury, Joint President, UltraTech, Mumbai and Dr. Chetan Hazaree, R&D Manager, HCC, Mumbai made their respective presentations. Three presentations from CSIR-CBRI were made by Prof. S.K. Bhattacharyya, Director, Dr. L.P. Singh, Scientist (Workshop Coordinator) and Dr. P.C. Thapliyal, Scientist.

The Workshop was divided in four thematic sessions viz. (i) Synthesis & Modification of Materials at Nanoscale (ii) Nanoscale Characterization (iii) Design and Modeling of Materials Based on Nanotechnology and (iv)

Performance Enhancement of Concrete. The speakers made their presentations in the respective areas. Thematic group discussion was followed on the topics viz. (i) Nanoscale Modification and Characterization (ii) Design and Modeling of Material at Nanolevel and (iii) Nanotechnology for Sustainable Development. The two days presentations, brainstorming and discussion emerged out with the following futuristic goals:

It was clearly emerged out that to achieve ultra high strength and durable concrete, it is necessary to focus on the fundamental research with the applications of Nanotechnology in the area of concrete. It is essential to understand the behavior of cement paste at nano level to obtain durable concrete material.

* To establish a research consortium amongst Universities and Institutions to promote and lead nanotechnology based concrete research. It is very important to form a coalition of major research groups to generate knowledge base.
* The consortium shall include experts on construction materials, materials scientist, computational modeling etc.
* To establish a website on key research progress and outcomes in the area of concrete with emphasis on nanotechnology. The website will also secure/establish a link amongst researchers during research in progress.
* To create a bilateral forum for interaction amongst S&T community of both countries to establish broader strategies.
* Creation of network of scientist, technologists and entrepreneurs to work together to promote joint research and development to foster the mutually beneficial innovation and entrepreneurship.

• Republic Day

The Republic Day was celebrated at the Institute on January 26, 2011. Prof. Sriman Kumar Bhattacharyya, Director unfurled the National Flag and addressed the members of the staff. Children of Bal Vidya Mandir and CBRI Junior High School presented cultural programme. The CBRI staff club distributed sweets on the occasion.

• Participation in Rural Technology Mela

The Institute participated in Rural Technology Mela, Hyderabad during 2-5 February 2011. While inaugurating the rural mela exhibition, Shri Mathew C. Kannumkal, IAS, DG, NIRD spoke about the relevance and importance of the fair. He informed that this is the 8th rural craft mela organized at RTP, NIRD, Hyderabad and this time the mela has been arranged especially focusing on rural technology transfer. He further informed that NIRD aims to reach to 1 lakh village people to help in resolving their sustainable livelihood problems and invited participation of all stake holders in this endeavour.

Over 150 Govt. organizations and NGO's associated with Rural Development activities had participated and displayed their technologies and products/crafts in mela which was witnessed by over 1 lakh entrepreneurs, professionals, NGO's, villagers and students.

Besides CBRI, the other 7 CSIR institutions participated in mela/workshop include :

* Indian Institute of Chemical Technology, Hyderabad
* National Geophysical Research Institute, Hyderabad
* Institute of Himalayan Bioresource Technology, Palampur
* Central Food Technological Research Institute, Mysore
* National Environmental Engineering Research Institute, Nagpur
* Institute of Minerals and Materials Technology, Bhubaneshwar
* Advanced Material and Processes Research Institute, Bhopal

DG, NIRD and Prof. Senthil Vinayagam, the programme coordinators visited CBRI exhibition stall and held encouraging dialogues with the pavilion scientist. He desired to have closer interaction with CBRI, Roorkee in popularizing the housing technologies all over the country. The Chief Guest was told about CSIR-800 RSWNET Programme and other CBRI achievements. Dr. Senthil further informed that NIRD has been asked by the Govt. of Afghanistan to set up similar institute in Afghanistan and would invite CBRI, Roorkee to associate in this task.

CSIR-AMPRI, Bhopal jointly with NIRD, Hyderabad organized a One Day National Workshop on Rural Technologies for Sustainable livelihood on 4th February, 2011 which was attended by over 80 Senior delegates, executives, NGO, Exhibitors and representatives from DST etc.

The workshop was inaugurated by Dr. G. Perumal, Former Director of Extension Education, TNAU Coimbatore social activists & reformer and chaired by Dy. DG, NIRD. Sh. S.G. Dave, Chief Scientist, CBRI, Roorkee presented a case-study paper on **Field Demonstration of Appropriate Low Cost Housing in 7 regions of India** which evoked a considerate interest among participants. Large number of college and school childrens from several educational institutions of the city specially visited the mela and spent their one day time in exhibition interacting with stall exhibitors.

Interestingly many cost effective rural housing technologies were on display in the RTP of NIRD mela through permanent demonstration and house models. Over 20 technologies of CBRI have been already displayed and few model construction of housing invite attention of the visitors regularly.

• *CBRI Foundation Day*

The Institute celebrated its 65th foundation day on 10th February 2011 with usual gaiety and fanfare. The institute, which is one of the leading units of the Council of Scientific and Industrial Research (CSIR) was set up in 1947 to develop technology suited to people of different income groups in various geo-climatic regions of the country with focus on indigenous material, local skills and eco friendly approach.

Some of the landmarks achieved by the institute are the utilization of agricultural and industrial wastes for building materials, developing technology for earthquake resistant construction, rehabilitation work in natural disasters hit areas in the country and development of a device of gravitational and settling chambers of brick kilns to make them pollution free.

Speaking on the function organized on the occasion, the Chairman of the Kinetic Engineering Ltd., Pune, Mr. Arun H. Firodia said that the CSIR- CBRI should use its technology to develop model villages where people should feel proud to live in and stop migrating towards the cities. He further said that the task of the constructing cost effective and durable habitats, in sync with the requirements of a particular region, could only be achieved by combining applied engineering and research. "If we could do so, the whole scenario of the country, through building model villages , will undergo a radical transformation within the next 30-40 years", he remarked.

The former director of the institute, Dr Rajendra Kumar Bhandari , Guest of Honour, lauded the pioneering efforts of the institute in providing most appropriate economic solutions for housing to the poorest of the poor while also providing expertise for the highly specialized structures in the country. Highlighting the recent strides taken by the institute, Prof. S. K. Bhattacharyya, Director said that the institute is fully geared up, to face the challenges of future. Steps have been initiated to meet human resources crunch and along with research, higher studies courses have been launched in the institute. Prof. S.K. Bhattacharyya, Director highlighted a new vision and the thrust of the forthcoming R&D programmes of the Institute.

The foundation day function was also marked with the release of the CBRI Annual Report 2009-10, CBRI Information Brochure and a booklet on Ferro Cement at the hands of the dignitaries on the dias.

On this occasion, a Diamond Jubilee Director's award specially instituted for development of technology/innovation/know-how having maximum societal impact for the year 2010-11 was given jointly to Dr. B. Singh and Dr. Manorama Gupta, Scientists for their work on *"Production of Bituminous Polyurethane Water proofing/Sealing Compounds".*

The award comprises of a citation and cash award of Rs.5000/-. The technology know how was recently transferred to the industrialist who intends to set up a manufacturing plant at Gwalior, Madhya Pradesh.

The function was convened by Sri Y. Pandey, Scientist F of the institute. He briefed on the history of the institute highlighting its main R&D achievements, professional & societal contribution of CBRI in resolving and overcoming the problems of durable, safe and economical housing for the people of the country. He also introduced the guests to the audience. Sri S.G. Dave, Scientist `G' presented a vote of thanks.

• *National Conference on Landslide Hazards - Consequences & Challenges*

CSIR-Central Building Research Institute, Roorkee organised a three days National Conference on "Landslide Hazards - Consequences & Challenges" during 10-12 February 2011. The conference was organized to provide a platform to the scientists and academicians to discuss and transfer the knowledge into field practice to reduce the impact of disaster.

Many experts, academicians, scientists, practitioners, policy makers and students from different parts of the country participated in the conference. The conference was inaugurated by the Chief Guest Mr. B. Bhattacharjee, Member, National Disaster Mitigation Authority, New Delhi. The inaugural function was presided by Prof. S. K. Bhattacharyya, Director, CBRI and Patron of the conference. The theme lecture of the conference was delivered by Dr R.K. Bhandari, Former Director, CBRI.

The Abstract volume, which contains 42 papers, was also released in the inaugural function. The papers were presented in 6 technical sessions in the areas of hazard & risk mapping, instrumentation, monitoring & warning, impact of climate change, geotechnical investigation, slope stability analysis and control measures. Conference proceedings with full length papers and key note lectures will be published as post conference volume.

After three days of deliberations, it was recommended that dialogues have to be initiated amongst various organizations to form teams to undertake important issues both on the policy levels and on the implementation level. The Valedictory function was chaired by Shri G.M. Prasad, General Manager, THDC.

The conference was sponsored by CSIR, Ministry of Earth Sciences, NDMA, NIDM, AIMIL Ltd. and THDC and co-sponsored by National Jute Board and NTPC Ltd. The participant hoped that the policy makers, researchers and the field engineers were benefited by the deliberations during the conference and will be able to draw a framework to meet the challenges associated with landslide disaster.

• *National Conference on Recent Advances in Ground Improvement Techniques*

A two days **National Conference on Recent Advances in Ground Improvement Techniques (RAGIT 2011)** has been organized by CSIR-CBRI Roorkee in association with Indian Geotechnical Society, Roorkee chapter during 24- 25 Feb 2011 at CSIR-CBRI Roorkee. Increased building construction activities and scarcely available suitable land, particularly in metropolitan cities, poses a challenge for Civil Engineers. This obviously, demands adoption of some suitable ground improvement techniques that are becoming favourable choices for the utilization of all types of grounds having weak sub soil deposits. This becomes an essential need for construction of foundations of civil engineering structures. These project sites in the past have been rejected otherwise due to low bearing capacity. During the recent decades, many innovative techniques have been developed for ground improvement. Now, the present day demands to use even the land having poorest bearing capacity, such as - the reclaimed land near sea shores having marine clay etc. In such situations, rejection of project site becomes almost impossible. Few such ground improvement technique popular in the present day practice include earth walls, stone columns, soil nailing, deep grouting, dynamic consolidations and many more. These are being applied to achieve significant savings in the time, cost and effort. At the same time, adopting these techniques, civil engineers may convert these weak grounds to behave as per the design requirements for providing foundations with adequate safety. All such aspects require even more attention. The conference was organized considering an important aspect - Ground Improvement.

The conference was aimed at bringing together the design, research and practicing engineers working in the field of geotechnical engineering to foster and promote exchange of ideas on the recent advances in the field of **ground improvement**. The Conference themes were -

- Mechanical and Chemical Stabilisation of Soils
- Accelerated Consolidation of Clayey Soils
- Deep compaction of Granular Soils
- Soil Reinforcement
- Grouting
- Thermal Stabilisation of Soils
- Deep Soil Mixing, Micropiles, Stone Columns, Granular Piles
- Innovative Techniques in Ground Improvement

- Evaluation of Ground Improvement
- Environmental Aspects.

The Conference was inaugurated by Prof. Prem Vrat, Former Director (IIT Roorkee) & Former Vice Chancellor (U.P. Technical University) as Chief Guest. A Conference proceeding in the form of Book and CD on this occasion has also been released. The function was also graced by Prof. S.K. Bhattacharyya, Patron of Conf. & Director CBRI, Prof. Gopal Ranjan, Prof. K.S. Rao, President, IGS National Body.

A number of National and International Experts from field and academic front have presented their papers. Six Key Note Speakers invited were Prof. Robert Liang (USA), Dr. V.R. Raju (Singapore), Prof D. M. Dewaikar (IIT Bombay), Prof M. R. Madhav, Prof. Sarvesh Chandra & Prof. Basudhar (IIT Kanpur) and contributed papers by authors from other reputed institutions and organizations. All of them have presented their papers and highlighted the field problems or experimental investigations carried out related to different aspects of Ground Improvement Techniques. The research work being carried out during the recent few years has been discussed in details by these Key note speakers who are amongst the best few research workers in this field of research. Prof. Gopal Ranjan, Former IGS president and Chairman has delivered his theme-speech on this topic, whereas Prof. S. K. Bhattacharyya, has appreciated the effort of IGS Roorkee chapter to associate with CBRI to organize this National Conference on the emerging research area - Ground Improvement, which is the need of present day for a common man. This is also in order with the present research programmes of ongoing research activities at CBRI. Prof. Prem Vrat, has encouraged the participants to seriously work in near future on problems related to ground improvement. He is of the opinion that working out for various problems related to the theme shall certainly be useful to take care of building construction activity on the scarcely available land particularly in the urban area of the country or on the land which is hardly suitable for construction of civil engineering structures.

The general opinion of everyone participated in this event is that in view of rapid infrastructural development all over world & in India as well, all civil engineers have to adopt some ground improvement technique, particularly when the foundations are to laid on weak sub soil deposits before any Civil Engineering structure is constructed. This becomes more relevant in the present scenario when the suitable lands are scarcely available & construction activities are essentially required to be carried out on the weak lands that may not be adequate to support the foundation with safety.

Prof K.S. Rao, Professor (IIT Delhi) & President, IGS (National Body) has appreciated the initiative of IGS Roorkee chapter for selecting such an important theme for this Conference. He has also described the various activities and initiatives of the national body of IGS for information of delegates participating from different parts of the country.

The valedictory function of the Conference was held on 25th Feb. 2011. Prof. Prem Krishna, Chairman, Research Council, CBRI, Roorkee & former Head, Civil Engineering Department, Univ. of Roorkee was the Chief Guest. Prof. S K Bhattacharyya, Prof Rampal Singh, Dr Pradeep Kumar (Org. Secy.) also graced the occasion.

In the Feed back sessions, the participants and key note speakers have appreciated the efforts made by the organizers.

National Science Day

The Institute celebrated National Science Day on 28th February, 2011 to commemorate Raman Effect of the Nobel Laureate Sir C.V. Raman. The day celebration offers an opportunity to bring issues of science in the centre stage and provide awareness to the public of immediate concern. This results into purposeful interaction between the science fraternity and the common people for mutual benefit.

Prof. S.K. Bhattacharyya, Director, CSIR-CBRI narrated the contribution of Sir C.V. Raman in the field of Spectroscopy for a wide range of scientific investigations and industrial applications. He stressed the role of National Science Day's objectives in transforming our society. CBRI is pursuing faculty training and motivation for School and College faculty and students - A programme of CSIR to create interest, excitement and excellence in science education at the school and undergraduate level to raise the standard of science education and capabilities. He felt that it is an opportunity to take stock on the status of science in India. Such introspection is necessary as science and technology have become the most important drivers of the economy of the country.

On this occasion of National Science Day, Prof. T. Nautiyal, Department of Physics, IIT, Roorkee delivered National Science Day lecture on "Nanomaterials : A journey from Bulk to Nano". Her lecture had been widely appreciated by the scientists and college students. She had also interacted with college students on the models and charts prepared by them. An exhibition on Building Materials was also organized by Dr. B. Singh, Sc. 'F'. Dr. L.P. Singh, Scientist proposed a vote of thanks.

Participation in COGNIZANCE 2011, IIT Roorkee

As a part of creating awareness of Alternative Cost Effective Materials and Technologies among the Engineering students of different institutions, the CSIR-Central Building Research Institute, Roorkee participated in the 'COGNIZANCE 2011' organized by the Department of Metallurgical & Materials Engineering, Indian Institute of Technology, Roorkee during March 11 -13, 2011.

The Institute displayed its appropriate cost effective building materials and technologies by way of colorful and impressive charts on :

- Pine Needle Composites
- Geo-polymer Banded Bricks
- Panels and Door Shutters
- Concrete Masonry Blocks
- Improved Brick Production Technologies
- R&D on Fly-ash Utilization
- Wood Alternative using Plywood Vneer Waste
- Thermal Insulation Tile using Exfoliated Vermiculite Waste

About 500 professors and engineering students from various IITs, NITS and engineering colleges of the country witnessed the exhibition.

In the concluding session Prof. S K Bhattacharyya, Director CSIR-CBRI Roorkee, who was the chief guest of the function apprised the guests and gathering on the CBRI R&D activities and PG course. The students showed a keen interest in Post Graduate Research Programme in Engineering in EIDM and sought to know more about selection procedure for admission.

• Participation at Raj Bhawan, Dehradun

CSIR-CBRI has been showcasing its R&D efforts in various parts of the country through exhibitions, demonstrations, training programmes especially on Earthquake Resistant Buildings, construction of cost effective housing in rural and urban areas etc. On the request of Lok Nirman Vibhag, Uttarakhand, the Institute participated in 'Spring Festival' (Basant Utsav) organized by Lok Nirman Vibhag Uttarakhand Govt at Raj Bhavan , Dehradun during 4-6 March, 2011.

Her Excellency Mrs. Margrate Alva , Governor of Uttarakhand inaugurated the event and visited CBRI stall along with Shri Tripendra Singh Rawat Minister for Animal, Husbandry and Dairy Development, Uttarakhand State, Secretary & Deputy Secretary to Governor and some other dignitaries & important officials and also interacted with CBRI Scientists. There were about twenty five stalls in the festival including G.B. Pant University of Agriculture and Technology, Pant Nagar, Tea Development Board, Almora, Uttarakhand Akshya Urja Vikas Abhikaran etc.

The visitors were informed about the green building materials & technologies developed by CBRI appropriate to the state including Concrete Blocks, Prefabricated Building Components, Fly Ash C-bricks, Calcium Silicate Bricks, Clay fly ash bricks Pollution Control System for Lime Kilns, Pollution Control Settling Chamber for Brick Kiln, Improved Rural Mud Housing Technologies and Low Cost Sanitation Pine Needle Composite Boards, Geopolymer Bricks, Rice Husk Plastic Wood , Natural Fibre Composite Panels and Door Shutters, etc.

CBRI stall was witnessed by hundreds of people including several political leaders, Govt. officers, students, entrepreneurs, officials of voluntary organisations and other common people. All took keen interest in CBRI technologies. CBRI publications were distributed among interested visitors.

The stall was looked after by Shri Ashok Kumar, Scientist E-II, Sh. K. L. Chhabra, Tech. Officer & Mr. Prem Lal Tech, CBRI. The benefits of the creation of awareness regarding appropriate CBRI technologies may have reached thousands of people of local and surrounding areas.

• Faculty Training and Motivation and Adoption of Schools & Colleges

One day workshop on Faculty Training and Motivation and Adoption of Schools & Colleges 29 March, 2011 organized at CSIR-CBRI, Roorkee by Vigyan Prasar, Deptt. of Science & Technology, Govt. of India.

Vigyan Prasar (VP) has been engaged in extensive in-house research conceptualizing different programmes of science & technology. All the programmes are evolved by understanding the needs and requirements of the users at different levels and are designed and developed with an objective to create scientific awareness among the faculty members and students.

The scientists of VP organize one day workshop at CBRI Roorkee to promote interest, excitement and excellence in science education for students and faculty members of schools and colleges of Roorkee under Faculty Training and Motivation and Adoption of Schools & Colleges programme of CSIR. The Mr. R. Nath and Mr. Kapil Tripathi Scientists of VP organized a one day workshop at CBRI.

Twelve science faculty members and more than fifty students of following six schools and colleges of Roorkee participated in the workshop:

- K.L. DAV (PG) College, Roorkee
- Methodist Girls Inter College, Roorkee
- 7th Day Adventist Inter College, The Retreat, Roorkee
- Government Inter College, Roorkee.
- Bal Vidya Mandir School, CBRI, Roorkee
- CBRI Junior High School, CBRI, Roorkee

In addition to this Mr. H.K.Jain, PTO and Mr. Nagesh Babu Balam, Scientist 'C' CBRI, Roorkee have attended this Workshop.

The Workshop was inaugurated by Sh. S.G. Dave, Chief Scientist and Head (DC&E), CBRI who is also one of the Adviser of the programme and coordinated by Dr. P.K.Bhargava, Sc.'F' and Coordinator of the programme. Sh Dave during inauguration informed that workshop is a unique opportunity for school students to learn basic principles of science through real experiments. Such experience gained in workshop will imprint on the minds of the students and create permanent impression which will benefit to the students and their families.

Scientists of VP demonstrated Innovative Activities in the workshop covering experiments, demonstration of scientific kits etc. Mr. R.Nath told that 'Innovation has no boundaries'. Scientists from VP demonstrated Hands-on-Innovative activities covering the basic principles of Physics on :

- Basic principles of reflection and refraction of light
- Convergence and divergence of light rays
- Experiments based on the phenomenon of surface tension
- Effect of Pressure on boiling point of water
- Induced magnetic induction experiments based on Fleming's Left Hand Rule and Lenz's law
- Demonstration of Newton's laws

PC Interface science experiment on following activities were also demonstrated

- Measurement and control of light intensity using light sensor (LDR)
- Temperature measurement and control using temperature sensor
- Measurement and control of sound intensity using sound sensors

Kits on 'Emergent of Modern Physics' and CDs on 'Innovative Activities in Physics' were distributed to participants by Sh. S.G.Dave, Adviser of the programme.

The activities of the workshop were successfully completed mainly due to encouragement, motivation and continuous guidance of Prof. S.K.Bhattacharyya, Director CBRI, Roorkee.

Dr. P.K.Bhargava, SC(EB) & Coordinator of the programme said that one day workshop on demonstration of basic principles & laws of Physics are great opportunity to students and faculty members to learn and interact with senior and experienced scientists of VP. This will certainly be useful to create scientific awareness and interest towards science among the faculty members and students of various schools and colleges participated in the workshop. The VP scientists have demonstrated these experiments in such a way that participants can easily perform the experiments by themselves using very simple devices. The kit on 'Emergence of modern Physics' and CD given to faculty members and students will provide benefit for all. Dr. Bhargava appreciated the efforts of VP scientists in conducting the workshop and also thanked the faculty members and students who participated in the workshop.

Colloquium

The Following Colloquims were given during the period

Date	Delivered By	Title
07.04. 2010	Dr. Bikash Chandra Raymahashay Ex Prof. Geology, Civil Engg. Dept. IIT, Kanpur	Weathering of Stone Monuments
09.04. 2010	Prof. (Dr.) H.P. Garg, Vice Chairman, BLS Group of Institutions, New Delhi	Energy Outlook: Key Trends
28.04.2010	Dr. Abha Mittal and Smt. Neeta Mittal, Scientists CBRI	Work Life Balance for Women Scientists
05.05.2010	Dr. D.P. Kanungo, Scientist CBRI	Landslide Hazard and Risk Assessment
19.05.2010	Dr A K Pandey, Scientist CBRI Roorkee	Shrinkage and Other Cracks in Pavement Quality Concrete
25.05.2010	Dr. Purnendu Parhi Postdoctoral Fellow, Pennsylvania State University, USA	Synthesis and Characterization of Micro and Nano Ceramics
02.06.2010	Shri Pravin Goel , Business Head, Jindal Stainless Limited. New Delhi	Stainless Steel Plumbing
10.06.2010	Prof. J N Mandal, Professor, IIT Bombay	Development and Designing with Geosynthetics Clay Liners For landfills
23.06.2010	Dr. B K Rao, Scientist, CBRI	The Role of Fly ash in Concrete & Permeability as the Criterion for the Durability of Concrete
25.06.2010	Prof. V. Kodur, Michigan State University USA	World Trade Center Disaster: Stimulus for Fire Safety Innovation
01.07.2010	Shri S G Dave, Scientist, CBRI	CSIR – 800 at CBRI : Potential & Achievements
06.07.2010	Prof. K S Rao, IIT Delhi	Slope Stability Analysis of Chenab & Anjikhad Bridge Abatement
14.07.2010	Shri S C Tyagi, COA and Dr. P K Bhargava, Scientist, CBRI	Planning for Life after Retirement
26.07.2010	Dr George Sergi, Technical Director, Vector Corrosion Technologies	Investigation, Testing & Remediation of Steel Reinforced Concrete
29.07.2010	Shri R K Jain, AGM, CEL Sahibabad	Solar Photovoltaic Power Plant

04.08.2010	Dr. B M Suman, Technical Officer, CBRI	Impact of Different Technologies on Energy Conservation in Buildings
11.08.2010	Dr. Navjeev Saxena, Scientist, CBRI	Seismic Response of an Un-reinforced Brick Masonry Building
17.08.2010	Dr. Martin Gillie, Lecturer, Structural Fire safety Engineering Institute for Infrastructure and Environment The University of Edinburgh, UK	Introduction to Structural Engineering for Fire Resistance
25.08.2010	Dr. S. P. Agrawal, Scientist, CBRI	Plant Cost Estimation And Feasibility
01.09.2010	Shri Ashok Kumar, Scientist, CBRI	Glass: A Versatile Modern Building Material(Use of Glass in Buildings)
08.09.2010	Dr. Suvir Singh, Scientist, CBRI	Fire Safety Engineering and Structures in Fire
14.09.2010	Shri Y. Pandey, Shri S K Negi and Shri A K Sharma, Scientists, CBRI	LEH : Cloudburst Devastation & Construction Practices
29.09. 2010	Ms. Alpa Sheth, Managing Director, Vakil Mehta Sheth Consulting Engineers, Mumbai	New Trends in the Structural Framing Systems Design of Tall Buildings – Use of Flat Slabs with Central Shear Wall Core
05.10.2010	Ms R. Deepthi, Scientist, CBRI	Control of Vortex Induced Oscillations of Chimney
13.10.2010	Dr. B S Rawat, Scientist, CBRI	Kashthaharika
20.10.2010	Dr Vasant G.Havanagi, Scientist, Central Road Research Institute, New Delhi	Overview of Specifications and Construction Practices of Road Embankment and Pavement Layers.
03.11. 2010	Dr. R. K. Goel, Scientist Central Institute of Mining & Fuel Research, Regional Centre, CBRI Campus, Roorkee	Tunnelling in the Himalayas
26.11.2010	Dr. Dipyan Sanyal, Scientist, CGCRI Kolkatta	Smart NDT & SHM for Civil Infrastructure with Hybrid Optoacoustic Sensors
01.12. 2010	Mr. Sean Collins Myrtle Beach, Fire Department, USA	Firefighting (Share his Experiences during Firefighting)

16.12. 2010	Prof. R. Panneer Selvam Department of Civil Engineering, BELL 4190, University of Arkansas, Fayetteville (USA)	Building and Bridge Aerodynamics using Computational Wind Engineering
05.01 2011	Prof. S K Bhattacharyya, Director, CBRI Roorkee	Response Control of Buildings Using Tuned Liquid Dampers
12.01.2011	Dr. B K Rao, Scientist, CBRI	Performance of Concretes with Mineral Admixtures against Chloride Ion Penetration, Carbonation and Corrosion
19.02 2011	Shri Y. Pandey, Scientist, CBRI	Concepts of Landslide Warning
09.02 2011	Dr. B. Singh, Scientist, CBRI	Polymer Modified Bitumen
09.03.2011	Dr. Neeraj Jain, Scientist, CBRI	Environmental Audit For Chemical & Process Industries- A Case Study for Cement Industries
16.03. 2011	Dr. N K Saxena, Scientist, CBRI	Fire Hazards & their Minimization through Passive Fire Protection
23.03. 2011	Shri R K Garg, Scientist, CBRI	Housing the Urban Poor: Challenges and Opportunities

As on 31 March 2011

Group-IV-Scientific Staff

Sl. No.	Name	Designation
1.	Prof. S.K. Bhattacharyya	Director
2.	Sh. M.P.Singh	Scientist G
3.	Sh. S.G.Dave	Scientist G
4.	Dr.B.Kameshwara Rao	Scientist G
5.	Sh. A.Ghosh	Scientist G
6.	Dr.Sunil Kumar Sharma	Scientist G
7.	Dr. (Ms.) Manju Mittal	Scientist F
8.	Dr. P.K.Bhargava	Scientist F
9.	Sh. R.K.Garg	Scientist F
10.	Dr. S.P.Agarwal	Scientist F
11.	Sh. V.K.Sharma	Scientist F
12.	Dr. S.K.Saini	Scientist F
13.	Sh. Y.Pandey	Scientist F
14.	Dr.(Ms.)Abha Mittal	Scientist F
15.	Dr.A.K.Minocha	Scientist F
16.	Sh. R.S.Chimote	Scientist F
17.	Dr.Brajeshwar Singh	Scientist F
18.	Dr. Suvir Singh	Scientist F
19.	Dr.N.K.Saxena	Scientist F
20.	Dr.S.K.Agarwal	Scientist E-II
21.	Ms. Neeta S. Mittal	Scientist E-II
22.	Dr.A.K. Pandey	Scientist E-II
23.	Sh. Ashok Kumar	Scientist E-II
24.	Sh. Surender Kumar Negi	Scientist E-II
25.	Dr.Shantanu Sarkar	Scientist E-II
26.	Dr.(Ms.) Mridul Garg	Scientist E-II

Sl. No.	Name	Designation
27.	Dr.Harpal Singh	Scientist E-II
28.	Dr.Pradeep Kumar-I	Scientist E-II
29.	Dr.(Ms.)Manorama Gupta	Scientist E-II
30.	Dr.Atul Kumar Agarwal	Scientist E-II
31.	Sh. A.K. Sharma-I	Scientist E-II
32.	Sh. Rajendra Kumar	Scientist E-II
33.	Sh. A.A.Ansari	Scientist E-II
34.	Sh. Nadeem Ahmad	Scientist E-II
35.	Dr.(Ms.) Rajni Lakhani	Scientist E-II
36.	Dr.Achal Kumar Mittal	Scientist E-II
37.	Dr.D.P.Kanungo	Scientist E-II
38.	Dr.S. Karthigeyan	Scientist E-II
39.	Dr.Sukhdeo Rao Karade	Scientist E-II
40.	Sh.. S.K. Singh	Scientist E-I
41.	Dr.Rajesh Deoliya	Scientist E-I
42.	Dr.Pradeep Kumar-II	Scientist E-I
43.	Dr.Sujit Kr.Saran	Scientist E-I
44.	Dr.Navjeev Saxena	Scientist E-I
45.	Sh. S.K.Jain	Scientist E-I
46.	Sh. A.P.Chourasia	Scientist E-I
47.	Dr.B.S.Rawat	Scientist E-I
48.	Dr.P.C. Thapliyal	Scientist E-I
49.	Dr.Rajesh Kumar Verma	Scientist E-I
50.	Sh. Shorab Jain	Scientist E-I
51.	Sh. S. K.Panigrahi	Scientist E-I
52.	Sh. V.Srinivasan	Scientist E-I

Sl. No.	Name	Designation
53.	Dr.P.K.S.Chauhan	Scientist E-I
54.	Sh. H.C.Arora	Scientist E-I
55.	Dr.Lok Pratap Singh	Scientist E-I
56.	Dr.(Ms.) Leena Chourasia	Scientist C
57.	Dr.Neeraj Jain	Scientist C

Group III Technical Staff

Sl. No.	Name	Designation
58.	Dr. Rajiv Kumar	Principal T.O.
59.	Sh. H.K.Jain	Principal T.O.
60.	Sh. Ajay Singh	Principal T.O.
61.	Sh. K.L.Chhabra	Principal T.O.
62.	Sh. Ramesh Chandra	Principal T.O.
63.	Sh. Deepak K. Sehgal	Principal T.O.
64.	Sh. N.S.Tyagi	Principal T.O.
65.	Sh. S.K.Srivastava	Principal T.O.
66.	Sh. Sudhir Sharma	Principal T.O.
67.	Sh. Ashok Kr.Sharma-II	Principal T.O.
68.	Sh. Suresh Kumar	Principal T.O.
69.	Sh. R.K.Yadav	Principal T.O.
70.	Sh. Rajesh Kumar	Senior T.O.(3)
71.	Sh. Narendra Kumar	Senior T.O.(3)
72.	Dr.B.M.Suman	Senior T.O.(3)
73.	Sh. Prakash Chand	Senior T.O.(3)
74.	Sh. Rajeev	Senior T.O.(3)
75.	Sh. Jaswinder Singh	Senior T.O.(3)
76.	Dr.P.K.Yadav	Senior T.O.(3)
77.	Sh. Bhupal Singh	Senior T.O.(3)
78.	Sh. S.K.Senapati	Senior T.O.(3)
79.	Sh. Dalip Kumar	Senior T.O. (3)
80.	Sh. Sushil Kumar	Senior T.O. (2)
81.	Dr.M.K.Sinha	Senior T.O.(2)
82.	Sh. S.K.Gupta	Ex.Er.Gr.V (5)
83.	Sh. Zamir Ahmad	Senior T.O.(2)
84.	Sh. A.K.Jain (SE)	Senior T.O.(1)
85.	Sh. Rajeev K. Sharma	Senior T.O.(1)
86.	Sh. Rakesh Kumar-II	Senior T.O.(1)
87.	Sh. Vivek Sood	Senior T.O.(1)
88.	Sh. Jalaj Parashar	Senior T.O.(1)
89.	Sh. Naresh Kumar	Senior T.O.(1)
90.	Sh. Ram Ashray Rai	Senior T.O.(1)
91.	Sh. Bharat Bhushan	Senior T.O.(1)
92.	Sh. Rajesh R.Ghadse	T.O.
93.	Sh. Itrat Amin Siddiqui	T.O.
94.	Sh. B.K.Kalra	T.O.
95.	Sh. Amit Kush	T.O.
96.	Ms. Deepti Karmakar	T.O.
97.	Sh. Ajay Dwivedi	S.T.A.
98.	Ms. Gayatri Devi	T.A.
99.	Sh. Sameer	T.A.
100.	Sh. D. S.Dharmshaktu	T.A.

Group II

Sl. No.	Name	Designation
101.	Sh. A.P. Sharma	Senior Tech.(2)
102.	Sh. Prem Lal	Senior Tech.(2)
103.	Sh. Shiv Kumar	Senior Tech.(2)
104.	Sh. Virendra Singh	Senior Tech.(2)

Sl. No.	Name	Designation
105.	Sh. Shiv Dass (SE)	Senior Tech.(2)
106.	Sh. R.P. Gupta (SE)	Senior Tech.(2)
107.	Sh. Kuldeep Singh	Senior Tech.(2)
108.	Sh. S.P. Vardhya	Senior Tech.(2)
109.	Sh. Rizwanul Hasan	Senior Tech.(2)
110.	Sh. Naval Singh	Senior Tech.(2)
111.	Sh. C.S.Mayl	Senior Tech.(2)
112.	Sh. Govind Singh	Senior Tech.(2)
113.	Sh. M.K.Nazir	Senior Tech.(2)
114.	Sh. Rajender Kumar	Senior Tech.(2)
115.	Sh. Kirpal Singh	Senior Tech.(2)
116.	Sh. Chottey Lal (SE)	Senior Tech.(2)
117.	Sh. Surendra K. (SE)	Senior Tech.(2)
118.	Sh. Bishan Lal	Senior Tech.(2)
119.	Sh. Nankanwar Singh	Senior Tech.(2)
120.	Sh. Gopal Chand	Senior Tech.(2)
121.	Sh. Har Sagar Sharma	Senior Tech.(2)
122.	Sh. P.K.Yadav	Senior Tech.(1)
123.	Ms. Neelam Gupta	Senior Tech.(1)
124.	Sh. Prem Singh	Senior Tech.(1)
125.	Sh. Sheeraj Ahmed	Senior Tech.(1)
126.	Ms. Saroj Rani	Senior Tech.(1)
127.	Ms. Sangeeta Sharma	Senior Tech.(1)
128.	Sh. Anil Kumar Sharma	Senior Tech.(1)
129.	Sh. Rishi Pal Singh	Senior Tech.(1)
130.	Sh. Sushil Kumar	Senior Tech.(1)
131.	Sh. Himanshu Sharma	Senior Tech.(1)
132.	Sh. Manmeet Singh	Senior Tech.(1)
133.	Ms. Urmila Kotnala	Senior Tech.(1)
134.	Sh. Manoj Kumar Tyagi	Tech.(2)
135.	Sh. Amar Singh	Tech.(2)

Sl. No.	Name	Designation
136.	Sh. D.K.Chopra	Tech.(2)
137.	Sh. Kedar Nath	Tech.(2)
138.	Sh. Santosh K. Mishra	Tech.(2)
139.	Sh. Rajeev Bansal	Tech.(2)
140.	Sh. Pradeep Kumar Kapooria	Tech.(2)
141.	Sh. Arvind Saini	Tech.(2)
142.	Sh. Ashwini K. Mishra	Tech.(2)
143.	Sh. Harish Kumar	Tech.(2)
144.	Sh. Sukhbir Sharma	Tech.(2)
145.	Sh. Arvind Kumar	Tech.(2)
146.	Sh. Sharad Kumar	Tech.(2)
147.	Sh. Mam Chand Agarwal	Tech.(2)
148.	Sh. Arvind Kumar Sharma	Tech.(2)
149.	Sh. Tahir Hussain	Tech.(2)
150.	Sh. Ghanshyam Mittal	Tech.(2)
151.	Sh. Francis Charles	Tech.(2)
152.	Sh. Jai Pal	Tech.(2)
153.	Sh. Iqbal Ahmad	Tech.(2)
154.	Sh. Jameel Hasan	Tech.(2)
155.	Sh. Umesh Chandra Bhatnagar	Tech.(2)
156.	Shiv Prakash Tyagi (SE)	Tech.(2)
157.	Sh. B.S.Bisht (SE)	Tech.(2)
158.	Sh. Sohrab Khan (SE)	Tech.(2)

Group I - Supporting Staff

159.	Sh. Hamir Dass	Lab. Asstt.
160.	Sh. Harpal Singh	Lab. Asstt.
161.	Sh. D.P.Yadav	Lab. Asstt.
162.	Sh. Janeshwar Prasad	Lab. Asstt.
163.	Sh. Akhtar	Lab. Asstt.
164.	Sh. Yakub Ali	Lab. Asstt.

Sl. No.	Name	Designation
165.	Sh. Sita Ram	Lab. Asstt.
166.	Sh. Deepak Singh	Lab. Asstt.
167.	Sh. Guru Charan Singh	Lab. Asstt.
168.	Sh. Rajeshwar	Lab. Asstt.
169.	Sh. Amar Singh (SE)	Lab. Asstt.
170.	Sh. Vijay Kumar (SE)	Lab. Asstt.
171.	Sh. Sham Lal (SE)	Lab. Asstt.
172.	Sh. Shiv Kumar	Lab. Asstt.
173.	Sh. Vijay Kumar	Lab. Asstt.
174.	Sh. Jai Pal Singh	Lab. Asstt.
175.	Sh. Rishi Pal (SE)	Lab. Asstt.
176.	Sh. Shiv Kumar	Lab. Asstt.
177.	Sh. Vishwas Kumar	Lab. Asstt.
178.	Sh. Abhay Dass	Lab. Asstt.
179.	Sh. Jagdish Pal	Lab. Asstt.
180.	Sh. Deepak Kumar	Lab. Asstt.
181.	Sh. Bharat Singh	Lab. Asstt.
182.	Sh. Hira Lal	Lab. Asstt.
183.	Sh. Subhash Chand (SE)	Lab. Asstt.
184.	Sh. Shyam Bir (SE)	Lab. Asstt.
185.	Sh. Rajendra Kumar Arya	Lab. Asstt.
186.	Sh. Rajesh Kumar	Lab. Asstt.

House-Keeping/ Administrative Staff

Group-A

Sl. No.	Name	Designation
187.	Sh. S.C. Tyagi	C.O.A.
188.	Sh. Anil Kumar	A.O.
189.	Sh. Ramesh Chandra	S&PO
190.	Sh. R.K. Raina	F&AO
191.	Sh. R. C. Saxena	Sr.Hindi Officer

Group-B

Sl. No.	Name	Designation
192.	Sh. Md.Salaudin Ansari	S.O.(S&P)
193.	Sh. J.K. Chourasia	S.O.(F&A)
194.	Sh. Babu Ram (SE)	S.O.(F&A)
195.	Sh. Avnish Kumar	S.O.(F&A)
196.	Sh. Alok Sharma	S.O.(G)
197.	Sh. S.K. Jakhwal	S.O.(G)
198.	Sh. S.P. Kapil	P.S.
199.	Sh. B.K. Sharma	Security Officer
200.	Sh. V.P.S. Rawat	Security Officer
201.	Sh. Sanjeev Bansal	Asstt(S&P)Gr.I
202.	Sh. Arpan Maheshwari	Asstt(S&P)Gr.I
203.	Ms. Anju Rani Simon	Asstt(S&P)Gr.I
204.	Sh. Virendra Singh (SE)	Asstt(F&A)Gr.I
205.	Sh. Aman Kumar	Asstt(F&A)Gr.I
206.	Sh. C. Kujur	Asstt(G)Gr.I (ACP)
207.	Sh. V.K.Sharma	Asstt(G)Gr.I
208.	Ms. Nisha Tyagi	Asstt(G)Gr.I
209.	Ms. Saroj Sethi	Asstt(G)Gr.I
210.	Ms. Sarita Khanna	Asstt(G)Gr.I
211.	Sh. Neeraj Kumar	Asstt(G)Gr.I
212.	Sh. B.B.Dimri	Asstt(G)Gr.I
213.	Ms. Sheema Farhat	Asstt(G)Gr.I
214.	Sh. K. S. Chauhan	Asstt(S&P)Gr.I
215.	Sh. V. K. Sharma (SE)	Asstt(F&A)Gr.I
216.	Sh. Sudhir Kumar	Asstt(G)Gr.I
217.	Sh. Vishwas Tyagi	Asstt(S&P)Gr.I

Sl. No.	Name	Designation
218.	Sh. Yogesh Kumar	Asstt(G)Gr.I
219.	Ms. Sunita	Asstt(G)Gr.I
220.	Sh. Shiv Kumar	Asstt(G)Gr.I
221.	Sh. R.K. Johar	Asstt(G)Gr.I
222.	Sh. Surinder Singh	Sr.Steno(ACP)
223.	Sh. Khushpendra Arora	Sr.Steno(ACP)
224.	Sh. Suresh Giri	Sr.Steno(ACP)
225.	Sh. Naresh Yadav	Sr.Steno(ACP)
226.	Sh. Satya Pal	Sr.Steno (ACP)
227.	Sh. Rajinder Kumar	Sr.Steno (MACP)
228.	Ms. Archana	Sr.Steno
229.	Sh. Arvind Kumar	Sr.Steno
230.	Sh. Dalpat Singh	Sr.Steno
231.	Sh. Dhram Singh Negi	Sr.Steno
232.	Sh. Mehar Singh	Sr.Translator
233.	Sh. Subha Singh	Sr. Translator

Group C

Sl. No.	Name	Designation
234.	Sh Suraj Pal Singh	Asstt(F&A) Gr.II
235.	Sh. Dharam Pal Singh	Asstt(G)Gr.II
236.	Ms. Arun Lata	Asstt(G)Gr.II
237.	Sh. Sushil Kumar	Asstt(G)Gr.II
238.	Ms. Mamta Sharma	Asstt(G)Gr.II
239.	Ms. Rubina Zaidi	Asstt(G)Gr.II
240.	Sh. Satyarth Prakash	Asstt(G)Gr.II
241.	Sh. Sanjay Kr.Tyagi	Asstt(G)Gr.II
242.	Sh. Ravindra Kumar	Asstt(G)Gr.II
243.	Ms. Seema Ahuja	Asstt(G)Gr.II
244.	Sh. C.P.Tyagi	Jr.Steno
245.	Sh. Rajendra Singh	Sr. Tech. (1)
246.	Sh. R. S. Goswamy	Sr. Tech. (1)
247.	Sh. Sushil Kumar	Sr. Tech. (1)

Sl. No.	Name	Designation
248.	Sh. M.Ramakrishna	Driver
249.	Sh. Vijay Kumar-II	Driver
250.	Sh. N. C. Yadav (SE)	Daftri Cum R/Keeper
251.	Sh. Suresh Pal	Safaiwala (ACP)-Gr.B
252.	Sh. Baljeet Singh	Counter Clerk(ACP)
253.	Sh. Satya Pal	Daftri-Cum-R.Keeper
254.	Sh. Vikram Pal	Daftari-Gr.B
255.	Sh. Sant Ram (SE)	Farrash-Gr.B
256.	Sh. Naresh (SE)	Safaiwala(ACP)
257.	Sh. Nanak Chand (SE)	Safaiwala-Gr.B
258.	Sh. Ram Samaj	J.S.G.-Gr.B
259.	Sh. Raj Kumar	J.S.G.-Gr.B
260.	Sh. Lakhmi Chand (SE)	Chowkidar-Gr.B
261.	Sh. Kailash Chand	Peon-Gr.B
262.	Sh. Inderpal	Peon-Gr.A
263.	Sh. Mukesh Kumar	Peon-Gr.A
264.	Ms. Kusum Lata	Peon-Gr.A
265.	Sh. Desh Raj	Peon-Gr.A
266.	Sh. Rakesh Kumar	Peon-Gr.A
267.	Sh. Ramesh Kumar	Peon-Gr.A
268.	Sh. Shiv Kumar	Peon-Gr.A
269.	Sh. Santosh Kumar	Peon-Gr.A
270.	Sh. Jagdish Chand	Peon-Gr.A
271.	Sh. Rakesh Kumar-III	Peon-Gr.A
272.	Sh. K. Gopal Thakur	Peon-Gr.A
273.	Sh. Mani Ram	Peon-Gr.A
274.	Sh. Rohitash Kumar	Peon-Gr.A
275.	Sh. S. Chand (SE)	Peon-Gr.A
276.	Sh. Md. Naeem (SE)	Peon-Gr.A
277.	Sh. R. Shyam (SE)	Peon-Gr.A
278.	Sh. Shyam Narain	Farrash-Gr.B

Sl. No.	Name	Designation
279.	Ms. Usha	Farrash-Gr.B
280.	Sh. Devendra Kumar	Farrash-Gr.A
281.	Ms. Prakash Kaur	Farrash-Gr.A
282.	Ms. Anju	Farrash-Gr.A
283.	Ms. Bala	Safaiwala-Gr.A
284.	Sh. Khalil Ahmed	Farrash-Gr.A
285.	Sh. Ranbir Singh	Peon-Gr.A
286.	Sh. Subhan Singh	Peon-Gr.A
287.	Sh. Anit Kumar Pal	Peon-Gr.A
288.	Sh. Maharaj D. Khan	Peon-Gr.A
289.	Sh. Pritam Giri	Peon-Gr.A
290.	Sh. Pooranwasi	Farrash
291.	Sh. Kiran Pal	OPS Group D(NT)
292.	Sh. Kirat Pal	OPS Group-D(NT)
293.	Sh. Rajesh Kr. Yadav	OPS Group-D(NT)
294.	Sh. Jai Prakash	OPS Group-D(NT)
295.	Sh. Ranjeet Singh	OPS Group-D(NT)
296.	Sh. Satya Pal	OPS Group-D(NT)
297.	Sh. Sunil Kumar	OPS Group-D(NT)
298.	Sh. Dharam Singh	OPS Group-D(NT)
299.	Sh. Satya Pal Singh	OPS Group-D(NT)
300.	Sh. Dharam Pal	OPS Group-D(NT)

Canteen Staff

301.	Sh. Rakesh	Tea Maker-ACP
302.	Sh. Arun Kumar	Bearer-ACP
303.	Sh. Ravindra Nath	Bearer-ACP
304.	Sh. Dil Bahadur	Bearer-ACP
305.	Sh. Rajender Pal	Bearer-ACP
306.	Sh. Malkhan Singh	Bearer-ACP
307.	Sh. Pooran	Wash Boy-ACP
308.	Sh. Dheer Singh	Wash Boy-ACP

Superannuation

Following staff members superannuated from CBRI family during the year :

Name	Designation	Date of Retirement
Hari Singh	Tech Gr. I(4)	30.04.2010
Kamalbir	JSG	30.07.2010
Jagan Nath	Tech. Gr.II	31.07.2010
Shiv Kumar Sharma	Helper Gr.I	31.07.2010
K.K. Murthy	Jr. Steno	31.07.2010
A.K. Jain	P.S.	31.07.2010
Chandra Prakash	T.O. E II	31.07.2010
Shree Kumar	Scientist F	31.08.2010
Sushil Kumar	Farash	05.10.2010
S.L. Kaushik	Wireman Gr. II(4)	30.11.2010
H.C. Madan	Asstt.(G) Gr.I	30.11.2010
Yash Pal Singh	Section Officer	31.01.2011
M.K. Nazir	Technician Gr II(4)	31.03.2011

Transfer

Nand Kishore	Technician Gr II(4)	24.02.2011
(From CBRI Roorkee to NBRI Lucknow)		

Promotion

A.Ghosh	Chief Scientist	15.12.2008
Sunil K. Sharma	Chief Scientist	01.02.2009
N.K. Saxena	Sr. Principal Scientist	09.08.2008
Nadeem Ahmed	Principal Scientist	19.05.2008
D.P. Kanungo	Principal Scientist	24.08.2008
Achal Kr. Mittal	Principal Scientist	08.09.2008
Rajni Lakhani	Principal Scientist	30.12.2008
S. Karthigeyan	Principal Scientist	01.01.2009
S.R. Karade	Principal Scientist	19.03.2009
S.K. Singh	Sr. Scientist	01.01.2005
L.P. Singh	Sr. Scientist	27.04.2008
P.K.S. Chauhan	Sr. Scientist	10.12.2008
V. Srinivasan	Sr. Scientist	14.10.2008
H.C. Arora	Sr. Scientist	01.01.2009
Shiv Kumar	Lab Assistant	24.12.2007
Gayatri Devi	Technical Assistant	08.09.2008
Zamir Ahmed	Sr. Tech. Officer (2)	12.05.2009
Dalip Kumar	Sr. Tech. Officer (3)	07.05.2009
Sameer	Technical Assistant	01.06.2009
Amar Singh	Sr. Technician (1)	12.01.2010
Deepti Karmakar	Technical Officer A	20.07.2009
Rajendra Singh	Sr. Technician (1)	21.09.2009
Radhey Shyam	Sr. Technician (1)	21.09.2009
Sushil Kumar	Sr. Technician (1)	21.09.2009
Har Sagar Sharma	Sr. Technician (2)	01.08.2009

Dinesh Chandra	Sr. Technician (2)	01.08.2009
Jagan Nath	Sr. Technician (2)	01.08.2009
P.K. Yadav	Sr. Technician (2)	01.08.2009
Neelam Gupta	Sr. Technician (2)	01.01.2010
Prem Singh	Sr. Technician (2)	01.01.2010
Sheeraj Ahmed	Sr. Technician (2)	01.01.2010
Sangeeta Sharma	Sr. Technician (2)	01.01.2010
Ram Pal Singh	Sr. Technician (2)	01.01.2010
Vishwas Tyagi	Assistant (S&P) Gr-I	06.04.2010
Yogesh Kumar	Assistant (G) Gr-I	23.07.2010
Shiv Kumar	Assistant (G) Gr-I	13.10.2010
Sunita	Assistant (G) Gr-I	01.12.2010

Appointment

Rashmi Devi	Section Officer	22.11.2010
Appointments (on Ad hoc basis)		
Dr. Amrit Kumar Roy	Scientist ` Fellow'	16.07.2010
Subhas Chandra Bose Gurram	Scientist ` Fellow'	09.08.2010
Saroj Kumar Panda	Scientist `Fellow'	16.08.2010
Manojit Samanta	Scientist `C'	13.08.2010
Soju Joseph Alexander	Scientist `C'	13.08.2010
Ravindra Singh Bisht	Scientist `C'	16.08.2010
Soumitra Maiti	Scientist `C'	16.08.2010
Srinivasarao Naik B.	Scientist `C'	26.08.2010
Nagesh Babu Balam	Scientist `C'	26.08.2010
R. Deepthi	Scientist `C'	27.08.2010
Jaya Venkata Gowri M	Scientist `C'	27.08.2010
Syed Ibrahim Sohel	Scientist `C'	27.08.2010
Subham Dastidar	Scientist `C'	27.08.2010
Ms. Swarnali Sanyal	Scientist `C'	08.09.2010

Glimpses of Activities

Her Excellency Mrs. Margrate Alva, Governor of Uttarakhand at CSIR-CBRI Pavalion at Raj Bhawan, Dehradun

Shri Kapil Sibal, Hon'ble Union Minister, HRD and Science & Technology at CSIR-Technofest Pavilion at IITF, New Delhi

Shri Kapil Sibal, Hon'ble Union Minister, HRD and Science & Technology, Director General, CSIR, alongwith Laboratory Directors during visit at CSIR-Technofest Pavilion at IITF, New Delhi

Er. Ajay Chourasia welcoming the guests on Short Term Course on Earthquake Resistant Design & Construction Practices

INDO-US workshop on Nanotechnology in the Science of Concrete

Group photograph of INDO-US workshop on Nanotechnology in the Science of Concrete

Teachers and students interacting with Scientists

Releasing the Proceedings of the Course Material on Seismic and Wind Resistant Design of Building Structures

Group photograph of Workshop cum Training Course on Seismic and Wind Resistant Design of Building Structures followed by International Advance School in Wind Engineering

Demonstration on Low Cost Housing Technologies under CSIR 800: RSWNET Programme

Staff taking Oath during Vigilance Awareness week

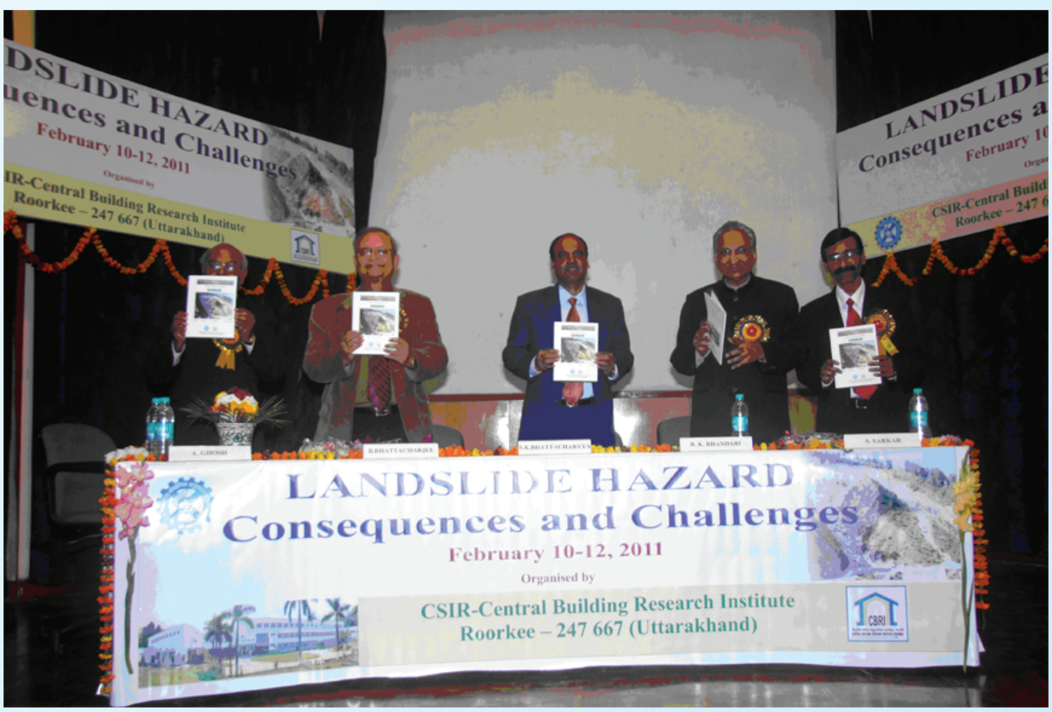
Prof S K Bhattacharyya, Director, CSIR-CBRI addressing the staff on Republic Day

Prof K.L.Chopra, Chief Guest delivering Inaugural speech on CSIR Foundation Day

Dignitories on dais on the occasion of Hindi Week celebrations

Release of CSIR-CBRI Annual Report on CBRI Foundation Day

Prof. Prem Vrat, Former Director, IIT Roorkee & Former Vice Chancellor (UP Technical University) delivering Inaugural speech on National Conference on RAGIT-2011



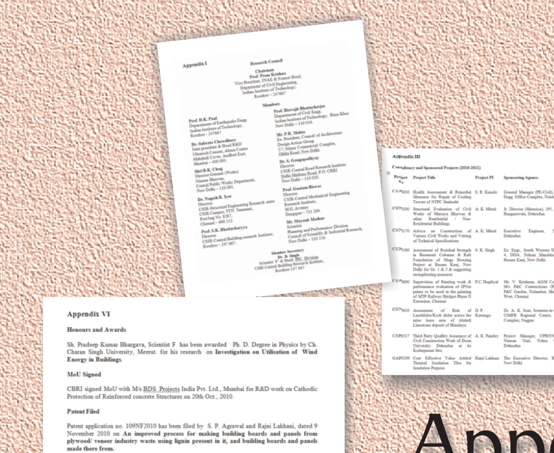
Release of Conference Abstract Proceedings on "Landslide Hazard: Consequences and Challenges"

Training at Solan, Himachal Pradesh

CSIR-CBRI staff interacting with students on CBRI technologies

Orientation Programme of PGRPE on Engineering of Infrastructure and Disaster Mitigation (Building/Roads)

Dignitories on dais on the occasion of National Science Day



Appendices

Appendix I

Research Council

Chairman

Prof. Prem Krishna
Vice President, INAE & Former Head,
Department of Civil Engineering,
Indian Institute of Technology,
Roorkee - 247667

Members

Prof. D.K. Paul
Deparatment of Earthquake Engg.
Indian Institute of Technology,
Roorkee - 247667

Dr. Subrato Chowdhury
Joint President & Head R&D
Ultratech Cement, Ahura Centre
Mahakali Caves, Andheri East,
Mumbai - 400 093.

Shri B.K. Chug
Director General (Works)
Nirman Bhawan,
Central Public Works Department,
New Delhi - 110 001.

Dr. Nagesh R. Iyer
Director
CSIR-Structural Engineering Research Centre
CSIR Campus, TTTI Taramani,
Post bag No. 8287,
Chennai - 600 113.

Prof. S.K. Bhattacharyya
Director
CSIR-Central Building research Institute,
Roorkee - 247 667.

Prof. Biswajit Bhattacharjee
Deparatment of Civil Engg.
Indian Institute of Technology, Hauz Khas
New Delhi - 110 016.

Mr. P.R. Mehta
Ex. President, Council of Architecture
Design Action Group
2/7, Julana Commercial Complex,
Okhla Road, New Delhi.

Dr. S. Gangopadhyay
Director
CSIR-Central Road Research Institute
Delhi-Mathura Road, P.O. CRRI
New Delhi - 110 020.

Prof. Gautam Biswas
Director
CSIR-Central Mechanical Engineering Research Institute, M.G. Avenue
Durgapur - 713 209.

Mr. Mayank Mathur
Scientist
Planning and Performance Division
Council of Scientific & Industrial Research,
New Delhi - 110 110.

Member Secretary

Dr. B. Singh
Scientist 'F' & Head, PPC Division
CSIR-Central Building Research Institute,
Roorkee-247 667

Management Council

Chairman

Prof. S.K. Bhattacharyya
Director,
CSIR-Central Building Research Institute,
Roorkee - 247 667

Members

Dr. S. Gangopadhyay,
Director
CSIR-Central Road Research Institute,
Delhi-Mathura Road,
NEW DELHI 110 020

Dr. Shantanu Sarkar,
Scientist 'EII',
Geotechnical Engg.,
CSIR-Central Building Research Institute,
Roorkee - 247 667

Dr. L.P. Singh
Scientist 'EI',
EST Division,
CSIR-Central Building Research Institute
Roorkee - 247 667

Shri P.K. Bhargava,
Scientist 'F' &
Head, EB,
CSIR-Central Building Research Institute,
Roorkee - 247 667

Dr. B. Singh
Scientist 'F',
Head, PPC,
CSIR-Central Building Research Institute,
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Dr. (Mrs.) Manorama Gupta
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Finance & Accounts Officer,
CSIR-Central Building Research Institute,
Roorkee - 247 667

Secretary
Controller of Administration,
CSIR-Central Building Research Institute,
Roorkee - 247 667

Appendix II

List of In-House R&D Projects and Support Activities (2010-2011)

Sl. No	Project No	Title of the Project	Principal Investigator/ Co-Investigator	Duration
1.	OLP-327	Calcination of gypsum for producing plaster of paris utilizing solar energy as partial replacement of heat energy	Dr. S.K. Saini/ Sh. Narendra Kumar	0410-0312
2.	OLP-328	Low clinker factor cements as an alternate cements	Dr. S.K. Agarwal / Dr. LP Singh	0410-0312
3.	OLP-329	Utilization of construction and demolition wastes as secondary resource materials for developing value added building components	Dr. A.K.Minocha /Dr. Mridul Garg	0410-0312
4.	OLP-330	Preparations and applications of nano-materials in cementitious system	Dr. LP Singh / Dr. S.K. Agarwal	0410-0312
5.	OLP-331	Development of environment - friendly material/component for termite and fungi management in buildings		0410-0312
		Part-A Development of physical barrier for termite management in buildings	Dr. B.S. Rawat	
		Part-B Development of environment - friendly component from medicinal plants/ agro wastes for fungi management in buildings **(Project converted in OLP-354 EMPOWER Project)**	Dr. R. K. Verma/ Dr. Leena Chaurasia	
6.	OLP-332	Development of design guidelines for energy efficient buildings in different climatic regions of India **(Merged with OLP-343 by 42nd RC)**	Sh Shree Kumar/ Sh V.K. Sharma/ Sh.H.K.Jain/ Dr B.M. Suman	0410-0312
7.	OLP-333	Studies on ceiling vents in enclosure fire	Dr.Rajeev Kumar/ Dr.S.K.Sharma	0410-0312

8.	OLP-334	Fire retardants compositions for building materials		0410-0312
		Part-A Toxic combustion from lining materials & their minimization	Dr. N. K. Saxena/ Dr. Sunil K. Sharma	
		Part-B Rigid foam insulation boards with reduced combustion products	Dr. Harpal Singh/ Dr. Sunil K. Sharma	
		Part-C Fire retardant compositions for reduced heat release from lining materials	Sh. A. A. Ansari/ Dr. Sunil K. Sharma	
9.	OLP-335	Development of value-added high burnback resistance fire extinguishing foaming materials for class B fires as well as spin-off corrosion-resistant foaming-agent for lightweight foamed/ cellular concretes for building industry	Sh. R. S. Chimote / Dr. B.K. Rao	0410-0312
10.	OLP-336	Development of performance based criteria for fire safety in assembly buildings	Sh. Shorab Jain/ Sh. M. P. Singh	0410-0312
11.	OLP-337	Geochemical, physical and engineering characterization of Indian red mud	Sh. A. Ghosh/ Dr. S.Sarkar / Sh. S.K. Jain	0410-0312
12.	OLP-338	Performance assessment of pile foundations under indirect loading due to adjacent excavations	Dr. S. Karthigeyan/ Sh. A. Ghosh	0410-0312
13.	OLP-339	Landslide hazard evaluation and risk assessment		0410-0312
		Part A Landslide risk assessment in the upper reaches of Alaknanda Valley, Garhwal Himalaya and development of guidelines for control measures	Dr. S. Sarkar/ Dr. D.P. Kanungo	
		Part B Development of methodology for landslide susceptibility and risk zonation on a meso-scale and guidelines for scheme of remedial measures	Dr. D.P. Kanungo /Dr. S. Sarkar	

		Part C Engineering geological, resistivity survey of landslides & rock slope stability evaluation using modified SMR approach, Kullu–Manali area, Himachal Himalaya	Dr. Pradeep Kumar II	
14.	OLP-340	Seismic studies of Jammu city		0410-0312
		Part A Evaluation of seismic ground motion parameters of Jammu City for earthquake resistant design of structures	Dr Abha Mittal/ Dr S. Karthigeyan	
		Part B First order seismic microzonation of Jammu city using strong motion data	Dr. P.K. S. Chauhan/ Sh. Y. Pandey	
15.	OLP-341	Ground improvement techniques		0410-0312
		Part A: Parametric study on strength improvement of composite ground	Sh. A.K. Sharma/ Sh. A. Ghosh	
		Part B: Granular anchor pile system for resistance of uplift force – a parametric study	Dr Pradeep Kumar-I/ Sh A.K. Sharma	
		Part C: Behaviour of shallow foundation on randomly distributed fibre reinforced fly ash (RDFF)	Dr Sujit Kumar Saran	
16.	OLP-342	Impact study of climate change and natural disasters on Uttarakhand cultural heritage sites	Sh. Y Pandey/ Sh. S.K. Negi	0410-0312
17.	OLP-343	Design and development of energy efficient affordable houses		0410-0312
		Part A Design & development of affordable rural housing in hilly area, Uttarakhand.	Sh. S.K. Negi/ Sh. V.Srinivasan	
		Part B Utilization of solar energy in buildings for improvement of built environment in cold climatic region	Mrs. Neeta Mittal /Dr. B.M.Suman	

		Part C Development of a framework to reduce the carbon – footprint and enhance the energy efficiency in buildings	Sh. Ashok Kumar/ Sh R.K. Garg	
		Part- D Planning approach for reducing blast effects on buildings **(Dropped by 42nd RC)**	Sh V.Srinivasan/ Sh S.K.Negi	
18.	OLP-344	Development of multifunctional thermal insulation coatings for buildings	Dr P.C. Thapliyal	0410-0312
19.	OLP-346	To study the behaviour of consolidants for strengthening stone surface and weak jointing mortar.	Dr. Rajni Lakhani	0410-0312
20.	OLP-347	Study on wind induced interference on tall buildings	Dr. Achal Kumar Mittal	0410-0312
21.	OLP-348	Performance evaluation of confined masonry buildings under quasi-static condition	Sh Ajay Chourasia	0410-0312
22.	OLP-349	Studies on behaviour of plain & strengthened RC structural elements exposed to fire & marine environment		0410-0312
		Part A Investigations on fire engineering of structural concrete system	Dr Suvir Singh/ Sh S. K. Singh	
		Part B Characterization of Plain & FRP strengthened structural elements exposed to fire	Sh. S. K. Singh/ Dr Suvir Singh	
		Part C Studies on durability of FRP wrapped concrete structures in marine exposure conditions	Sh Harish C. Arora/ Dr B.K. Rao	
23	OLP-350	Health monitoring of building structures using wireless sensor networks	Prof. S.K. Bhattacharyya/ Sh Ajay Chaurasia/ Sh S.K. Singh	0410-0312

24	OLP-351	Development of software for selecting estimating & costing wood alternatives for building useful for architects and contractors **(Dropped by 42nd RC)**	Dr S.P. Agarwal	0410-0312
25	OLP-352	Up-gradation of CALFIRE software **(Project is extended by Director up to March 2011)**	Dr Rajiv Kumar Sh R.K. Sharma	0510-1010
26	OLP-353	Architectural design of cyclone resistant roofing system	Dr P.K. Bhargava Dr A.K. Roy	0410-0312
27	OLP-354 (EMPOWE)	Development of eco-friendly component for fungi management on exterior surface of building in sub topical region of India	Dr R.K. Verma Dr. Leena Chaurasia	1010-0912
28	OLP-355	Behaviour of geosynthetics reinforced fly ash bed over soft soil	Sh. Manojit Samanta/ Dr. SKarthigeyan /Sh. A. Ghosh	0411-0312
29	OLP-356	Design and development approach of a prototype climbimg robot in building industry applications	Sh. R.S. Bisht	0111-0112
30	OLP-357	Recycling of sorted demolition building waste as secondary resource material for developing structural concrete	Ms. Swarnali Sanyal Dr. Mridul Garg	0111-0312
31	OLP-358	Studies of phase change material for energy efficiency	Mr. Srinivasarao Naik B. Dr L.P. Singh	0111-1211
32	OLP-359	Modeling composite action of beam and slab in fire	Mr. S.C. Bose Gurram	0111-0112
33	OLP-360	Development of new composite material made by layers of geopolymer concrete and PC concrete	Ms. M.J.V. Gowri	0111-0312
34	OLP-361	Resuspension of respirable particles in the built environment	Mr. Sayed Ibramin Sohel/ Dr. A.K.Minocha	0111-0312
35	OLP-362	Removal of heavy metals from water using fly ash and its subsequent use in the production of value added building components	Mr. Soumitra Maiti/ Dr. A.K. Minocha	0111-0312
36	OLP-363	Energy efficient wireless network sensor platform	Mr. Soju J. Alexander	0411-0312

37	OLP-364	Development of polymer nanocomposite as a flame retardant material	Mr. Subham Dastidar	0111-0312
38	OLP-365	Solar air conditioner	Mr. Nagesh Babu Balam/ Dr. P.K. Bhargava	0111-1211
39	OLP-366	Wind energy conversion for domestic usage	Dr A.K. Roy/ Dr P.K. Bhargava	0111-1211
40	OLP-367	CFD modeling of Enclosure Fire	Mr. Saroj Kumar Panda	0111-0312
COLLABORATIVE PROJECT				
43	CLP-0110	Infrastructure creation and development of expertise in the area of cathodic protection (CP) for RCC structures	Dr S.R. Karade	0410-0312
MAJOR LAB PROJECT				
44	MLP-00510	Study of flow behaviour around building, fire propagation characteristics and health monitoring of building and creation of Advanced Computing Facilities	Prof. S.K. Bhattacharyya Dr Abha Mittal Dr Navjeev Saxena Sh. Shorab Jain	0710-0312
NETWORK PROJECTS				
45	NWP-39	Engineering of structures against natural and other disasters	Sh. A. Ghosh	0407-0312
46	NWP-45	Advancement in metrology	Dr. A.K. Minocha	0708-0312
CSIR-800 PROJECT				
47	RSP-03	Dissemination, training and demonstration of appropriate rural housing technologies	Sh. S.G. Dave	0407-0312
SUPRA INSTITUTIONAL PROJECT				
48	SIP-29	High performance materials and construction technologies for sustainable built space	Dr. B. Singh	0407-0312

R&D SUPPORT (DECISION UNIT 06)			
Sl. No	Activity Number	Title of the Activity	Activity Coordinator
1	STS 0001	KNOWLEDGE RESOURSE CENTRE Acquisition collation & Documentation of resources and providing services	Sh. S.K. Senapati
2	STS 0002	PLANNING MONITORING & EVALUATION RC agenda (R&D), deployment of manpower, APAR, project costing, accounting & budgeting, expert panel, research utilization data, quarterly progress report, monthly progress report, annual plan, five year plan & mid term appraisal report, externally funded projects, services tax & MC agenda	Dr Sunil K Sharma Sh. R.K.Yadav
3	STS 0003	RESEARCH PLANNING & BUSINESS DEVELOPMENT Technology transfer/ technology database management, maintenance of patent records/database etc., Royalty collection/ management, preparation of legal agreements for technology transfer and externally funded projects, audit replies, replies of parliament questions, business replies to external agencies, customer feedback analysis, and liasoning with NRDC etc., preparation of documents as per day to day requirement/ instructions of CSIR HQ.	Dr Sunil K Sharma Dr. P.K.Yadav
4	STS 0004	TECHNOLOGY DISSEMINATION (DC&E) Inland liaison including exhibition, displays, training, special function & visitors, development, technical guidance/ aid film, demonstration, constructions, feedback & documentation	Sh. S.G. Dave Sh. H.K.Jain
5	STS 0005	EXTENSION CENTER (DELHI)	Sh. Rajendera Kumar
6	STS 0006	PABX	Sh. D.K. Sehgal
7	STS 0007	PUBLICATION & PUBLICITY	Dr. Atul Kumar Agarwal

8	STS 0008	HR MANAGEMENT & INFORMATION DISSEMINATION Photography & audio system	Sh. S.G. Dave
9	STS 0009	COMPUTER FACILITIES & SERVICES	Dr. S.K. Saini
10	STS 0010	IT SUPPORT PROFESSIONAL SERVICES	Nodal Officer, ICT/NKN Amit Kush
11	STS 0011	UP-GRADATION OF LABORATORY FACILITIES	Dr L.P. Singh

ADMINISTRATIVE SUPPORT (DECISION UNIT 08)			
S.N.	Activity Number	Title of Activity	Activity Coordinator
1	Infra 0001	General administration & house keeping	Director
2	Infra 0002	ADMINISTRATION	COA/AO
3	Infra 0003	FINANCE & ACCOUNTS	F&AO
4	Infra 0004	STORES & PURCHASE	S&PO
5	Infra 0005	SECURITY	Security Officer
6	Infra 0006	HEALTH SERVICES (DISPENSARY)	Medical Officer
7	Infra 0007	ESTATE & TECHNICAL SERVICES i. Civil work, new construction, maintenance, horticulture services, cleaning & sanitation, water supply and maintenance of vehicles. i. Electrical & air conditioning services and electrical works, telephone. DIRECTOR'S TECHNICAL SECRETARIAT (DTS)	 Sh. Ajay Singh Sh. D.K. Sehgal Director

Appendix III

Consultancy and Sponsored Projects (2010-2011)

Project No	Project Title	Project PI	Sponsoring Agency
CNP0030	Health Assessment & Remedial Measures for Repair of Cooling Towers of NTPC Simhadri	S. R. Karade	General Manager (PE-Civil), NTPC, Engg. Office Complex, Noida
CNP0100	Structural Evaluation of Civil Works of Matsaya Bhawan & other Residential / Non-Residential Buildings	A. K. Mittal	Jt. Director (Matasiya), 295, T State Bangarawala, Dehradun
CNP0270	Advice on Construction of Various Civil Works and Vetting of Technical Specifications	A. K. Mittal	Executive Engineer, MDDA, Dehradun
CNP0580	Assessment of Residual Strength in Basement Columns & Raft Foundation of Mega Housing Project at Basant Kunj, New Delhi for Gr. I & 2 & suggesting strengthening measures	S. K. Singh	Ex. Engr., South Western Division-4, DDA, Nelson Mandela Road, Basant Kunj, New Delhi
CNP0600	Supervision of Painting work & performance evaluation of IPNet paints to be used in the painting of MTP Railway Bridges Phase II Extension, Chennai	P.C.Thapliyal	Mr. V. Krishnan, AGM Contracts, M/s P&C Contructions (P) Ltd., P&C Garden, Nolambur, Mogappair West, Chennai
CNP0610	Assessment of Risk of Landslides/Rock slides across the mine lease area of Alsindi Limestone deposit of Himalaya	D. P. Kanungo	Dr. A. K. Soni, Scientist-in-Charge, CIMFR Regional Centre, MECL Complex, Nagpur
CNP6317	Third Party Quallity Assurance of Civil Construction Work of Doon University Dehradun at its Kedarpuram Site	A. K. Pandey	Project Manager, UPRNN Ltd., Nirman Unit, Nehru Colony, Dehradun
GAP0509	Cost Effective Value Added Thermal Insulation Tiles for Insulation Purpose.	Rajni Lakhani	The Executive Director, BMTPC, New Delhi

GAP0529	Development of Building Components from Sponge Iron Waste.	Lok Pratap Singh	The Executive Director, BMTPC, New Delhi
GAP0579	Development of Technology for Bio-Degradable Nursery Pots	S. P. Agrawal	Advisor (RE), Ministry of Environment & Forest (RE Division), New Delhi
GAP0789	Gypsum & Gypsum Products: Their Science & Technology	Manjit Singh	Dept. of Science and Technology, Ministry of Science & Technology, New Delhi
SSP0061	Utilization of ETP Sludge for Making Value Added Building Materials	Mridul Garg	Sh. V.V.Joshi, AGM, M/s Tata Motors Ltd., Plot No. 1, Sector 11, Integrated Industrial Estate, SIDCUL, PantNagar
SSP0071	Assessment of Residual Strength in Basement Columns & Raft Foundation of Mega Housing Project at Basant Kunj, New Delhi for Gr. 1 & 2 & suggesting strengthening measures	S. K. Singh	Ex. Engr., South Western Division-4, DDA, Nelson Mandela Road, Basant Kunj, New Delhi
SSP0079	Third party Quality Assurance of Construction of Government Allopathic Medical College at Saharnpur.	B. K. Rao	Shri. P.K Aggarwal, Zonal Manager, U.P Rajkiya Nirman Nigam, Dehradun
SSP0081	Evaluation of Phoshogypsum for use in Gypsum Board	Mridul Garg	M/s Sherlock Industries, Plot No. 831, G.I.D.C, Near Narmada Rest House, Ankleshwar Gujarat
SSP0161	Development of Light Weight Bricks/ Blocks from Fluorogypsum	Mridul Garg	Mr. Partha Roy Chowdhury, M/s Navin Fluorine International Ltd., Mumbai
SSP0180	Measurement of Temperature Differential and Energy Saving for Cooling of Identical Pair of Rooms, One Treated and Other Treated by Heat Reflective Paint and EIFS Seperately. Measurement of R&U Values of Heat Reflective Paint	B. M. Suman	Sr. Vice President - R&D, M/s Berger Paints (I) Ltd., Howrah

SSP0181	Design & Construction Monitoring of School Buildings under Sarva Shiksha Abhiyaan	A. K. Mittal	State Project Director, Sarva Shiksha Abhiyan, Dehradun
SSP0188	Studies on Microbial Formulation (Metarizium Spps) for Termite Management in Buildings	B. S. Rawat	Dr. D. K. Mishra, GM-Technical, International Pannacea Ltd., E-34, Cannaught Circus, New Delhi
SSP0190	Study of Effect on Bulk Density on Thermal Transmission Through Twiga RB Fiberglass for Five Different Temperatures	B. M. Suman	Asstt. Manager Marketing, UP Twiga Fiberglass Ltd., New Delhi
SSP0290	Physical, Structural and Material Study of Qutub Minar	Y. Pandey	Superintending Archaeologist, ASI, Delhi Circle, New Delhi
SSP0370	Evaluation of Structural Design of Existing Masonry Building (EWS houses) at Indirapuram & Suggesting Remedial Measures for Earthquake Resistant Design	Ajay Chourasia	Er. S. S. Shukla, EE III, GDA, Hapur Road, Ghaziabad
SSP0439	Determination of Temperature Profile and Energy Load on Computer Model for Three Composite Buildings and Validation of Thermal Properties (K,R & U-values) of BASF Products.	B. M. Suman	Mr. Deepak Thuse M/s BASF India Limited, Thane Belapur Road, Turbhe, Navi Mumbai
SSP0440	Studies on Effect of Natural Exposure for One Year on Performance of Funder Max Panel of Product	S. P. Agrawal	Mr. Chandra Shekhar, Technical Head, Funder Max India Pvt. Ltd., Bangaluru
SSP0510	Post Fire Investigations and Remedial Measures for Fire Damaged Collectorate Building at Nainital	Suvir Singh	M/s Executive Engineer, PWD, Nainital
SSP0570	Performance Evaluation of Recron 3S Polyster Micro Fiber Reinforced Concrete in Structures	S. K. Singh	Sri Rajeev Gauri, GM, Reliance Industries Ltd. (Fibre Marketing Division), New Delhi

SSP0939	Comprehensive Study for Rehabilitation of People Affected by Maximum Pond Level of 1108m Joshiyara Barrage, Uttarkashi	A. K. Sharma	DGM(Const)., Uttarakhand Jal Vidyut Nigam Limited, Camp Office Maneri-Uttarkashi
TSP0090	Study the Effect of Density on Thermal Performance of Expanded Pertile and Pertile Products	B. M. Suman	M/s Keltech Energies Ltd., 32/1-2, 6th Floor, crescent Tower, Crescent Road, Bangalore
TSP0310	Fire Retardant Treatment & Performance Studies on Bamboo Mat Boards (BMB) and BMB Composites	A. A. Ansari	National Mission on Bamboo Applications, Technology Information, Forecasting and Assessment Council (TIFAC), DST, New Delhi
TSP0530	Assessment of Different Waterproofing Systems	M. Gupta	Dr. Randhir Singh Parmar, Sr. Manager (Technology), M/s Asian Paints Research and Technology Center, Thane Belapur Road, Navi Mumbai
TST0010	Fire Performance Assessment of Fire Doors	Suvir Singh	Office of Superintending Engr(C), BSNL Civil, Administrative Bldg Project, 16-A, Greams Road, Chennai
TST0011	Fire Performance Assessment of Fire Door	Suvir Singh	M/s Doorwin Engineering, 3-Heera Estate, Phase-II, Vatva GIDC, Near Vinzol Crossing, Ahmadabad
TST0020	Fire Performance Assessment of Lloyd Fire Stop Sealing Systems	Suvir Singh	M/s Lloyd Insulations (I) Ltd., Kalkaji Industrial Area, New Delhi
TST0021	Evaluation of Mineral Wood Slabs for Non-Combustibility	A. A. Ansari	Ex. Engr., Garrison Engineer (P), Ambala Cantt., Ambala
TST0031	Fire Characteristic Studies on Subtex Nubby	A. A. Ansari	Anutone Walls & Ceilings, 231, 7th Cross, Indira Nagar, Ist Stage, Bengaluru
TST0040	Fire Performance Assessment of Fire Rated Doors	Suvir Singh	Kutty Flush Doors & Furniture Co. Pvt. Ltd., 1167, Poonamallee High Road, Loyambedu, Chennai

TST0041	Fire Performance Assessment of Fire Door	Suvir Singh	M/s Satya Fibrotech India Pvt. Ltd., 154-A, Sultanpur Extn, New Delhi.
TST0051	Reaction to Fire Characteristic Studies on Aluminium Composite Panel	A. A. Ansari	M/s Alstrong Enterprises, E 40/3, Okhla Phase-II, New Delhi.
TST0060	Fire Performance Assessment of Coating on Electric Cable	Suvir Singh	M/s Superon Schweisstechnik India Ltd., 15-16, Old Sewa Nagar Market, P.O. Lodhi Road, New Delhi.
TST0070	Fire Performance Assessment of Fire Doors	Suvir Singh	M/s Pacific Fire Controls, 1654, Outram Lines, Kingsway Camp, Delhi.
TST0080	Fire Performance Assessment of Steel Fire Doors	Suvir Singh	M/s Sunbeam Infratech, Office no. C/3, Chintamani Nagar, Pune.
TST0091	Fire Performance Assessment of Insulated Panel Partition	Suvir Singh	M/s Ahlada Engineers Pvt. Ltd., SY#66, Bahadurpally, Qutbullapur Mandal, R.R. Dist, Hyderabad.
TST0101	Fire Performance Assessment of Fire Check Doors	Suvir Singh	Office of Ex. Engr. (Stadia Project), Civil Engg. Project, New Delhi Municipal Department, New Delhi Municipal Council, 91, Ist Floor, SBS Place, Gole Market, New Delhi
TST0110	Fire Performance Assessment of Fire Door Assembly	Suvir Singh	CIMFR, CIMFR Regional Center Nagpur, 3rd Floor MECL Complex, Seminary Hills, Nagpur.
TST0111	Burglary Resistance Assessment of Safe Class - BB	Suvir Singh	M/s Methodex Systems Ltd., 35-A, Fort Industrial Estate, Indore.
TST0120	Fire Performance Assessment of Wooden Fire Door	Suvir Singh	Ex. Engr., CPWD, Jawaharlal Nehru Bhawan, Project Site Office, 23-D Maulana Azad Road, New Delhi

TST0121	Reaction to Fire Characteristic Studies on PIR Panels	A. A. Ansari	M/s Asawa Insulation Pvt. Ltd., Plot No. 52 & 53, Arkose Industrial Estate, Sajgain, Takai, Adoshi Road, Khalapur, Khapoli, Dist Raigarh (Maharashtra).
TST0130	Fire Performance Assessment of Fire Check Door	Suvir Singh	Airport Authority of India, NSCBI Airport, Kolkata Project, Kolkata.
TST0131	Fire Performance Assessment of Fire Doors	Suvir Singh	M/s Delhi Metro Rail Corporation Ltd., Office of CPM(S), NBCC Campus, Mehrauli, Delhi.
TST0140	Fire Performance Assessment of Fire Door	Suvir Singh	M/s Basic Arch Products Pvt. Ltd., 240, New Timber Mkt Rd., Near Ramoshi Gate, Pune.
TST0141	Reaction to Fire Characteristic Studies on Slat (Wood Panel)	A. A. Ansari	Anutone Acoustics Ltd., 231/2, 7th Cross, Indira Nagar, Ist Stage, Bengaluru.
TST0150	Fire Performance Assessment of Protected Steel Beams	Suvir Singh	M/s Jaslonite Konard Hi-Tek Pvt. Ltd., Dharam Complex, Chhokra nala, GE Road, Raipur.
TST0151	Fire Performance Assessment of Fire Doors	Suvir Singh	Ex. Engr, INA Project Division, CPWD, New Delhi
TST0200	Fire Performance Assessment of Fire Door	Suvir Singh	M/s IJM (India) Infrastructure Ltd., MCD Civic Centre Site, Minto Rd., New Delhi.
TST0200	Fire Performance Asessment of Fire Door.	Suvir Singh	M/s IJM (India) Infrastructure Ltd, MCD Civic Centre Site, Minto Road, New Delhi.
TST0220	Fire Performance Assessment of MPP System Schroders Single Leaf Fire Fdoor	Suvir Singh	M/s MPP Technologies Pvt. Ltd., 487/C, 14th Cross, 4th Phase, Peenya Industrial Area, Bangalore.
TST0220	Fire Performance Assessment of MPP System Schroders Single Leaf Fire Door.	Suvir Singh	M/s MPPP technologies pvt. ltd., 487/C 14th cross , 4th phase, peenya industrial area, Bangalore.

TST0230	Fire Performance Assessment of Wooden Door	Suvir Singh	M/s MS Export, B-101, Nirav Apts, 90 Feet Rd., Asha Nagar, Kandavali East, Mumbai.
TST0230	Fire performance assesment of wooden door.	Suvir Singh	M/s MS Export, B-101, Nirav apts, 90 feet road, Asha Nagar, Kandivali East, Mumbai.
TST0250	Fire Performance Assessment of Fire Door	Suvir Singh	M/s Delhi Metro Rail Corporation Ltd., Shastri Park Depot, Near Water Treatment Plant, Delhi.
TST0260	Fire Performance Assessment of Wooden Fire Rated Door	Suvir Singh	M/s Piccadily Hotels Pvt. Ltd., Piccadily House, 275 Capt. Gaur marg, Sriniwas Puri, New Delhi.
TST0320	Fire Performance Assessment of Fire Dampers	Suvir Singh	M/s Fedders Lloyd Corporation Ltd., C-4, Phase-II, Noida
TST0340	Fire Performance Assessment of SS Landing Door	Suvir Singh	M/s Johnson Lifts Pvt. Ltd., Plot No. 147, Udyog Vihar, Phase I, Gurgaon
TST0380	Fire Performance Assessment of Wooden Fire Door	Suvir Singh	M/s V. K. Patel & Co., Shop 2/3/4, Mahesh Darshan, Nr. Makhmali Talao, Old Agra Road, Thane (W)
TST0390	Fire Performance Assessment of Protected Steel - I Beam	Suvir Singh	M/s Lloyd Insulations (I) Ltd., Kalkaji Industrial Area, New Delhi
TST0400	Fire Performance Assessment of Safe Deposit Lockers	Suvir Singh	M/s Methodex Systems Ltd., 35-A, Fort Industrial Estate, Indore
TST0410	Fire Performance Assessment of Protected Steel - I Beam	Suvir Singh	M/s United Insulation, Unit No. G2, Laxmi Industrial Estate, New Link Road, Andheri (W), Mumbai
TST0420	Performance Ealuation of New R&D Roofing Tile with Recycled Material	S. P. Agrawal	Ms. Richa Bajpai, NextGen PMS Pvt. Ltd., 5, NSRCEL, IIM, Bangalore

TST0430	Fire Performance Assessment of Fire Door	Suvir Singh	M/s BSNL, O/o The Suprerintending Engr ©, BSNL Administrative Bldg Project, 16-A, Greams Road, Chennai
TST0450	Fire Performance Assessment of Fire Door	Suvir Singh	M/s Godrej & Boyce Mfg. Co. Ltd, Pirojshnagar, Vikhroli, Mumbai.
TST0460	Evaluation of Aluminium Panel Grade 5052 for Fire Propagation Index and Surface Spread of Flame	A. A. Ansari	Azco Noble Coatings Pvt. Ltd., Haskote Industrial Area, Bangalore
TST0470	Fire Performance Assessment of Lagyp Partition System	Suvir Singh	M/s Lafarge Boral Gypsum India Pvt. Ltd., 33-B, Sector 32, Gurgaon
TST0480	Fire Performance Assessment of Fire Door	Suvir Singh	M/s National Building Construction Corp. Ltd., 66/1, Ravindra Lok, Karam Path, IIT Roorkee
TST0490	Fire Performance Assessment of Fire Check Doors	Suvir Singh	M/s Navair International Ltd., 59/17, 2nd Floor, Kalkaji Extn, Guru Ravi Dass Marg, New Delhi.
TST0500	Fire Performance Assessment 'V' - Panel Partition	Suvir Singh	M/s Visaka Industries Ltd., "Visaka Tower", 1-8-303/69/3, S.P. Road, Secunderabad
TST0520	Fire Performance Assessment of Fire Door	Suvir Singh	M/s Talin Modular Office Furniture Systems Pvt. Ltd., No. 189-190, Kacharakanahalli, 15th Cross, 3rd Block, 1st Stage, H.B.R. Layout, Kalayanagar Post, Bangalore
TST0540	Fire Performance Assessment of Fully Glazed Door	Suvir Singh	M/s Signature Interiors Pvt. Ltd., Shop No. 4 & 5, SM Mody Commercial Complex No. 5-4-187/5, Karbala Maidan, Off Mahatma Gandhi Road, Secunderabad.

TST0550	Reaction to Fire Characterisic Studies on FRP - Pultruded Cable Tray Specimen	A. A. Ansari	M/s Sintex Industries Ltd., Plastic Division, Kalol (N.G.)
TST0560	Fire Performance Assessment of Fire Door	Suvir Singh	M/s Sematic Re Elevator Products (I) Pvt. Ltd., Madhuban, F/101, Ist Floor, W.E. Highway, Near Dahisar Telephone Exchange, Dahisar (E), Mumbai
TST0590	Fire Performance Assessment of Fire Door	Suvir Singh	M/s Lanco Infratech Ltd. (Construction Division), Plot - 270, Udyog Phase II, Gurgaon

Appendix IV

Research Publication (2010-2011)

(a) Journal Publication

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4. B.M. Suman and G.V. Swamy, (2010), Impact of environment friendly foam insulation on green building, Journal of Indian Building Congress, V.XVII, No.2, 27-32.
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6. B. Singh, M.Gupta and Hina Tarannum, (2010), Jute sandwich composite panels for buildings applications, J. Bio-based materials and Bioenergy, Vol. 4, No. 4, 397-407, (USA).
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17. M. Gupta, Monika, Naseeba Khatoon and B. Singh, (2010), Composite boards from iso cyanate bonded pine needles, J. Applied Polymer Science, Vol. 118, 3477-3489, (USA).

18. Mridul Garg, A. K. Minocha and Neeraj Jain, (2011), Environmental hazard mitigation of waste gypsum and chalk: Use in construction materials, Construction & Building Materials , 250, 944-949.

19. Mridul Garg and Neeraj Jain, (2010), Waste gypsum from intermediate dye industries for production of building materials, Construction & Building Materials, 24 (9), 1632-1637.

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27. Rajiv Kumar and Sunil K. Sharma, (2008), Experimental validation of RELIEF- A zone model to predict fire behaviour in enclosures with wall linings, Journal of Applied Fire Science, vol. 17(4), 309-334. (Published in 2010).

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

1. A. Ghosh, S. Sarkar, D. P. Kanungo, P.K.S. Chauhan and Z. Ahmed, (2010), Stability assessment and suggestion for control measures of a potential landslide slope on NH 94, Uttarakhand Himalaya, India, 5th Int. Conf. on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics, San Diego, California.

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6. Ajay Chourasia, Ayon Mohan Ghosh, J. Parashar and S.K.Singh, (2010), Structural health monitoring of buildings using wireless sensors : A review, 14th Symposium on Earthquake Engineering, IIT Roorkee, India, 17-19 Dec. 2010.

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15. Jaswinder Singh, Neeraj Jain, A. K. Minocha and Deepmala,(2010), Bhawan nirman samugri udyogon se pradushan tatha unka nivaran (in Hindi), Rashtriya Sangoshthi-2010 on Nirman Samagriya- Vision 2030 at CSIR-CRRI, New Delhi jointly organized by CSIR-CBRI, Roorkee and CSIR-AMPRI, Bhopal.

16. L.P. Singh, (2010), Preparation and Applications of Nano-Silica in Cementitious System at INDO-US workshop on Nanotechnology in the Science of Concrete at CSIR-CBRI, Roorkee, Uttarakhand, 14-15 December, 2010.

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Appendix V

Visits Abroad

Prof. S.K. Bhattacharyya, Director visited Lyon, France

Prof. S.K. Bhattacharyya, Director, CSIR-CBRI, Roorkee was invited by the Lafarge Research Group, France to participate in an International Workshop on ` Science-driven Engineering of Concrete`, organized by Lafarge Research Group, France at Lyon, France. The topic of the workshop was very appropriate and timely as very rapid developments are taking place in the field of Concrete Technology of late. The participants of the workshop were on invitation by Lafarge. The participants were from USA, France, Brazil, Japan, China and India. The deliberations in the workshop continued over two days i.e. 22 - 23 July 2010. During the visit Prof. Bhattacharyya had on opportunity to interact with the scientists of Lafarge Research Group and discussed about possible collaborative research activities on the cement-based material apart from the participation in the workshop. Also modalities about student exchange were discussed.

The probable areas emerged out from the discussions for possible exchanges were:

i. Research exchanges on the developments of different cement based construction materials, specifically the areas in which CSIR-CBRI has expertise.

ii. Supporting students of their project work in areas of mutual interest.

iii. Research activities on any other aspects related to concrete science of mutual interest.

The workshop was well organized with participation from different countries. Different aspects related to the need for research in the area of cement concrete was deliberated and some recommendations did emerge out from the deliberations

Dr. D.P. Kanungo, Principal Scientist visited Japan on CSIR Raman Research Fellowship

Dr. D.P. Kanungo, Principal Scientist, Geotechnical Engineering Division, CSIR-CBRI, Roorkee has been awarded CSIR Raman Research Fellowship for the year 2010-2011 by Council of Scientific & Industrial Research (CSIR), New Delhi, India vide award no. 22/RRF/2009-ISTAD dated 07.04.2010. The period of fellowship was for four months. He worked on "Initiation and movement mechanism of landslides during heavy rainfall" under the guidance of Prof. Toshitaka Kamai at Research Center on Landslides (RCL), Disaster Prevention Research Institute (DPRI), Kyoto University, Japan during June to September 2010.

During his stay in Japan, he worked with Prof. Toshitaka Kamai, Head; Dr. Hiroshi Fukuoka, Associate Professor; Dr. Gonghui Wang, Assistant Professor at RCL, DPRI and also with research scholars of this department from different countries like China and Cambodia. During this period, he got an exposure and an opportunity to work on the laboratory experimental facility on undrained dynamic loading ring shear apparatus developed by this Institute to understand the residual shear resistance mobilized along the sliding surface and to simulate the entire process of failure of a soil/sand sample, from initial static or dynamic loading, through shear failure, pore-pressure changes and possible liquefaction, to large-displacement, steady-state shear movement.

Also, he visited Tokushima Landslide Observatory and few landslide sites such as Azue landslide and Nishi Ikada landslide during this period along with the faculty and students of RCL. The purpose of this visit was to get an idea and to acquire knowledge on the landslide instrumentation and real time monitoring program implemented and maintained by this Institute.

During this period, he visited a number of landslides such as Kuchisakamoto landslide, Ishidaru landslide and Yui landslide with senior officials from Nippon Koei Pvt. Ltd., Tokyo, Japan. As Nippon Koei is one of the best companies in Japan to work on landslide mitigation and management, he acquired knowledge and get an exposure on the landslide preventive and rehabilitation measures effectively implemented in different landslide sites and on slopes along express ways in Japan.

Apart from this, he visited the unique and famous Kobe Earthquake museum in Awaji Island, Japan where some of the geo-tectonic features and effects of earthquake such as fault plane exposure at the epicentral area, ground cracks, displacements etc. were preserved.

He participated and contributed a research paper in the International symposium on a robust and resilient society against natural hazards and environmental disasters and the third AUN/SEED-NET regional conference on Geo-disaster mitigation during 24-26 August 2010 held at Kyoto University, Uji Campus, Japan. The research paper entitled "Landslide Susceptibility Assessment - An attempt towards standardizing the methodology in Indian scenario" was presented during the conference and published in the proceedings.

He gathered valuable information and acquired knowledge on recent trends of research and work on various aspects of landslide disaster mitigation and management such as laboratory simulation of field material to understand the landslide failure mechanism, landslide instrumentation and real time monitoring to develop early warning system and landslide control/remedial measures. The expertise developed during this period on various aspects of landslide disaster mitigation will help the Institute to initiate such activities in Indian context so that it may lead to develop a suitable program on landslide instrumentation and monitoring leading to development of warning system and to implement and evaluate the efficacy of suitable remedial measures for controlling landslide.

Dr. B. Kameswara Rao, Chief Scientist visited COLOMBIA

Dr B Kameswara Rao, Chief Scientist, Structural Engineering Division participated in six member Indian delegation in the 17th Plenary Meeting of ISO/TC 71 `Concrete, Reinforced Concrete, and Pre-stressed Concrete' and its Sub-committees held on 20-23 September 2010 at Cartagena de Indias, Colombia and attended the meetings of ISO/TC 71 'Concrete, Reinforced Concrete and Pre-stressed Concrete' and its subcommittees SC 1, SC 3, SC 4 and SC 6 of which India (BIS) is a participating 'P' member for the second time, though India has been very actively voting on all the ISO documents being received under the Committee for last many years. This gave an opportunity to the Indian delegates, who are also member of the concerned BIS national technical committee, to get first hand experience of the procedure, thinking and developments in standardization on the subject at international level and effectively contribute in the same to protect India's interest. By this participation, India could raise important issues relating to temperature and humidity requirements for test conditions suitable to tropical/warm countries, which are different than those being adopted suiting to colder climates and on other technical aspects of the documents being developed by the Committee. The points raised were given due cognizance and various technical views of India were effectively shared during discussion to convince the committees with respect to different provisions of the documents. Following recommendations & Follow-up were identified:

- The Indian views should be followed up through appropriate communications and continued voting/ comments on various ISO documents being received regularly,
- Regular participation of India in meetings of ISO/TC 71 and its subcommittees may be considered to make further substantial impact in standardization in concrete material, design and construction, at international level.
- The Civil Engineering Division of BIS requires further strengthening with addition of few more officers to handle the large volume of work involved including analysis of no. of documents being received from ISO, dissemination of the same to the appropriate experts and convey the collated views to the ISO Secretariat and also keep track of the voting schedule.

Dr Achal Kumar Mittal, Principal Scientist visited South Korea

Dr. Achal Kr. Mittal, Scientist visited South Korea during 21-25 October 2010 for paper presentation in the APEC-WW 2010 and in the 6th Workshop on Regional Harmonization on Wind Loading and Wind Environmental Specifications in Asia- Pacific Economies (APECWW 2010) and in Joint Workshop with IGWRDRR at Incheon City, South Korea, sponsored by GCoE Tokyo Polytechnic University, Japan.

He presented paper on "Indian National Report on Wind Effects on Structures" in PECWW 2010 covering the research being carried out at SERC Chennai, IIT Roorkee, IIT Kanpur and CBRI Roorkee. The paper also included the activities of Indian Society for Wind Engineering (ISWE) and Important Milestones in R&D activities of wind engg. in India. The full text of the paper is available at http://www.wind.arch.tkougei.ac.jp/APECWW/Report/2010/INDIAa.pdf.

He also pesented another paper on "Wind Related Disaster Risk Reduction Initiatives in India" in the Joint Workshop meeting of APEC-WW and IG-WRDRR (International Group on Wind-Related Disaster Risk Reduction). The paper covered Wind Related Disasters in India, List of Major Tropical Cyclone Disasters during the past 270 years in terms of Human Loss, Damage Assessment of Cyclone Affected Building, Past Initiatives and Present Status of Disaster Management in India and about the various activities of National Cyclone Risk Mitigation Project (NCRMP). Full paper is available at website. http://www.iawe.org/WRDRR/2010/Mittal.pdf.

Appendix VI

Honours and Awards

Sh. Pradeep Kumar Bhargava, Scientist F has been awarded Ph. D. Degree in Physics by Ch. Charan Singh University, Meerut for his research on Investigation on Utilisation of Wind Energy in Buildings.

MoU Signed

CBRI signed MoU with M/s BDS Projects India Pvt. Ltd., Mumbai for R&D work on Cathodic Protection of Reinforced concrete Structures on 20th Oct., 2010.

Patent Filed

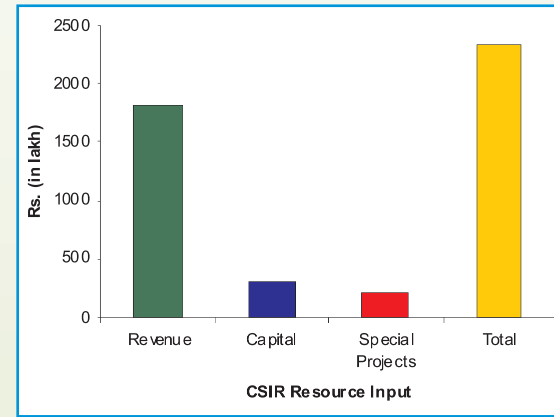
Patent application no. 109NF2010 has been filed by S. P. Agrawal and Rajni Lakhani, dated 9 November 2010 on An improved process for making building boards and panels from plywood/ veneer industry waste using lignin present in it, and building boards and panels made there from.

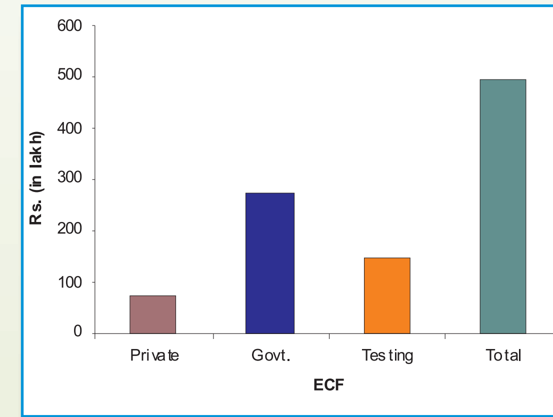
Date-line

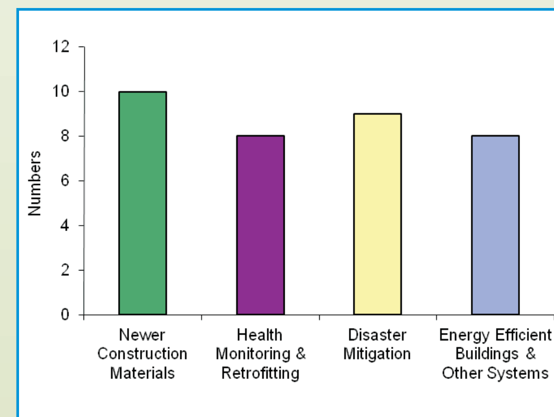
Sl.No.	Date	Salient Details
1.	May 14-15, 2010	Exhibition on Rural Housing Technologies, Sundernagar, H.P.
2.	May 11, 2010	National Technology Day
3.	May 21, 2010	Anti-Terrorism Day
4.	July 5-9, 2010	Entrepreneurship Development Programme on Low Cost Housing Technologies under CSIR 800 : RSWNET Programme
5.	June 5, 2010	World Environment Day
6.	August 9, 2010	Launched POST GRADUATE COURSE on Engineering of Infrastructure (Buildings/ Roads) and Disaster Mitigation
7.	August 15, 2010	Independence Day
8.	August 20, 2010	Sadbhawna Divas
9.	September 8-14, 2010	Hindi Week
10.	September 21-24, 2010	Short-Term Course on Earthquake Resistant Design & Construction Practices
11.	September 26, 2010	CSIR Foundation Day
12.	October 25-November , 2010	Vigilance Awareness Period
13.	November 14-27, 2010	CSIR-Technofest - 2010, IITF , Pragati Maidan , New Delhi
14.	December 3-8, 2010	Workshop cum Training Course on Seismic and Wind Resistant Design of Building Structures" followed by International Advance School in Wind Engineering (IAS 7)
15.	December 6, 2010	CSIR-CBRI, Roorkee Flag off Lok Awaas Yatra (A CSIR-800 RSWNET Programme)
16.	December14-15, 2010	Indo-US workshop on Nanotechnology in the Science of Concrete
17.	January 26, 2011	Republic Day

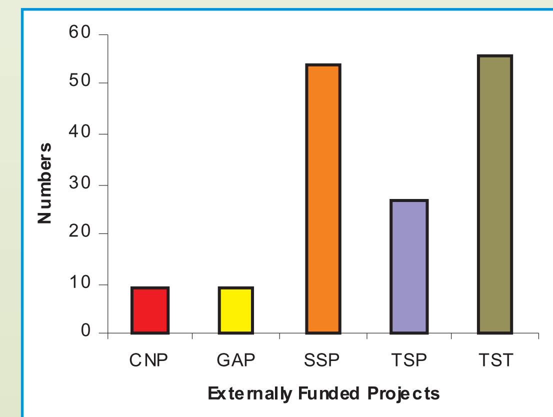
18	February 2 -5, 2011	Rural Technology Mela, National Institute of Rural Development , Hyderabad
19.	February 10-12, 2011	National Conference on Landslide Hazards - Consequences & Challenges
20.	February 17-18, 2011	Exhibition on Disaster Resistant Rural Housing Technologies at Nauni , Solan , H.P
21.	February 24-25, 2011	National Conference on Recent Advances in Ground Improvement Techniques
22.	February 23-26, 2011	Exhibition on Appropriate Technologies for Rural Development during North Zone Regional Agriculture Fair, NIT, Hamirpur, Himachal Pradesh
23.	February 28, 2011	National Science Day
24.	March 4-6, 2011.	Participation at Raj Bhawan, Dehradun
25.	March 11-13, 2011	Participation in COGNIZANCE 2011, IIT Roorkee
26.	March 29, 2011	Faculty Training and Motivation and Adoption of Schools & Colleges

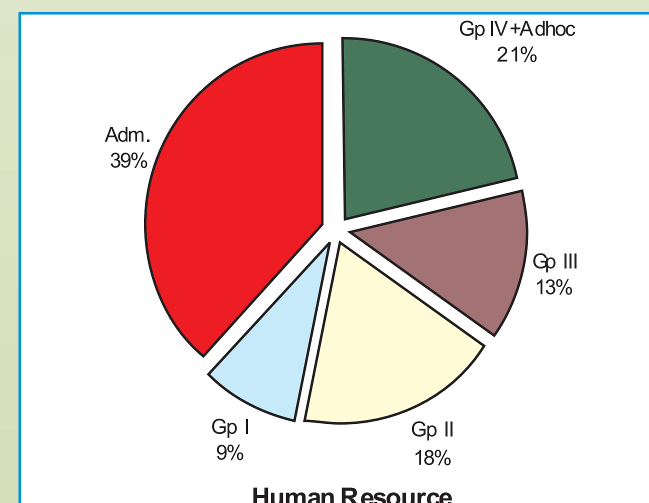
Performance/Projects/Human Resource











वार्षिक प्रतिवेदन
Annual Report
2010-2011

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