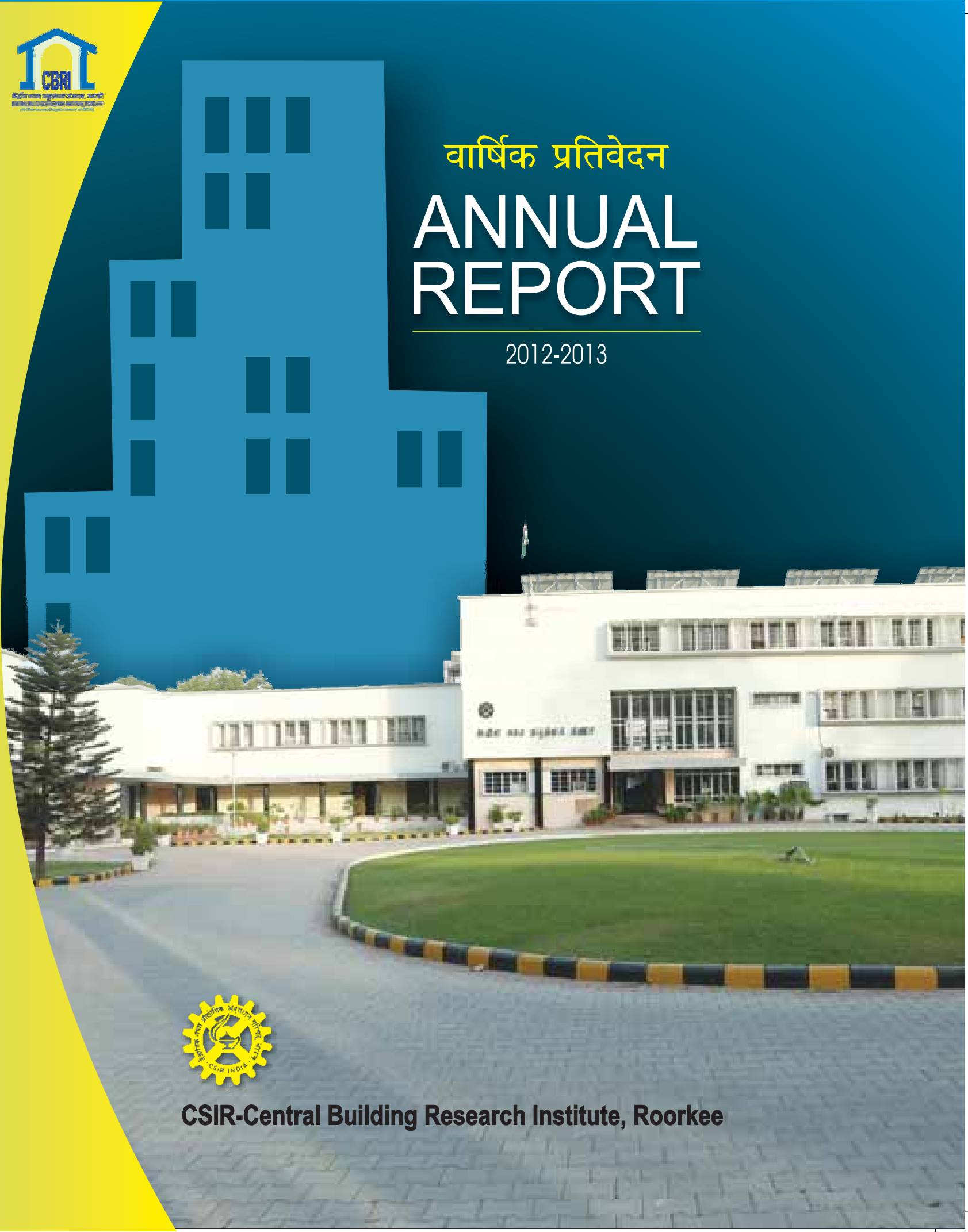
वार्षिक प्रतिवेदन

ANNUAL REPORT

2012-2013



CSIR-Central Building Research Institute, Roorkee

वार्षिक प्रतिवेदन
Annual Report
2012-2013

सीएसआईआर–केन्द्रीय भवन अनुसंधान संस्थान, रुड़की

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Printed at

CSIR-National Institute of Science Communication And Information Resources
Dr. K. S. Krishnan Marg, New Delhi 110 012

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निदेशक की कलम से

सीएसआईआर–केंद्रीय भवन अनुसंधान संस्थान, रूड़की का वर्ष 2012–13 का वार्षिक प्रतिवेदन प्रस्तुत करते हुए मुझे अत्यंत हर्ष का अनुभव हो रहा है। भवन एवं निर्माण उद्योगों के हित में संस्थान ने वैज्ञानिक अनुसंधान और विकास, प्रौद्योगिकी विकास, प्रौद्योगिकी प्रसार, सामाजिक गतिविधियों, मानव संसाधन विकास और भवन अनुसंधान के लिए राष्ट्रीय नियोजन में काफी योगदान दिया है। संस्थान ने, वैज्ञानिकों के बीच संपर्क और तालमेल के स्तर में वृद्धि के लिए, अपने उपलब्ध वैज्ञानिक, तकनीकी और बुनियादी संसाधनों को लक्ष्य-उन्मुख इकाइयों में प्रवृत्त करके, अनुसंधान गतिविधियों में सर्वांगीण प्रगति दर्शायी है। यह भवन विज्ञान और प्रौद्योगिकी के क्षेत्र में बड़ी चुनौतियां स्वीकार करने के लिए संस्थान को मजबूत करने का एक प्रयास है।

यह वर्ष हमारे लिए बहुत महत्वपूर्ण रहा क्योंकि अप्रैल 2012 में 12 वीं पंचवर्षीय योजना की गतिविधियां संपन्न हो गयीं। सभी स्तरों पर लगभग दो वर्ष की एक लम्बी विवेचना के बाद संस्थान ने दो परियोजनाओं को आगे बढ़ाने का निर्णय लिया-एक है संस्थान की विशेष योग्यता के क्षेत्र में सुप्रा इंस्टीट्यूशनल नेटवर्क परियोजना (SINP) तथा दूसरी है संस्थान द्वारा समन्वय की जा रही नेटवर्क परियोजना, जिसमें अनेक सीएसआईआर प्रयोगशालाएं भाग ले रही हैं। साथ ही संस्थान अन्य सीएसआईआर प्रयोगशालाओं के समन्वय से चलाई जा रही छः परियोजनाओं में भाग ले रहा है।

इस अवधि के दौरान, विभिन्न वर्क पैकेज द्वारा अगली पीढ़ी ग्रीन बिल्डिंग्स के लिए अभिनव सामग्री और प्रौद्योगिकियों पर एक सुप्रा इंस्टीट्यूशनल नेटवर्क परियोजना (SINP) आरंभ की गयी। नैनो प्रौद्योगिकी के द्वारा सामग्रियों का निष्पादन संवर्धन नामक वर्क पैकेज में विभिन्न कार्यों जैसे – अति उच्च निष्पादन और स्थायित्व हेतु इंजीनियर्ड कंक्रीट, नैनो प्रौद्योगिकी द्वारा बहुकार्यात्मक विलेपों का विकास, नैनोकम्पोजिट्स द्वारा पॉलीमर सामग्रियों की अग्नि अवरोधकता बढ़ाना, ऊर्जा दक्ष भवनों हेतु फेज चेंज सामग्रियों पर अध्ययन किये गये। टिकाऊ निर्माण हेतु अगली पीढ़ी कंक्रीट वर्क पैकेज के अंतर्गत, जियो पॉलीमर कंक्रीट में प्रबलित सरियों का बंधन व्यवहार, स्व उपचारी (सैल्फ हीलिंग) सामग्री के रूप में बायो कंक्रीट, प्रवेश्य कंक्रीट का विकास पर अध्ययन किये गये। ग्रीन बिल्डिंग प्रौद्योगिकियां वर्क पैकेज के अंतर्गत, कार्यालय भवनों के लिए ग्रीन रेटरोफिट स्ट्रेटेजीज, ठण्डे जलवायु क्षेत्रों के लिए सौर खिड़की प्रणाली का विकास, टिकाऊ निर्माण उत्पादों हेतु, विध्वंस अपशिष्ट का कच्चे माल के रूप में उपयोग, सोलर थर्मल, एयर कंडीशनर, ठोस औद्योगिक अपशिष्ट. सिविल निर्माण हेतु, एक भू–सामग्री संसाधन, उड़न राख/चावल की भूसी/मारबल डस्ट के साथ विभिन्न औद्योगिक अपशिष्टों को मिलाकर हल्के ब्लॉक विकसित करने के उद्देश्य से देश के विभिन्न भू–जलवायु परिक्षेत्रों के अंतर्गत शहरी क्षेत्रों में आवास समूहों हेतु प्रौद्योगिकी पैकेज, खोखले जिप्सम पैनल बनाने वाली स्वचालित मशीन का विकास, पूर्व निर्मित पैनलों एवं चिनाई के लिए फलूरोजिप्सम से सीमेंट विहीन प्लस्तर का अनुप्रयोग, नये भवनों के लिए दीमक प्रतिकर्षी अवरोधक का विकास, कठोर मिट्टियों के लिए मजबूत नींव (रोबस्ट फाउण्डेशन) का विकास पर अध्ययन किये गये। जोखिम न्यूनीकरण हेतु सामग्रियॉ, एवं प्रौद्योगिकियॉ वर्क पैकेज में इस्पात प्रबलित कंक्रीट संरचनाओं के लिए स्वदेशी कैथोडिक संरक्षण प्रणाली, प्रबलित कंक्रीट तत्वों का प्रभाव व्यवहार, अग्नि में सुरक्षित पॉलीमर कम्पोजिट प्रणाली का विकास, अधिक स्वच्छ भवन पर्यावरण के लिए उन्नत संवातन प्रणाली पर अध्ययन किये गये।

आपदा न्यूनीकरण इंजीनियरी तथा सुरक्षित एवं स्मार्ट भवन पर्यावरण हेतु स्वास्थ्य प्रबोधन पर नेटवर्क परियोजना (ईडीएमआईएसएसआईबीएलई) विभिन्न वर्क पैकेजों के साथ आरंभ की गयी। भूस्खलन आपदा न्यूनीकरण इंजीनियरी के अंतर्गत

निदेशक की कलम से

सीएसआईआर की कईं प्रयोगशालाएं एक साथ मिलकर काम कर रही हैं। चमोली–जोशीमठ क्षेत्र, गढ़वाल हिमालय का भूस्खलन जोखिम निर्धारण (सीएसआईआर–सीबीआरआई), चमोली– जोशीमठ क्षेत्र, गढ़वाल हिमालय में भूस्खलन के लिए पूर्व चेतावनी हेतु यंत्रीकरण तथा निर्णय पैकेज (सीएसआईआर–सीबीआरआई), चमोली– जोशीमठ क्षेत्र, गढ़वाल हिमालय में जोखिम निर्धारण हेतु जीपीएस आधारित, समन्वित भूस्खलन प्रतिरूपण (सीएसआईआर–सीएमएमएसीएस), एसएआर इंटरफेरोमीटरी के उपयोग द्वारा भूस्खलन प्रबोधन (सीएसआईआर–सीएसआईओ), भूस्खलन प्रबोधन हेतु ऑप्टीकल फाइबर आधारित मल्टीप्लैक्स सेंसर नेटवर्क प्रणाली का विकास (सीएसआईआर–एनईआईएसटी), चमोली– जोशीमठ क्षेत्र, गढ़वाल हिमालय में भूस्खलन के लिए समन्वित भू–अन्वेषण एवं नियंत्रण उपाय (सीएसआईआर–सीबीआरआई), भूस्खलन जोखिम सूचना प्रणाली एवं भूस्खलन नियंत्रण के लिए उन्नत (नवोन्मेषी) उपायों का अभिकल्पन (सीएसआईआर–सीआरआरआई), बायो–इंजीनियरी–पहाड़ी क्षेत्रों में भूस्खलन एवं ढ़लान स्थिरता समस्याओं के समाधान हेतु एक फाइटोरेमेडिएशन विकल्प (सीएसआईआर–एनईईआरआई)। वर्क पैकेज भूकम्प आपदा न्यूनीकरण इंजीनियरी में, श्रीनगर उत्तराखण्ड का भूकम्पीय सूक्ष्म वर्गीकरण, गतिक पार्श्व भारण में पाइलों का भूकम्पीय व्यवहार, अर्द्ध–स्थैतिक अवस्थाओं में परिरूद्ध चिनाई भवनों का निष्पादन, पर कार्य किया जा रहा है। वर्क पैकेज अग्नि जोखिम न्यूनीकरण इंजीनियरी में, ओजोन का कम ह्रास करने वाली उन्नत अग्नि शमन प्रणाली का विकास, संरचनात्मक तत्वों का अग्नि निष्पादन मूल्यांकन एवं पुनःस्थापन उपायों पर कार्य प्रगति पर हैं। वर्क पैकेज आपदा पश्चात आश्रय नियोजन में, पश्चिमी हिमालय के ग्रामीण क्षेत्रों में आपदा पश्चात आश्रय नियोजन (सीएसआईआर–सीबीआरआई), बाढ़ प्रभावित लोगों के लिए आपदा पश्चात आश्रय (सीएसआईआर–एनईआईएसटी, जोरहट) पर कार्य किया जा रहा है। वर्क पैकेज मॉडल आवासीय इकाई हेतु बुद्धिमत्तापूर्ण भवन प्रणाली में, बुद्धिमत्तापूर्ण भवन युक्तियों से परिपूर्ण एक आवासीय इकाई का वास्तुविदीय नियोजन एवं अभिकल्पन, परिवेशी पर्यावरण के परिप्रेक्ष्य में इंटेलिजेंट एचवीएसी (HVAC) और प्रकाश नियंत्रण, शीशे की सतह की सफाई करने वाली रोबोटिक प्रणाली (सीएसआईआर–सीबीआरआई) पर कार्य प्रगति पर हैं।

एक नेटवर्क परियोजना में, जिसमें सीएसआईआर–सीबीआरआई एक सहायक प्रयोगशाला है, उड़नराख का उपयोग करके पानी से भारी धातुओं को हटाने, तथा इसका मूल्यवान भवन घटकों के उत्पादन में उपयोग करने पर अध्ययन (नोडल प्रयोगशाला सीएसआईआर–नीरी), भूमिगत खानों में फंसे कोयले की इष्टतम निकासी के लिए कृत्रिम खंभों के लिए समुचित सहायता प्रणाली के विकास (नोडल प्रयोगशाला सीएसआईआर– सीआईएमएफआर) पर अध्ययन किये जा रहे हैं। खानों में फंसे कोयले को निकालने की परियोजना लागू होने से लम्बे समय से चली आ रही राष्ट्रीय समस्या का निराकरण संभव हो सकेगा।

सीएसआईआर द्वारा वर्ष 2009 में, इंजीनियरी में स्नातकोत्तर अनुसंधान कार्यक्रम (पीजीआरपीई) आरंभ करने के साथ ही हमने अपनी सहयोगी प्रयोगशाला सीएसआईआर–सीआरआरआई, नई दिल्ली के साथ मिलकर अगस्त 2010 में अवसंरचना एवं आपदा न्यूनीकरण इंजीनियरी (भवन/सड़कें) पर दो वर्षीय पीजीआरपीई कार्यक्रम आरंभ किया था। इसके अंतर्गत छात्रों का दूसरा बैच अपने अंतिम सत्र में मास्टर परियोजनाएं पूरी कर रहा है। वैज्ञानिक एवं नवोन्मेषी अनुसंधान अकादमी (एसीएसआईआर) को संसद के दोनों सदनों ने स्नातकोत्तर उपाधि प्रदान करने के लिए प्राधिकृत करने की सिफारिश की थी और 6 फरवरी 2012 को माननीय राष्ट्रपति महोदय ने अधिनियम पर अपनी स्वीकृति प्रदान की ।

संस्थान ने, कागजी कार्रवाई को प्रभावी ढंग से कम करने के लिए ईआरपी गतिविधियों को अपनाया और सीएसआईआर में ईआरपी कार्यान्वयन के लिए सिल्वर आइकन पुरस्कार भी जीता.

संस्थान में विभिन्न कार्यक्रमों का आयोजन किया गया जैसे-भवनों में ऊर्जा संरक्षण के इंजीनियरिंग ट्रेंड्स पर राष्ट्रीय सम्मेलन, सिविल इंजीनियरी और भू जोखिमों के लिए इंजीनियरी भूभौतिकी पर राष्ट्रीय कार्यशाला। इंडियन नेशनल एकेडमी ऑफ इंजीनियरिंग के वार्षिक सम्मेलन, पवन इंजीनियरी पर राष्ट्रीय सम्मेलन तथा ऊर्जा कुशल भवनों के लिए उन्नत सामग्रियां पर अंतर्राष्ट्रीय सम्मेलन ने देश एवं विदेशों से शिक्षा और उद्योगों के प्रतिनिधियों को बड़ी संख्या में आकर्षित किया।

निदेशक की कलम से

छात्रों तथा आम जनता को संस्थान की अनुसंधान एवं विकास गतिविधियों के प्रति जागरूक करने के लिए संस्थान में राष्ट्रीय विज्ञान दिवस, विश्व पर्यावरण दिवस, राष्ट्रीय प्रौद्योगिकी दिवस, सीएसआईआर स्थापना दिवस, सीएसआईआर–सीबीआरआई स्थापना दिवस को मुक्त दिवस के रूप में मनाया गया। संस्थान को जनसामान्य के लिए खुला रखने के साथ–साथ विभिन्न कार्यक्रम, स्थापना दिवस व्याख्यान, राष्ट्रीय दिवसों की महत्ता के विषय में लोगों को जागरूक करने के लिए विभिन्न राष्ट्रीय दिवसों पर प्रख्यात व्यक्तियों के व्याख्यान आदि आयोजित किये गये। संस्थान में सितम्बर माह में हिंदी सप्ताह मनाया गया। इस सप्ताह के दौरान हिंदी टिप्पण एवं मसौदा लेखन प्रतियोगिता, हिंदी निबंध प्रतियोगिता, हिंदी प्रश्नोत्तरी तथा हिंदी लेखन प्रतियोगिता (हिंदीतर भाषी कार्मिकों के लिए) आयोजित की गयी। देश–विदेश के लोगों के साथ निरंतर संवाद एवं संचार बनाए रखने के क्रम में संस्थान ने बड़ी संख्या में भवन एवं निर्माण क्षेत्र की विभिन्न समस्याओं संबंधी पूछताछ के उत्तर दिये। भवन निर्माण के क्षेत्र में नये अनुसंधान एवं प्रौद्योगिकियों के विषय में आम जनता के बीच जागरूकता पैदा करने के उद्देश्य से निदर्शन सह प्रशिक्षण कार्यक्रमों, तकनीकी प्रदर्शनियों आदि का आयोजन किया गया । संस्थान ने अपने दिल्ली स्थित प्रसार केंद्र के साथ मिलकर देश भर में केंद्रीय, राज्य सार्वजनिक/निजी क्षेत्रों के संगठनों के साथ संपर्क बनाए रखा। उपर्युक्त सभी गतिविधियां वैज्ञानिक साथियों, तकनीकी तथा प्रशासनिक कार्मिकों के कर्तव्यनिष्ठ तथा सच्चे प्रयासों के बिना संभव नहीं हो पाता जिन्होंने सौंपे गये कार्यों को सफलतापूर्वक करने के लिए कठिन परिश्रम किया। मैं उन सभी की हार्दिक प्रशंसा करते हुए उन्हें शुभकामनाएं देता हूं। हमारी अनुसंधान परिषद के अध्यक्ष और सदस्यगण अपने अमूल्य परामर्श, मार्गदर्शन एवं सहायता के लिए विशेष धन्यवाद के पात्र हैं। मैं सीएसआईआर के महानिदेशक, प्रो. समीर के. ब्रहमचारी तथा सीएसआईआर मुख्यालय के अपने साथियों का, हमें निरंतर सहयोग एवं मार्गदर्शन करने के लिए सद्भावनापूर्वक धन्यवाद देता हूं। मैं आवश्यक सूचनाएं उपलब्ध कराने वाले सहकर्मियों तथा इस वार्षिक प्रतिवेदन की उतम प्रस्तुति के लिए संपादक दल को भी बधाई देता हूं। अंत में, अपने मूल्यवान ग्राहकों, प्रायोजकों, शुभचिंतकों तथा सीएसआईआर–सीबीआरआई के सेवानिवृत्त कार्मिकों के सहयोग तथा सहायता का स्मरण करना मेरे लिए प्रसन्नतादायक पल है।

भवन निर्माण एवं अवसंरचनात्मक उद्योग में वृद्धि के साथ हम उज्जवल भविष्य की ओर अग्रसर हैं।

दिनांक : नवम्बर 20, 2013

एस.के. भट्टाचार्य

(प्रो. एस. के. 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 2012-13. The Institute has contributed immensely in scientific research and development, technology development, technology dissemination, societal activities, human resource development and national planning for building research in order to sustain the building and construction industries. The Institute witnessed an all-round progress in its research activities through reallocation of available scientific, technical and infrastructural resources into a few, object oriented units to catalyze increased level of interaction and synergy among the scientists. This is an endeavor to strengthen the Institute to take up larger challenges in Building Science & Technology.

This year was very crucial for all of us as from April 2012, the activities of 12th Five Year Plan took off. After a prolonged deliberation of almost two years at all levels, the Institute decided to carry forward two important projects - One Supra Institutional Network Project (SINP) in core competency area of the Institute and the other one as Network project being Co-ordinated by the Institute and being participated by a number of sister laboratories. Also this Institute is participating in six network projects being co-ordinated by other sister laboratories.

During the period, a **Supra Institutional Network Project (SINP)** on Innovative Materials & Technologies for Next Generation Green Buildings (**INMATE**) was initiated through different work packages. In Work Package, **'Performance Enhancement of Materials through Nanotechnology',** Studies on various tasks such as Nano-Engineered Concrete for Ultra High Performance and Durability, Development of Multifunctional Coatings using Nanotechnology, Enhancing the Fire Retardancy of Polymeric Materials using Nanocomposites, Studies of Phase Change Material for Energy Efficient Buildings were carried out. In Work Package, **'Next Generation Concrete for Sustainable Construction',** Studies on Bond Behavior of Reinforcing Bars in Geo-polymer Concrete, Bio Concrete as Self Healing material, Development of Pervious Concrete were carried out. Under the Work Package, **'Green Building Technologies',** Studies on Green Retrofit Strategies for Office Buildings, Development of Solar Window System for Cold Climatic region, Demolition Wastes as Raw Materials for Sustainable Construction Products, Solar Thermal Air Conditioner, Solid Industrial Waste – A Resource Geo-material for Civil Construction, Technology Packages for Mass Housing in Urban Areas for different Geo-Climatic Regions of the Country with a view to develop light weight blocks using different industrial wastes based on Fly ash/rice husk ash/marble dust, Development of an Automatic Hollow Gypsum Panel Making Machine, Application of cement free plaster from fluoro gypsum for prefabricated panels and Masonary work, Development of Anti-Termite Barrier for New Buildings, Development of Robust Foundation for Difficult soils were carried out. In Work Package, **'Materials & Technologies for Hazard Reduction',** Studies on Indigenous Cathodic Protection System for Steel Reinforced Concrete Structures, Impact Behavior of Reinforced Concrete Elements,

Development of Fire Safe Polymeric Compsite System, Improved Ventilation System for Cleaner Built Environment have been initiated.

Network Project on Engineering of Disaster Mitigation & Health Monitoring for Safe & Smart Built Environment (**EDMISSIBLE**) was initiated through different work packages. Under **Engineering of Landslide Disaster Mitigation,** different sister laboratories are participating. Landslide Hazard and Risk Assessment of Chamoli-Joshimath Region, Garhwal Himalaya (CSIR-CBRI), Early Warning Instrumentation & Decision Package for a Landslide in Chamoli-Joshimath Region, Garhwal Himalaya (CSIR-CBRI), GPS based Integrated Landslide Modeling for Hazard Assessment in Chamoli-Joshimath Region, Garhwal Himalaya (CSIR- CMMACS), Landslide monitoring using SAR Interferometery (CSIR-CSIO), Development of Optical Fibre based Multiplex Sensor Network System for Landslide Monitoring (CSIR-NEIST), Comprehensive Geo-Investigation and Control Measures of Landslide in Chamoli-Joshimath Region, Garhwal Himalaya (CSIR-CBRI), Landslide hazard Information System and Design of Innovative Measures for Landslide Control (CSIR-CRRI), Bio-Engineering – A Phytoremediation Option for the Mitigation of Landslide and Slope Stability Problems in the Hilly Regions (CSIR-NEERI). In Work Package, **'Engineering of Earthquake Disaster Mitigation',** Seismic Microzonation of Srinagar, Uttarakhand, Seismic Behaviour of Piles under Dynamic Lateral Loading, Performance of Confined Masonry Buildings under Quasi-Static Condition were undertaken. In Work Package, '**Engineering of Fire Disaster Mitigation',** Development of Low Ozone Depletion Potential Innovative Fire Suppression System, Fire Performance Evaluation of Structural Elements and Rehabilitation Measures are progressing. In Work Package, '**Post Disaster Shelter Planning',** Post Disaster Shelter Planning for Rural Areas in the Western Himalayas (CSIR-CBRI), Post Disaster Shelters for Flood Affected People (CSIR-NEIST, Jorhat) are working. In Work Package, **'Intelligent Building System for Model Residential Unit',** Architectural Planning and Design of a Residential Unit integrating Intelligent Building Features, Intelligent HVAC & Lighting Controls in Response to Ambient Environment, Glass Facade Cleaning Robotic System (CSIR-CBRI) are progressing.

In a **Network Project** where CSIR-CBRI is a Participating Laboratory**,** Studies on Removal of Heavy Metals from Water Using Fly Ash and its subsequent use in the production of value added building components (Nodal lab CSIR-NEERI), Development of appropriate support system for artificial pillars for optimal extraction of Locked-up coal from underground mines (Nodal lab CSIR-CIMFR) are being carried out . The project on locked up coal is expected to resolve a long standing national problem, if made operational.

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 second batch of students are in their final semester completing their Masters projects. The Academy of Scientific and Innovative Research (AcSIR) received the approval from both the houses of parliament to offer post graduate degree and the Act received the assent of the President on 6th February 2012.

The Institute adopted ERP activities to reduce paper work effectively and also won the Silver Icon Award for implementing ERP in CSIR.

FROM THE DIRECTOR'S DESK

The Institute organized various programmes viz. National conference on 'Engineering Trends of Energy Conservation in Buildings', National Workshop on 'Engineering Geophysics for Civil Engineering and Geo-hazards', Annual Convention of the Indian National Academy of Engineering, National Conference on 'Wind Engineering', International Conference on 'Advanced Materials for Energy Efficient Buildings' attracted a large number of delegates from academia and industries from all over the country and abroad.

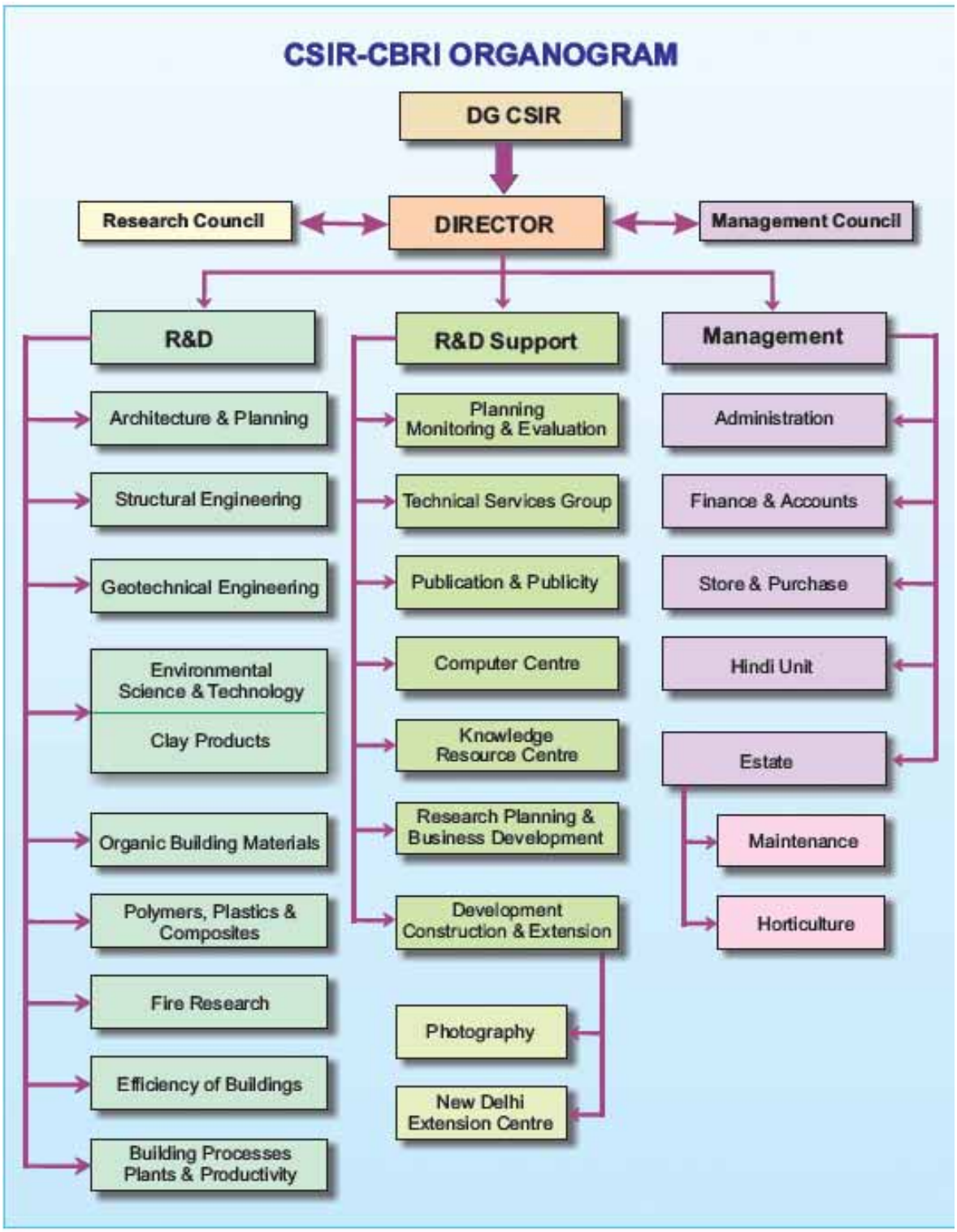
The Institute observed open days on the occasion of National Science Day, World Environment Day, National Technology Day, CSIR Foundation Day, CSIR-CBRI Foundation Day to make the students and general public aware with the R&D activities of the Institute. Apart from keeping the institute open for general awareness, different programmes, foundation day lectures, lectures by eminent personalities on different National days to make people aware of the importance of the National days were arranged. The Institute celebrated Hindi week in the month of September. Hindi Noting & Drafting competition, Hindi Essay writing competition, Hindi Quiz & Hindi Writing competition (for non-Hindi speaking employees) were organized during the week. To maintain regular interaction and communication with the people of India and abroad, the Institute attended various enquiries pertaining to various problems of Building and Construction sector. Demonstration cum training programmes, technical exhibitions etc. were also 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 New Delhi continued to maintain liaison with Central, State, public/private sectors throughout the country.

All could not have been possible without the sincere and honest efforts made by fellow scientists, technical and administrative staff who worked hard in successfully completing the works 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 Prof. Samir K. Brahmachari, Director General, CSIR and other colleagues from CSIR Head quarters for their continuous 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-colleagues of CSIR-CBRI.

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

Dated: November. 20, 2013

(Prof. S. K. Bhattacharyya)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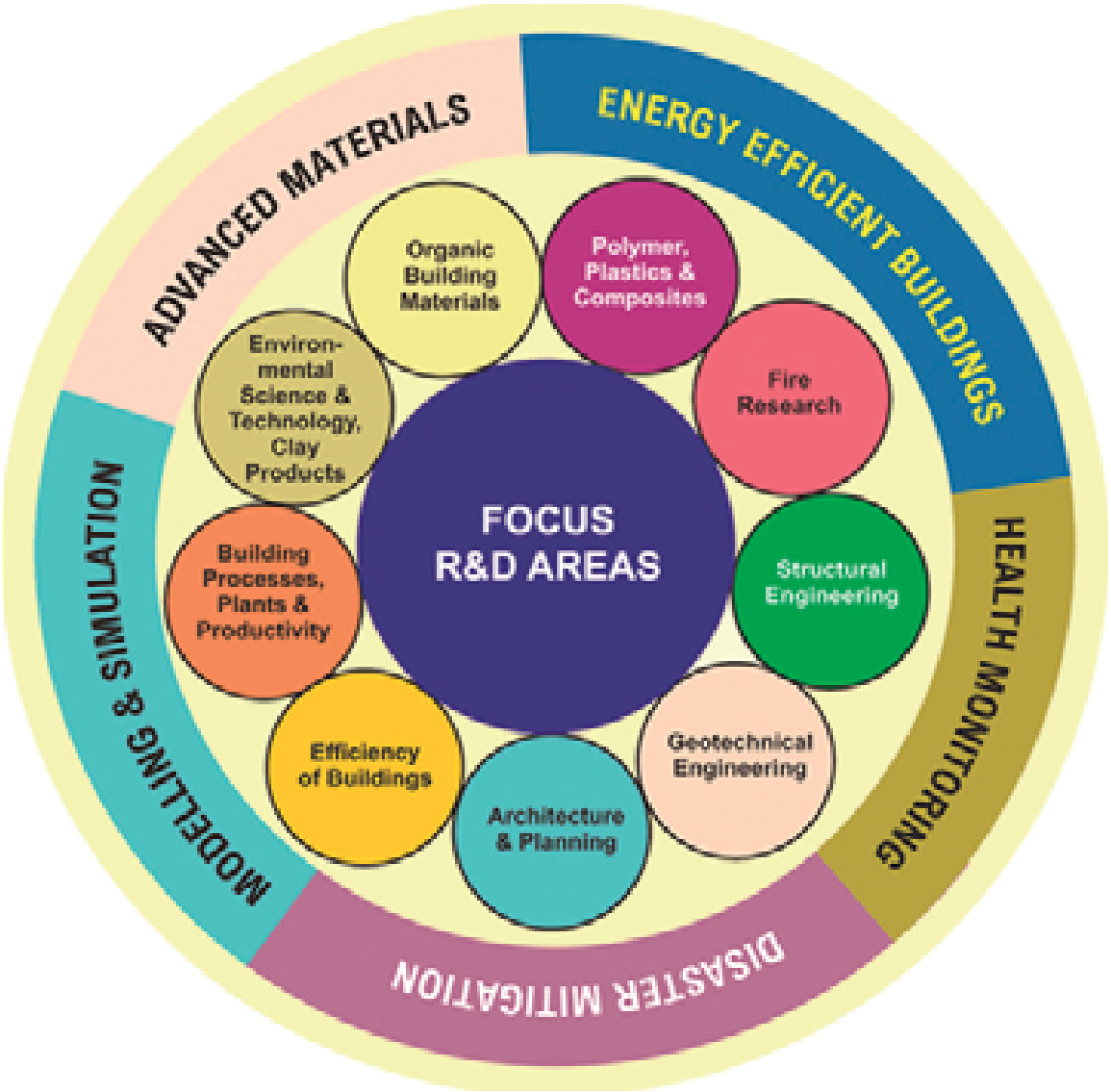
CSIR-CBRI to work as world class knowledge base for providing solutions to almost all area of Building / Habitat planning and construction including building materials, construction technology, fire engineering and disaster mitigation.



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To carry out R&D on all aspects of building and housing and assist the building industry in solving problems of planning, designing, foundations, materials and construction including disaster mitigation in all kinds of buildings with a view to achieve economy, comfort, functional efficiency, speed, productivity in construction, environment preservation and energy conservation.

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SUPRA INSTITUTIONAL NETWORK PROJECT

Innovative Materials & Technologies for Next Generation Green Buildings (INMATE)

INNOVATIVE MATERIALS & TECHNOLOGIES FOR NEXT GENERATION GREEN BUILDINGS (INMATE)

WP-1: Performance Enhancement of Materials through Nanotechnology.

PI: Dr. L. P. Singh **Task: 04 Nos.**

1.1. Nano-Engineered Cementitious Materials, PI: L. P.Singh, S. K. Bhattacharyya, S. R. Karade & Team

1.2. Multifunctional Coating using Nano-Technology, PI: P.C.Thapliyal & Team

1.3. Enhancing the Fire Retardancy of Polymeric Materials using Nano-Composites, PI: Subham Dastidar, P.C. Thapliyal & L.P.Singh

1.4. Phase Change Materials, PI: Srinivasrao Naik B, L.P. Singh, P. C. Thapliyal & Ashok Kumar

WP-2: Next Generation Concrete for Sustainable Construction.

PI: Er. S. K. Singh **Task: 04 Nos.**

2.1. Cement free Geopolymer Concrete, PI: B. Singh, M. Gupta & S. K. Bhattacharyya

2.2. Bio-Concrete as Self Healing Material, PI: Leena Chourasia

2.3. Hybrid Fibre Reinforced Concrete, PI: S. K. Singh

2.4. Pervious Concrete for Tropical Climate, PI: R. Deoliya & S. C. Gurram

WP-3: Green Building Technologies.

PI: Ashok Kumar **Task: 06 Nos.**

3.1. Green Retrofit Strategies for Office Buildings,PI: Ashok Kumar, R. Deoliya, Rajni Lakhani, B.M.Suman & Neeraj Jain

Sub Task 3.1: Development of Solar Window System for Cold Climatic Region, PI: Neeta Mittal & B.M.Suman

3.2. Demolition Wastes, PI: A. K. Minocha, Mridul Garg & Team

3.3. Solar Thermal Air Conditioner, PI: Nagesh B. Balam

3.4. Solid Industrial Waste-Resource Geo–Material, PI: M. Samanta, A. Ghosh, S.Maiti, D. Kumar & Z. Ahmed

3.5. Technology Packages for Mass Housing in Urban Areas, PI: Ashok Kumar, Mridul Garg, R. Lakhani , S.K.Panigrahi, Vivek Sood, B. S. Rawat & Team

Sub Task 3.5.1: To develop light weight blocks using different industrial wastes based on flyash/rice husk ash/marble dust, PI: Vivek Sood & Ashok Kumar

Sub Task 3.5.2: Development of an automatic hollow gypsum panel making machine, PI: S.K.Panigrahi & Team

Sub Task 3.5.3: Application of cement free plaster from fluorogypsum for prefabricated panels and Masonry works, PI: Mridul Garg & Team

Sub Task 3.5.4: Development of anti termite barrier for new Buildings, PI: B.S.Rawat, Ashok Kumar & S. K. Negi.

3.6. Robust foundation for difficult soils, PI: Pradeep Kumar

WP-4: Materials & Technologies for Hazard Reduction.

PI: Dr. S.R. Karade **Task: 04 Nos.**

4.1. Indigenous Cathodic Protection System, PI: S.R. Karade & Team

4.2. Impact Behaviour of RCC, PI: A.K.Pandey

4.3. Fire Safe Polymeric Composite Panels, PI: Harpal Singh

4.4. Improved Ventilation System, PI: Syed Ibrahim Sohel, A.K. Minocha & Jaswinder Singh

WP-1 Performance Enhancement of Materials through Nanotechnology

L. P. Singh

Task 1.1: Nano-Engineered Concrete for Ultra High Performance and Durability

L. P. Singh, S. K. Bhattacharyya, S. R. Karade & Team

A set up for the bench scale preparation of silica nanoparticles has been created. A 1/6 HP motor of 1425 rpm with a stainless steel rotor was fixed on a frame in such a manner so as to generate low vibration at high rpm. For the bulk preparation of nanosilica, a plastic container of a 60 liter capacity was used (Fig.1). Spherical silica nanoparticles with controllable size (<100 nm) were synthesized using sodium silicate as starting material, hydrochloric acid (HCl) as a catalyst and cetyltrimethlammonium bromide (CTAB) as a structure directing agent by sol-gel method. For the silica nanoparticle preparation, first CTAB and HCl were mixed and then 1M sodium silicate solution was added drop wise to the reaction mixture until the pH of system was reached to ~8.5. The final molar ratio of the reaction system was 0.047:1:0.54 of CTAB:sodiumsilicate: HCl.

Fig.1: Set up for bench scale preparation of silica nanoparticles

Further, these silica nanoparticles were incorporated into the cementitious materials and mechanical properties were evaluated. Four series of fresh cement mortar with varying composition of silica nanoparticles (0.5, 1.0, 2.0, and 3.0%) were casted with moulds (50 x 50 x 50 mm) to prepare specimens keeping water cement ratio (w/c) as 0.4 for the measurement of compressive strength. The mechanical properties of cement

Fig.2: Compressive strength (kg/cm2) of cemeant mortar (i) 25% cement, (ii) 22% cement and (iii) 20% cement with different amount of silica nanoparticles, respectively.

mortar are enhanced by the addition of silica nanoparticles. The compressive strengths after 3, 7 and 28 days are increased substantially on addition of nanosilica (Fig.2). It can be inferred from Fig.2 that early strength is achieved at 3 & 7 days (254 kg/cm^2) on addition of nanosilica as compared to control sample at 28 days (252 kg/cm^2).

Further, chloride permeability of cement mortars was carried out using accelerated chloride migration method i.e. electromigration test. In this method, a glass cell assembly consisting of two-compartments separated by mortar specimen, where one of the cells was filled with 3% NaCl solution and the other cell was with 0.3N NaOH solution, as per ASTM C1202, was used. Two platinum electrodes placed on both sides of the specimens served as working electrodes whereas saturated calomel electrode (SCE) placed in analyte worked as reference electrode to monitor the potential applied (Fig.3).

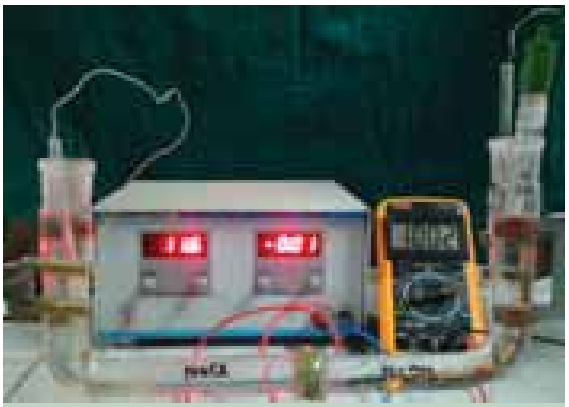


Fig.3: Experimental set-up for chloride penetration

Once the mortar specimen disc, solutions and electrodes were in place, the cells were connected with 7 V power source in which the electrode in NaCl solution becomes cathode and the electrode in NaOH solution becomes anode. During the test, small aliquot from destination solution (0.3 NaOH) was taken periodically to measure the free chloride ions concentration in destination solution using UV-VIS spectrophotometer. The incorporation of nanosilica and silica fume improved the penetration resistance of cement mortar as indicated by the reduction in chloride ion concentration in destination solution. An addition of 3% of nanosilica, improved chloride ion resistance in the order of ~43%, as where silica fume was able to reduce by only ~15% as compare to control specimen (Fig.4).

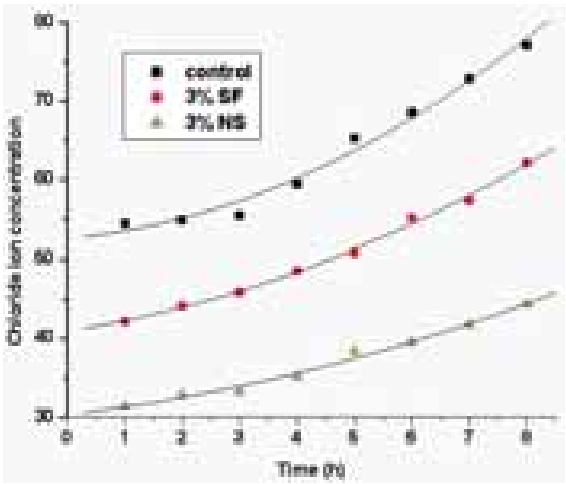


Fig.4: Chloride ion concentration in anodic cell at 7 V.

These results signify that the incorporation of nanosilica forms more hydration products and a denser microstructure is developed as compared to silica fume.

In conclusion, large scale preparation of silica nanoparticles was achieved using sol-gel method with a predefined reaction protocol along with cost effective ingredients. Prepared silica nanoparticles significantly enhanced the mechanical properties of cement mortar system. Further, silica nanoparticles with 3% addition improved the chloride ion resistance up to ~43%.

Task 1.2: Development of Multifunctional Coatings Using Nanotechnology

P.C. Thapliyal & Team

Objective of the present work is to prepare multifunctional (water resistant, energy efficient, anticorrosive) coatings for concrete.

Nano Titania with 40-50 nm size was synthesized using Nano Powder Synthesizer (NPS10) with different precursors such as titanium isopropoxide and titanium acetyl acetone. Work on the preparation of acrylic and epoxy coatings with/without nano additives is in progress. Physico-mechanical & morphological studies to characterize acrylic coatings is also in progress. Technical data for one of developed acrylic coating is given below:

- Appearance : Milky White Liquid
- System : Single Component
- pH : 7.0-8.0
- Coverage : 5-6 m^2/l
- DFT : 150-200 Microns

Physico-mechanical properties of some of the developed acrylic formulations are given below in Table 1. It were observed that addition of nano Titania (A1N) improved the overall properties of coatings.

Works on developing new aqueous formulations are in the pipeline. Characterization of developed multi-functional coatings will be carried out with studies to see the effect of constituents, especially shape and size of nano additives, on performance of multi-functional coatings and degradation characteristics of multifunctional coatings.

Table 1: Physico-mechanical properties

	A1	A2	A3	A1N*
Bond strength (MPa)	3.24	3.76	3.40	3.80
Tensile strength (Free film, MPa)	15	19	18	23
Elongation (Free film, %)	5	8	6	10
Water vapour transmission (mg/cm^2-mm-24hr)	0.348	0.340	0.292	0.186

*With nano Titania.

Task 1.3: Enhancing the Fire Retardancy of Polymeric Materials Using Nanocomposites

Subham Dastidar, P. C. Thapliyal and L. P. Singh

With increasing use of polymers in different applications, especially in building, by replacing conventional inorganic materials (metals) and natural materials (wood, fibers) results in a continuous demand for superior mechanical, thermal properties. Though polymer processing is highly energy consuming affair but life span improvement and limiting degradation against stringent condition can enhance efficiency. In the recent time, Polymer Clay Nanocomposite (PCN) appeared to be one of the promising alternatives to provide advantages over the conventional formulations in terms of enhanced physical, thermal, and mechanical properties. PCNs are well appreciated due to their approach in flame retardancy by reducing flame spread and fire propagation of varied polymers (e.g. PP, PE, PA, Nylon-6, EVA, PVC etc.). Along with that, it reduces the toxic smoke emission and form a protective barrier to improve the burn efficiency. In the ongoing project the involvement of nanoclay to improve the flame retardancy of polypropylene is being considered.

Reactor Design

In this context a reaction scheme was designed. The nanoclay platelets grafted with the specific linker molecules will capture the monomers and then subsequent polymerization would take place. For this purpose an ultrasonication assisted batch reactor had been proposed. During OLP - 364 (Yr. 2011 -2012) some parts of the batch reactor was designed.

Selected Dimensions

Vessel height (h) = 0.4 m and fluid height (H) = 0.3 m, Diameter of vessel (T) = 0.3 m

Power Consumption for Selected Impeller (6 - 45° pitched blade turbine)

P_d = 0.553 kW and $P_{motor} = P_{design} = P_d/(100 - \%\ Loss)$

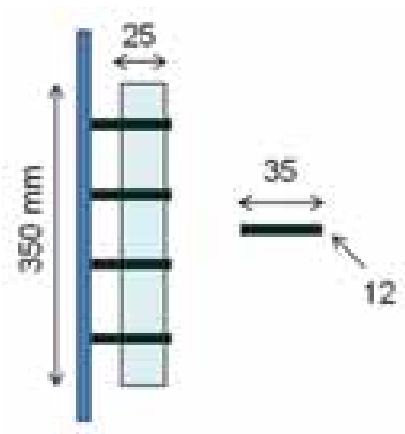


Fig.1: Floating Baffle

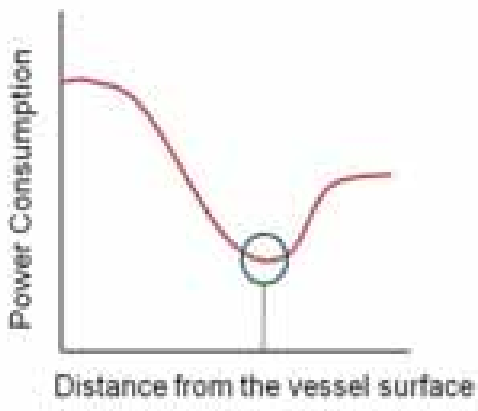


Fig.2: Power variation with Distance

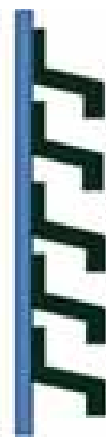


Fig.3: Extended Strip Baffle

The energy efficiency of the reactor was a prime concern. To bring energy efficiency in the system different types of baffle design were evaluated.

Baffle Design

1.Floating baffle

These kinds of baffles are attached to the inner surface of the reactor vessel using small metallic strips. The power consumption in this case can vary with the following parameters.

- Dimensions of the Baffle
- Number of strips
- Positioning of the helical coil (for coolant flow inside reactor)

For the dimensions shown in Fig. 1 the power consumption calculated is 0.442 kW. However, point to note that the distance from the vessel surface has a profound effect on the power consumption. There exist an optimum distance for which the minimum power consumption can be achieved. Fig.2 depicts this thing keeping the baffle dimensions same as Fig.1.When the distance is zero the power consumption is same as a normal baffled reactor. Also in this case the maximum distance possible is limited to the positioning of the helical coil.

2. Extended Strip Baffle:

This kind of baffle provides space for fluid flow inside the two twisted strips. As a result they introduce new surface to resist fluid flow. Thus they are not efficient enough to save energy. Fig.3 presents such kind of baffle.

The design of the strip is very important in this kind of baffle design. For a specific case, where five strips for each of the four baffles were considered with the dimension of 35 mm extended part a power consumption of 0.63 kW was calculated.

Material Development:

For selecting appropriate linker molecule specific to requirement, nanoclay (Montorillonite) was organically modified using two different kinds of amine based coupling agents. They were termed as MMT 1 and MMT 2. Along with that unmodified montorillonite (MMT) which is termed a MMT (Bentonite), was used as control.

The samples were characterized in particle size analyser. The characterization plot is shown in Fig.4.

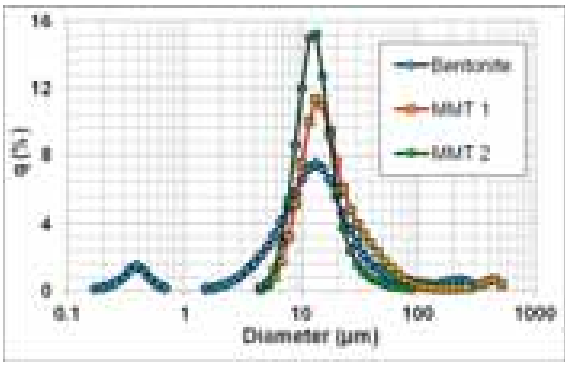


Fig.4: Diameter Vs count for Nanoclay

From the analysis the following sizes were obtained.

- MMT (Bentonite): **11.75 µm**
- MMT1: **14.95 µm**
- MMT2: **12.01 µm**

Now it is evident from the result that due to the presence of the organic modifiers the effective sizes of the clay samples has increased. For MMT 1 the increase in size is higher than MMT 2 sample. Hence the organic modifier used for MMT1 is more efficient to set apart the clay platelets which in turn would reduce the required power during the processing time. However, point to note that, though the clay is in nano sized but the sizes were in micro range and that is due to agglomeration and limitation of the instrument.

Task 1.4: Studies of Phase Change Material (PCM) for Energy Efficient Buildings

Srinivasarao Naik B, L. P. Singh, P. C. Thapliyal and Ashok Kumar

In the recent years the research on the use of the PCM is increasingly being considered for solar heating system, waste heat recovery, load shifting, building energy conversation and air conditioning applications. There are several promising developments taking place in the field of application of PCM for heating and reduction of energy load to buildings. Inclusion of PCM into building has a potential for minimizing energy consumptions in buildings. Classification of PCM is shown in Fig.1.

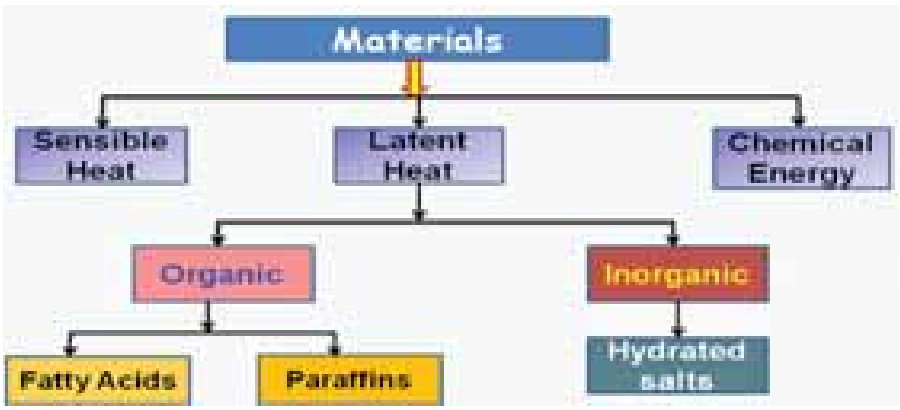


Fig.1: Classification of Phase Change Material

PCM's are widely used in different applications i.e. textiles, military, air conditioner, computers and buildings. Thermal storage materials have specific melting point.

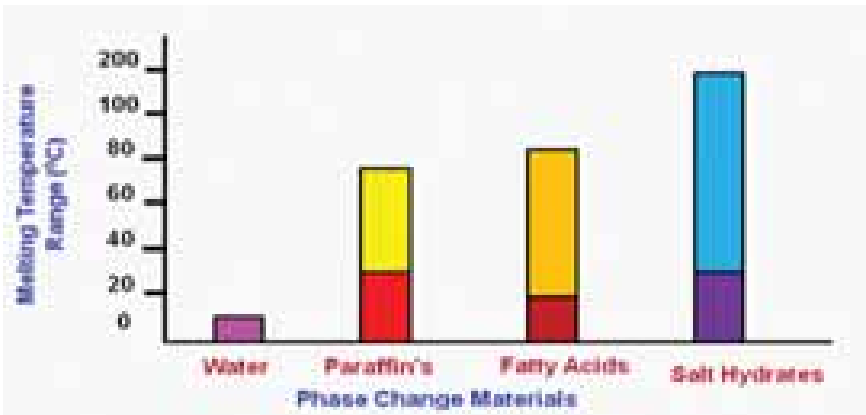


Fig.2: Different melting point range of PCM

Differential Scanning calorimeter (DSC)

Capric acid and Lauric acid were tested by DSC (Fig.3). DSC runs were carried out at a heating of 5^0C/min under constant stream of Argon at atmosphere pressure. The Specimen weight was about 2.5-10 mg for PCM alone.

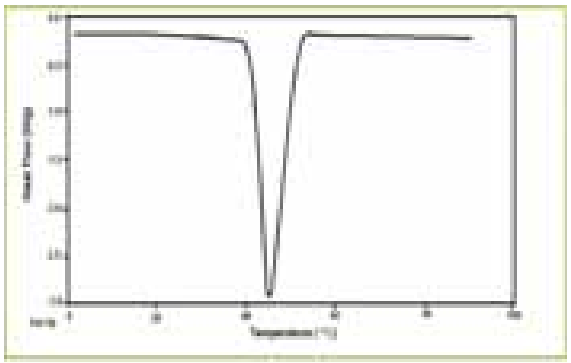


Fig.3: DSC curve of lauric acid, heating rate 5^0C/min

The melting point temperature of PCM corresponded to the onset temperature obtained by drawing a line at the point of maximum slope of the leading edge of the peak. The latent heat was calculated as the under the peak by numerical integration. The melting temperature of Capric acid and Lauric acid were 30^0C was 40^0C . The latent heat were 155 and 227.1 kJ/kg.

Accelerated thermal cycle test

The accelerated thermal cycle test was conducted to study the changes in melting temperature and latent heat of fatty acid after repeated number of melt/freeze cycle. The fatty acid was heated above melting temperature and cooled below solidifying temperature. The above procedure was performed consecutively until the number of cycle 60 and 120.after that DSC thermal analysis was performed weather melting point and latent heat of fusion changed or not. Table 1 Showed that melting point and latent heat of fusion was not changed.

Table 1: Melting and heat of fusion of fatty acid after thermal cycle test

S.No	No Of Cycles	Melting Point (^{0}C)	Heat of fusion (kJ/kg)
1	0	40	227.1
2	60	40	227
3	120	40	277

Thermal stability of Phase change material (TGA)

Thermal stability test was conducted in Thermal Gravimetric Analysis (TGA) Samples were (8-10 mg) performed from 40-60^0C with heating rate of 5 ^{0}C/min and 10^0C/min under constant steam of nitrogen at atmospheric pressure. During the time period of 60 min there was no weight loss observe after 0, 60 120 cycles.

Temperature effect on Thermal Conductivity of PCM

When the temperature increases thermal conductivity of PCM decreases. Generally thermal conductivity has descending order in material i.e solid < liquid< gases. Fatty acid phase changes at 40^0C (solid to liquid). During the phase change the thermal conductivity of PCM decreases. Thermal conductivity of Phase Change Material decreases when its phase changes with respect to the temperature.

Eutectic model

The transition temperature of both CA and LA exceed the indoor comfortable temperature.There after mixing them, the transition temperature of mixtures can possibly be in the range.The mixing process is regarded as the ideal

solution model and the transition temperature of mixture is always lower than that of any pure compounds. .According to schroder's equation : Eq. (1), eutectic transition temperature of mixtures of CA and LA can be calculated.

$$\ln (X_A) = -H_A/R\ (1/T - 1/T_f) \quad \ldots (1)$$

Where X_A and H_A are the molar fraction and latent heat of fusion of compound A, respectively T and T_f are the melting temperature value of mixture and compound A respectively. R is the gas factor.

By calculation, the eutectic transition temperature of mixture of C A and LA was 20.2 C the ratio of CA to LA was 65% to 35% approximately. (Fig.4)

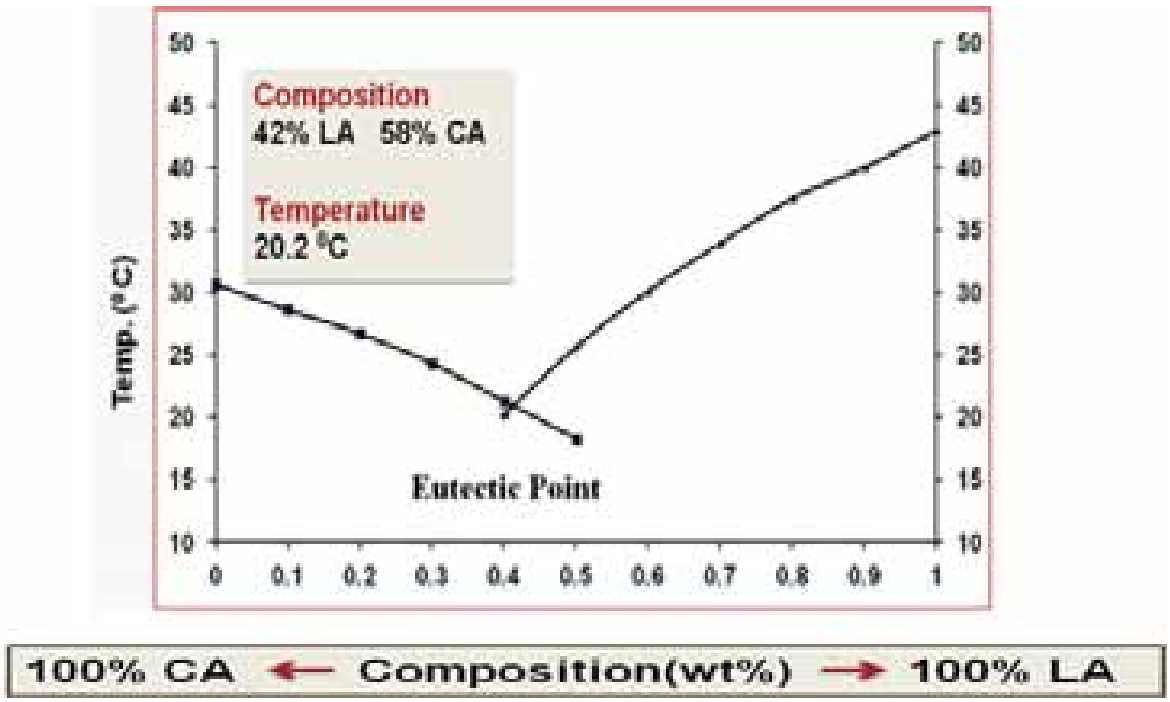


Fig 4: Eutectic mixture of PCM

Conclusion

Thermal characteristics of CA and LA were tested by Differential Scanning Calorimetre (DSC).The phase change material of CA and LA melting temperature were 30 was 40^{0}C. The latent heat was 155 and 227.1 kJ/kg. Accelerated thermal cycle test has been tested. The results showed that no regular degradation happened in 60, 120 cycles. Thermogravametric (TGA) test has been conducted. The results showed that no weight loss happened. By Eutectic model the transition temperature of both CA and LA was 20.2. Further research is going on in the direction of studying the engineering and thermal properties of PCM incorporated in building component and preparing different eutectic mixture which has high latent heat of fusion water in thermal comfort range will be studied and evaluating temperature profile of the prototype building.

WP-2: Next Generation Concrete for Sustainable Construction

S. K. Singh

Task 2.1: Bond Behaviour of Reinforcing Bars in Geopolymer Concrete

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

An optimum mix proportioning of geopolymer concrete for a target mean strength of 35 MPa was made using Fuller's gradation curve. Based on the aggregate gradation, the mix contains 26.7% 20 mm down coarse aggregates, 50.1% 10 mm down aggregates and 23.2% fine aggregates (sand) respectively. The water-geopolymer solid ratio was kept at 0.22. The superplasticizer was added at a dosage of 1.5% of the binder. The cubes, cylinders and prisms were cast and tested for their compressive strength, split tensile strength and flexural strength. The density of resulting concrete was in the range of 2300-2400 kg/m^3. The average compressive strength was 37.25 MPa for cube and 33.09 MPa for cylinder. The flexural strength of prism was ~ 4 MPa which lies in the 10-15% of compressive strength. These experimental results were validated through empirical equation for OPC based concrete mentioned in ACI guidelines. The maximum deviation of 5-10% was observed indicating adherence to the theoretical values. The experimental stress-strain curve was compared with the theoretical curve obtained through Collins et. al equation (Fig.1). The deviation from the theoretical curve is attributed mainly to the existence of voids in the samples and also aggregate-geopolymer paste interaction. The peak strain in GPC was found to be ~ 0.002 which is slightly higher than the OPC. The strength of geopolymer concrete increased with increasing molarity of the activators probably due to formation of stable alumino-silicate networks following the dissolution of more silica and alumina in the solution. The strength of geopolymer concrete also increased with decreasing water-geopolymer solid ratio as it is said to analogous to the water-cement ratio in OPC based concrete.

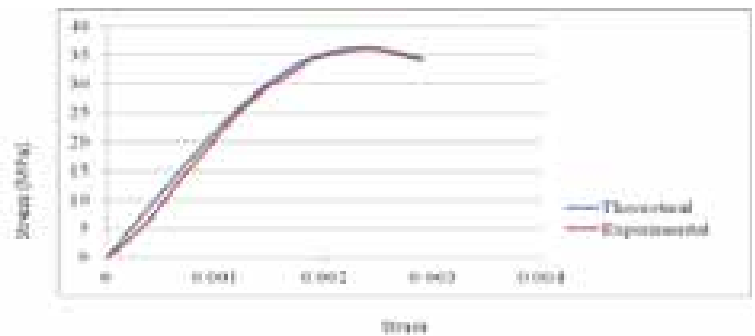


Fig.1: Stress strain curves of geopolymer concrete

A trend line curve between the compressive strength and modulus of elasticity was plotted and compared with equation in ACI guidelines for concrete and Ivan Diaz-Loya et.al equation for geopolymer concrete. As expected, the modulus of elasticity increased as the compressive strength of geopolymer concrete increased. It was found that experimental values were lower (17%) than that predicted by Ivan Diaz-Loya et.al for geopolymer concrete and also the values obtained with ACI guidelines (E_c = 3.32"f_{cm} + 6.9).

This is attributed to the type and fracturing of coarse aggregate and geopolymer paste used in the concrete manufacturing. The lower value of modulus of elasticity and a higher value of strain indicates that geopolymer concrete is more ductile than the OPC based concrete. A relationship between the split tensile strength and compressive strength of geopolymer concrete was also studied and an equation $f_{sts} = 0.305\ fc'^{0.69}\ MPa$ was proposed. A comparison of values was made with the Sofi et.al empirical equation and ACI guidelines (Fig.2).

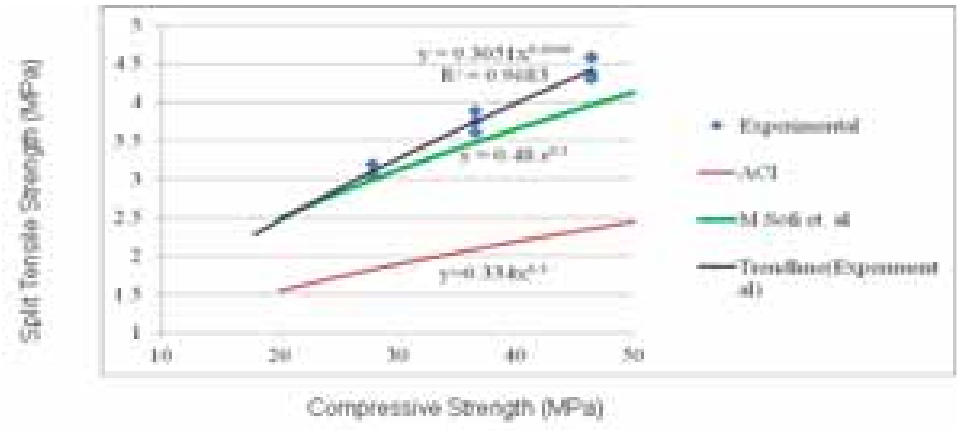


Fig.2: Variation of split tensile strength with compressive strength of geopolymer concrete.

It was found that the split tensile strength of GPC was more than those of predicted values. This equation had a R^2 Value (coefficient of determination) of 0.968 which tells that there is 96.8% probability that the value would lie on this line. The experimental split tensile strength of geopolymer concrete was higher than the cement concrete as per ACI guidelines. The increased strength is accounted for a denser interfacial zone established between the aggregates and geopolymer due to its three dimensional network formation.

The pull-out strength of reinforcing steel bars (6 mm dia standard bar, 12 mm and 16 mm dia deformed bar) in geopolymer concrete was determined. For comparison purpose, the bond strength of reinforcing bars with cement concrete was also tested. As expected, the bond strength of geopolymer concrete increased with increasing compressive strength (Fig.3). It was noted that the bond strength between geopolymer concrete and reinforcing bars was found to be higher than the cement concrete.

This is attributed to the adequate adherence of geopolymer matrix on the surface of steel bars as observed in its fractured surface. Reinforcements were designed as per IS: 456-2000 considering balanced section. The plain and reinforced geopolymer concrete beams were tested under two point loading of 780 mm span. It was

found that enhanced concrete strength increases ultimate load carrying capacity, ultimate moment and bearing stress. The flexural response exhibited by reinforced concrete indicated high moment capacity and flexural strength upto 70 % of its compressive strength.

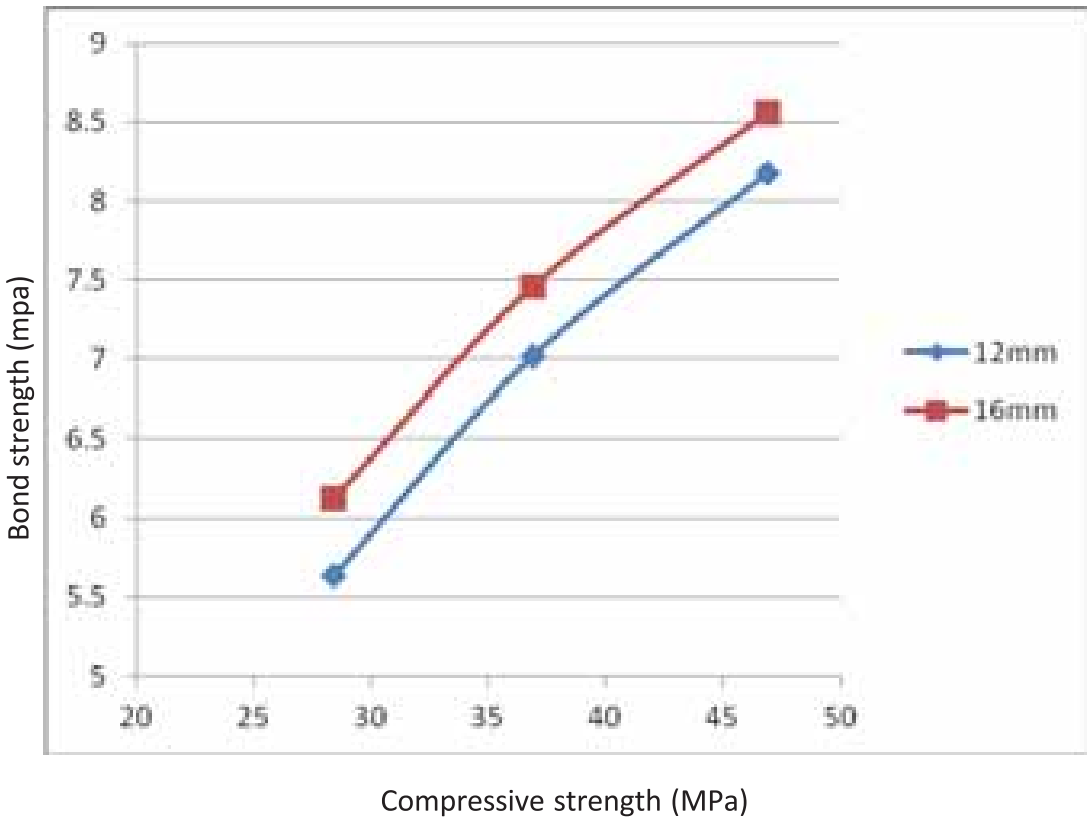


Fig.3: Bond Strength of geopolymer concrete with respect to its compressive strength.

Task 2.2: Bio-Concrete as Self Healing Material

Leena Chaurasia & Rajesh K. Verma

Cracks are a common phenomenon in reinforced concrete (RC) structures during their service life due to several reasons. If left unattended, they can cause structural deterioration with high level of risk and maintenance cost in long term. In order to control the cracks, ccurrently, such issues are addressed using admixtures such as epoxy, resins, epoxy mortar and other synthetic mixtures, which are highly labor intensive and costly. Possible strategies to deal with cracks in buildings is manual inspection and repair, which is time consuming and not always possible. The proposed developed product, 'Bio-concrete' has excellent potential in cementing concrete as well as several other types of structural and nonstructural cracks as self healing material. The present research program attempts to develop a smart material *'bio-concrete'*, for arresting cracks using environmentally friendly biological activity that is continuous self-remediation process, over and above its economical aspects.

Extremophiles calcifying bacteria are producing urease enzyme which is capable to hydrolysis urea into ammonium and CO_2. The bacterial degradation of urea locally increases the pH and promotes the microbial deposition of carbonate as calcium carbonate in a calcium rich environment. These precipitated crystals can thus fill the cracks and enhance the durability. The proposed process to generate 'Bio-concrete' by incorporating very specific extremophiles calcifying bacteria is helpful for cementing concrete as self healing materials. Around 7% CO_2 is produced during manufacture of cement. The less emission of CO_2 in environment would also be possible due to reduced utilization of cement for repair of cracks and enhanced durability. The following work has been carried out:

- Collected & isolated alkaliphilic calcifying bacteria from various potential site & maintained them in the laboratory

• Bacterial cultures were maintained for various experimentation

• Prepared bacteria embedded mortar samples (25x25x25 mm with bacterial broths and with/without chemical feed,) to evaluate their behaviour

• Standardized methodology for cracks generation

• Study of crack healing capacity on mortar samples are under progress

• The establishment of bio-concrete laboratory was initiated.

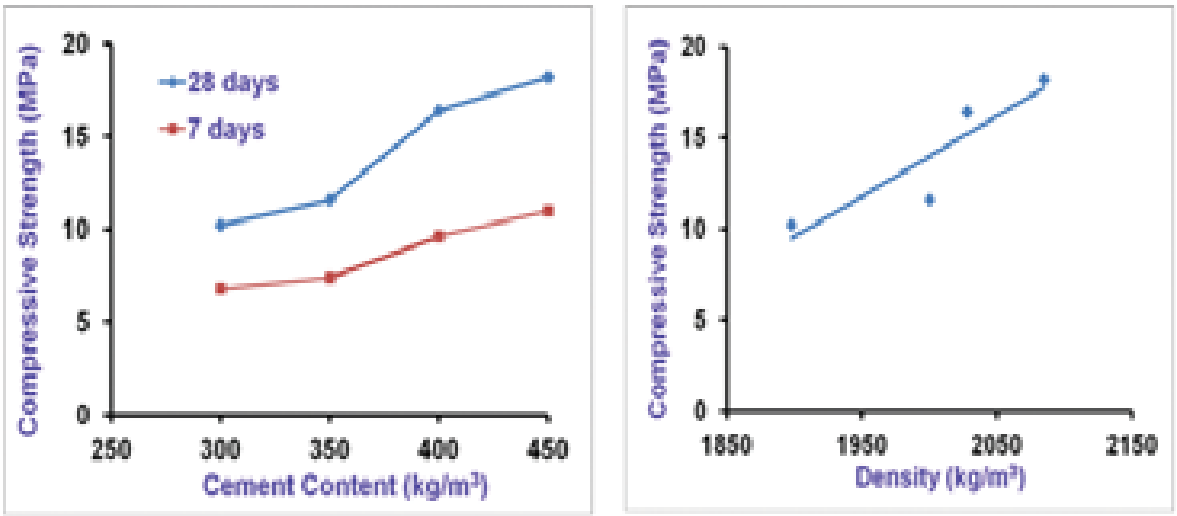
Task 2.4: Development of Pervious Concrete

Rajesh Deoliya and Subash C. Bose Gurram

Pervious concrete is a kind of concrete with high porosity and permeability. Pervious concrete is made using water, cement, coarse aggregate and admixtures. It has little or no fine aggregate. Cement paste should be sufficient enough to coat aggregate surface and should not fill the voids in the concrete. Pervious concrete allows water from precipitation and other sources to pass through it. Pervious concrete reduces runoff from paved areas and thus recharges ground water locally. Other applications include walls for two-story houses, load-bearing walls for high-rise buildings (up to ten stories), in fill panels for high-rise buildings, sea groins, roads, and parking lots.

In this area, work started long back (in 18th century) but then stopped. After World War II, large number of construction in Europe required optimum material utilization which again prompted the builders to use pervious concrete in big way. Present requirement of LEED rating of built environment has promoted the use of pervious concrete in USA. The importance of pervious concrete in Urban India should be recognized as water table is going down day by day. Since labor wages are low in India, pervious concrete can be prepared manually. Pervious concrete minimizes use of sand in construction, which is sometimes not available in nearby locality, and its low density provides an opportunity to produce concrete blocks in the regions where good soil is not available for making bricks. It can also be used as an alternate building material for bricks protecting precious fertile soil layer. Further, use of fly ash helps in improving the environment. Cost effective, environment friendly pervious concrete is going to be very popular construction material in India very soon and a comprehensive study of the design and performance of the same will prove to be very helpful for infrastructure building of nation and will be very important to the society.

The objective of this project is to develop pervious concrete of porosity 10–25% with corresponding strength of 25–10 MPa with locally available materials. The proposed work includes development of mix proportions to achieve desired porosity and strength, durability studies in aggressive environment, and field performance studies of pervious concrete in parking lots, pathways and low-height retaining walls. In this report, some results of pervious concrete mix tests are discussed. Pervious concrete cubes and cylinders are cast with aggregate content of 1540 kg/m^3 and water-cement ratio 0.3. Cement used is ordinary Portland cement with a variation of cement content was varied from 300 to 450 kg/m^3. Aggregate size of 20 mm was taken and its characterization has been carried out. No fine aggregate is used. Compaction of cubes and cylinder is done manually with tamping rod. Since slump value has no relevance in case of pervious concrete, it is not measured. Specimen are cured in water pond. Cubes are tested for compressive strength at 7 and 28 days. Density of cubes is calculated by dividing the weight of cube in surface dry condition by volume of the cube mold. Strength of pervious concrete mixes has varried from 10-18 MPa at 28 days. Strength increases with increase in cement content and is directly related to the density of the concrete as shown in Fig.1. Failure pattern of cubes and cylinders of pervious concrete in compression is shown in Fig.2. It is observed that cracks ran from top to bottom.



(a) (b)

Fig.1: Cube test results (a) compressive strength vs. cement content (b) compressive strength vs. cement content

(a) (b)

Fig.2: Failure pattern of pervious concrete (a) cube (b) cylinder

WP-3 Green Building Technologies

Ashok Kumar

Task 3.1: Green Retrofit Strategies for Office Buildings

Ashok Kumar, Rajesh Deoliya & Team

Development of green retrofit methodologies for existing office buildings in composite climate. To accomplish the objectives, the following studies were carried to develop green retrofit strategies:

- Literature review and State of the Art.
- As part of performance assessment of the existing buildings CSIR- CBRI, was taken up the study area. The analysis of the main building reveals that the energy efficiency was not a concern when the building was constructed with burnt clay brick masonry walls of 229 mm and 345 mm thickness, and reinforced cement concrete roofs & floors of 100 to 120 mm thickness without any roof insulation for thermal protection except mud phuska and lime terracing. The windows are single glazed with 4 mm thick clear glass. The energy inefficient compact fluorescent tube lights, fans and window or split air – conditioners have been used.
- The study also reveals that the maximum heat transfer takes place from the 100 mm thick RCC roof having no insulation and no other roof treatments, on the two storeyed administration and accounts departments and in the second floor of the building having RCC coffer slabs roof of 115 mm thickness.
- Day lighting, measurements were taken using Lux Meter to monitor the light level (in lux) for the windows without venetians and with venetian slots in closed and open vertical position. Based on the sizes of different office rooms used for reading and writing activity, room indices were estimated and illuminance measurement grid points were selected. As the rooms of the reference building do not have a depth greater than 7.0m, the windows provided in the rooms fulfill the requirements of daylight and to facilitate natural ventilation indoors.
- To study the '*night ventilation effectiveness*', the temperature measurements were taken by ventilating the rooms during the night hours in the reference building during March - October months. The data reveals that there is a reduction of the maximum indoor temperature by approximately 2 - 3°C during the period as nights are cooler in composite climate, thus contributing to increased indoor comfort during daytime and reduced cooling load of about one hour from 9:00 – 10:00 am. As the building has 345 mm thick brick masonry walls, so the night ventilation removes the heat stored in the building's thermal mass and re-cools the building and starts its diurnal cycle at a lower temperature.
- Similarly, a study on building materials used in the existing buildings built after 1950, was carried out.

Sub Task: 3.1.1: Development of Solar Window System for Cold Climatic region

Neeta Mittal & B. M. Suman

Utilization of Solar energy through solar window system for improvement of Indoor environment in cold climatic region for residential buildings.

The following activities have been undertaken:

Two types of metal windows has been fabricated for the study:

Black coated and perforated GI sheet is shown in Fig. 1.

- Effect of a blackcoated Al sheet using inside and glass outside the window on indoor air temperature has been studied. The performance of the window has been depicted in Fig 2.
- The effect of black coated and perforated GI sheet using inside and glass at outside the window on indoor air temperature has been studied The performance is shown in Fig.3.

Fig.1: Perforated GI Sheet- 4 mm holes

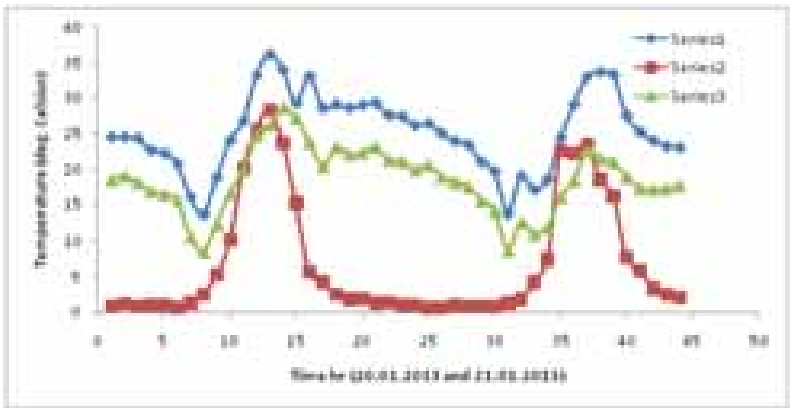


Fig.2: Performance of Window with black metal Aluminum sheet

Series1- Indoor air temperature of treated room
Series2- out Door air temperature
Series3- Indoor air temperature of un-treated room

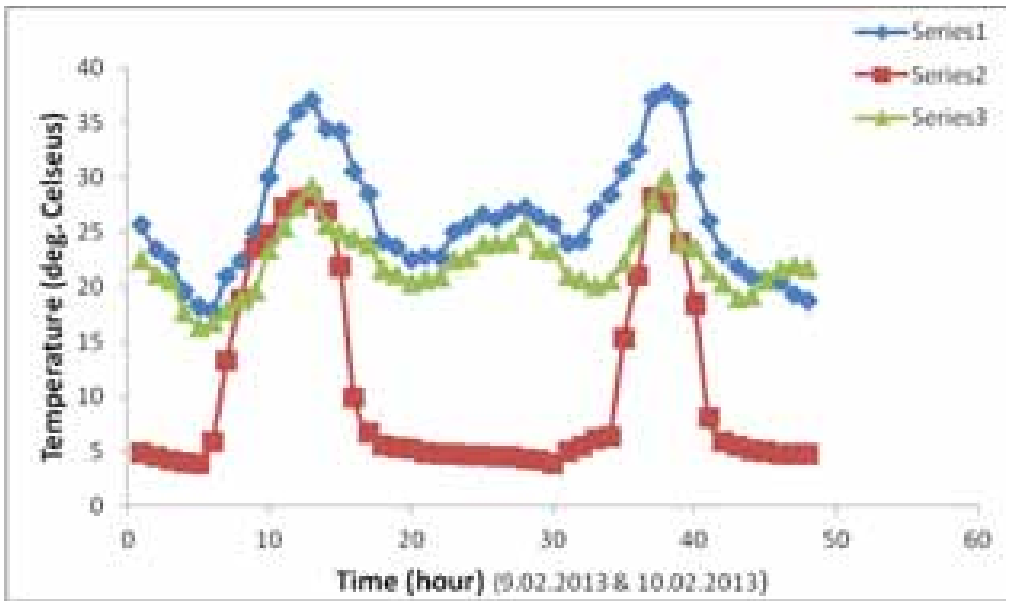


Fig.3: Performance of perforated blackened GI sheet Window

Series1- Indoor air temperature of treated room
Series2- out Door air temperature
Series3- Indoor air temperature of un-treated room

It is observed during winter season that-

- The maximum indoor air temperature difference of 7.8° C could be achieved in the room having windows with Aluminum sheet without holes.
- The indoor air temperature difference of 8.8°C could be achieved in the room having windows with GI sheet with holes (Fig.3).
- Metal sheet with holes performed better in window. Hot air circulation through holes improves the indoor air temperature. The light level in the room is reduced also in case of sheet used without holes.

Task: 3.2: Demolition Wastes as Raw Materials for Sustainable Construction Products

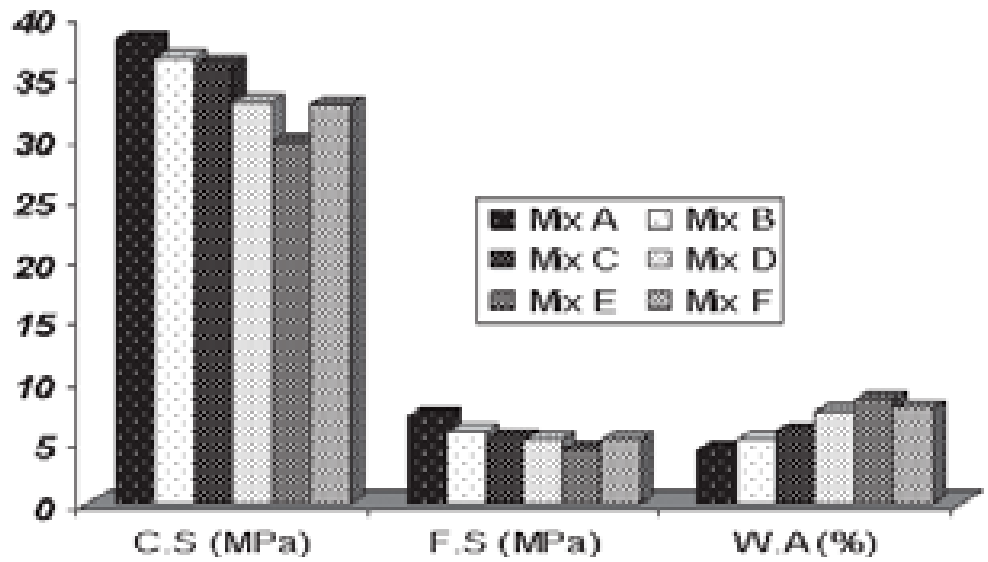
A. K. Minocha, Mridul Garg and Team

The samples of C&D waste of different grades were collected from MCD plant, Burari, New Delhi. The physical and mechanical properties of natural and recycled washed and unwashed aggregates of size passing 10 mm IS sieve and retained over 4.75 mm IS sieve determined as per IS:2386-1963 are given in Table 1. The results show that different properties of aggregates like crushing value, impact value, water absorption etc. were improved after washing due to the removal of the cement mortar adhered to the surface of aggregate. The properties of aggregates complied the requirements as specifiedin IS: 383-1970.

Table 1: Properties of Recycled and Natural Aggregates

Properties studied	Natural Aggregate		Recycled Coarse Aggregate	
	Fine	Coarse	Unwashed	Washed
Fineness Modulus	2.52	6.58	6.47	6.48
Bulk Density (kg/l)				
Compact	1.50	1.51	1.34	1.38
Loose	1.45	1.43	1.24	1.39
Specific Gravity	2.52	2.64	2.30	2.50
Water Absorption (%)	0.28	0.60	5.14	4.40
Flakiness Index(%)	--	14.2	5.2	5.4
Elongation Index (%)	--	22.5	15.3	15.5
Crushing value (%)		20.5	30.6	24.26
Impact Value (%)		15.2	32.4	26.62

The cement concrete tiles of size 150 x 150 x 25 mm have been prepared by compaction technique using different proportions of cement, sand and natural aggregate. The natural aggregate was replaced by 0, 25, 50, 75 and 100% recycled aggregate designated as Mix A,B,C,D, E respectively. Hydraulic pressure of 50 tones was applied for 30 seconds and after releasing the pressure, the tiles were taken out and demoulded. After 24 hrs, the tiles were immersed in water for a period of 28 days and then tested for physical properties (Fig.1). It can be seen that the properties of tiles decreases with replacement of natural aggregate but fulfilled the requirements laid down in IS 1288-1988. An enhancement in properties of tiles prepared from 100% washed aggregate designed as Mix F has been noticed in comparison to tiles prepared from unwashed aggregate. The durability studies are under progress. The typical photograph of tiles is shown in Fig.2.



C.S: Compressive Strength
F.S: Flexural Strength
W.A: Water Absorption

Fig.1: Properties of Cement Concrete Tiles

Fig.2: Cement Concrete Tiles

Task 3.3: Solar Thermal Air Conditioner

Nagesh Babu Balam

Design and development of an Air-Conditioner energized by solar energy for residential buildings

Development of Solar Tracker

A solar tracker for phyreliometer (Fig.1), to track the sun has been designed and fabricated. The following figure shows the fabricated solar tracker for phyreliometer. Bi axial tracking has been implemented in the solar tracker using two stepper motors. These stepper motors act independently controlled by Microprocessor based on Michalsky-Alamnac algorithm written for sun angle calculations (Fig.2). The tracking accuracy attained is 0.0001 degree of the movement of the sun.

Fig.1: Fabricated Solar Tracker without cover

Some features of the solar tracker include

- Ability to track solar azimuth angle and zenith angle separately
- Azimuth and Zenith Stepper motors: 25000 steps per revolution
- Azimuth Bearing ratio – 1:100
- Zenith Bearing Ration – 1:100
- Tracking updates for every second.

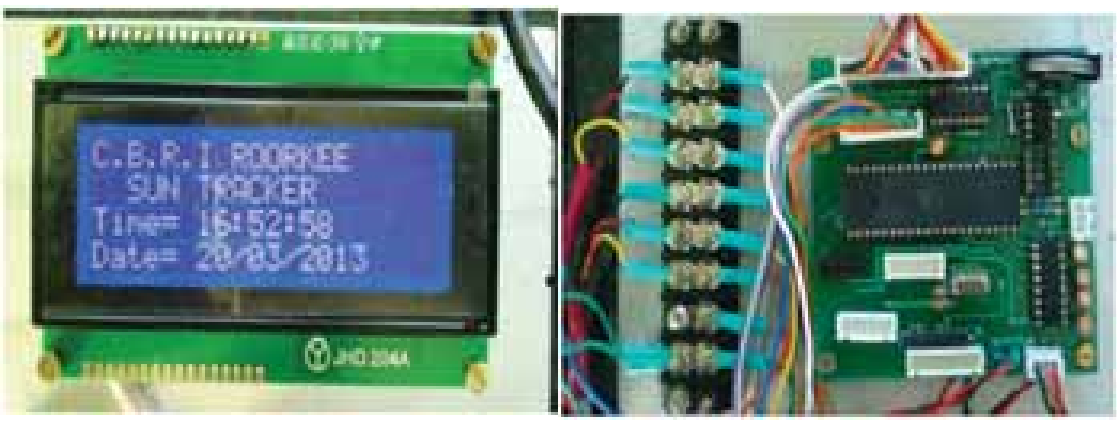


Fig.2: Solar Tracker - Micro Processor based electronic control

Task 3.4: Solid Industrial Waste – A Resource Geo-material for Civil Construction

M. Samanta, A. Ghosh, S. Maiti, D. Kumar and Z. Ahmed

Bulk utilization of solid industrial waste for civil construction

India is a developing country whose economic growth largely depends on the industrialization and in the near future its dependency on industry will increase. The byproduct produced by these industry is a matter of concern as its amount also increases with industrialization and needs large space to store it, without or limited use.

Fly ash is a byproduct of thermal power plant generated during the combustion of coal. India produces of about 110 million ton/year of fly ash from burning of 250 million ton of coal and by the year 2017 the fly ash production in India is going to be about 225 million ton/year. The safe disposal of fly ash is a matter of concern as it is not environment friendly and requires a large amount of land to store such a huge quantity of material. Presently 65,000 acres of land is used to store it. According to Ministry of Forest and Environment, only 30% of this by- product is reused in various purposes as resource material.

Red mud is a byproduct of alumina producing industry. Presently, at world's 85 alumina plants, 1.0–1.6 tons of red mud is generated per ton of alumina and it is estimated that over 66 million tones of this waste is impounded annually in the world. Safe disposal of such a large quantity alkaline waste sludge is challenging, as it is not environment friendly and requires a lot of land (approximately 1 km^2 per 5 years for a 1 Mtpy alumina plant). Till date, the means of its bulk utilization have not been found and common practice is to discharge it as slurry in river or sea.

Present study investigates the possibility of bulk utilization of solid industrial waste for civil construction purposes. Two solid industrial waste, fly ash and red mud have been taken for present study. Fly ash and red mud are collected from different industry and geotechnical and chemicalcharacterization are carried out. Table 1 shows the different chemical constituent present in fly ash and Red mud for two different sites. Problems associated with fly ash and Red mud as construction material are identified from the geotechnical property. Low shear strength and high compressibility of Redmud makes it unsuitable for construction material. Cement and bentonite clay has been selected to improve the strength and compressibility of these two solid industrial wastes. Presently laboratory test are carried out on mixture of fly ash-red mud on different proportion. Unconfined compression, compaction, consolidation test and micro - structural analysis of the fly ash – red mud mixture are in progress.

Table 1: Chemical constituents of Fly Ash and Red Mud

Constituents	Red Mud		Fly Ash	
	Site 1 (%)	Site 2 (%)	Site 1 (%)	Site 2 (%)
SiO_2	5.85	9.67	60.02	59.64
Al_2O_3	21.48	14.28	28.46	28.93
Fe_2O_3	60.85	46.54	5.82	4.35
TiO_2	4.71	17.78	2.21	2.15
K_2O	-	-	1.19	1.66
Cao	1.24	1.41	0.91	1.29
Na_2O	4.64	8.43	-	-
MgO	-	-	0.43	0.71
P_2O_5	0.15	0.27	0.38	0.63
Others	1.45	1.66	0.58	0.64

Task 3.5: Technology packages for mass housing in urban areas for different geo-climatic regions of the country

Ashok Kumar, Mridul Garg, S. K. Panigrahi, Vivek Sood, B. S. Rawat, Navjeev Saxena, S. K. Negi & Team

Development of energy efficient, environmentally, socially & economically sustainable and affordable mass housing package.

To accomplish the objective, the following studies are under progress:

- Literature review and State of the Art.
- Computation of U- Factor (W/ m^2 ^{0}C) for different types of alternative building materials & technologies from energy efficiency point of view.
- Parametric study including thermal performance of different building materials & systems.
- Design of a dwelling unit that can be built as single unit and can also be combined to make a cluster of four units with a staircase has been finalized.

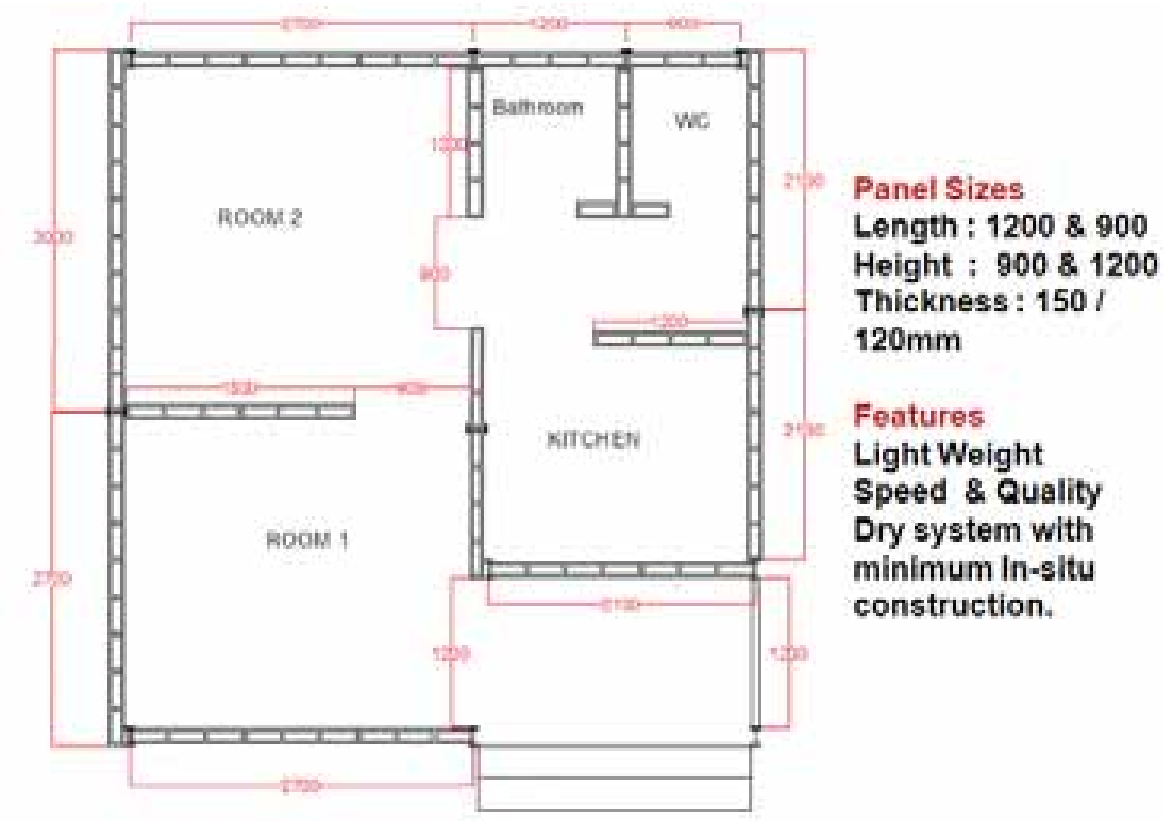


Fig.1: Design of a dwelling unit

Sub Task 3.5.1: To develop light weight blocks using different industrial wastes based on fly ash/rice husk ash/marble dust

Vivek Sood & Ashok Kumar

Light weight blocks have been widely used as building components in the form of masonry blocks, precast units, wall panels etc. Rising demand of housing complexes and growing cost of conventional building materials like brick and cement has necessitated the development of newer building materials and alternate walling units.

During this period, literature survey has been carried out on the non-autoclaving of light weight blocks. It has been found that no work has been carried out regarding use of additives in the development of light weight blocks. Procurement of raw materials like flyash and rice husk ash has been done from the site. Physical and chemical analysis of the waste materials such as particle size distribution, surface area, activity index etc. has been carried out.

For each mix, the weighed quantities required for the constituents were blended thoroughly. Water required for the mixer is added and high speed stirrer is used for homogenous mixing for a set period of time. Any contents adhering to mixing bowl has been cleaned off into bowl and mixing is carried for another set period of time. Then this mix was poured gently into 100 mm size moulds. These moulds are opened after a certain period of time depending upon the drying condition of the cube. The extra material due to air entrainment is chopped off and leveled. The cubes wrapped with a cloth are cured in humidity chamber until tested at 28 days (Fig.1, 2 & 3).

Emphasis has been to adjust the doses of additives so that blocks of desired densities can be de-moulded in minimum time. Further, optimization of materials has been carried out and a preliminary block on the desired composition has been done. Some blocks have been cast and their properties like compressive strength, water absorption, thermal conductivity and petrographic etc. have been evaluated.

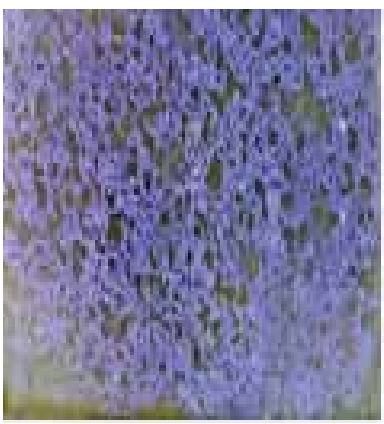


Fig.1: Petrographic study

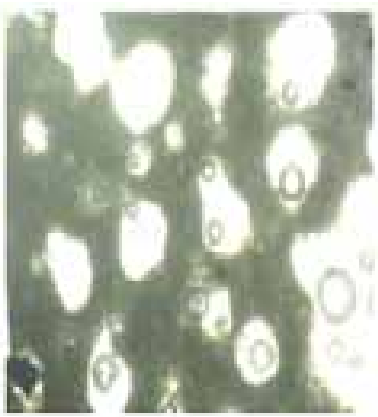


Fig.2: Microscopic view of CLC section

Fig.3: 100x100x100 mm cubes under test

Sub Task 3.5.2: Development of an automatic hollow gypsum panel making machine

S. K. Panigrahi & Team

To develop a machine for production of 900 mm X 300 mm X 150 mm Hollow gypsum panels.

Scope:

- To produce three panels in one batch.
- Automation of the machine starting form weighing of ingredients to casting of panels.
- The machine to be flexible for any future change - mould and other parameters

Work done till date:

The following activities have been carried out:

- Maintenance and modification in the existing hollow cored unit system.
- Trial tests and preparation of Fluro- Gypsum panels of size 900 mm X 300 mm X 130 mm as per the existing mould shape (Fig.1)
- Test of engineering properties under progress

Fig.1: Fluro Gypsum Panel

Sub Task 3.5.3: Application of cement free plaster developed from fluoro gypsum in prefabricated panels and masonry works

Mridul Garg and Team

Energy efficient low cost high strength cement free plasters has been developed from fluorogypsum for use in external and internal surfaces, masonry works, light weight gypsum blocks and prefabricated panels. The fluorogypsum, a by-product of the hydrofluoric acid industry is available in anhydrite form of gypsum. It does not set and hardened as such due to close packing of Ca^{2+} and SO_4^{2-} ions in the structure. It is therefore essential to activate its hydration behavior by using chemical activators. After suitable treatment and activation of fluorogypsum with chemical activators comprising of sulphates of alkali/alkaline earths, high strength gypsum cement with fast setting, low water absorption and porosity has been produced. The properties of the material comply the requirements of ASTM C-61-50.

Properties:

- Setting Time(min); Initial: 45
  Final: 98
- Compressive strength : 35 MPa
- Flexural strength : 6.0 MPa
- Thermal Conductivity : 0.19 W/mK
- Water absorption : 5 % & Porosity :10%
- Possess fire resistance & good acoustic properties

The phases responsible for strength development of the cement free plaster were studied by differential thermal analysis (DTA) and scanning electron microscope (SEM). The free plaster cement is found suitable for use in plastering, light weight blocks and prefabricated panels.

Masonry Works

Since construction industry is facing a scarcity of source materials i.e. sand, a comparative study has been made by replacing sand with stone dust and fly ash. The properties of masonry mortars prepared from the gypsum cement and different aggregates are given in Table 1. It was observed that after 24 hours of application on brick wall, the plaster patches developed adequate strength and hardness which further continued.

Light weight gypsum blocks

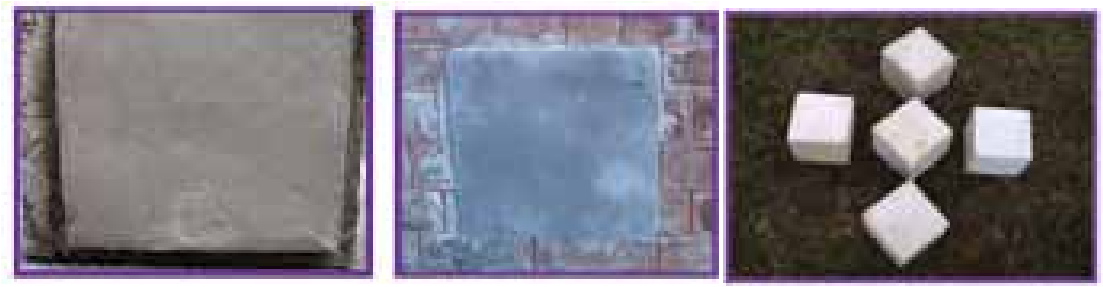
The light weight gypsum blocks (150 x 150 x 150mm) were prepared by using air entraining agent (<0.3%). These blocks possess compressive strength; 5.6 MPa, bulk density; 1200 kg/m^3 and water absorption; 16.3% and fulfilled the requirements of Indian Standards.

Prefabricated gypsum panel

The prefabricated panel of size 900 mm x 300 mm x 135 mm has been prepared by vibration technique. The density of panel is 1.08 g/cc. Other physical properties are to be determined. Some typical photographs of products are shown in Fig.1.

Table 1: Properties of masonry mortars with different aggregates

S.No	Mix Ratio of mortars (by wt.)			Compressive Strength, MPa			Bulk Density, gm/cm^3			Water Absorption, % (24 h)
	Gyp	Cem :	Agg. (F.M.)	3d	7d	28d	3d	7d	28d	
			Sand (1.91)							
1	1		1	9.3	16.5	20.3	1.92	1.93	1.98	5.4
	1		2	6.4	9.5	12.5	1.95	1.97	1.99	6.8
	1		3	3.8	5.2	7.9	1.96	1.98	1.99	7.7
			Sand (1.28)							
2	1		1	8.2	12.5	15.5	1.86	1.86	1.91	9.8
	1		2	4.5	6.5	8.7	1.87	1.91	1.95	12.5
	1		3	2.1	3.5	5.2	1.93	1.95	1.98	15.2
			Fly Ash							
3	1		0.5	7.5	9.2	9.8	1.64	1.66	1.67	12.3
	1		1	1.5	2.7	3.1	1.46	1.54	1.58	17.8
			Stone Dust (2.47)							
4	1		1	12.5	16.8	17.9	2.06	2.08	2.11	5.1
	1		1.5	10.5	15.4	16.7	2.07	2.10	2.14	5.6
	IS: 3466-1967 Limits			--	Min.2.5	Min.5.0				



(a) *(b)* *(c)*

Fig.1: Photographs of products prepared from cement free plaster (a) Plastering of gypsum cement with stone dust (ratio; 1:1), (b) Plastering of gypsum cement with fly ash (ratio; 1:0.5), (c) Light weight blocks

Sub-Task 3.5.4: Development of anti-termite barrier for new buildings

B. S. Rawat, Ashok Kumar, S. K. Negi & Team

Many approaches have been tried to protect structures from termites. Currently, it is the most common practice to treat the ground with insecticides or pesticides (termiticides) in order to poison the soil against termites. Major disadvantage of pesticide based Anti-Termite Treatment (A.T.T.) is the effect of toxic chemicals on health and environment. Due to such concerns, many of the commonly used termiticides have been outlawed, restricted or banned. Further, pesticide based A.T.T. often requires special precautions and specially trained personnel during application of termiticides; which increases the cost of construction as well. A still further disadvantage of conventional methods of A.T.T. is the necessity for retreatment at periodic intervals. Ultimate goal of most of the approaches of A.T.T. is to create physical or chemical barrier between termite and its food source. Therefore the objective of this research study is to provide an effective, long lasting and completely pesticide free anti-termite barrier for buildings. It is also envisaged to provide an anti-termite barrier that may be easily installed and does not substantially increase the cost and complexity of construction.

In the present work, variety of inert materials e.g. stone dust, glass waste, granite waste, marble, ceramic waste, local sand and C&D waste etc. were studied for penetration behavior of termites. Materials were crushed, washed, sieved and various particle sizes (granules) ranging from 0.7mm to 3.0mm were prepared and studied in the laboratory. Specific material were identified and its particles were prepared, modified, altered ,optimized and engineered in the laboratory to support structural units and to protect structure from termites. Some of the specifications of desirable material calculated so far are raw material- any suitable hard material or stone type, desirable particle size-0.7-3.0 mm fineness modulus 5.64-5.81, desirable thickness of anti-termite layer 100 to 150 mm, specific gravity 2.30-2.67, angle of friction 40°-46°, optimum moisture content (OMC) 6-16 (Fig.1, 2). Work on other aspects is in progress.

Uses

The termite barrier of the invention may be used to resist, prevent, delay, inhibit or otherwise obstruct entry of termite into a structure. The building structure may be a house, shed, patio, pergola,garage or any other building structure that are directly in contact with ground or otherwise potentially prone to entry, infestation and / or damage by subterranean termites.

Installations

In particular non-limiting embodiments, the anti-termite barrier of the invention may be installed:

a) Between a concrete slab and a sub slab;
b) Between a concrete slab or sub-slab and ground;
c) In one or more cavities associated with a concrete slab;
d) Between ground and a suspended floor;
e) Between internal and external walls; and /or
f) Surrounding the outer edge of a concrete slab or walls.
g) In and around foundation of structure.

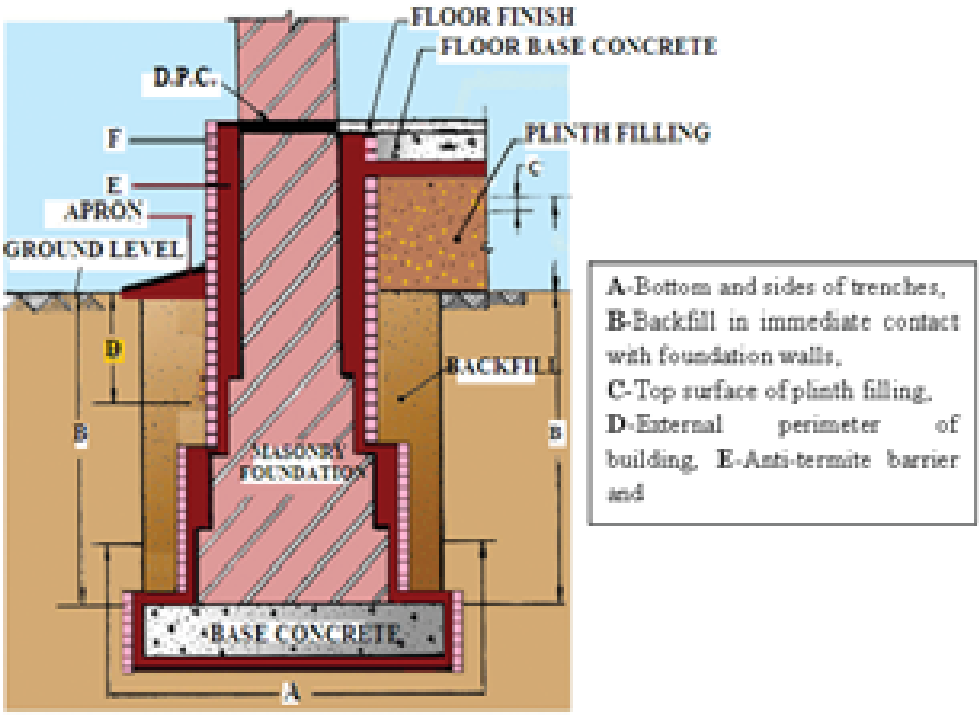


Fig.1: Anti-termite barrier (E) with 100mm barrier support wall (F)

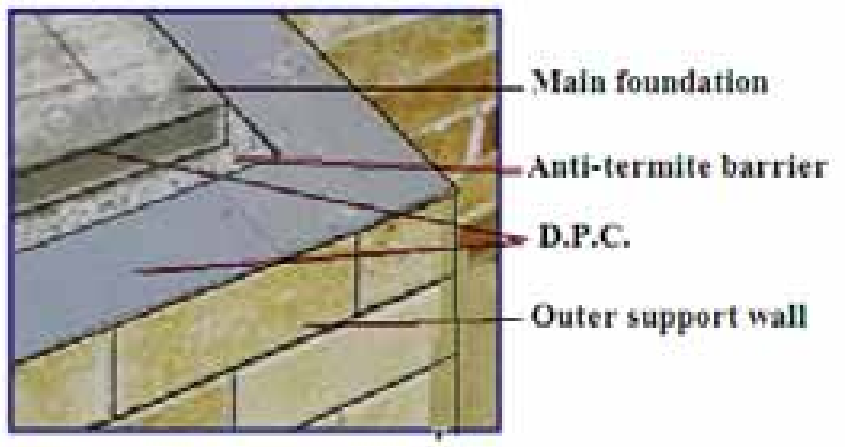


Fig.2: Top and side view of foundation with anti-termite barrier.

WP-4 Materials & Technologies for Hazard Reduction

S. R. Karade

Task 4.1: Indigenous Cathodic Protection System for Steel Reinforced Concrete Structures

S. R. Karade & Team

A large number of steel reinforced concrete structures are deteriorating in India due to corrosion of the steel rebars. The magnitude of this problem can be appreciated considering the fact that India has a more than 7500 km long coastline and hot and humid conditions in large parts of the country. Although conventional protection measures like coatings and corrosion inhibitors are being used, their effectiveness reduces with time. Many authorities and agencies are in search of suitable materials and technologies that can protect their infrastructure and extend service life to a large extent. However, at present there is no such technique available in the market for long term repair of chloride induced corrosion affected reinforced concrete (RC) structures. Cathodic protection (CP) is one such technique, but it is not much practiced in India and therefore lack expertise and skilled manpower. Moreover, it is very costly, which can limit its widespread application.

Under the 12th Five Year Plan (2012-17), initiatives have been taken in the institute to address the above mentioned issues by developing cost effective CP system. The project aims to assess the performance of different components of CP available in India and to develop economical anodes. The selected components and materials will be applied on real/live structures for demonstration to increase awareness about this technology among the engineers/contractors. The laboratory and facilities will also be utilised for academic/training purpose and for various corrosion studies related to mitigation of corrosion in RC & steel structures.

A review of literature revealed that in current practice the proper bond between surface applied anodes and uniform current distribution in a reinforced concrete CP system is difficult to achieve due to the complex nature and varying microstructure of reinforced concrete. Consequently, some rebars are overprotected while some others are inadequately protected. Studies on the influence of corrosion state of steel and alternative anode arrangement on the current distribution have been attempted. However, these issues still remain unresolved.

The present study aims to develop conductive mortar/concrete, which will be helpful in uniform distribution of current along the steel bars and could also be used as anodes. In this effort mortar specimens with varying amount of steel fibers and steel wool (Fig.1) have been prepared and evaluated for reduction in their resistivity. The results obtained so far indicate that there is no significant effect of age on the resistivity of the mortar. However, the resistivity reduces with the increase in addition of steel fibers and steel wool. It has also been found that with addition of steel fibers upto 2% by weight, percolation threshold could not be achieved. Because of mixing difficulty and high cost of steel fibres, it is not technically and economically viable

to increase its ratio above 2%. Steel wool, on the other hand, is a cost effective alternative and has been used upto 4% by weight (Fig.2). The results indicate that the percolation limit for steel wool is around 2% by weight. Further study is in progress.

(a) Crimped steel fibres

(b) Chopped steel wool

Fig.1: (a & b) Steel fibres and steel wool used

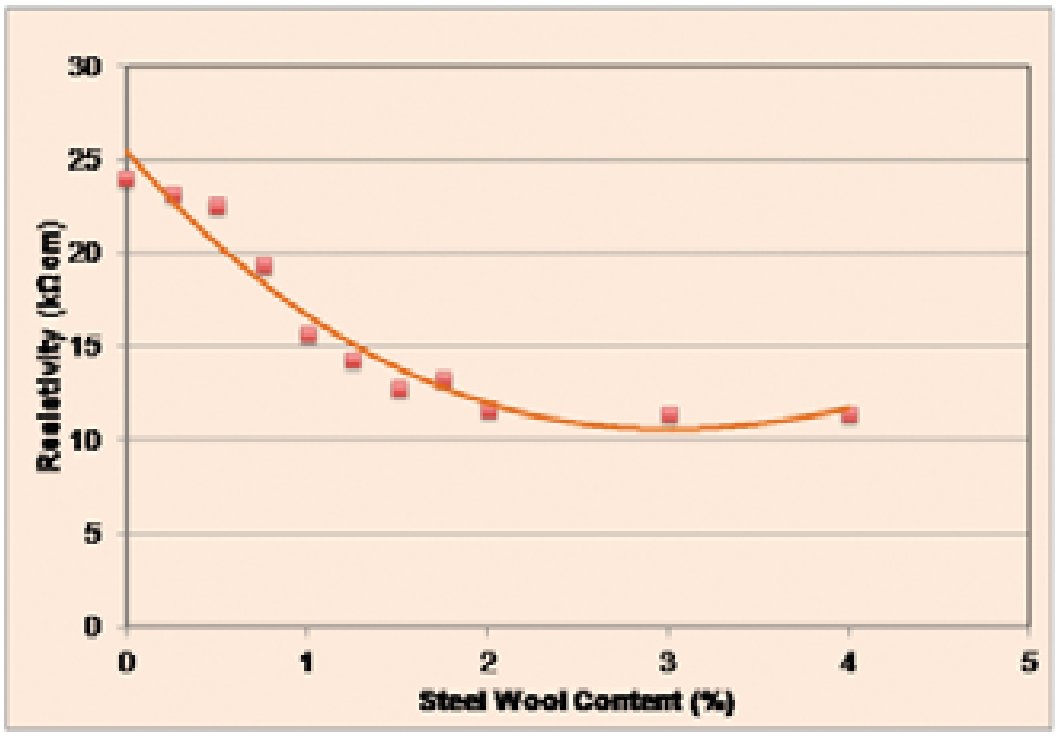


Fig.2: Effect of steel wool on resistivity of concrete

Task 4.2: Impact Behaviour of Reinforced Concrete Elements

A. K. Pandey

Some reinforced concrete structures has to be designed for impact loads, which may result from crashing of comparatively rigid heavy objects at low velocities, such as falling rocks in mountain areas and falling heavy loads dealt with in factories and warehouses due to accidents, aircraft impact on nuclear containments, vehicular impact on bridges. At present stage, most of these structures, except nuclear power plants, have been designed by statically surcharging the maximum impact forces following the allowable stress design concept and/or the maximum impact forces with a construction coefficient following the ultimate limit state design concept. Based on these design concepts, the structural analysis results exhibit a high safety margin for the impact design event which has a low probability of occurrence. Therefore, the safety level of such structures should be determined by means of a more accurate evaluation of the characteristic impact-resistant capacity which in turn requires study of impact behavior of structural components with focus on structural response parameters such as deflection, residual deflection, strains in steel reinforcement with acceptable degree of accuracy in a real impact event. The objective of the project is performance based impact resistant design of reinforced concrete beams. The scope of the project is as follows:

- Experimental study of impact behavior of RC elements (normal strength concrete) by drop weight impact tests
- Prediction of impact behavior of RC elements by non-linear FEM analysis for generation of impact response data which has not been covered in experiments .
- Establish relationship between impact energy, static flexural capacity, maximum deflection and residual deflection for RC Beams for PBD

An instrumented impact loading test setup for dropping the weight at variable height up to 2.5 meter and recording the impact event (deflection, support reaction and strains vs. time) has been designed. A specially designed support system (Fig. 1(a)) for loading the beam and installing the strain gauge based load cell has been fabricated. The impact loading system with the data logger and with the beam instrumented for performing the drop weight experiment is shown in Fig. 1(b). As shown in Fig. 1(b), the 100 kg weight is attached with an electro magnet and which in turn is connected to an electric wire hoist installed on top of a steel portal frame. With the help of an electric wire hoist, the weight can be raised to a desired height (0-2.5 m) and can be released with the electromagnet. In order to restrict the lateral movement of the electrical wire hoist a guiding cage of diameter 500mm has been used to raise the hammer just above the test specimen. The drop hammer is cylindrical in geometry with a diameter of 360 mm and a depth of 145 mm. The striking surface of the hammer is of hemispherical type with a diameter of 90 mm and height of 10 mm. Two guiding rails are used near the test specimen to ensure proper fall on the specimen, and that after rebounding the hammer does not damage the surrounding, by falling back on the specimen. The Deflection of the specimen is measured with strain gauge based dial gauge, which is kept just below the mid-span of the beam. The maximum deflection which can be measured by the electronic dial gauge used is 40mm.The experimental setup included 2 load cells of capacity 500 kN to measure the reaction force. The sensors are connected with a Data Acquisition system from National Instruments, consisting of an IBM computer, National Instruments PCI acquisition card and LABVIEW VI software with trigger function which had 8 LVDT channels, 4 accelerometer channels and 16 slots for universal channels which support strain gauge, dial gauge and load cell.

(a)

(b)

Fig.1: (a) Support system to support beam and load cell (b) Experimental Setup

The reactions forces for three beams of A1 series (A1-1, A1-2, A1-3) have been analyzed first. The reaction forces for beam A1-1 measured with Load cell installed at supports (Left and Right) has been converted into kilo Newton unit and the same are plotted with respect to time in Fig. 2(a&b). As seen from the Fig. 2(a&b), the peak value for the left and Right supports are 41.8 kN and 54.8 kN respectively. The reaction values for other two beams (A1-2 and A1-3) are plotted in Fig. 3(a&b) and Fig. 4(a&b) respectively. The average of peak reaction of the three cases (six numbers) are 43.2 MPa and coefficient of variation is 13.1%. The impulse (area of the reaction time curve) has been obtained for the three beams of the first series and the impulse value for the three cases are close, the average impulse being 0.16 kN sec and coefficient of variation is 15%. As seen from the Fig.2, 3&4

that initially, when striker strikes the beam, immediately for an instant, the reaction is negative showing downward direction, the negative value is a fraction of positive peak, the reason for the negative reaction is that in the beginning as the weight is dropped there is tendency to uplift at the support which is resisted by the clamping device.

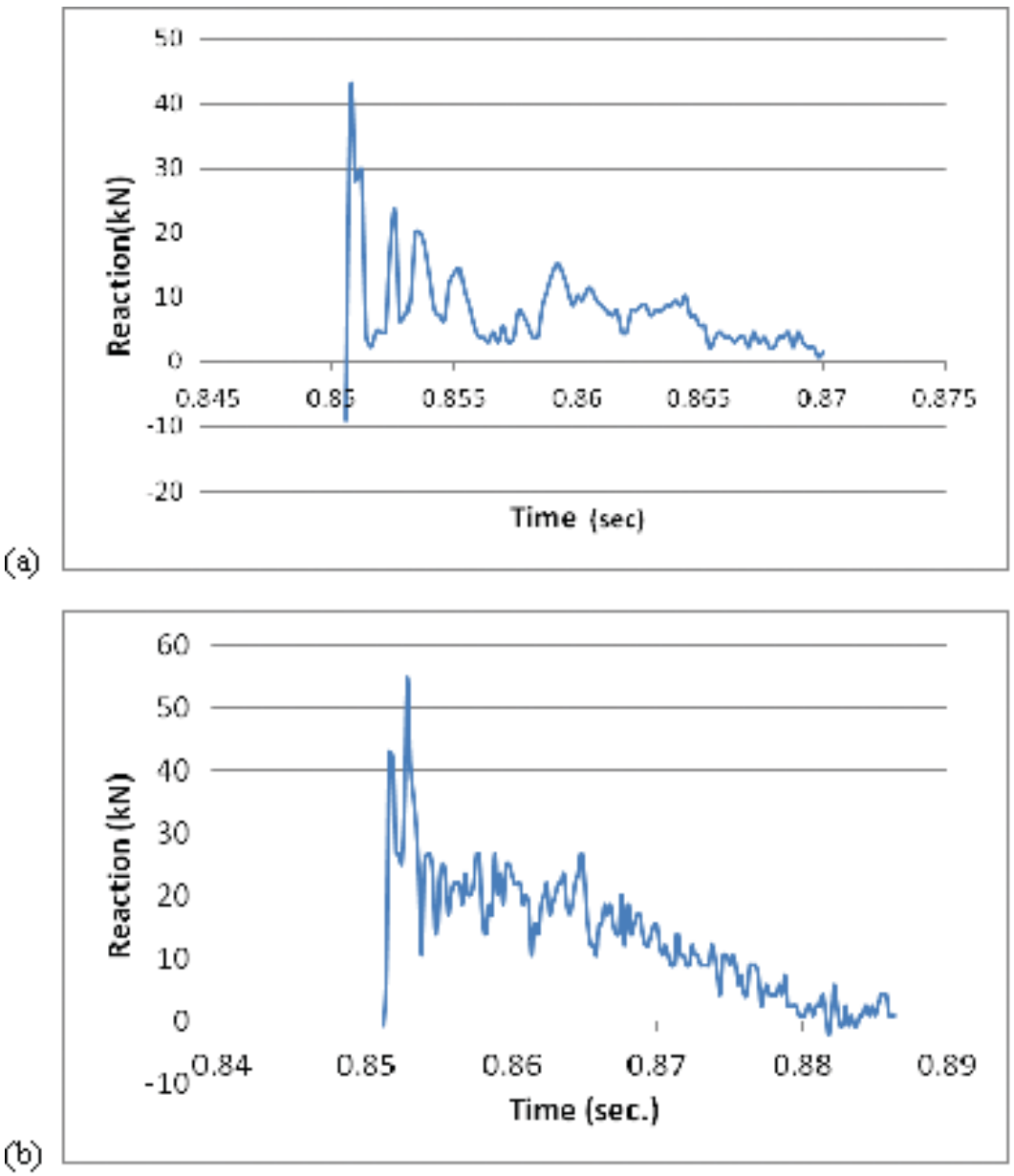


Fig.2: Reaction Force vs. Time for 1.5 k Joule IE (a) Sample A1- 1 L (b) Sample A1- 1 R

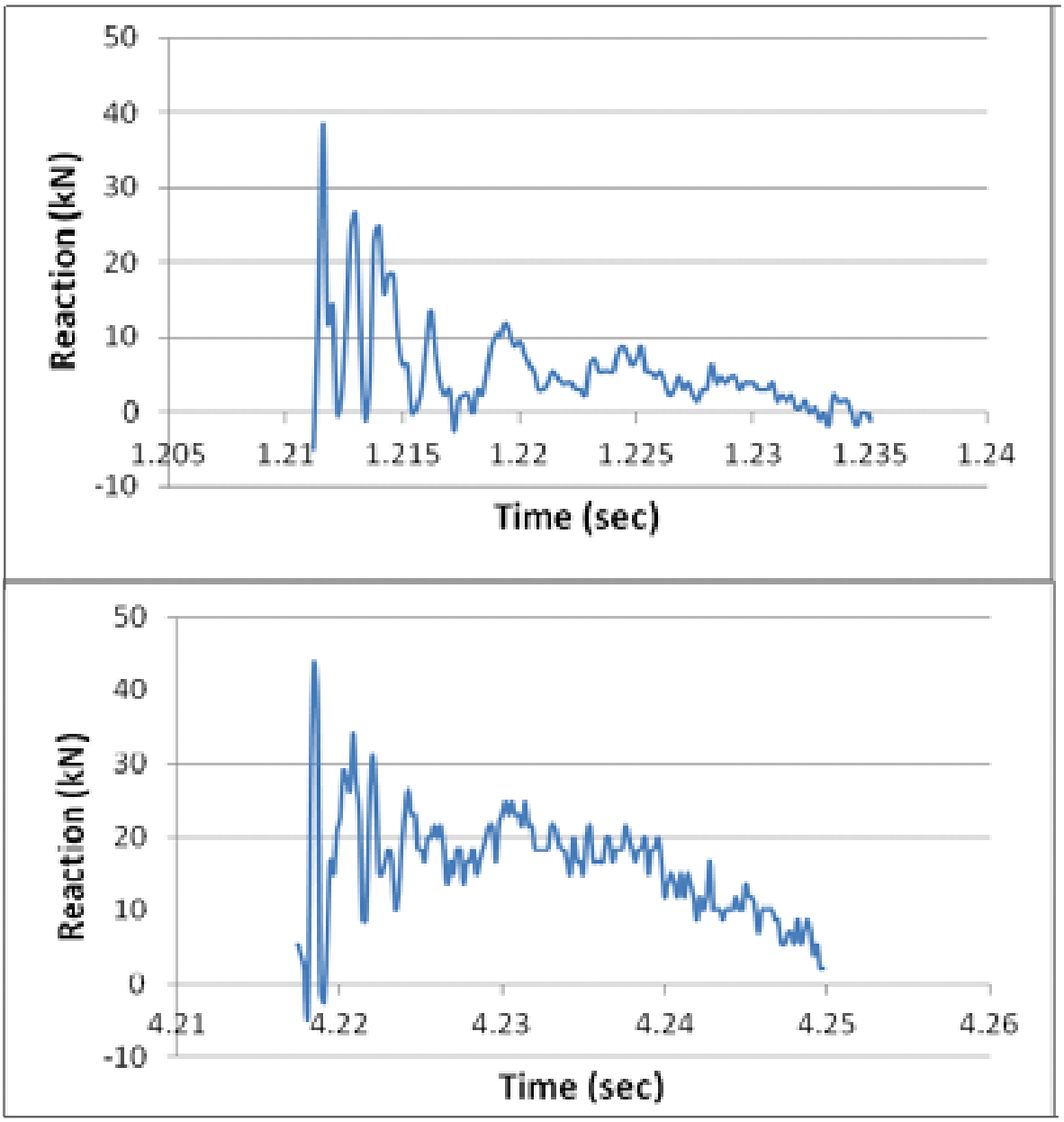


Fig.3: Reaction Force vs. time for 1.5 k Joule IE (a) Sample A1- 2 L (b) Sample A1-2 R

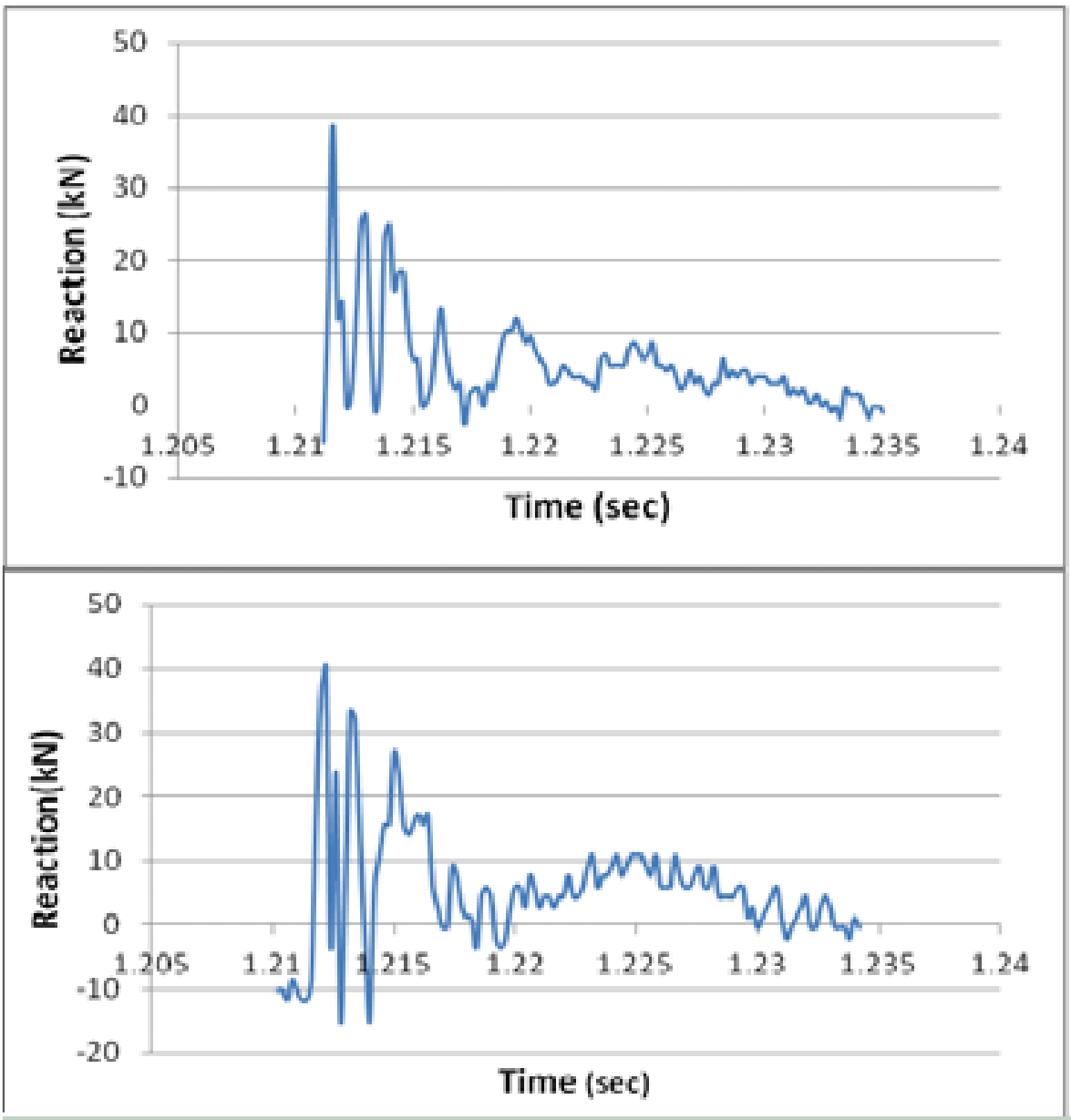


Fig.4: Reaction force vs. time for 1.5 K Joule IE (a) Sample A1-3 L (b) Sample A1-3 R

Task 4.3: Development of Fire Safe Polymeric Composite Panels

Harpal Singh and Team

Composite panels such as expanded perlite insulation board, polystyrene graphite board, polyurethane foam composite etc. are mostly organic polymer in nature and comprise of core and facing materials. They are widely used in the form of thermal insulation, lining, false ceiling, partitioning etc. throughout the world due to their attractive properties such as low thermal conductivity, low density, high strength to weight ratio and low moisture permeability. They are based on cellulose and synthetic polymers and hence are combustible in nature. On exposure to fire, they have low thermal stability and high flammability and generate large quantity of heat and smoke containing toxic combustion products. Thus, they pose great fire hazard which needs to be mitigated in order to impart fire safety in buildings. The resultant composite panels will be fire retardant, generate low smoke and combustion gases having lower toxicity index. Thus utilization of developed fire safe polymeric composite panels in the building envelope will substantially mitigate fire hazard and protect the environment efficiently. Some significant achievements on chemical composition, fire retardant additives incorporation, density measurement and fire performance evaluation are presented.

Chemical composition of core material based on diisocyanate, polyether polyol, catalyst, surfactant, water and physical blowing agent was prepared at the bench scale. Fire retardant additives were added into the prepared composition at the polymerization stage. The chemical composition of core material is presented in Table 1. The effect of fire retardant additives on basic foaming properties such as mixing time, cream time, gel time and tack-free time was studied. The foam process of core material is shown in Fig.1. Control and fire retardant core material cakes were prepared by using the one-shot process. Prepared control and fire retardant core material cakes are shown in Fig. 2(a, b) respectively. The density of control and fire retardant additives incorporated core material was measured according to ASTM D1622. Specimens were conditioned at 25^{0}C and 55% relative humidity for 48 hours prior to their density measurement. It was observed that density of the core material is increased as the fire retardant additive contents are increased. The fire performance evaluation of additives incorporated core material and comparison with control samples was carried out as per BS: 4735. The results showed that additives incorporation is very effective to render core material fire retardant. Samples were also exposed to vertical flammability test which is more severe condition than the standard test. The samples were weighed before holding vertically on support gauge stand. The lower end the sample was exposed for 20 minutes to 50 mm diameter oxygen enriched LPG burner of 100 mm non-luminous flame height. Exposed control and fire retardant core material samples are shown in Fig. 3(a, b). After complete fire exposure extent burnt, burning rate and percent mass loss (PML) were

Table 1: Chemical composition of core material

Raw ingredients	Parts by weight
Polyether polyol	100
Catalyst	0 - 0.7
Water	0 - 3.0
Surfactant	0 - 1.0
Chemical blowing agent	0.5 – 3.0
Physical blowing agent	0 - 6.0
Fire retardant additives	5 - 30%
CMDI (1.05)	Stoichiometric + 5%

measured and averaged for analysis. Control core material cake was completely engulfed in fire whereas, fire retardant core material cake does not support flame spread and only charred during the vertical flammability test. This is further confirmed by the fact that fire retardant core material cake showed only 11% weight loss. During flammability test the presence of fire retardant additive accelerates the decomposition of foam at lower temperature which leads to an increase in the amount of high temperature stable char residue. The stabilized char residue acts as protective thermal barrier which does not allow further flame spread. This may leads to reduced burning rate which resulted into enhanced flame retardancy. Overall, it can be concluded that incorporation of fire retardant additives into the formulation of core material enhanced the fire retardancy significantly.

Fig.1: Foaming process of core material

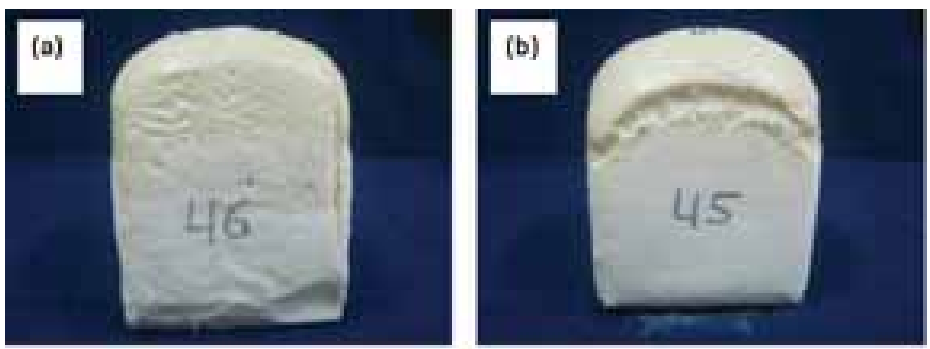


Fig.2: Core material cake: (a) Control cake, (b) Fire retardant cake

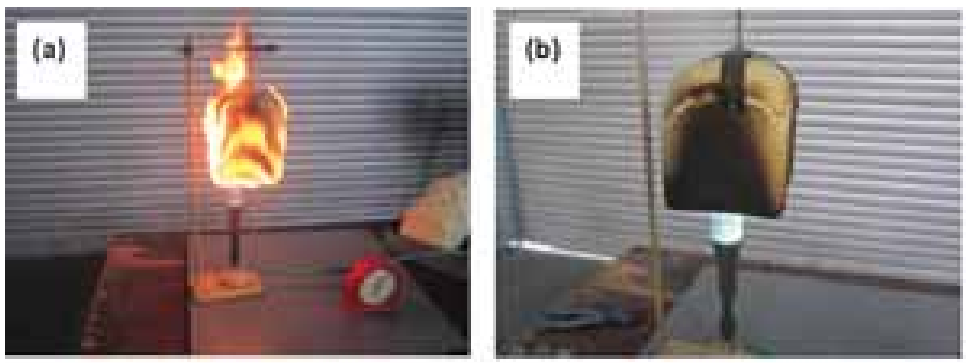


Fig.3: Core material cake under flammability test: (a) Control cake, (b) Fire retardant Cake.

Task 4.4: Improved ventilation system for cleaner built environment

Syed Ibrahim Sohel, A. K. Minocha and Jaswinder Singh

To design and develop an Improved Ventilation System to reduce inhalable particles in built environment

This project aims at developing an improved ventilation system to restrict the outdoor inhalable particles from entering the enclosure as well as facilitating the exfiltration of the indoor particles. To achieve this, experimental data on indoor particle dynamics under the influence of human activities and ventilation will be studied and a model will be developed which will help in designing an improved ventilation system. The research methodology has been submitted earlier (refer to report OLP 361).

To study the effect of human activities and ventilation, a macro-scale study has been done using a GRIMM particle counter for monitoring 1-3 micron particles. Total of eight participants were involved and monitoring was done for 65 minutes. The details of experiment are presented below.

Description of Experiments

Site 1: First Floor Conference room at CBRI was chosen as a site which has two doors and three ACs. Windows were closed all the time. Most of the indoor surfaces are wooden.

Methodology: Before the monitoring was started, the routine sweeping and cleaning activity was done in the room, suspending indoor particles which deposited over a period of 30 - 40 minutes to attain a background concentration, as it can been seen in Fig.1. During this period, there were no occupants present and no ventilation provided. The rest of the activities are shown in Table 1.

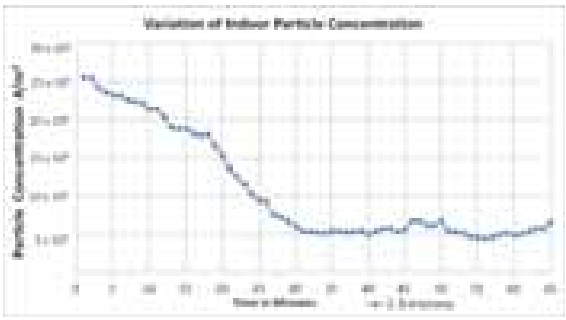


Fig.1: Variation of Indoor Particle Concentration throughout the experiment

Table 1: Activities performed at site.

S. No.	Time (Min.)	Activity
1	40-45	No occupants; Ventilation provided
2	45-50	Occupants entering; no ventilation
3	50-55	Occupants sitting; Ventilation provided
4	55-60	Normal walking by occupants; no ventilation
5	60-65	Rigorous walking by occupants; no ventilation

Fig.2 magnifies the variation of particle concentration when interference by ventilation and human activity was introduced. It can be observed from 40-50 minutes that increased ventilation and human activities suspend the settled particles due to increase in turbulence. But, when occupants sat idle and cross ventilation was provided (50-55 minutes), the concentration decreased due to dilution i.e., combined infiltration and exfiltration effect.

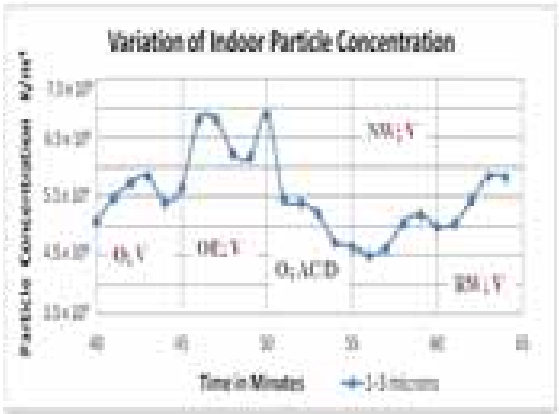


Fig.2: Effect of activities on particle concentration

Hence, from above experiment, it can be established that affect of human activities play a very important role in Resuspension of particles from surfaces and should be studies before designing a ventilation system.

Site 2: Advanced Computational Facility at CBRI which is on ground floor. The site was highly ventilated with ACs, Doors and Windows. To control the variables, only two windows and a door was operated based on its orientation.

Methodology: To understand the relationship between indoor/outdoor particles, a methodology presented in Thatcher (1994) was adopted because only one particle counter was available. The indoor concentrations were measured for 3 minutes and immediately after that outdoor concentration was measured assuming that there is no meteorological change between these successive measurements. Hence, the assumption that the two measurements were made simultaneously. Three particle ranges were considered as shown in Table 2. The room was semi airtight so air change rate was taken as 0.35. The deposition loss rate was adopted from Thatcher (1994), the deposition velocity was calculated by the formula:

Table 2: Deposition properties as per particle size

Particle size in microns	Infiltration rate (λ_v)	Deposition loss rate (λ_d)*	Deposition Velocity (V_d)
1 – 1.6	0.35	0.25	0.5
1.6 – 2	0.35	0.3	0.6
2 - 3	0.35	0.55	1.32

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Deposition velocity = deposition loss rate * Volume of room/ area of room

A total of five runs were done. For first three runs, occupancy was 4 and 2 windows and a door was opened. For last two runs, there was no occupancy and no ventilation provided. 15 minutes monitored data for indoor/outdoor particles of 1- 3 microns is presented in Fig.3. The last three minutes show an increase in the concentration, which might be due to pollutant buildup inside the room as the ventilation was shutdown.

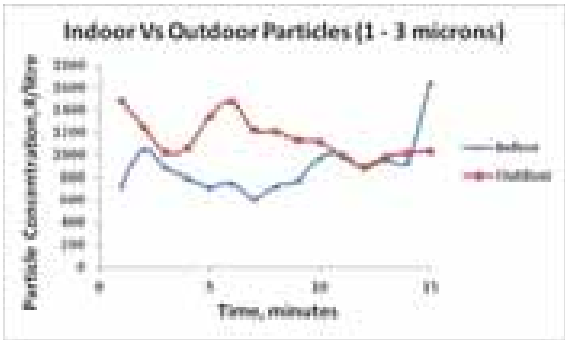


Fig.3: Indoor/Outdoor relationship in ACF lab for 1-3 micron particles

Penetration factor (P) represents the air tightness of the building envelope. If P (eqn. 1) approaches 1 then it is inefficient in stopping the outside air to enter the building.

$$P = \left(\frac{C_{in}}{C_{out}} \right) \frac{(\lambda_d + \lambda_v)}{\lambda_v} \quad \ldots(1)$$

Effect of deposition loss rate on penetration factor P can be observed in Fig.4 & 5 which affect the Resuspension calculations.

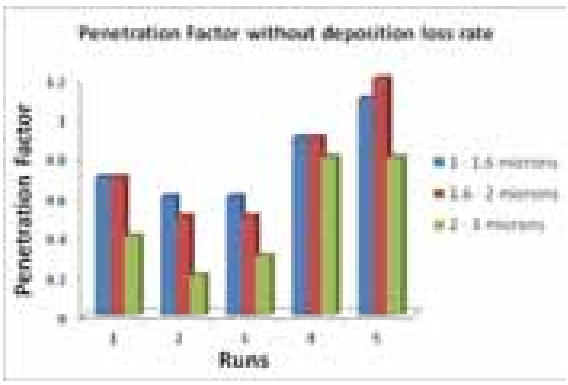


Fig.4: Variation of penetration factor without deposition loss rate

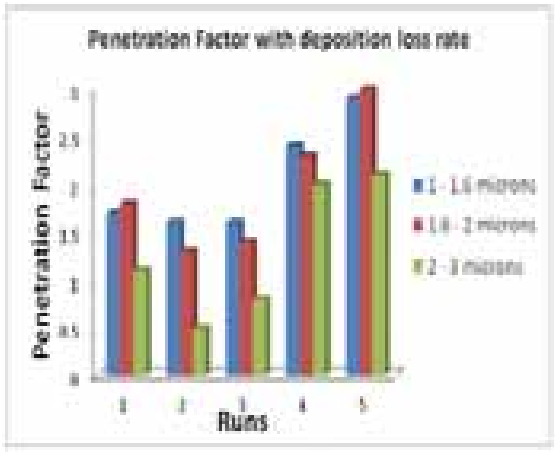


Fig.5: Variation of penetration factor with deposition loss rate

Based on literature survey, following parameters can be shortlisted for modeling of Resuspension rate 'R' (eqn. 2).

1. Density of particle, ρ_P
2. Friction velocity, u_*
3. Relative humidity, RH
4. Roughness length of surface, Z_o
5. Hamaker's constant for adhesive forces, A_{132}

$$R = f\left\{ \frac{\rho_p}{\rho_a}, \frac{u_*(t)}{d_p}, RH, \frac{z_o}{d_p}, A_{132}, R_e \right\} \quad \ldots (2)$$

Hence, based on the above presented model and the experimental methodology, the future work shall be executed.

NETWORK PROJECT

Engineering of Disaster Mitigation & Health Monitoring for Safe & Smart Built Environment (EDMISSIBLE)

ENGINEERING OF DISASTER MITIGATION & HEALTH MONITORING FOR SAFE & SMART BUILT ENVIRONMENT (EDMISSIBLE)

WP-1: Engineering of Landslide Disaster Mitigation.

PI: Dr. S. Sarkar & Dr. D.P. Kanungo **Task: 08 Nos.**

1.1 Landslide Hazard and Risk Assessment of Chamoli-Joshimath Region, Garhwal Himalaya (CSIR-CBRI),PI: D.P.Kanungo

1.2 Early Warning Instrumentation & Decision Package for a Landslide in Chamoli-Joshimath Region, Garhwal Himalaya (CSIR-CBRI), PI: D.P.Kanungo

1.3 GPS based Integrated Landslide Modeling for Hazard Assessment in Chamoli-Joshimath Region, Garhwal Himalaya (CSIR-CMMACS), PI: Dr. Sridevi Jade

1.4 Landslide Monitoring using SAR Interferometery (CSIR-CSIO), PI: Dr. S.K. Mittal

1.5 Development of Optical Fibre based Multiplex Sensor Network System for Landslide Monitoring (CSIR-NEIST), PI: K. Buragohain

1.6 Comprehensive Geo-Investigation and Control Measures of Landslide in Chamoli-Joshimath Region, Garhwal Himalaya (CSIR-CBRI), PI: Dr. S. Sarkar

1.7 Landslide hazard Information System and Design of Innovative Measures for Landslide Control (CSIR-CRRI), PI: P.Parsad

1.8 Bio-Engineering - A PhytoremediationOption for the Mitigation of Landslide and slope Stability Problems in the Hilly Regions (CSIR-NEERI), PI: Dr. Asha Juwarkar

WP-2: Engineering of Earthquake Disaster Mitigation.

PI: Er. Ajay Chourasia & Dr. P.K.S. Chauhan Task: 03 Nos.

2.1 Sesmic Microzonation of Srinagar, Uttarakhand (CSIR-CBRI), PI: Dr. P.K.S. Chahuhan

2.2 Sesmic Behaviour of Piles under Dynamic Lateral Loading (CSIR-CBRI), PI: Ms. Parvathi G.

2.3 Sesmic Resistance of Confined Masonary Construction under Different Axial Stress (CSIR-CBRI), PI: Er. Ajay Chourasaia

WP-3: Engineering of Fire Disaster Mitigation.

PI: Sh. R..S.Chimote & Dr. Suvir Singh **Task: 03 Nos.**

3.1 Development of Innovative Fire Suppression System (CSIR-CBRI), PI: Sh. R.S.Chimote

3.2 Fire Performance Evalution of Structural Elements and Rehabiliation Measures (CSIR-CBRI), PI: Dr. Suvir Singh

3.3 Development of Fire Resistant Coating on Structural Element (CSIR-CGCRI), PI: Dr. Kaushik Dana

WP-4: Post Disaster Shelter Planning.

PI: Er. S.K. Negi **Task: 02 Nos.**

4.1 Design and Development of Disaster Resistant Intermediate Shelters for Western Himalyan Region (CSIR-CBRI), PI: Ar. S. K.Negi

4.2 Post Disaster Management- Design and Development of Transitory Houses for Disaster Vulnerable Rural Sectors in North Eastern Region (CSIR-NEIST), PI: Mr. Dipankar Neog

WP-5: Health Monitoring of Buildings Using Wireless Sensor Network.

PI: Er. Ajay Chourasia & Er. Soju Alexander Task: 05 Nos.

5.1 Development of Fiber Bragg Grating (FBG) Sensors and Interrogator System for Buildings (CSIR-CGCRI), PI: Dr. Somnath Bandhopadhay.

5.2 Development of Wireless Sensors, Interrogator System and Technnique for Wireless Link for Buildings (CSIR-CSIO), PI: Dr. R. Bhatnagar

5.3 Design and Development of ARM and FPGA Processor and Sensor Placement Optimization (CSIR-CEERI), PI: Dr. Kota Soloman Raju

5.4 Development of Statistical/ Artificial Intelligence (AI) Models to Quantify the Damage State of Buildings (CBRI-CEERI), PI: Dr. J. L. Raheja

5.5 Collection & Validation of Data Using Developed Sensor, Numerical Modelling, Model Updation and Field Implementation for Building System (CSIR-CBRI), PI: Er. Ajay Chourasia

WP-6: Intelligent Building System for Model Residential Unit.

PI: Er. R.S. Bisht & A.K. Mittal Task: 08 Nos.

6.1 Architectural Planning and Design of a Residential Unit for Integrating Intelligent Building Features (CSIR-CBRI), PI: Ar Ashok Kumar.

6.2 Intellegent HVAC and Lighting Control in Response to Ambient Environment (CSIR-CBRI), PI: Nagesh B.Balam

6.3 Glass Façade Cleaning Robotics System (CSIR-CBRI), PI: R. S .Bisht.

6.4 Development of Building Energy Management System Software and Interface Instrumentation (CSIR-CSIO, Chennai), PI: Dr. Kota Srinivas

6.5 Remote Control of Home Appliances using Mobile or Web Connectivity (CSIR-CMERI), PI: Dr. Jaydeep Roy Choudhary

6.6 Design and Development of a Communication, Safety and Security System (CSIR-CEERI), PI: Dr. Kota Soloman Raju

6.7 Design and Implementation of Robot for Automatic Floor Cleaner using Wireless Technologies (CSIR-CEERI), PI: Dr. Kota Soloman Raju

6.8 Communication Network Architecture for Intelligent Buildings (CSIR-CEERI), PI: Dr. Kota Soloman Raju

Engineering of Disaster Mitigation and Health Monitoring for Safe & Smart Built Enviroment

Nodal Scientist: S. Sarkar

Co-Nodal Scientists: D. P. Kanungo, Ajay Chaurasia & S. K. Singh

The safety of the built environment is of paramount importance from the point of view of natural disasters. It is essential to have built environment, which can resist different natural calamities effectively. Living with the risk of natural disasters is a part of everyday life in the Himalayas. The Himalayan region is frequently subjected to several natural disasters like earthquakes, landslides, avalanches, floods due to glacial lake outburst, flooding etc. Landslides, rock fall, avalanches in particular are posing serious problems in the mountainous areas, and the means of mitigation and/or corrective measures are scarce. Hence it is imperative to assess the hazard and risk along with modeling of landslide dynamics for efficient mitigation measures and development of early warning system. As the population of the country is getting agglomerated in the form of urban clusters and cities, the risk of economic and human loss due to seismic hazard is increasing every year. Development of seismic micro-zones and design of safe built forms against earthquake are essential tasks for earthquake disaster mitigation. Although a fire disaster may not necessarily reach to catastrophic proportions all the time, it will present some of the characteristic aspects of a disaster because of destructive action of fire and of considerable losses of life and property. A fire of large proportions can cause damage to the built environment due to massive production of heat and the emanation of burn gases and fumes.

Building, a complex structural system, comprising of different materials, is often subjected to harsh loading scenarios and severe environmental conditions, generally not anticipated during the design stage, resulting in long-term structural deterioration. Therefore, monitoring of health of building is essential from safety, durability, serviceability, and sustainability point of view during its long-term service. Instrumentation plays an important role in the modern building architecture to evolve green buildings by effectively utilizing the resources which are energy efficient and environmental friendly with smart control features by incorporating safety and security measures.

With this in view, CSIR-CBRI has undertaken the assignment related to disaster mitigation, health monitoring of buildings and intelligent buildings by utilising the strengths of different sister laboratories of CSIR in network mode so that individual expertise of laboratories can be utilised in a holistic manner.

WP-1 Engineering of Landslide Disaster Mitigation

S. Sarkar, D. P. Kanungo & Team

Indian Himalayas is one of the tectonically most active mountain ranges of the Himalayas and is very prone to different geo-hazards such as earthquakes and landslides. The physical factors of the terrain such as immature geology, unstable geological structures and rugged topography along with the triggering factors like earthquake forces and heavy precipitation during monsoon seasons cause severe landsliding phenomena in the Indian Himalayan region. Landslides of different types occur frequently in geodynamically active domains in Indian Himalayas. These landslide incidences have been of serious concern to the society due to loss of life, natural resources, infrastructural facilities, etc. and also posing problem for future urban development.

With this in view a project on "Engineering of Landslide Disaster Mitigation" has been undertaken under the 12th Five Year Plan. The objectives of the project are as follows:

- Landslide hazard and risk assessment of Chamoli-Joshimath region
- Development of a landslide early warning system
- Comprehensive geo-investigation for design & development of cost effective land slide control measures

The project has been initiated with rainfall studies and geological & geotechnical investigation of landslides.

Study Area

The study has been focussed along the vulnerable road stretch in Chamoli-Joshimath region (Fig. 1) along the Rishikesh-Badrinath National Highway (NH-58) in the upper reaches of Alaknanda valley of Garhwal Himalayas in the Uttarakhand State of India. The main geological formations belonging to the Garhwal Group and Central Crystalline Zone of rocks comprises of quartzites, dolomites with slates, metavolcanics, gneisses and schists. Physiographically the areas lie in a region of tectonic or folded and overthrust mountain chain with strata structurally marked by complex folds, reverse faults, overthrusts and nappes of great dimensions. The area is traversed by many faults and Main Central Thrust (MCT) is one of them which are responsible for crushing and shearing of rocks. Every year due to heavy rainfall, landslides get triggered causing casualties and several incidences are reported from different parts along the major communication route in this area. The landslides along this highway corridor are mostly shallow debris slides, debris flows, rock slides and rock falls.

In Indian Himalayas, most of the landslides are caused or reactivated primarily by monsoon rainfall. The relationship between landslide incidences and rainfall characteristics in Indian Himalayas still remains unattended and unclear, either in terms of empirical relations, or in terms of

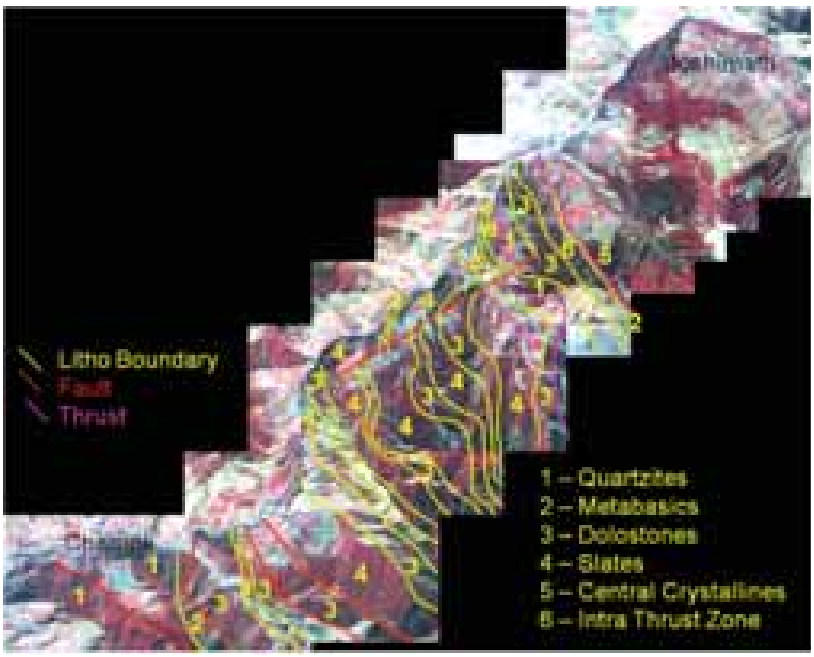


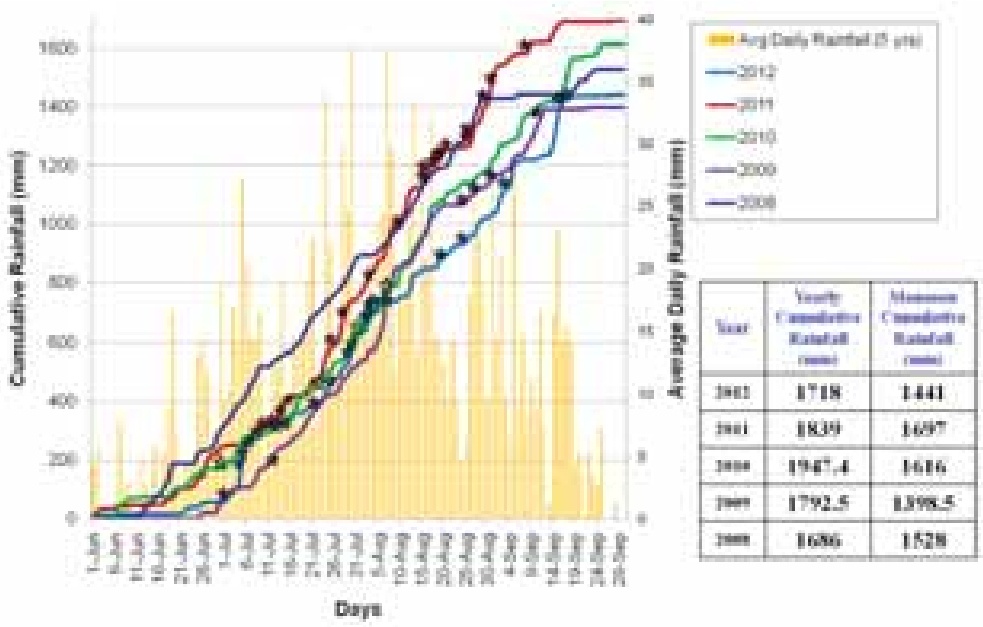
Fig.1: Geoeyesatellite image of the study area along with geological information Rainfall Thresholds for landslide occurrences

physical interactions of slope materials. In order to derive a local rainfall threshold model for the landslide occurrences along the National Highway corridor of about 80km stretch around Chamoli-Joshimath region, the rainfall and landslide information were collected from the Border Road Organisation (BRO), office stationed at Pipalkoti. The daily rainfall data for the duration of 2008 to 2012 (five years) were extracted from the BRO record. However, the record for landslide occurrence data was available for the duration of 2009 to 2012 (four years) in their record. Hence, for establishing the rainfall threshold for landslide incidences along this highway corridor, the daily rainfall data along with the landslide information available for recent past four years were used.

The rainfall data of this region envisaged that the cumulative annual rainfall from 2008 to 2012 were 1686, 1792.5, 1947.4, 1839 and 1718 mm respectively. The cumulative rainfalls for the monsoon period (June to September) for the study area over these five years (2008 to 2012) were 1528, 1398.5, 1616, 1697 and 1441 mm respectively (Fig.2). Hence, it can be inferred that the monsoon rainfall over this region contributed in the order of 90.6, 78, 83, 92.3 and 83.9 percent of the annual rainfall over the period 2008 to 2012 respectively. The maximum daily rainfall during the monsoon period in the study area over 2009 to 2012 as observed from the records are 115 mm on 7th August 2009, 90 mm on 17th August 2010, 74 mm on 12th August 2011 and 96 mm both on 5th July and 15th September 2012. The average value of rainfall intensity on a day with landslide events over a period of 2009-2012 in the study area was approximately 26 mm.

The landslide database was prepared from the records available with BRO for the clearance and maintenance of the road for the pilgrims during monsoon season. Landslide information in terms of location of slide with reference km milestone, name of road, name of nearest place/camp/village, name of landslide, dimension of disruption due to landslide, type of slide, date of occurrence/

re-occurrence etc. were extracted to make the landslide database. Finally, a database of 128 landslide events of different types, dimensions and damage levels for the monsoon period during 2009-2012 was prepared from the available records. These landslides were plotted on the daily average rainfall vs. cumulative rainfall graph (Fig.2). Most of these landslides caused slight to severe damage in terms of damage to the road infrastructure, habitation and few accidents involving loss of lives and injuries to the people. The landslide events include mostly debris slides and debris flows along with few rock slides and rock falls. Out of the total 128 landslide events, 81 events were considered for deriving the rainfall intensity-duration threshold model whereas all the 128 events were considered for studying the effect of antecedent rainfall.



Year	Yearly Cumulative Rainfall (mm)	Monsoon Cumulative Rainfall (mm)
2012	1718	1441
2011	1839	1697
2010	1947.4	1616
2009	1792.5	1398.5
2008	1686	1528

Fig.2: Cumulative rainfall and landslide occurrences during monsoon period from 2008 to 2012

Rainfall intensity-duration (ID) threshold using combinations of precipitation measurements obtained from different rainfall events that resulted in landslides has been attempted. An intensity duration threshold identifies the minimum rainfall condition that leads to slope failure or landslide. As already stated, out of 128 landslide events, 81 landslides were considered with respect to rainfall duration to work out on the ID threshold. In total, 23 rainfall events during the monsoon period over the years 2009 to 2012 were identified based on the landslide occurrences during these events. The hourly rainfall intensities were calculated for each of these 23 rainfall events responsible for occurrences of 81 landslide events by dividing the total rainfall (in mm) by the rainfall event duration (in hours). Using these data corresponding to rainfall intensity and duration for all the rainfall events causing landslides in the area, a threshold relationship between rainfall intensity and duration for landsliding was established (Fig.3). The threshold, as defined by the lower boundary of the points representing landslide triggering rainfall events, is expressed as:

$$I = 1.82\ D^{-0.23} \qquad ...(1)$$

Where *I* is the hourly rainfall intensity in mm (mm h^{-1}) and *D* is the duration of rainfall in hours. Eq. (1) has a coefficient of determination of 0.997. Among the 81 landslide data, the proposed curve optimally defines the rainfall events with duration between 24 h (1 day) and 336 h (14 days).

It is revealed from the above threshold relationship that for rainfall events of shorter duration (i.e., 24 h) with a rainfall intensity of 1.06 mm h^{-1}, the risk of landslide occurrence in this part of the terrain is expected to be high during monsoon period. Also, an average precipitation of 0.6 mm h^{-1} appears sufficient to cause land sliding activities in the area during monsoon period, if continued for about 120 h (5 days).

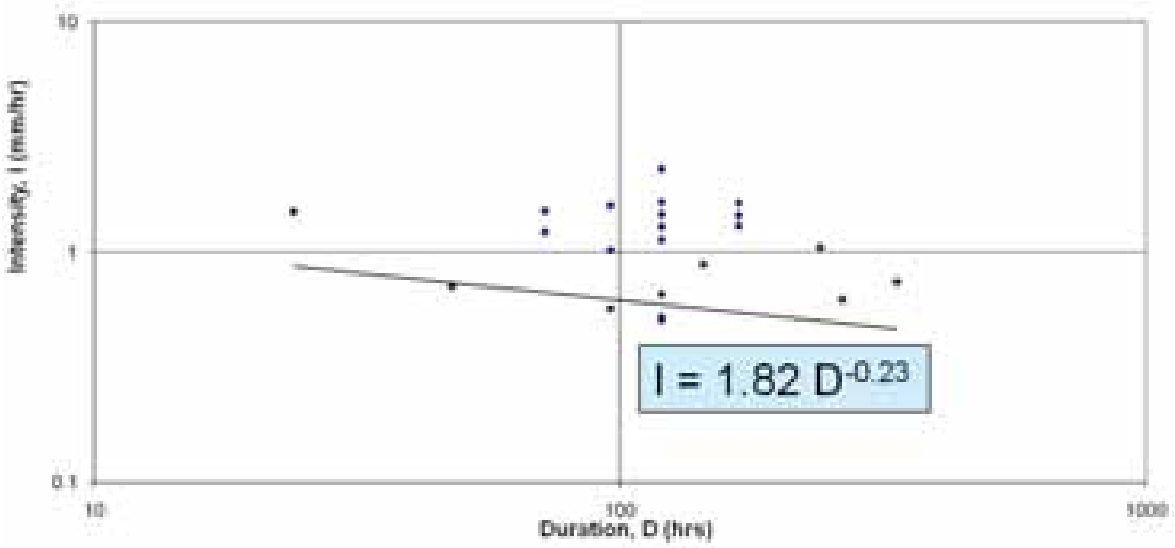


Fig.3: Rainfall intensity-duration (ID) threshold for the initiation of landslides in Chamoli-Joshimath region of Garhwal Himalaya, India

Monsoon rainfalls in the study area usually occur with interruptions and are generally characterized by low intensity and long duration, though there are occasional cloud bursts. Therefore, the role of antecedent rainfall in initiating or reactivating landslides in the region seems to be pertinent. The data of 128 landslide events are considered to analyze the daily rainfall at failure in relation to the antecedent rainfall (i.e., total cumulative rainfall) of 3, 7, 10, 15, 20 and 30 days prior to failure. The daily rainfall on the day of failure for all the landslide events were plotted against the antecedent rainfalls of above mentioned time durations. The diagonal line divides the graph into two halves in order to distinguish between the scattering bias of daily rainfall (y-axis) and antecedent rainfall (x-axis). The diagonal divider itself indicates that the daily rainfall on the day of failure and the antecedent rainfall prior to the failure are same. As observed, majority of landslide events are biased towards the antecedent rainfall prior to failure in comparison to the daily rainfall at failure. This result gave a confidence to further analyze the daily rainfall in terms of antecedent rainfall prior to failure with individual time duration and to establish a threshold based on antecedent rainfall of a particular duration. When analyzed for these cases, the ratio of biasness towards daily rainfall and antecedent rainfall were observed to be17.2:82.8 in case of 3-day antecedent rainfall, 3.1:96.9 in case of 7-day antecedent rainfall

and 1.6:98.4 in case of 10-day, 15-day, 20-day and 30-day antecedent rainfall cases. Hence, it can be stated that a maximum of 98.4% of the landslide events (i.e., 126 landslides) occurred under the influence of 10-day antecedent rainfall prior to failure and the effect remained constant for 15, 20 and 30 days of antecedent rainfall. In other words, out of 128 total landslide events, only 17.2% of the events (i.e.,22 landslides) occurred under the influence of daily rainfall on the day of failure when compared to 3-day antecedent rainfall and this effect decreases up to 1.6% of the events (i.e., only 2 landslides) in case of 10-day antecedent rainfall and onwards.

It can further be inferred from above observations that the 10-day antecedent rainfall of 55 mm (Fig.4a) can be used as a threshold for initiation or triggering of landslides in this region. Further, it is observed that in case of 20-day antecedent rainfall (Fig.4b), the sample points are clearly concentrated along the x-axis (representing the 20-day antecedent rainfall prior to failure) in comparison to other cases where the sample points are more scattered along the x-axis. Hence, it can further be inferred that the best correlation with landslide occurrences may be that for 20-day antecedent rainfall of 185 mm in the study area.

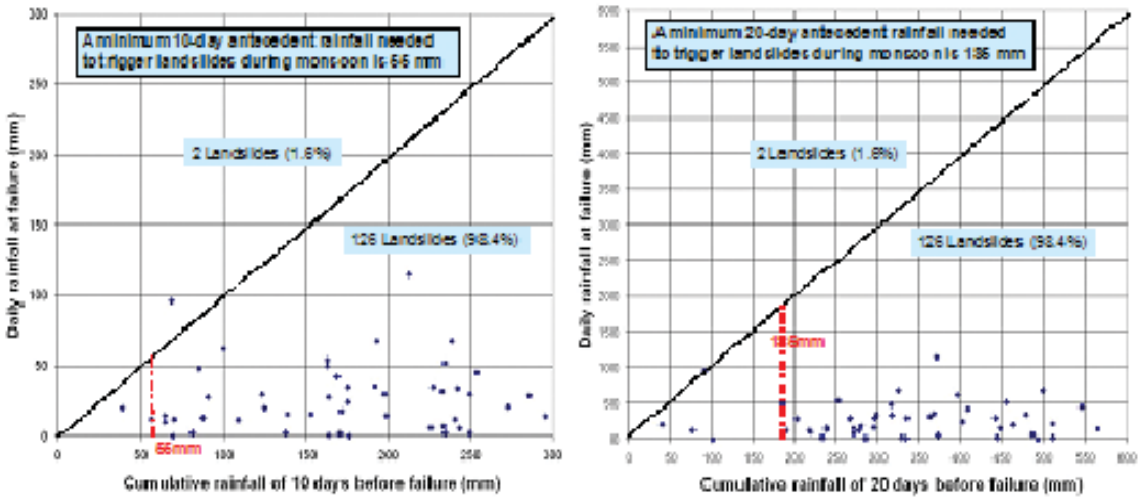


Fig.4: Relationship between antecedent rainfall prior to failure (10 and 20 days) and daily rainfall at failure for 128 landslide occurrences

Geological and Geotechnical study of landslides

Two active landslides along Pipalkoti-Joshimath road have been selected for a comprehensive geo-investigation for planning and design of a suitable control measures (Fig.5&6). These landslides are of debris slide types with minor rock slides at the flanks. The slide body comprises of debris materials and a few rock boulders on the steep slope. The rock types exposed in the slide area are dolostones which is primarily consists of calcites and quartz (Fig.7).

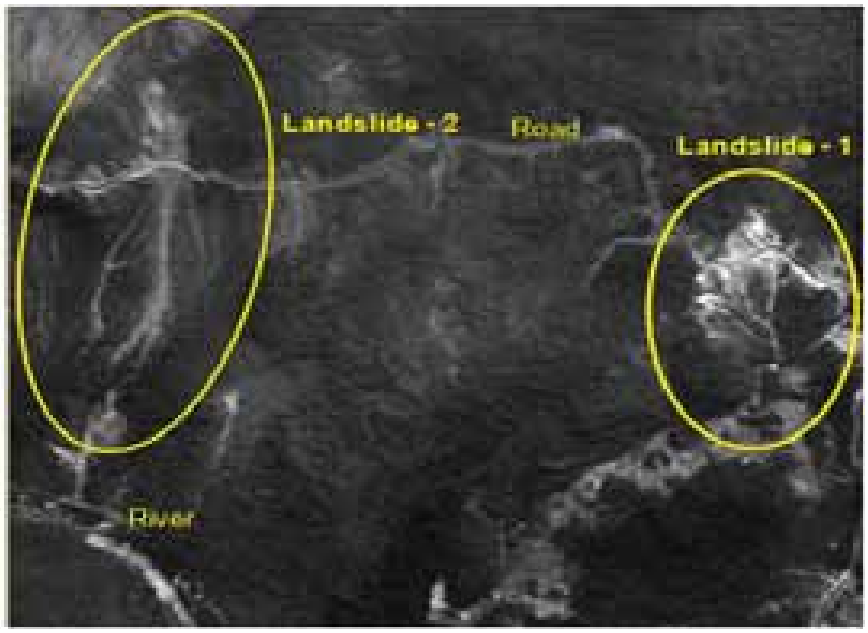


Fig.5: Landslides on Geo-eye satellite image

Fig.6: View of landslides

Fig.7: Field photo and micrograph of Dolostone

Topographic survey of the landslides have been carried out to know the topographic features and to generate a contour map on 1:500 scale with 1m contour interval. A DEM was prepared in GIS from the contour map and a few derivative maps were generated (Fig.8). From the slope map it can be observed that maximum area is covered by the slope angle 35-45 degrees and there are a few escarpments which are having slope of 45-60 degrees. The landslide is divided into two slopes by a seasonal drain. The road has been severely damaged on the downhill slide due to ongoing landslide activities.

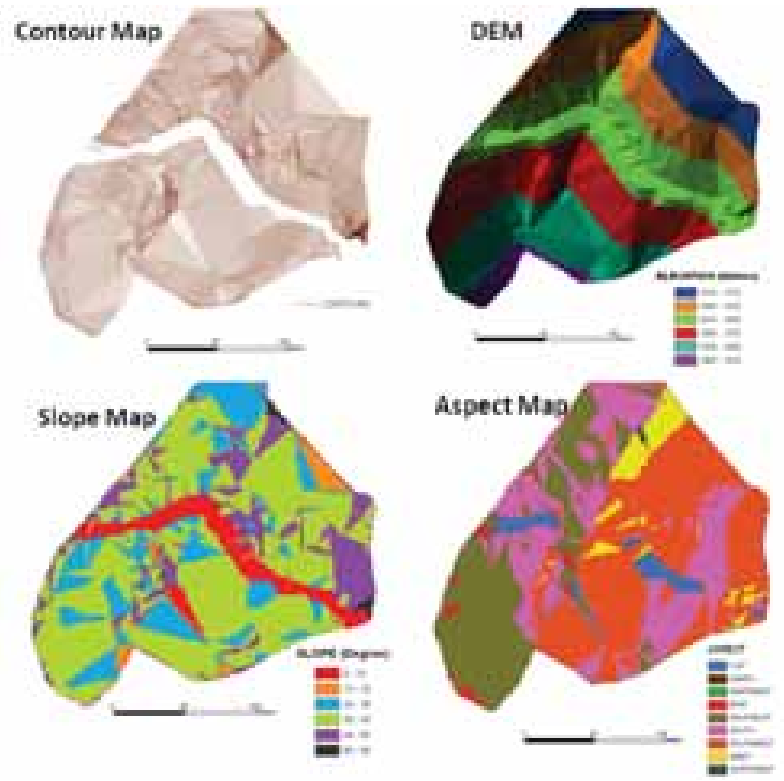


Fig.8: Contour, DEM, Slope and Aspect maps of landslide

Soil samples were collected from the different levels of the landslide for laboratory investigation to determine the engineering properties of the debris material (Fig.9). The materials were tested for grain size analysis, density and shear parameters.

Fig.9: Collection of samples from landslide and laboratory testing

The grain size analysis shows that the material is dominated by gravels and sand size particle (Fig.10). There is no clay content which indicates that the slide material has no cohesion. Direct shear tests were carried out using a large shear box apparatus, as the slide materials contain a significant amount of gravels and sands. The test results show cohesion of 0.015 kg/cm^2 and friction angle of 39^0 in dry condition while with 4% moisture, cohesion increased to 0.11 kg/cm^2 and friction value drops down to 36^0 (Fig.11).

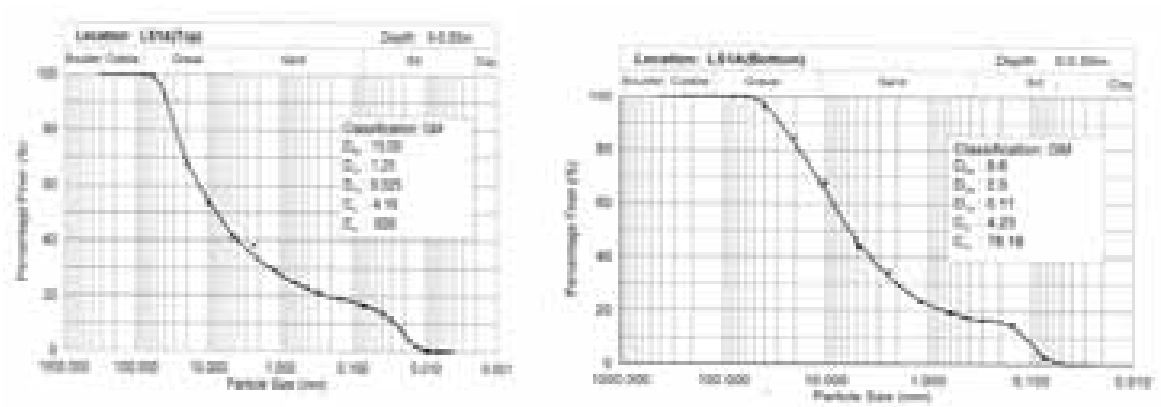


Fig.10: Grain size analysis

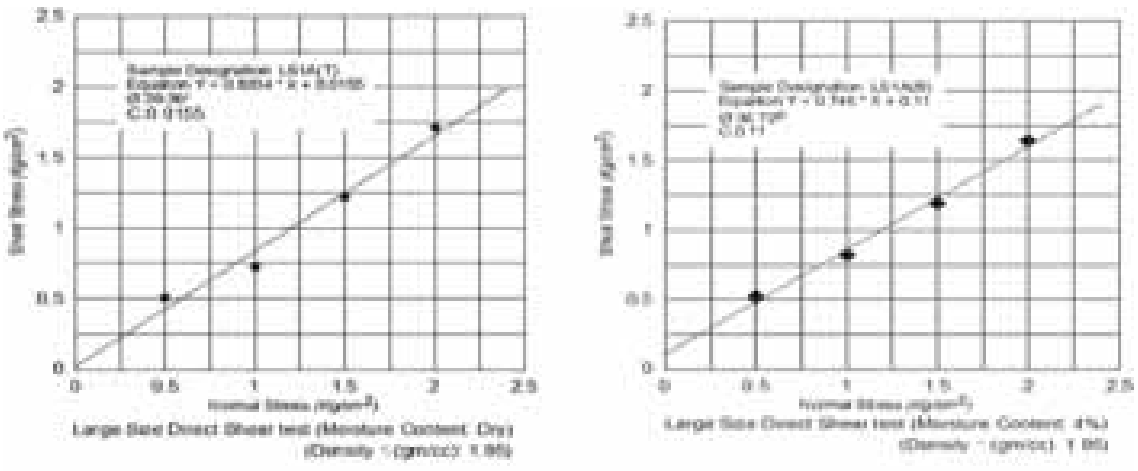


Fig.11: Direct shear test results

Geo-investigation is being continued to model the landslide failure mechanism before we undertake the design & development of cost effective suitable control measures. To develop landslide early warning system, a scheme of landslide instrumentation has been planned. The landslide monitoring instruments will include inclinometers, piezometers, wire extensometers, rain gauzes which will help to measure the surface and sub-surface movements in the slide area. Landslide movements will be monitored in real time and will be correlated with rainfall to define a real time alarm system for landslide early warning.

WP-2 Engineering of Earthquake Disaster Mitigation

Task 2.1: Seismic Microzonation of Srinagar, Uttarakhand

P. K. S. Chauhan

The aim of microzonation is to estimate the locations and relative severity of future seismic events in an area so the potential hazard can be assessed and the effects can be mitigated or avoided. The seismic microzonation maps generated through this study will help town planners, engineers, builders and civil administrators in planning and development of the city. Engineers will be in position to design the safe buildings with the help of inputs derived through this study.

Srinagar, falls in Seismic Zone V one of the Most Active Seismic Zone of India. Region has prolonged history of devastating earthquakes. Srinagar is fast growing city of Uttarakhand. No such complete studies have been undertaken so far. Keeping this in mind the Seismic Microzonation of Srinagar (Uttarakhand) has been initiated in April 2012 under the Engineering of Earthquake Disaster Mitigation (EEDM) in the 12th Five year plan with the following objective. *Seismic Microzonation of Srinagar, Uttarakhand using geological, geophysical, geotechnical, seismological and liquefaction studies.*

In last one year the following works were completed.

- Seismicity data of the area has been collected
- Geological data has been collected for Srinagar
- Tentative sites for SMA installation has been identified

The past earthquake data from the study area has been collected from USGS and seismicity map of the region has been prepared (Fig.1) Geological data of Srinagar has been collected from different sources and it was found that Srinagar town mainly rests over the quaternary fluvial terraces of boulders and sand deposited by Alaknanda river.

The hard rock under these boulder-sand terraces is the proterozoic phyllite called *Pauri Phyllite*. This highly fractured *Pauri Phyllite* of Chandpur Formation is separated from the quartzite and lime stone of Rudraprayag Formation by the *North Almora Thrust* (NAT). The geological map of Srinagar is shown in Fig.2.

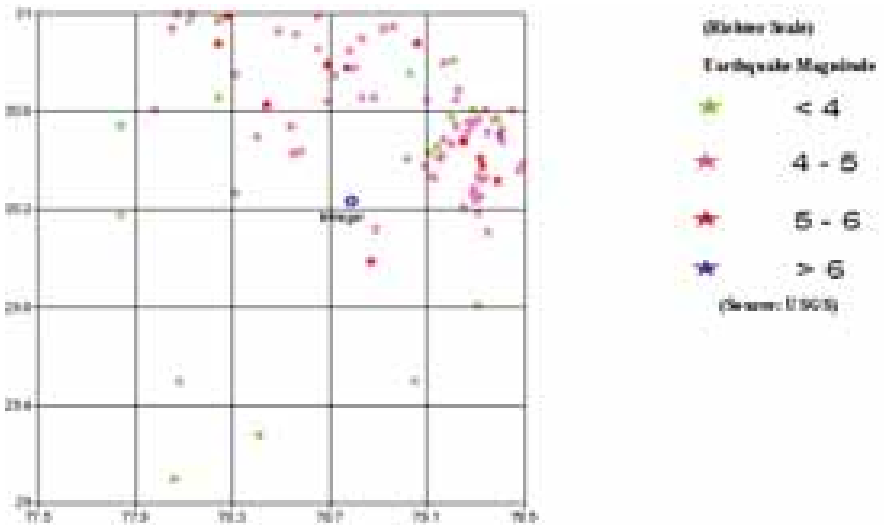


Fig.1: Seismicity map of Srinagar Area

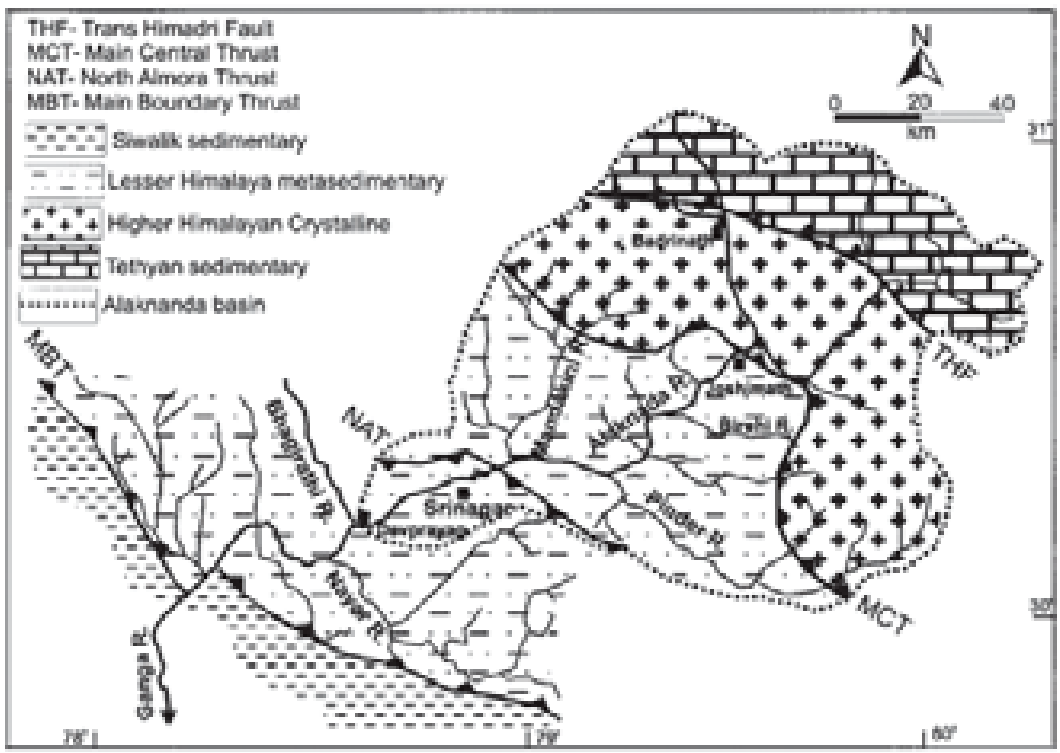


Fig.2: Geological and Tectonic Map of the Alaknanda Basin (After Sati et.al. 2007)

One of the objectives of the study was to establish a strong motion network in the city. According to master plan of Srinagar the area of the city is about 22.5 sq Km. The tentative sites for Strong Motion Accelerographs (SMA) installation has been identified on the basis of geology, topography and relief. The eight tentative locations have been finalized. The locations are given below and shown in Fig.3.

1. Tehsil Kirti Nagar
2. Tehsil Srinagar
3. SSB Srinagar
4. Ranihat
5. HAPPRC, Srinagar
6. GGIC Srinagar
7. Geology Deptt. Univ. (New Campus)
8. Medical College, Srinagar

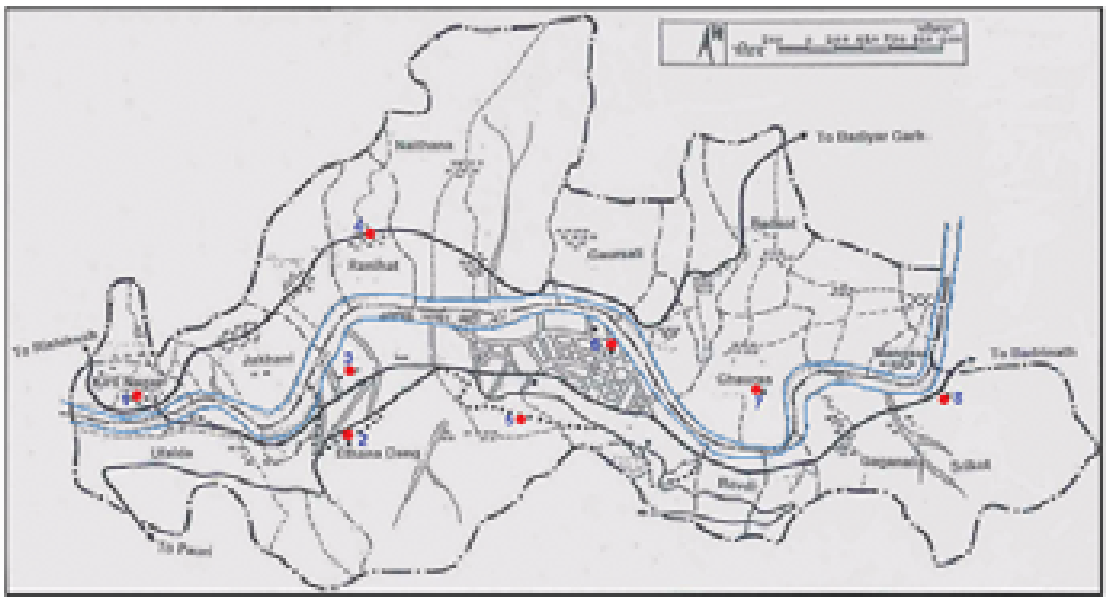


Fig.3: Tentative Sites for SMA Network

Task 2.2: Seismic Behaviour of Piles under Dynamic Lateral Loading

Parvathi, Manojit Samanta, Piyush Mohanty, Dalip Kumar & Zamir Ahamad

To investigate the seismic behavior of piles subjected to dynamic lateral loading through experimental model testing and numerical analysis. The investigations envisage by bringing out the influence of various soil and pile parameters on the seismic behavior of piles under dynamic lateral loading. It also aimed towards the development of a methodology for seismic design features of piles in liquefiable soils.

Progress made so far:

1. Experimental model test design is completed. This includes the design of laminar shear box test pile, reaction wall, shake table and base plate.
2. Shake table and its specification for dynamic model test have been finalized. Procurement process of the shake table is almost done.
3. Numerical modeling of pile groups on loose and dense sandy soils, subjected to combined axial and lateral loading is on progress. Parametric studies are also on line.
4. Numerical modeling to study the dynamic behaviour of single pile on sand, subjected to combined axial and lateral loading is also on progress.
5. Literature review

Discussion: Model tests will be performed on floating aluminum piles of diameter 25mm (single and in groups of 2x2 and 3x3) in a testing tank of size 2x2x1.5. The dynamic capacity of shake table needed to depict the earthquake condition of Indian soils on earthquake Zone 4 and 5 in the current model test set up was finalized as 50 kN. Type of soil and its characterization will be finalized after the numerical analysis. Numerical analysis using 3D Dynamics module of plaxis will give a better insight into the soil characterization needed for the dynamic test studies.

Task.2.3: Performance of Confined Masonry Buildings under Quasi-Static Condition

Ajay Chourasia

Recent earthquakes around the world have resulted in loss of human lives and high economic losses due to poor performance of unreinforced masonry as well as poorly-built reinforced concrete framed construction. This has prompted a need for alternative building technologies with improved seismic performance. Confined masonry (CM) construction, which has similar cost and skill requirements to unreinforced masonry and RC framed construction, is promising technology; however, the technology is not prevalent in India and need to be investigated from Indian construction practices and material point of view. In direction, extensive experimental work on material characterisation of brick masonry & its constituents with different mortar proportions thereby development of relationship to estimate modulus of elasticity, prism compressive strength, prism tensile strength and peak longitudinal prism strain based on brick and mortar strengths have already been completed.

Based on prevalent construction practices, a 3-dimensured full-scale models of confined brick masonry, single room, 3030x3030 mm in plan with one storey height of 3000 mm has been constructed in the laboratory. The model is constructed with 230 mm thick brick masonry wall in 1:6 cement-sand mortar with openings in two walls. The roof comprise of 100 mm thick RCC cast-in-situ slab. All RCC work was carried out using M20 grade of concrete, and Fe 415 as reinforcement. The model is construction with 4 nos. of 220x220 mm RCC column, one each at corner, with nominal reinforcement of 4-10# bars with lateral ties of 6 mm (MS) @ 100 mm c/c at ends and 200 mm c/c at mid section, with adequately anchored in footing beam and roof slab. A RC tie beam of size 220x200 mm is also provided at lintel level with reinforcement of 4-10# bars with lateral ties of 6 mm (MS) @ 200 mm c/c. The construction of CM model was carried out by constructing masonry first upto 1200mm high, followed by RCC work in column. 40mm grooves have been provided in the masonry at the intersection of RC tie column and masonry. Fig.1 shows the sequence of construction of CM model.

A distributed load is to be applied at eight points of the roof slab through a grillage mechanism to simulate application of uniform inertia force generated in the roof slab system during earthquakes. The displacement controlled loading is applied at a very slow rate (õ.005 Hz) to eliminate material strain rate effects under quasi-static condition (QST). To generate the cyclic lateral loading, the grillage loading system was also provided on opposite sides of the roof slab. A 500 kN capacity, with ± 75 mm stroke servo-hydraulic actuator is used to apply the displacement controlled cyclic loading on the building. LVDTs and strain gauges were placed at critical locations of the model to measure the response (Fig.2).

Fig.1: Sequence of construction of Confined Masonry Model in Laboratory

Fig.2: Experimental set-up for full scale test on Confined Masonry Model under QST

Also, the 3D building was modelled using 4-node quadrilateral shell elements with 4 integration points in the plane and 3 integration points in thickness direction in FE software TNO-DIANA. Material properties for the masonry structures were defined as obtained from masonry tests. The thickness of the masonry was taken equal to 220 mm.

The stiffness adaptation analysis with application *STADAP is implemented to be an alternative for a full nonlinear analysis with application *NONLIN for calculating load distributions, deformations, crack patterns, and crack-width in reinforced concrete structures. A stiffness adaptation analysis performs a sequence of linear static analyses, in which a subsequent iteration of elastic stiffness are reduced in those integration points wherein the stresses in a previous iteration were beyond a user-specified uni-axial stress-strain curve.

In such a case the isotropic elastic stiffness model is changed into an orthotropic elastic stiffness model with a reduced stiffness in the direction of the maximum stress, such that, with the same strain in the integration point, the maximum stress are mapped on the stress-strain curve.

Fig.3 shows the crack-width results in the outer-surfaces of wall with window opening at maximum loading of 10, 20 and 30 mm for forward loading direction. The major crack wrapping from the bottom corner of window opening and at interface between RC tie column and brick masonry as recognised from the Stiffness Adaptation Analysis results. Further, the analytical results will be verified with the experimental observations.

Fig.3: Cracks in wall with opening of CM model as a result of Stiffness Adaptation Analysis in +ve loading direction at 10, 20 and 30 mm prescribed displacement

WP-3 Engineering of Fire Disaster Mitigation

Task: 3.1: Development of Low Ozone Depletion Potential (0.01-0.5) Innovative Fire Suppression System

R.S. Chimote, Manju Mittal, Shorab Jain and A. Arvind Kumar

Objectives:

Development of water-mist based fire extinguisher

Development of evaluation facilities for fire extinguishing system

Work Progress:

Fire Suppression knowledge gaps under Montreal Protocol and in context of the current Indian and global fire protection requirements have been identified by carrying out:

- IP-profile white space mapping on fire extinguishment from1930-2012, as shown in Fig.1.
- Publication white space mapping from 1955-2012.
- SWOT analysis.
- Global trend analysis of fire protection white spaces

White space mapping with Knowledege gaps & IP

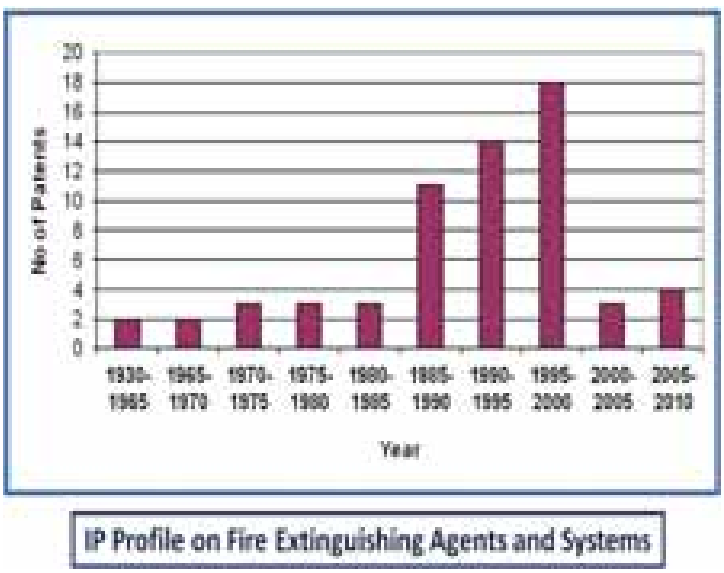


Fig.1: IP Profile on Fire Extinguishing Agents and Systems

Profiles done for the project:

R&D knowledge Gaps:

- Challenges in fire measurement
- Extremely harsh thermal environment
- Transient chemical species,
- Soot-laden flows,
- Measurement interference,
- Scaling issues
- Turbulent flow fields

♦ Lack of knowledge about interacting fire processes that inhibitaccurate simulation of suppression

♦ Halon fire extinguishants (CFC-Based) phase out limit ended in 2010.

♦ Commercial fixed water mist/aerosol is hardly in use in India. Need for Common man's Fire Sefety, low cost water-mist fire extinguisher arises

♦ India needs fire extinguishing agents with low ODP (0.01-0.5)

♦ Class I substances phased out in 2005, Class II substances (Hydro Chloro Fluro Carbons) to be phased out in 2013 – 2015

♦ Development of low ODP fire extinguishing system is required to be rigorously undertaken.

♦ Worldwide R&D programs on development and characterization of water mist aerosol fire extinguishants are on.

Scope of Work

♦ Development of low ODP Fire extinguishing system for water mist of size: 10μ to 1000μ.

♦ Characterization of fire extinguishing system Particle size distribution, velocity profile, and discharge density for different fires).

♦ Fire suppression modeling.

New/Novel Experimental Facility for the development of low ODP(0.01 to 0.5) Fire Extinguishants: 1m^2 Turbulent Diffusion fire Experimental fire suppression set-up as shown in Fig.2 has been fabricated for low ODP (0.01 to 0.5) extinguishant development studies for rapid fire extinguishment of Class A and Class B Fires in building and industrial occupancies.

Fig.2: Experimental facility for development of low ODP (0.01 to 0.5) fire extinguish ants Experiments Measurements:

Developmental experiments were conducted with water-mist as shown in Table 1 and other indigenously developed liquid extinguishants in 10,000 nm to 1,00,000 nm size range (currently, we have developed and experimenting in the range of: 18,000nm-10,00,000nm as per NFPA, USA requirement) for :

- determining the effective sauter mean dia of particle size distribution required for effective extinguishment and
- velocity Profile in the range of 0.4m/s to 20m/s for characterization of Nozzle size and specifications,
- Characterization of compositions against the fire knock-down and complete extinguishment time of 30s.
- Particle discharge density

Simultaneously, CFD modeling is being done for simulating and validating the published data for comparison as well as our experimental results.

CFD Modelling Approach:

- Eulerian-Lagrangian Method.
- Air Ideal Gas Phase (Continuous Phase) will be studied with Eulerian equation.
- Water Mist (Particle Transport Fluid) with Lagrangian equation.
- Buoyancy effects will be considered.
- Turbulence
- The turbulence model $k - \in$ model will be chosen (equations for the kinetic energy k, and the energy dissipation rate $\in$).
- Drop size distribution.
- Uniform diameter/ Variable diameter distribution will be used.
- Velocity
- Velocity of water mist and air will be required.
- Particle number
- Number of representative particles to be tracked is defined.
- Fluid pair interaction
- Interphase Mass transfer Model (Ranz Marshall) taken for the study.
- Particle breakup model
- Particle Collision parameters models are considered for the study.

CFD Modelling Issues:

- The Combustion modelling reported as volumetric heat source in the literature due to complexity in the solver.
- The Eulerian-Lagrangian Approach can not solve two Continuous phases.
- The methane combustion can be modelled using Eulerian-Lagrangian approach. However, the Liquid pool fire models can not be modelled due to above reason.
- The velocity tracking of the individual particles are not possible but averaged mass mean diameter particle tracking is possible.

Validation of results:

- The following are the validations of CFD simulation and comparison of results for the CFD simulation published data and CBRI experimental data are shown in Fig.4 & 5 respectively.

Fig.3: 1000 cm² fire suppression by low ODP extingushants

Table 1: Velocity profile of 0 to 20 m/s for the water mist particle size distribution from 18μ to 1000μ

Water-mist Droplet/ Particle size (microns)"		Cumulative % Volume of water-mist Particle	Velocity profile (m/sec)	
18.0	19.0	0.0009	0.00	0.40
23.8	25.2	0.0026	0.40	0.80
26.7	28.2	0.0065	0.80	1.20
29.9	31.6	0.0161	1.20	1.60
35.4	37.4	0.0198	1.60	2.00
39.6	41.9	0.0243	2.00	2.40
41.9	44.3	0.0296	2.40	2.80
46.8	49.6	0.0360	2.80	3.20
49.6	52.4	0.0500	3.20	3.60
52.4	55.5	0.0574	3.60	4.00
55.5	58.7	0.0666	4.00	4.40
58.7	62.1	0.0857	4.40	4.80
62.1	65.7	0.1072	4.80	5.20
65.7	69.5	0.1192	5.20	5.60
73.5	77.7	0.1611	5.60	6.00
87.0	92.0	0.2039	6.00	6.40
97.4	103.0	0.2586	6.40	6.80
109.0	115.3	0.4211	6.80	7.20
115.3	121.9	0.6903	7.20	7.60
121.9	129.0	0.8179	7.60	8.00
129.0	136.5	1.2974	8.00	8.40
136.5	144.4	1.9320	8.40	8.80
144.4	152.7	2.5227	8.80	9.20
152.7	161.6	3.1891	9.20	9.60
161.6	170.9	3.8472	9.60	10.00
170.9	180.8	4.6885	10.00	10.40
180.8	191.3	5.3481	10.40	10.80
191.3	202.3	6.7255	10.80	11.20
202.3	214.0	8.0255	11.20	11.60
214.0	226.4	8.9663	11.60	12.00
226.4	239.5	9.8639	12.00	12.40
239.5	253.4	11.4849	12.40	12.80
253.4	268.1	12.5861	12.80	13.20
268.1	283.6	14.1044	13.20	13.60
283.6	300.0	15.8800	13.60	14.00
300.0	317.4	17.3631	14.00	14.40
317.4	335.7	18.0451	14.40	14.80
335.7	355.2	20.4981	14.80	15.20
355.2	375.7	22.0424	15.20	15.60
397.5	420.5	24.1594	15.60	16.00
420.5	444.8	25.8521	16.00	16.40
444.8	470.6	28.7526	16.40	16.80
470.6	497.8	32.4711	16.80	17.20
526.6	557.1	35.9755	17.20	17.60
589.3	623.4	40.8234	17.60	18.00
659.5	697.7	44.4521	18.00	18.40
697.7	738.1	57.4689	18.40	18.80
738.1	780.8	62.3659	18.80	19.20
924.4	977.9	83.0610	19.20	19.60
977.9	1000	100.0000	19.60	20.00

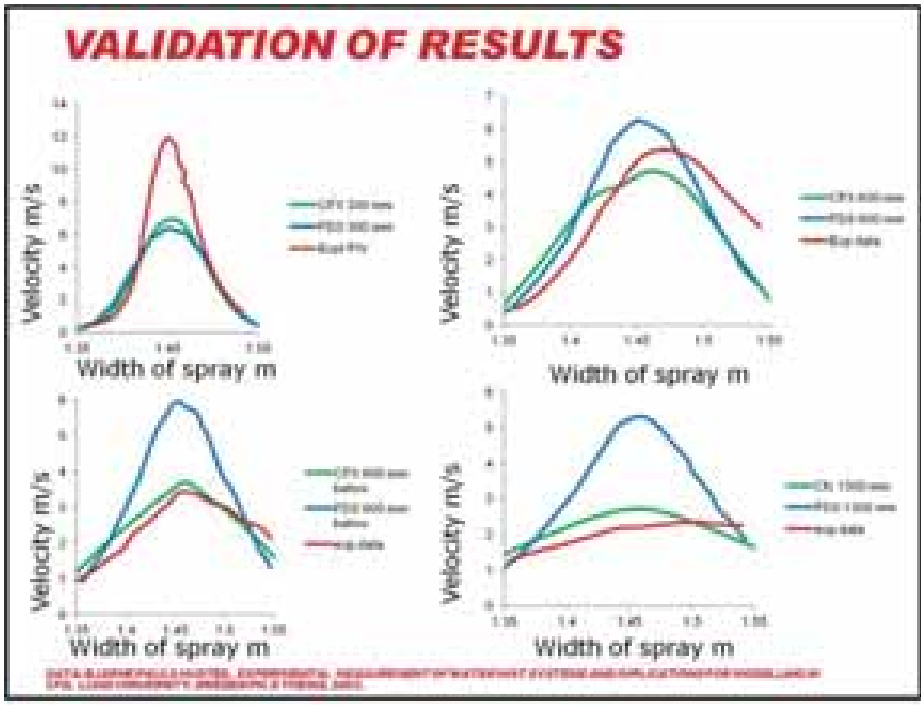


Fig.4: Validations of CFD simulation results

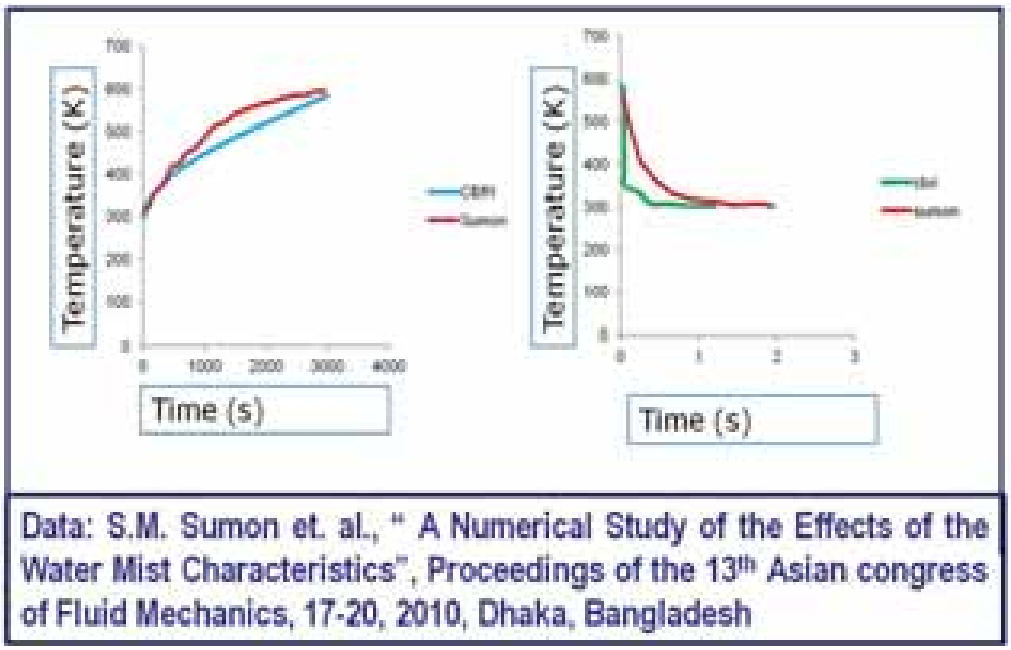


Fig.5: Comparison of Numerical and experimental results of data from CBRI study and SUMON, et al, 2010

Task: 3.2: Fire Performance Evaluation of Structural Elements and Rehabilitation Measures

Suvir Singh

To study the fire performance of structural elements and material properties at high temperature, different specimen i.e cube, cylinders, prism, slabs and beams were prepared.

Studies were carried out on reinforced concrete slabs by exposing the specimen to the controlled heating and cooling conditions as shown in Fig.1.

During the fire exposure temperature variation at different locations across the section were measured at different location. The variation observed at one point and rate of rise of temperature is shown in Fig.2.

After the fire exposure studies were carried out on the spalling behaviour of the specimens.Further the experimental work is in progress to study the fire behaviour of reinforced concrete beams when subjected to the ISO-fire exposure.

- Under full process of fire development with growing ISO-fires and decay phase.
- exposed under loaded conditions

Generated experimental data for validating computer programs developed for calculating thermal and structural behavior of beams exposed to fire.

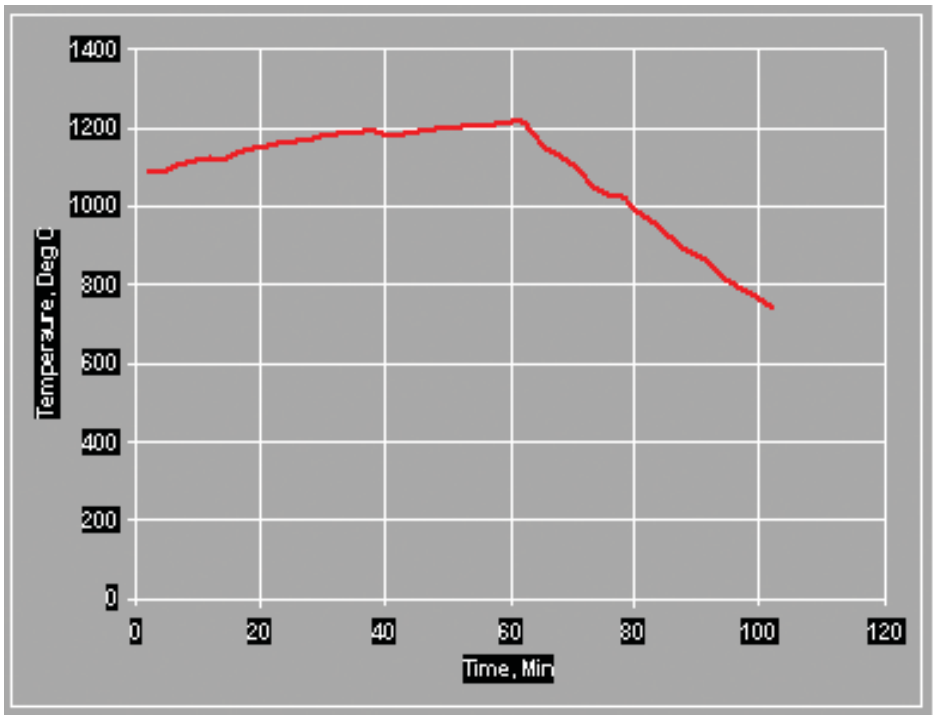


Fig.1: Time temperature curve maintained during the fire exposure and cooling of the specimen

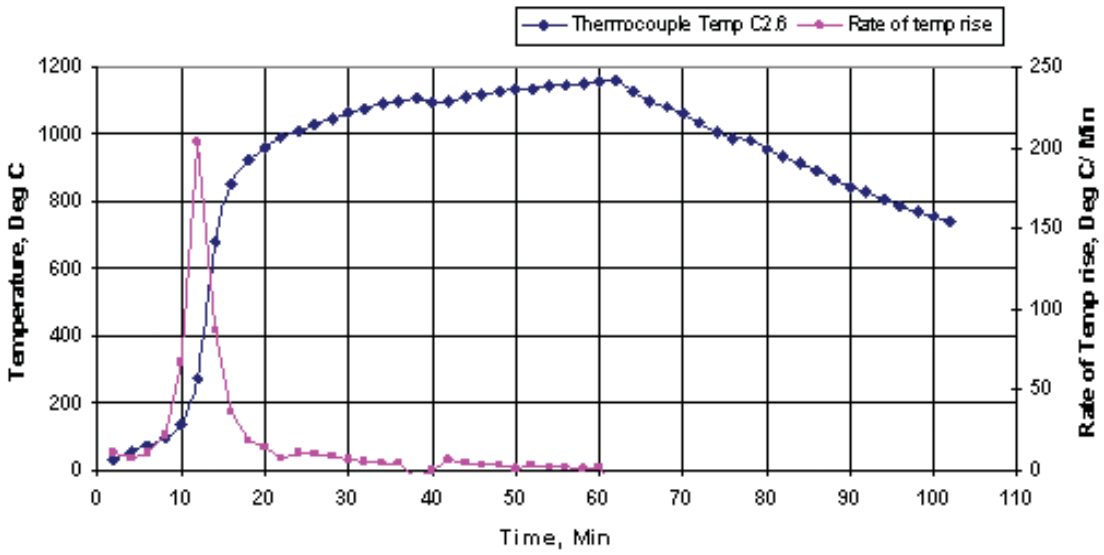


Fig.2: Time temperature variation observed during the fire exposure and cooling of the specimen

WP-4 Post Disaster Shelter Planning

Task 4.1: Post Disaster Shelter Planning for rural areas in the Western Himalayan Region

S.K. Negi, R. K.Garg, Ashok Kumar, Navjeev Saxena, Ajay Chaurasia, P. C.Thapliyal & S. K. Panigrahi

The main objective of the project is to develop a technology package for Disaster Resistant Transit Shelters for Western Himalayan Region. As in the past 20 years, meteorological disasters have been more frequent and more intense than previously, in some regions of Asia and Latin America. These events have resulted in population displacements, increased mortality, large numbers of direct victims as well as many more indirectly affected, and thousands of families left homeless. Disaster is a sudden, calamitous event causing great damage, destruction & devastation of property and colossal loss of life. During all these disasters millions of people become homeless for months together and spend days in some high land or other places in different camps and shelters in very adverse situations. Western Himalayan Regions are more prone to natural disasters like earthquake, floods and landslides etc.

Therefore, it is of immense importance to design and develop 'Transit Shelter' which can be readily usable during above mentioned disasters to the disaster victims. Design and development criteria are to be developed based on the socio-economic conditions, available materials and construction technology. These hazards can be minimized by using modern scientific and technological advancements like design and development of 'Transit shelter" which can be readily usable during disasters without hampering the social streamlines and provide better environment to disaster victims from health, safety and security.

During the period white space mapping, literature based case studies of transit shelter and transit shelter design standards developed by United Nation High Commissioner for Refugees (UNHCR) & Shelter Centre Switzerland has been studied.

CASE STUDIES

More than 25 Transit shelters have been studied which are being constructed by International federation Red Cross (IFRC), and other agencies in different parts across the globe to understand the adopted construction practices and the material used by various agencies working in this area to identify the gaps. United Nation High Commissioner for Refugees (UNHCR) & Shelter Centre was first to introduced the concept of transit shelters standards in 2005 just after the Tsunami. The first draft came in 2007 & second on May 2009 and the final draft is steel awaited. The draft report can be

divided in three different parts are: logistics standards ,physical standards &social standards .At International level some agencies has already started working on the bases draft standards for Transit shelter by UNHCR & Shelter Centre and the agencies are; Even products Limited- UK, H. Sheikh Noor-ud-Din & Sons Pakistan, Maddel International. – Australia, Nunatak Systems. -Germany & World Shelters. - USA. Based on the literature and case studies major gaps has been identified and inferences have been worked out, and accordingly working on the geometry of the design concept for transit shelters.

GAPS

- Difficult to transport due to heavy weight.
- Requires specialized man power, tools & equipments for assembling and dismantling.
- Erection time is more.
- Acceptability – due to poor thermal comfort indoors.

INFERENCES

- Shelter erection time should be minimum.
- Shelter should be light in weight and durable.
- Structure's Stability.
- Specialized man power, tools & equipments should be used bare minimum for assembling and to knockdown of the shelters.
- Water & wind resistance, fire retardant, durability, renewable material and antibacterial.
- Anti-ultraviolet nature to protect the people from harmful U-V rays.

These Transit shelters will be designed in such a way that, these shelter can be easily dismantled and can be stored in large number, so that state / central disaster mitigation agencies can maintain a ready - to – use, store of such transit units and can be used in case of any disasters . With this aim we are working on design concepts of the Transit shelters.

WP-6 Intelligent Building System for Model Residential Unit

To identify, develop and integrate the intelligent features into a model house making it a fully automated residential unit which is occupant friendly, safe, secure, eco-friendly as well as energy efficient.

Task 6.1: Architectural Planning and Design of a Residential Unit integrating Intelligent Building Features

Ashok Kumar & Team

- The objective of the project is to develop a cost - effective and energy efficient intelligent residential unit.

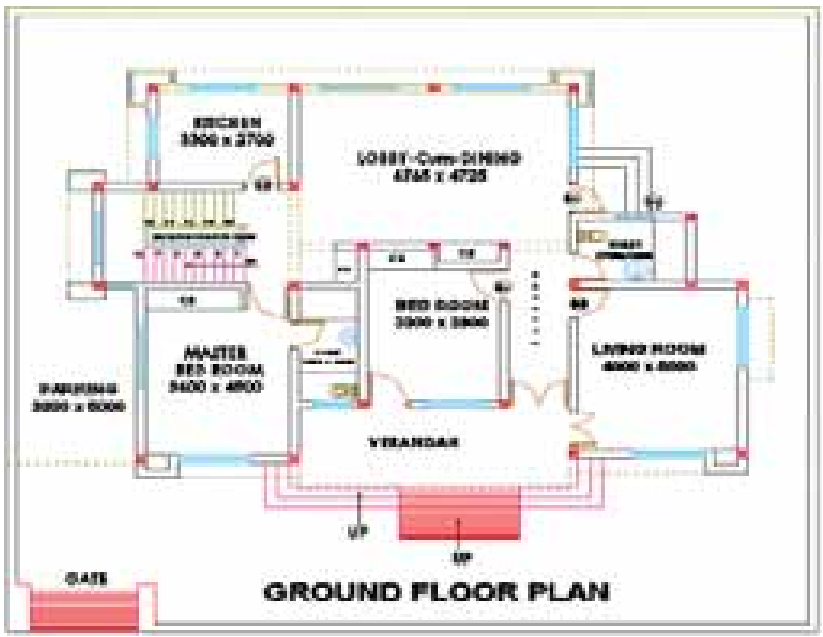
During the period, a comprelensive literature reviews has been carried out. A residential building contains many defined spaces, normally each with identified purposes. The functionality in a built space determines the potential of the capability of service, or intelligence e.g.,what the space is potentially capable to afford to the user. The built environment can be designed and implemented as a space of 'intelligence'. As soon as a user enters into the space, interaction between the user and the space will be possible due to the embedded systems/sensing devices in the spaces. Regulated by the norms in socio technical, economic and environmental dimensions, the activation of embedded systems will make the space function intelligently to meet the users' requirements.

Intelligent spaces in the residential buildings, where information and communication technology plays a key role in enhancing the interaction between people and buildings. The pervasive intelligent space will not only improve the quality of our work and life, but also be an effective approach to better building performance and environmental sustainability. The sketch plan as shown in Fig.1 for the proposed model residential building has been prepared and the possibility of incorporating Intelligent Building features as mentioned in Table 1 for the proposed model is being explored.

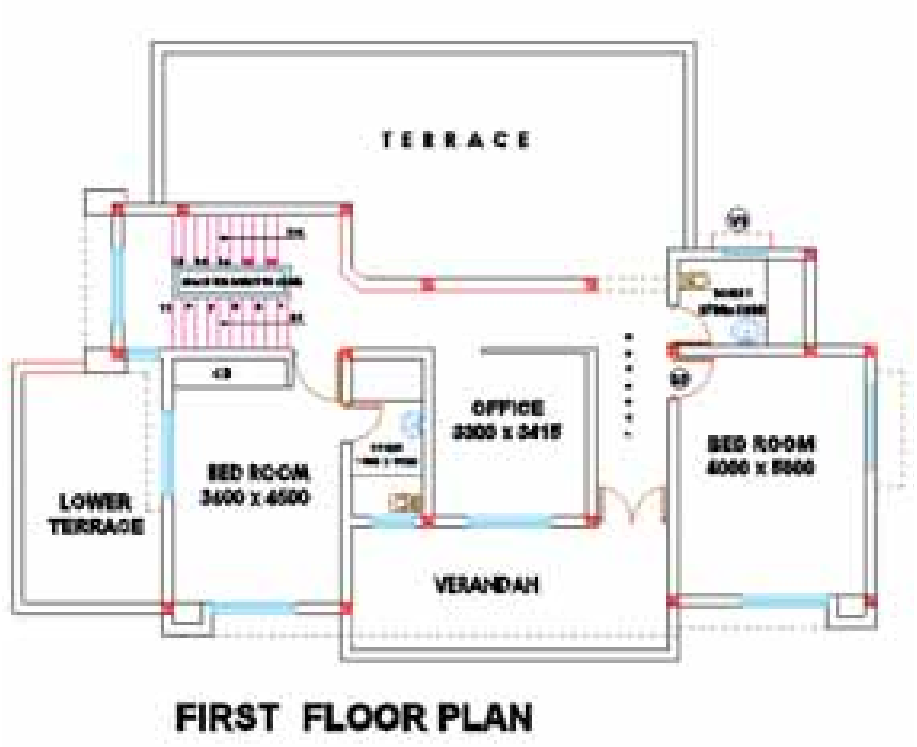
A cost-effective and energy efficient residential unit will be constructed by integrating all the intelligent systems/features available in the market and also being developed by a team of scientists in different tasks.

Table 1: Model residential unit and corresponding features

Unit in the Model Building	Intelligent Features	Corresponding unit in a full scale Intelligent Residential building
Gate	Basic Security System & CCTV	Main Gate for the compound
Compound and Parking Space	Lighting, Surveillance system & CCTV	Compound and Parking Space
Entryway (Ground Floor)	Biometric Identification System & CC TV Security camera	Verandah
Living Room (Ground Floor)	HVAC, Lighting with sensing devices , Entertainment system, Entrance security	Living Room
Lobby – cum- Dining Room (Ground Floor)	Master Control room , HVAC, Lighting with sensing devices, Entertainment system & CCTV	Lobby – cum- Dining Room
Master Bedroom (Ground Floor)	HVAC, Lighting with sensing devices	Master Bedroom
Guest Bedroom (Ground Floor)	Manual Override, HVAC, Lighting with sensing devices	Guest Bedroom
Kitchen (Ground Floor)	Safety and monitoring system for Gas leakage, Water line, Appliances	Kitchen
Bathroom (Ground Floor)	Geyser, Water supply	Bathroom
Toilet (Ground Floor)	Water supply	Toilet
Verandah (Ground & Ist Floor)	Lighting, Cleaning	Corridor
Stair Case / Stair hall (Ground & Ist Floor)	Lighting, Cleaning	Stairways
Office room (Ist Floor)	HVAC, Lighting, Entrance security	First Floor of the residential building
In addition to above, robot to be used for flow cleaning.		



(a)



(b)

(c)

Fig.1 (a, b, c): Proposed Conceptual Floor Plans and Elevation of a Model Residential Building

Task 6.2: Intelligent HVAC and Lighting Controls in Response to Ambient Environment

Nagesh Babu Balam, H.K Jain, & S. Alexander

The existing LED light bulbs produce high LPW (lumen per Watt) output and have highly efficient lighting technology in the present s cenario. The LED light bulbs have unique driving electrical requirements of Voltage and Current. Industrial grade LED light button bulbs operate at 3.3V and constant current. These button bulbs are connected in series/Parallel to get the required light intensity and LED light bulbs are made out of them. These bulbs are mostly used in commercial establishments and are now popular in residential sectors also. The unique requirement of driving voltage and current requirement of LED bulbs necessitates a driving electronic circuit which provides the required voltage and driving current. This existing driving circuit for LED bulbs is shown in the following Fig.1.

Each LED light bulb has this driving electronic circuit which converts the house hold 230V AC electric supply to DC voltage and current necessary to energize the LED bulb. Though LED is inherently a highly energy efficient technology the overall power conversion efficiency reduces due to the employment of high frequency oscillator as shown in the above Fig.1. A large heat sink is provided along with the high frequency oscillator which dissipates large amount heat produced in the high frequency oscillator to the surroundings. Conversion of electricity to heat and dissipation in the room causes an increase in the cooling load for Air conditioners. This phenomenon is specifically seen in super markets and commercial establishments where rows LED bulbs illuminate the establishment area.

A 18V DC microgrid system is proposed to eliminate the intermediate driving electronic circuit for LED light bulbs and hence utilize the high LPW advantage of LED lighting systems. The design of the DC microgrid system is in progress and this DC microgrid system has other advantage of operation of solar and low power intelligent systems for the intelligent building system.

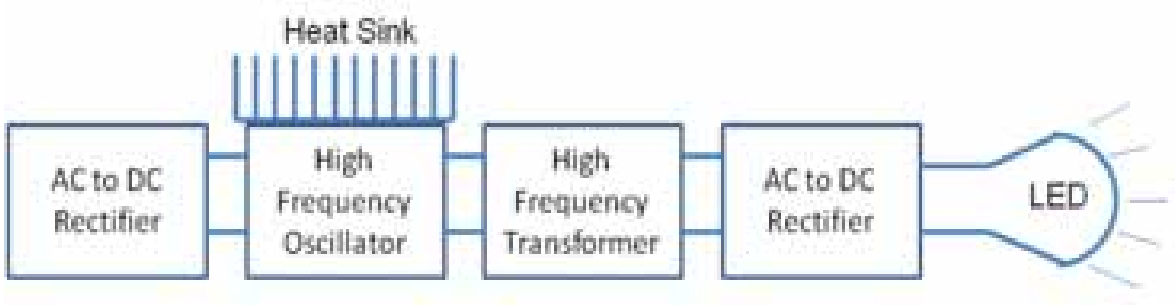


Fig.1. Driving Electronic circuit for LED Light bulbs

Task 6.3: Glass Facade Cleaning Robotic System

R. S. Bisht & S. Alexander

Many studies and research interest for the development of various autonomous cleaning robots (ACRs) for both ground and vertical surfaces have been taken up in the recent past. Mobile robots, capable of maneuvering on vertical/ inclined wall surfaces such as glass façade and glass windows at higher sites of buildings, could replace humans for autonomous cleaning, considering human safety as well as high productivity/efficiency to these locations. To reach such locations ACRs require both locomotion and adhesion mechanisms. Several locomotion and adhesion mechanisms using conventional methods such as pneumatic and electro-adhesive have been used for developing ACRs.

Research studies on Electro-adhesion mechanism was developed recently for wall-climbing robots applications as it was previously applied mostly in the robot end-effectors. The robot mechanism has advantage over other mechanisms such as pneumatic, magnetic, and boi-inspired, since the robot can work over a variety of material (conductive and non-conductive, rough and smooth) wall surfaces including dust. Electro-adhesion mechanisms are mostly integrated with robot track locomotion to gain net adhesion force due to more surface area for traction force by electrostatic principle, thus, more payload capacity can be obtained. Experimentally electro-adhesion robots are still not capable of carrying more payloads, though it has been theoretically stated that the robot can be designed for higher payload capacity.

In the present studies on mechanisms design for mobile robot application, theoretical investigations based on electrostatic principle have been made as shown in Fig.1&2. This analysis shows the feasibility i.e., payload capacity of mechanism under different material surface conditions (glassy and rough surface). Experimental setup design for mechanism testing and development has also been carried out for ongoing research work. Qualitative and comparative analyses of various locomotion and adhesion mechanisms as briefly illustrated in Table 1 & 2 have also been made.

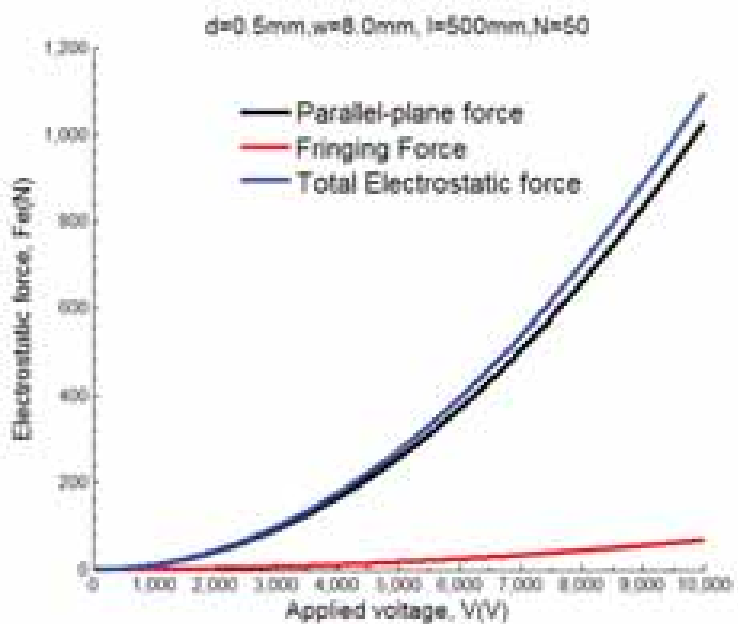


Fig.1: Electrostatic force versus applied input voltage

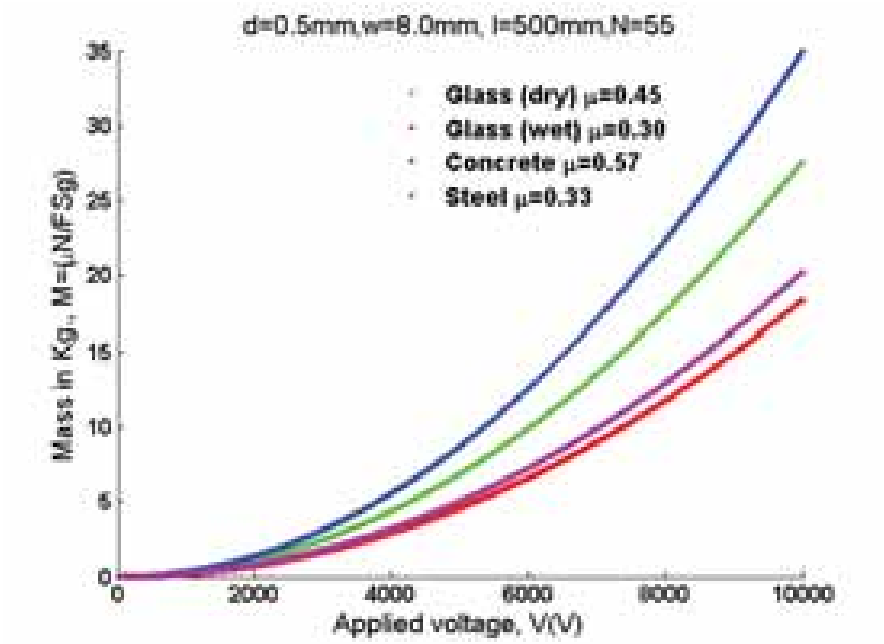


Fig.2: Electrostatic forces versus applied input voltage under different wall surface conditions

Table 1: Comparative and Qualitative analyses of locomotion mechanisms

Locomotion mechanisms	Performances					Developed prototype Robots
	Payload capacity	Speed	Transition capacity	Control simplicity	Obstacle crossing capacity	
Multi-legged	High	Low	High	Low	High	RAMR1, NINJA I-II, Stickybot I-III, ASIBOT, REST 1, RiSE, Climbot, Spinybot I-II
Wheel-driven	Low	High	Medium	High	Low	LARVA I-II, City-climber II, Wall Walker, MagneBike, CROMSCI, Cy-mag^{3D}, Alicia 1-2
Track-wheel	Medium/ High	Medium	Medium	Medium / High	Medium/ Low	Tripillar, Electroadhesive robot, Combot, TankBot, Cleanbot II
Sliding/ Translation	High	Low	Low	Medium	Medium/ Lw	Sky-Cleaner I–IV, Cleanbot I
Cable-driven	Medium	Medium	Low	High	High	TITO 500
Hybrid/ Combined types	Medium/ High	Medium	Medium	Medium/ Low	Medium	Alicia3, SIRIUSc, Waalbot II, ICAROS,

Table 2: Comparative and Qualitative analyses of adhesion mechanisms

Adhesion mechanisms			Developed prototype Robots	Suitability (wall surface)	Usefulness	Adhesion force			
						Nature	Range	Power consmption	Payload capacity
Conventional mechanisms	Pneumatic suction	Vortex pneumatic suction	LARVA I-II, City-climber	Smooth and rough	Reusable	Pneumatic force	3750KPa	High/ Medium	High/ Medium
		Active pneumatic suction	Sky-Cleaner I–IV, Cleanbot I-II,SIRIUSc, CROMSCI, Alicia3, RAMR1	Smooth	Reusable				
		Passive pneumatic suction	Caterpillar robot						
	Electro-adhesives		Electro adhesive robot	Smooth and rough	Reusable	Electrostatic force	1-15KPa	Medium	Low / Medium

NETWORK PROJECTS

CSIR-CBRI as Participating Laboratory

Network Projects

CSIR- CBRI AS A PARTICIPATING LABORATORY

Removal of Heavy Metals from Waste Water using Fly Ash & Secured Disposal of the sludge.

PI: Er. S. Maiti

[CSIR-NEERI, "Clean Water: Sustainable Options"]

Estimation of Crustal Deformation of Garhwal Himalaya.

PI: Dr. S. Sarkar

[CSIR-CMMACS, Advance Research in Engineering & Earth Sciences (ARiEES): Data Intensive Modelling & Crowd Sourcing Approach]

Energy Efficient Seed Storage Structures.

PI: Er. Nagesh B. Balam

[CSIR-CSIO, Advanced Instrumentation Solutions for Health Care and Agro – based Applications - ASHA]

Development of Artificial Pillars for Optimal Extraction of Locked-up Coal.

PI: Er. Ajay Chourasia

[CSIR- CIMFR, Dhanbad]

Service Robot for Building and other Structures.

PI: Er. Ravindra S. Bisht

[CSIR-CMERI, Micro Machines and Robotics]

CSIR Knowledge Gateway & Open Source Private Cloud Infrastructure.

(KNOWGATE),

PI: Dr. S. K. Senapati

[CSIR-NISCAIR, New Delhi]

Removal of Heavy Metals from Water Using Fly Ash and Its Subsequent Use in The Production of Value Added Building Components (Network Project (ESC 0306))

Somitra Maiti & A. K. Minocha

Coordinating Lab : CSIR-NEERI, Nagpur

Participating Lab : CSIR-CBRI, Roorkee

Objectives:-

- Design and construction of a packed bed reactor for removal of heavy metals from waste water by using fly ash and optimization of process variables.
- Use of the altered sludge for production of building component.

Pollution of water by heavy metals is one of the major concerns of the society in the 21st century. Heavy metal in water refer to heavy, dense, metallic elements that occur in trace levels, but are very toxic and cause serious damage to human life and environment. Zinc is the fourth most widely used metal after iron, aluminium and copper. Zinc is present in high concentration in wastewater of various industries such as electroplating, galvanizing, painting etc. Zinc is not biodegradable and travels through the food chain via bioaccumulation. That's why it is very essential to remove zinc from waste water before discharging it into the environment. In this study fly ash is used as an adsorbent for removal of zinc from waste water. For continuous removal of Zn^{2+} from water a packed bed reactor of 7 litre capacities was used. It was made of transparent acrylic sheet. The reactor has three sections of equal diameter (150 mm) bottom section (160 mm in height), packed bed section (160 mm in height), and top section (100 mm in height). The contaminated water is introduced in the bottom section of the reactor by a peristaltic pump. A stirrer is used to keep the fly ash slurry in suspension. In the packed bed section the Zn^{2+} was removed by fly ash. The unburnt carbon and the silanol ion play an important role for removal of metal ion. The clean water is coming out from the top section.

In this removal process, many factors such as pH, metal ion concentration, fly ash dosage and RPM influence the removal efficiency. The process efficiency can be significantly increased by the optimizing these factors. In conventional multifactor experiments, optimization is usually carried out by varying a single factor while keeping all the other factors fixed at a specific set of conditions. By application of Response Surface Methodology (RSM) it is possible to evaluate the interactions of possible influencing factors on treatment efficiency with a limited number of planned experiments. In the present study trial version of Design Expert 8.0.7.1, was employed for the optimization of Zn removal.

The central composite design (CCD), which is the standard RSM, was selected for the optimization of the parameters. Since different

variables are usually expressed in different units and/or have different limits of variation, the significance of their effects on response can only be compared after they are coded. For statistical calculations, the variables Xi were coded as x_i according to the following equation:

$$x_i = \frac{X_i - X_0}{dX}$$

Where Xi is the uncoded value of the i^{th} independent variable, X_0 the value of Xi at the centre point of the investigated area and dX is the step change. Metal ion concentration, pH, fly ash dosage and RPM were chosen as independent variables in this process. Their range and levels are given in Table 1. The experimental design & corrosponding result are presented in Table 2.

Table 1: Experimental range and levels of independent process variables

Variables	Coded value				
	-2	-1	0	1	2
X_1, Metal ion concentration(mg/l)	10	30	50	70	90
X_2, pH	4	6	8	10	12
X_3, Fly ash dosage (g/l)	20	40	60	80	100
X_4, RPM	20	40	60	80	100

The final second-order polynomial equation for removal efficiency in-terms of significant factors (confidence level > 95%) as determined by the Design-Expert software is given below.

Removal efficiency = 35.00 + 2.01 X_1+5.37 X_2+ 1.12 X_3 + 3.05 X_4 - 3.70 X_1X_2 - 0.071 X_1X_3 - 2.43 X_1X_4 + 1.32 X_2X_3 + 1.18 X_2X_4 - 1.20 X_2X_3 + 5.18$X_1$2 + 4.35 $X_2$2 + 1.85 $X_3$2 + 1.85 $X_4$2

Interactive effects of different operating parameters on removal efficiency are shown in the Fig.1 & 2. Fig.1 shows the 3D response surface of quadratic model obtained as a function pH and metal ion concentration. From the figure it is clear that removal efficiency of the packed bed reactor increases as pH increases. This is due to formation of negatively charged surface at high pH. SiO_2 and Al_2O_3 are the main constituents of fly ash. The oxygen atoms on the silica surface combine with water and forms silanol group. The acidity of the silanol (SiOH) groups determines the dependence of the charge of the silica surface on pH. At acidic pH, a positively charged silica surface results, and at alkaline pH negatively charged surface prevails. Alumina and iron also show the similar characteristic with change in pH.

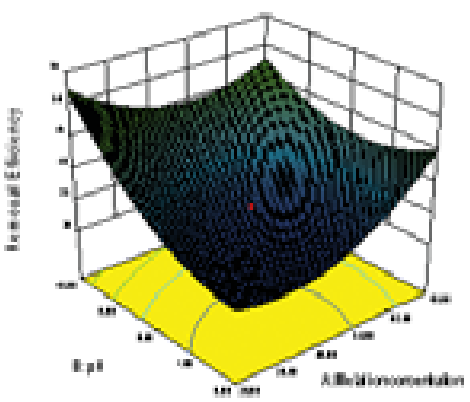
The main objective of the optimization is to determine the optimum values of variables for Zn removal from the model obtained using experimental data. In optimization, the desired goal for the response (Zn removal efficiency) was chosen to a target value of 100% and the variables of Metal ion concentration, pH, RPM and fly ash dosage were selected to be within range. The optimization results of the process variables for complete removal are shown in Table 3.

This study can be extended for removing other heavy metals from waste water using fly ash. The altered sludge will be used for production of building components.

Table 2: Center composite design in actual values and observed experimental and predicted response for Removal efficiency

Run	Factor : X_1	Factor 2 :X_2	Factor 3: X_3	Factor 4: X_4:	Response Y: Removal efficiency Actual %)	Removal efficiency Predicted (%)	Error (●)
1	50	12	60	60	65.00	63.15	1.85
2	50	8	60	60	35.00	35.00	0
3	50	8	20	60	33.00	40.18	-7.18
4	30	10	80	80	62.00	63.26	-1.26
5	70	10	80	80	50.00	54.90	-4.9
6	50	8	60	100	51.00	48.51	2.49
7	30	10	80	40	50.00	52.34	-2.34
8	30	6	40	80	42.00	42.78	-0.78
9	70	10	40	80	53.00	52.55	0.45
10	70	6	80	40	50.00	50.06	-0.06
11	70	10	40	40	48.00	46.56	1.44
12	50	8	60	60	35.00	35.00	0
13	70	10	80	40	53.00	53.69	-0.69
14	50	8	60	60	35.00	35.00	0
15	50	8	60	20	34.00	36.32	-2.32
16	30	10	40	40	52.00	44.93	7.07
17	70	6	40	40	48.00	48.22	-0.22
18	50	4	60	60	40.00	41.68	-1.68
19	90	8	60	60	61.60	59.74	1.86
20	30	6	40	40	38.00	31.80	6.2
21	30	6	80	80	40.00	40.13	-0.13
22	30	6	80	40	32.00	33.93	-1.93
23	50	8	60	60	35.00	35.00	0
24	50	8	60	60	35.00	35.00	0
25	10	8	60	60	50.00	51.69	-1.69
26	50	8	100	60	52.00	44.65	7.35
27	70	6	80	80	43.00	46.55	-3.55
28	50	8	60	60	35.00	35.00	0
29	70	6	40	80	53.14	49.49	3.65
30	30	10	40	80	62.00	60.63	1.37

bench scale
a nanoparticles



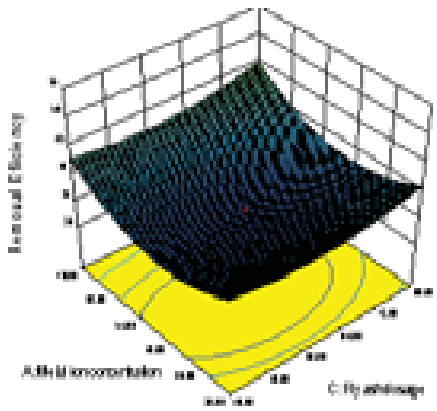


Table 3: Optimum and confirmative value of the process parameters

Processes Parameters	Optimized Values (Predicted Values)	Confirmation Values (Experimental Values)
Metal ion concentration (mg/l)	89.94	90
pH	11.98	12
Fly ash dosage (g/l)	100	100
RPM	99.50	100
Removal efficiency	91.33	87

Development of Appropriate Support System for Artificial Pillars for optimal Extraction of Locked-up coal from Underground Mines (ESC-0105)

Ajay Chourasia, Koushik Pandit, B. Singh & S. K. Bhattacharyya

Coordinating Lab : CSIR-CIMFR, Dhanbad

Participating Lab : CSIR-CBRI, Roorkee

Coal pillars in underground coal mines are critical in terms of both stability of excavated roadways and percentage of coal recovery. Bord and pillar method, which is being extensively used for coal extraction in India, wherein matrix of pillars is left out to support the overburden rock mass. An attempt has been made to optimize the pillar dimensions without sacrificing factor of safety (FoS) of mines, leading to improvement of coal. Accordingly, analysis of the data for stable 14 Indian coal mines has been considered. Numerical analysis in 2D and 3D has been carried out for estimating stresses on coal pillars, strength, checking FoS of pillars, and thereby development of an algorithm incorporating correlations between various influential parameters. The parameters investigated include unconfined compressive strength (UCS) of coal, width-to-height ratio (w/h) of pillars, depth of cover to width of opening ratio (D/B) etc. Fig.1 presents the variation in FoS with (w/h) & (D/B) ratios.

The in-depth analysis of (w/h) ratio with reference to FoS indicates that both parameters follow similar trend, however, the comparison of (D/B) ratio with FoS indicates that with the increase in D/B ratio, there is appreciable reduction in FoS. Thus, it indicates that (D/B) ratio is also one of the

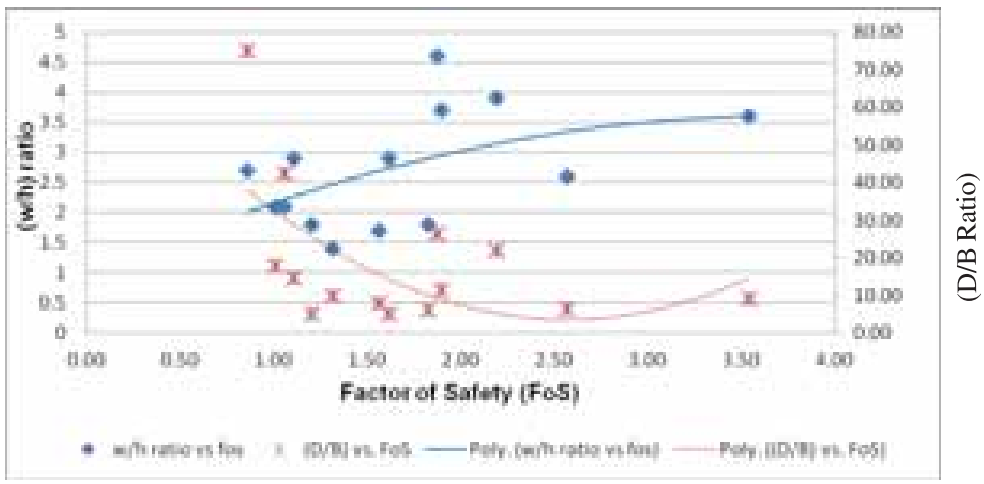


Fig.1: Variation in FoS with (w/h) & (D/B) ratios of Coal Mines

important factors having an impact on pillar strength and needs to be studied. The extensive analyses have been performed to establish general relationship between coal pillar strength to uniaxial compressive strength ratio (Sm/UCS); and (w/h) (Fig.2); (D/B) (Fig.3) ratios. Based on the analysis, correlations established are:

$$w/h = 15.109\ (S_m/UCS)^{0.83} \quad \ldots (1)$$

$$D/B = 116.71\ (S_m/UCS) - 2.33 \quad \ldots (2)$$

The correlations have been implemented in subsequent pillar design, indicating fairly high R^2 values.

A comparative model study of a coal mine following Coal Mines Regulation (CMR), 1957 guidelines has also been carried out vis-à-vis the developed approach to estimate coal recovery showing scope of considerable coal recovery.

Further, to evaluate the effect of strengthening techniques on coal pillars, various strengthening strategies are being investigated on Coal Cores. Also, the alternative schemes are being worked out as an artificial support system so as to enhance coal recovery.

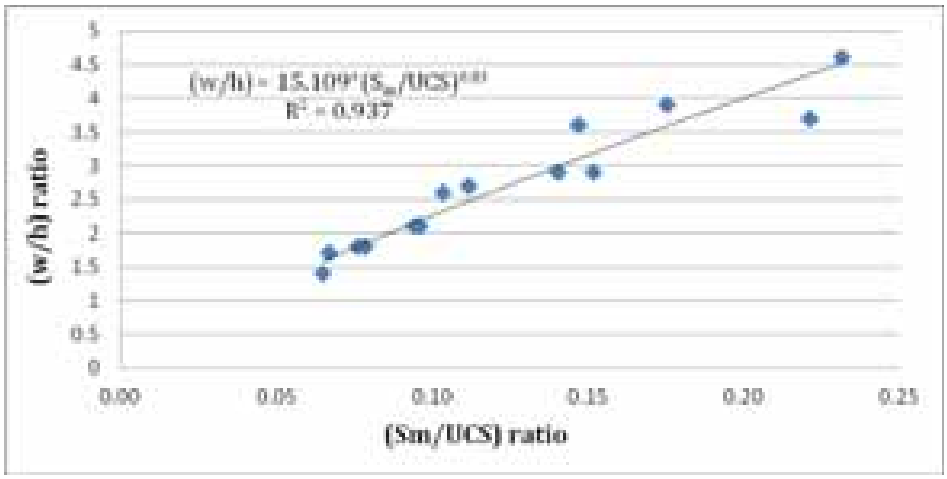


Fig.2: Correlation between (w/h) to (Sm/UCS) ratios for Indian Coal Mines

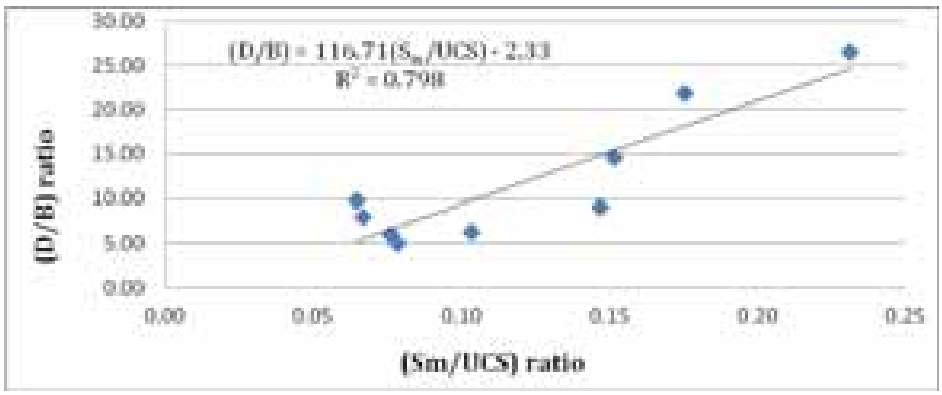


Fig.3: Correlation between (D/B) to (Sm/UCS) ratios for Indian coal mines

R&D PROJECTS

Development of Technology for Making Flooring and Wall Tiles using Kota Stone Waste (GAP-0132)

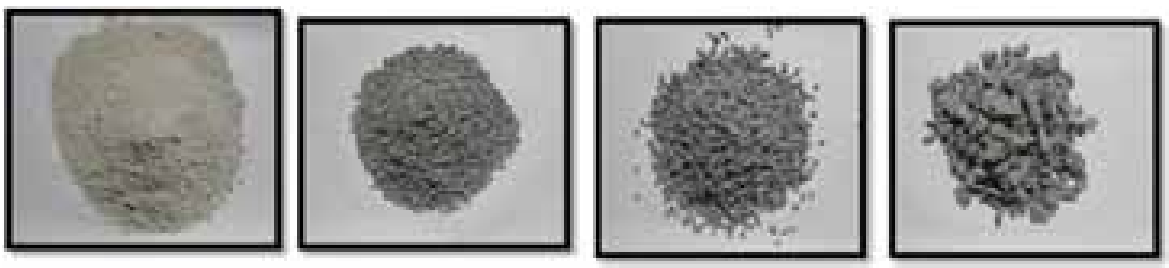
Rajni Lakhani and team

Jointly sponsored by Department of Science & Technology (DST), New Delhi and Rajasthan State Pollution Control Board (RSPCB), Jaipur.

Kota district of Rajasthan has been gifted by nature with huge deposit of Kota stone. It is an excellent flooring stone having unique geo-mechanical properties required for flooring stone. But, apart from this, Kota stone industry is generating different types of wastes (Fig.1), as a result of mining process in abundance over 5 decades. Besides, many environmental problems, disposal of this huge waste are also a major issue.

Fig. 1: Huge Waste Dumps of Kota Stone Mines in Ramganjmandi

Therefore, initiative has been undertaken by CSIR-CBRI, Roorkee keeping in view to develop value added construction materials utilizing Kota stone waste. Broken Kota stone waste pieces have been crushed using jaw crusher and the crushed material separated into different fractions (Fig.2).



Size < 4.75 mm | size 4.75-10 mm | size 10-12.5 mm | Size 12.5-20 mm

Fig.2: Different fractions of kota stone waste

Kota Stone is a siliceous calcium carbonate rock. It contains lime, silica, alumina and small amount of iron oxide such as FeO and Fe_2O_3. XRF studies shows that Kota stone quarry waste contain different oxides (Table 1).

Table 1: Chemical Composition of Kota stone powder

Description	Values % (wt.)
Loss on Ignition	34.06%
SiO_2	20.54%
Al_2O_3	1.38%
Fe_2O_3	1.16%
CaO	41.42%
MgO	1.03%

The prepared raw material is characterized for Bulk Density, Water Absorption, Crushing Strength, Impact Value, Specific Gravity, Void Ratio, Porosity and Fineness Modulus as per different specifications of Indian standard.

Under this work, an attempt of utilizing Kota stone fine aggregate (as a part replacement of sand) for the preparation of flooring tiles along with cement and sand has been tried. The different mix proportions using cement, sand and Kota stone waste are prepared for casting tiles using compaction technique. Physico-mechanical properties such as water absorption (%), compressive strength, and flexural strength of different prototypes have been determined (Fig.3-5). Further work inclusive of durability studies is in progress.

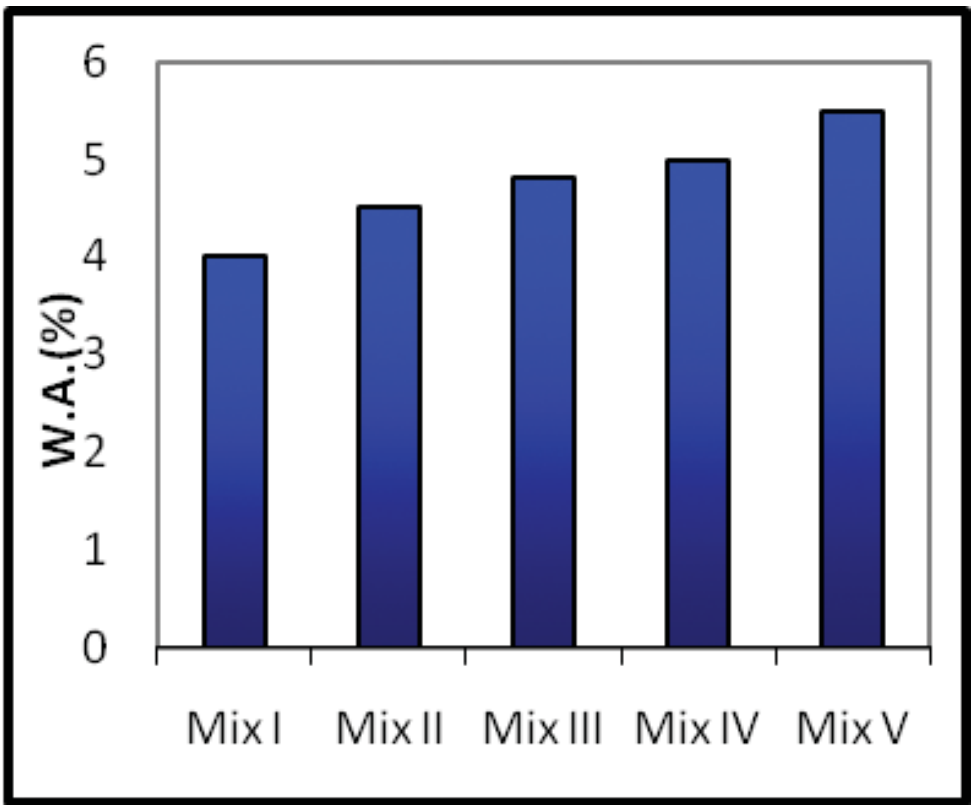


Fig. 3: Water absorption (%) of different mixes

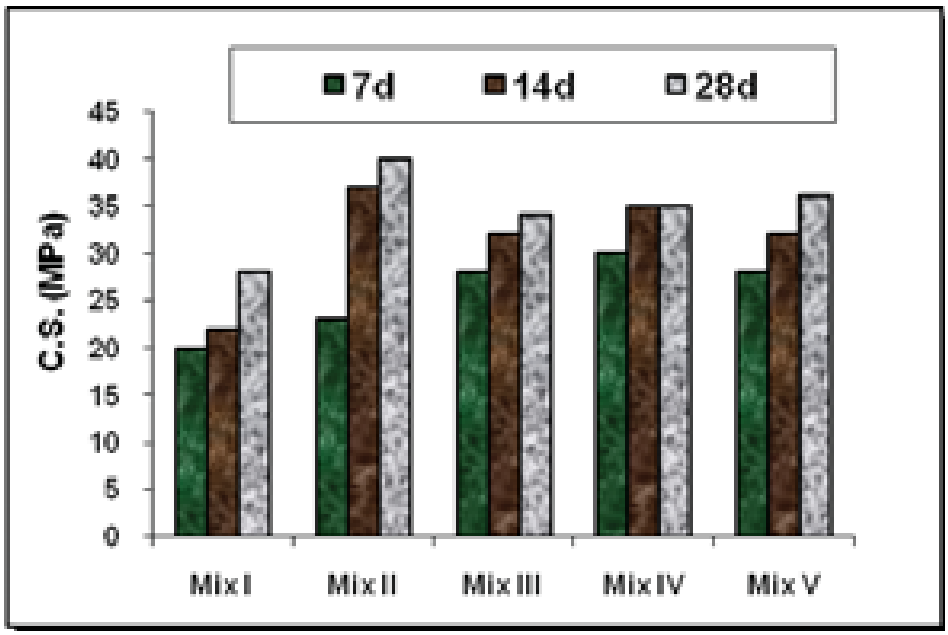


Fig. 4: Time based Compressive Strengths (MPa) of different mixes

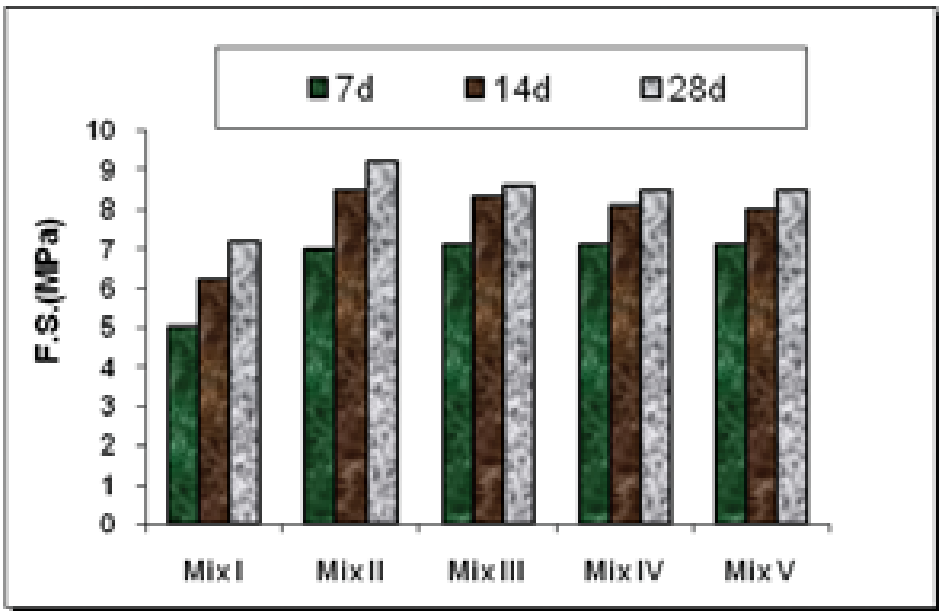


Fig. 5: Time based Flexural Strengths (MPa) of different mixes.

Demolition Wastes as Raw Materials for Low cost Construction Products

(GAP-0072)

A. K. Minocha, S. K. Bhattacharyya, Mridul Garg, Jaswinder Singh, Neeraj jain , S. Maiti & S. K. Singh

In India, projections for building material requirement of housing sector indicates a shortage of aggregates by up to 55000 million cubic meters (TIFAC ED 2003). Studies have showed that the concrete portion of the demolition waste constitutes of about 65-70% by volume of natural aggregate and 30-35% of cement. Recycling of aggregates from demolition waste may bridge this gap between supply and demand. Fig.1 shows a general composition of C&D waste in India. Proper recycling and management of demolition wastes can generate a high quantity of recycled aggregates which can be used further in structural concrete and building components such as bricks, blocks and tiles.

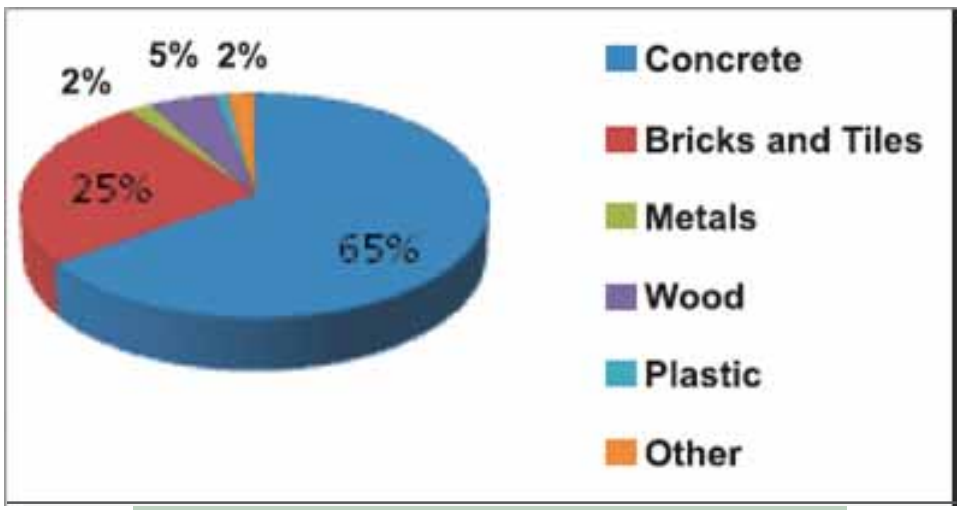


Fig.1: Composition of Construction and Demolition waste in India

Therefore the present work is focused for reuse of demolition waste in concrete paver blocks by converting it into recycled coarse aggregate (RCA).

The combined physical and mechanical properties of aggregates of size passing 10 mm IS sieve and retained over 4.75 mm IS sieve determined as per IS:2386-1963 by replacing 25, 50, 75 and 100% natural aggregate with washed and unwashed recycled aggregates are given in Table 1. The results show that properties of blended aggregates compiled the requirements as specified in IS: 383-1970.

Table 1: Combined properties of Natural and Recycled Coarse Aggregate (Before and after washing)

Parameters	Natural	Recycled (%)							
		Before washing				After washing			
		25	50	75	100	25	50	75	100
Flakiness Index (%)	13.7	5.1	4.6	4.30	4.23	6.6	6.0	5.8	4.5
Crushing value (%)	17.7	22.0	23.5	27.3	30.56	19.0	20.0	22.6	28.0
Impact Value (%)	17.0	16.2	24.2	25.8	32.24	16.0	17.6	21.0	23.0
Water Absorption (%)	0.6	1.6	2.8	3.6	5.20	1.0	1.6	2.1	4.0
Specific Gravity	2.63	2.53	2.47	2.42	2.11	2.5	2.45	2.43	2.27
Loose BD (kg/l)	1.45	1.37	1.35	1.32	1.24	1.37	1.35	1.3	1.26
Compact BD (kg/l)	1.53	1.5	1.47	1.43	1.32	1.50	1.48	1.43	1.39

The data clearly indicate declination in properties like crushing value, impact value, water absorption etc. with replacement of natural to recycled aggregate. The properties of blended natural and washed recycled aggregates enhanced as compared to blended natural and unwashed recycled aggregates. The improvement in properties of natural and washed recycled aggregates are due to the removal of the cement mortar adhered to the surface of aggregates.

Preparation of Concrete Paver Blocks

The cement concrete paver blocks of Grade M-35 and size 200 x 160 x 75 mm have been prepared by compaction technique using different proportions of cement, sand and natural aggregate (size passing 10 μ IS sieve and retained over 4.75 IS sieve). The natural aggregate was replaced by 25, 50, 75 and 100% unwashed and washed recycled aggregate designated as Mix B,C,D, E respectively. The paver blocks of size 200 x 160 x 75 mm were cast and after 24 hrs were immersed in water for a period of 28 days and then tested for physical properties as per the methods prescribed in IS 15658 - 2006. The results are shown in Fig.2-4. The durability behavior of concrete blocks is under progress.

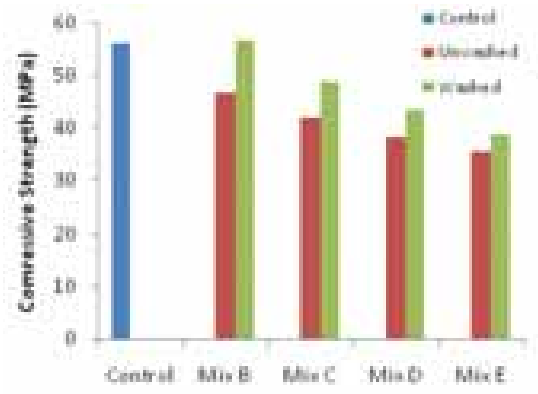


Fig.2: Compressive Strength of concrete paver blocks prepared with different compositions

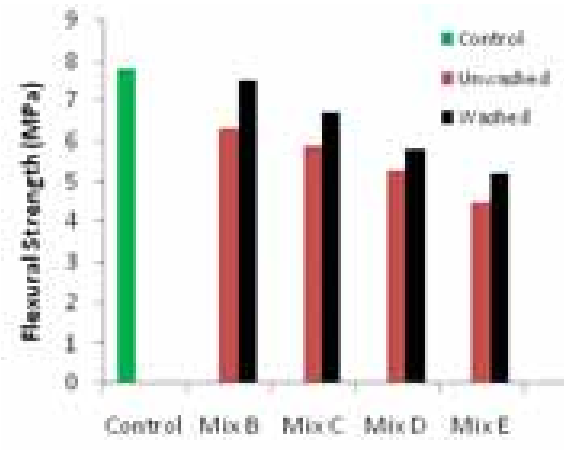


Fig.3: Flexural Strength of concrete paver blocks prepared with different compositions

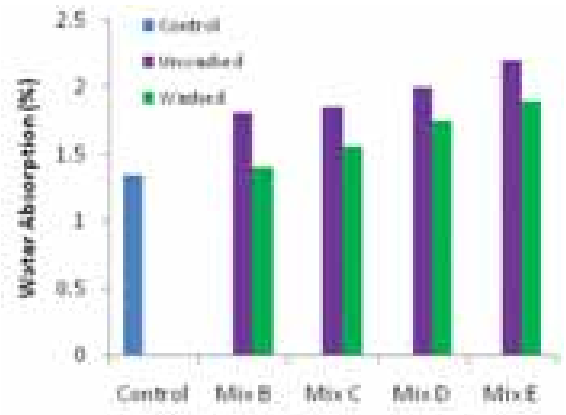


Fig.4: Water absorption of concrete paver blocks prepared with different compositions

It can be seen that the compressive strength and flexural strength of concrete blocks decreased with replacement of natural aggregate and water absorption of the blocks increased with an increase in the content of recycled aggregate. Moreover, an appreciable enhancement in strength of paver blocks i.e. 20% were observed with 100 % washed recycled aggregate as compared to unwashed aggregate and water absorption reduced up to 9% (Mix E). The typical photographs of concrete blocks are shown in Fig.5.

Fig.5: Concrete Paver Blocks

Health Monitoring of Buildings using Wireless Sensor Network

(GAP-0062)

Ajay Chourasia, S.K. Panigrahi, Soju Alexander, S. K. Bhattacharyya & Jalaj Parashar

The prescriptive methodology being adopted for safety evaluation of buildings is mainly through visual inspection and/or non-destructive testing; these methods have their own limitations. This calls for continuous monitoring of complex structures like buildings by making use of technological advancement in sensor and wirelessly data acquisition so as to greatly reduce routine maintenance and inspection costs, while providing an increased level of safety.

Keeping in view, the present assignment envisages the development of methodology to monitor the physical parameters using wireless technology to describe the health of building. Further, the research work aims to develop numerical model using FE technique based on measured response thereby assessing the health of building by performing modal updating. The evolved technique will be implemented on existing building to establish the sensitivity of system under ambient & forced condition.

Experimental investigations have been attempted on a steel cantilever beam (Fig.1) for damage identification. The steel section was induced with progressively increasing damages i.e. 10% to 50% reduction in cross-sectional area, under varying amplitudes & frequencies and capturing response with wireless sensors. The dynamic monitoring of a cantilever steel beam has been carried out under free and forced-vibration condition. The forced vibration was introduced using Long stroke-shaker connected close to the fixed end of the beam. The experimental setup consists of a cantilever beam (1000X75X8 mm), Wireless accelerometer motes (Microstrain), Base-station and signal display & processor, Long-stroke shaker and signal generator.

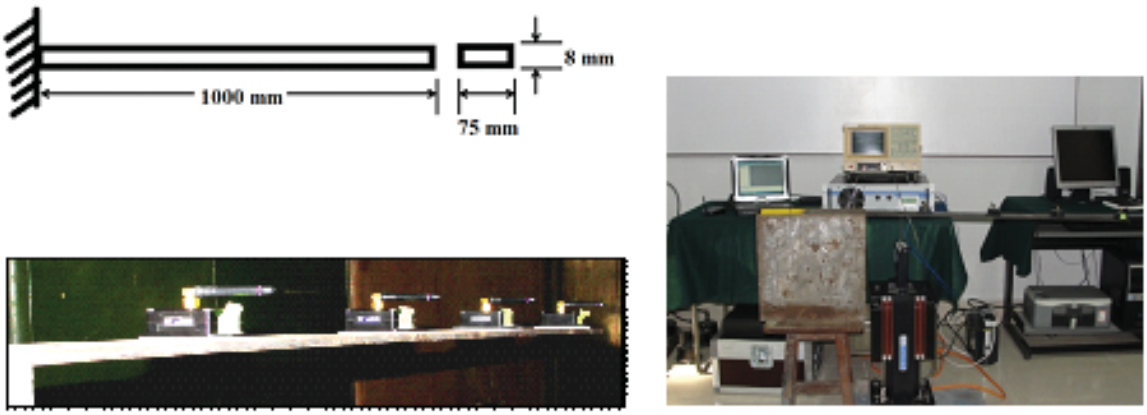


Fig.1: Geometry and Experimental setup for cantilever steel beam along with sensor placement

Modal analysis of beam has also been carried out and comparative study for undamaged & damaged steel section is presented in Fig.2. The data of mode shapes in terms of frequency and eigenvector have been used as input data for various damage identification methods. In present study, Curvature mode-shape method has been used along with Genetic algorithm. The Modal curvature method, which is a second derivative of mode shape (v"(x)), has been expressed in terms of M(x) - bending moment and EI - flexural stiffness. Thus, the curvature mode shapes are derived using a central difference approximation as under:

$$v''(x) = \frac{M(x)}{EI}\ ;\ v''(x) = \frac{v_{n+1} - 2v_n + v_{n-1}}{h^2}$$

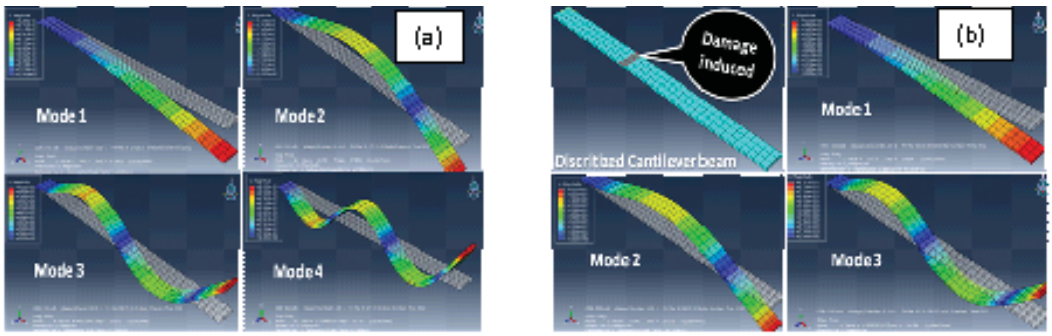


Fig.2: Mode shapes of cantilever in FEM analysis of (a) undamaged (b) damaged

Curvature damage factor (CDF) is a damage indicator, which is defined as the average absolute difference in undamaged and damaged curvature mode shapes of all modes.

$$CDF = \left(\frac{1}{N}\right)\sum_{i=0}^{N}\left|v''_{oi} - v''_{di}\right|$$

Curvature modal index (CMI) was identified as damage sensitive idiom, which derived from modal curvature. These methods have been implemented using output data of modal analysis. Fig.3 shows the damage location which was incorporated at 400mm away from fixed end.

$$c^2_{m,no\,\min ate} = \frac{c^2_{m-1} + 4c^2_m + c^2_{m+1}}{6}$$

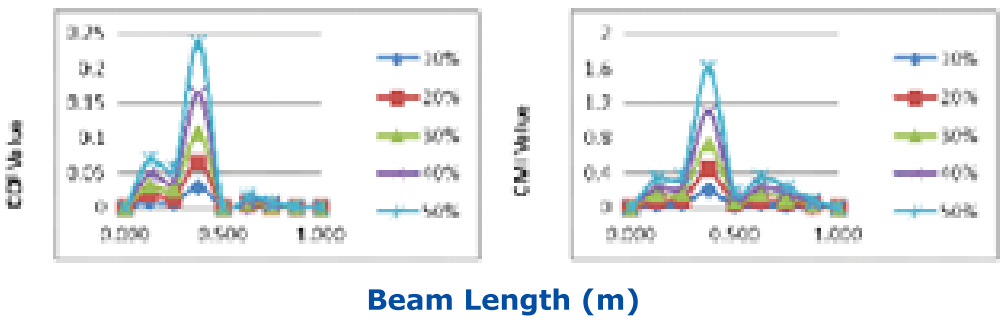


Fig.3: CDF and CMI values for cantilever steel beam with different percent of damage introduced at 400 mm from fixed end

The exercise carried out indicated that the mode-shape curvature method based on damage sensitive idiom can identify the location of the damage, but disable to quantify the same. To overcome this, an objective function using residual force vector method has been developed which needs to be further optimized to estimate location and extent of damage.

Further, FE Modal analysis of 5- storied MS Model building has also been carried out (Fig.4). Eigen value analysis of the model has been carried out and various modes of vibration dn modal mass participation was computed. These modal data in terms of frequency and eigenvector will be used as input data for various damage identification methods.

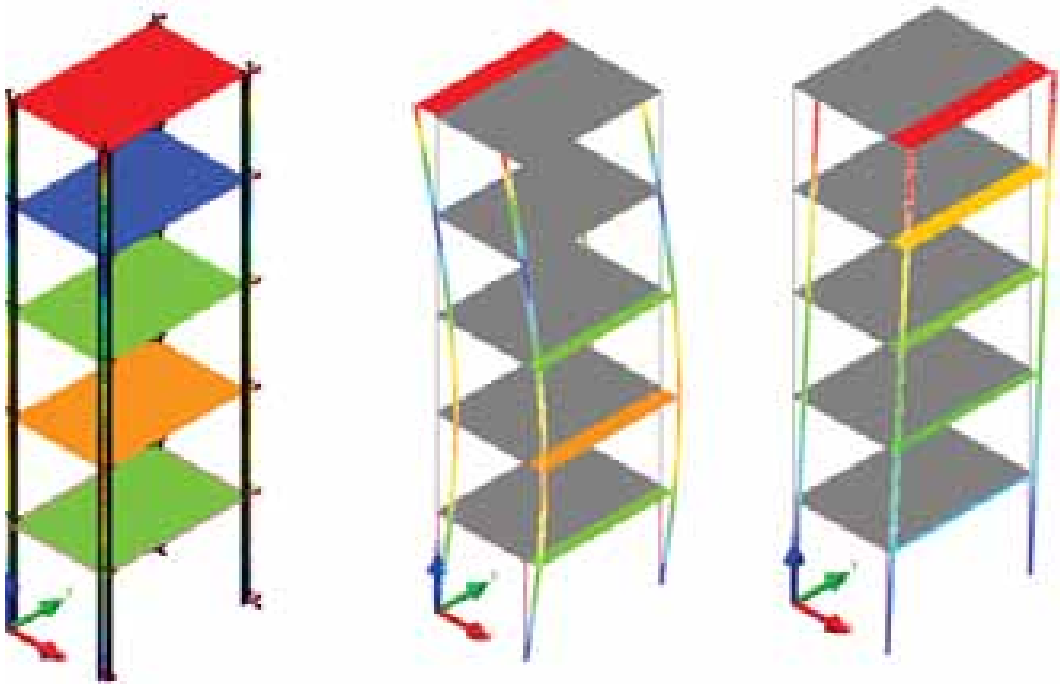


Fig.4: Mode shapes of 5-storied MS building in FEM analysis

	MODE FREQUENCY	EFF.MASS	TX PERCENTAGE	CUM.PERCENT.
1	0.39405E+01	0.55090E+01	0.32103E+02	0.32103E+02
2	0.76281E+01	0.55090E+01	0.32102E+02	0.64205E+02
3	0.24624E+02	0.16955E+01	0.98801E+01	0.74085E+02
4	0.47663E+02	0.16953E+01	0.98789E+01	0.83964E+02
5	0.68796E+02	0.58040E+00	0.33821E+01	0.87346E+02
6	0.13305E+03	0.57397E+00	0.33446E+01	0.90691E+02
7	0.20851E+03	0.13176E+00	0.76780E+00	0.93170E+02
8	0.25729E+03	0.28686E+00	0.16716E+01	0.94842E+02
9	0.35035E+03	0.12154E-26	0.70823E-26	0.94842E+02

Experimental investigation of a 5-storied MS Model building (Fig.5) has also been carried out under forced-vibration condition. The forced vibration was introduced using Long stroke shaker. The experimental setup consists of a 5- storied steel framed Model building, NI accelerometers & data acquisition system (Wired), Wireless accelerometer motes (Microstrain), Base-station, Long-stork shaker, signal generator and processor. This exercise was carried out using both National Instruments wired accelerometers and Micro-strain wireless accelerometers.

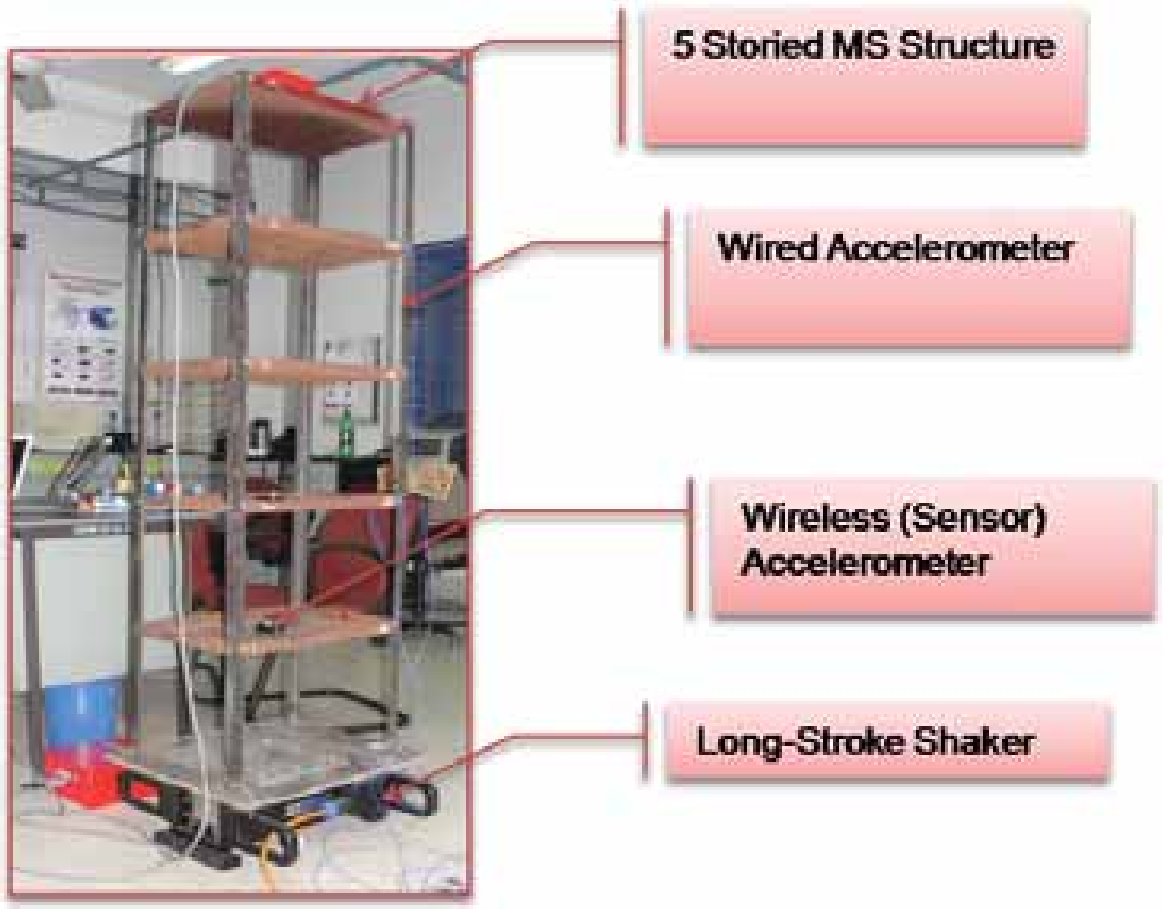


Fig.5: Experimental Set-up of 5 storied MS building Model

Different case of damaged situations have been considered and noise is superimposed to simulate experimental effect. The effect of different noise levels on damage identification has been thoroughly studied. The limitations of this methodology with noisy data and multiple damage scenario is identified. Further, similar cases have been tested on a 10- storey shear structure. A plot (Fig.6)shows influence of noise on computed modal curvature / CDF value for a 10-storey undamaged and damaged structure. Based on the analysis, it has been noted that as the number of modes in CDF computation increases, the disturbance level also increases.

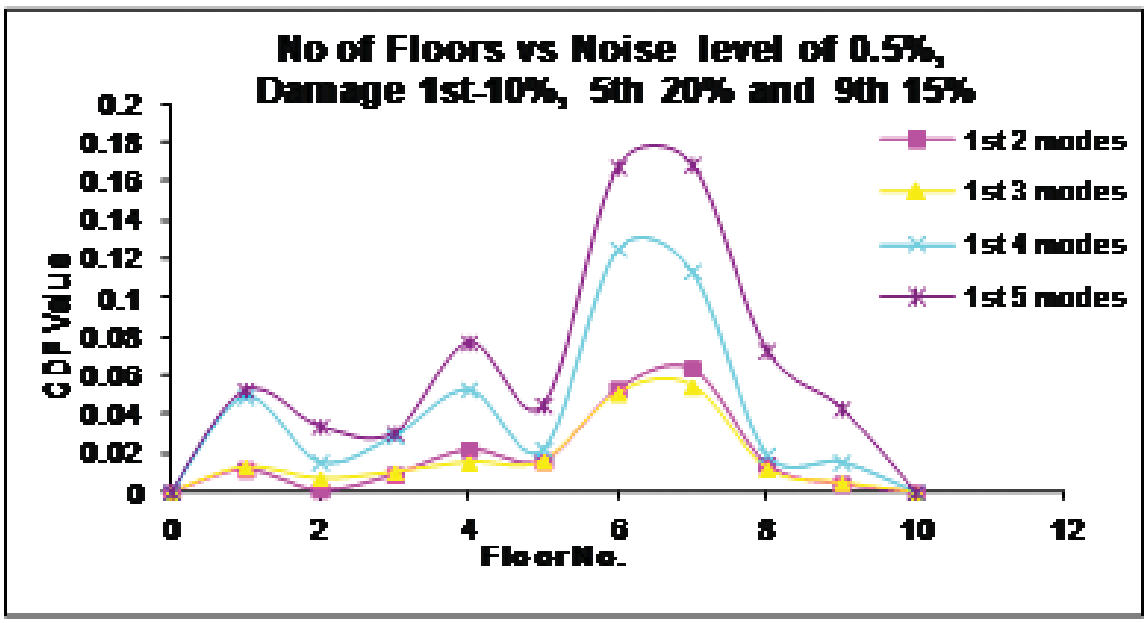


Fig.6: CDF at Varying damage at 1st, 5th and 9th floor of a building

Measurement of Temperature Differential and Energy Saving For Cooling of Identical Pair of Rooms, One Untreated and Other Treated by Heat Reflective Paint and EIFS Separately & Measurement of R & U Values of Heat Reflective Paint

(SSP-0180)

B. M. Suman, V. K. Sharma & P. K. Yadav

- Evaluation of Heat Reflective Paint for thermal resistance and overall thermal transmittance of the paint.
- Measurement of temperature differential of out-door and indoor temperature for both the identical room after the paint application on building surface.
- Observation of energy consumption in both the identical rooms, one treated and other untreated.
- Analysis of observed data to find performance of Heat Reflective Paint and External Finishing Insulation System (EIFS).

Progress Highlights/Significant Achievements: The summer observation involves different steps to find the performance of the paint.

Observation of temperature profile were recorded when heat reflective paint is applied on roof and wall both.

For studying the field performance of Heat reflective paint to existing two experimental rooms located in the campus of Central Building Research Institute Roorkee have been selected. The two rooms have identical dimensions, orientation and of conventional construction of 23cm brick wall plastered both side and 10cm RCC roof with plastered ceiling and normal cemented floor. The size of rooms is 3.45m x 3.20m x 3.14m. The upper surface of roof and all the four walls of one of the room were treated with heat reflective paint. The outer surfaces of roof and wall were coated with ordinary white wash. This untreated room acts as a reference room for comparison purposes. The difference in the indoor temperatures of both the rooms when exposed under same environmental conditions is, certainly, attributed to the application of heat reflective paint. The application of heat reflective paint lowers down thermal resistance of roof and wall section by the 0.012 m^2K/W.

From the above figures, performance of Heat reflective paint has been compared with White wash. Fig.1 shows that the temperature amplitude of outside air is from 27°C to 43°C. As per this figure the maximum temperature difference between out side air and inside air of the room with whitewash is 12 °C approximately. From Fig.2 it is found that maximum temperature difference between outside air and inside air of the room coated with paint is 14 °C. Fig.3 describes the comparison of performance of White wash and Paint. From this figure it is found that the temperature difference of inside air temperature of the room coated with paint and White wash varies between 1°C to 3 °C approximately.

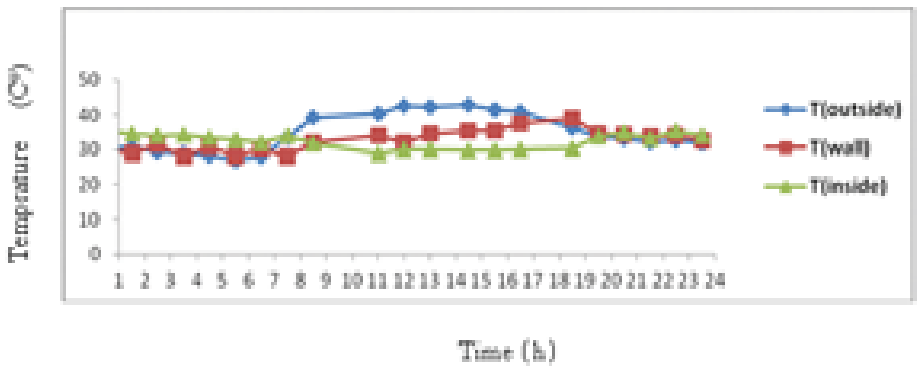


Fig.1: Thermal performance of Whitewash during summer

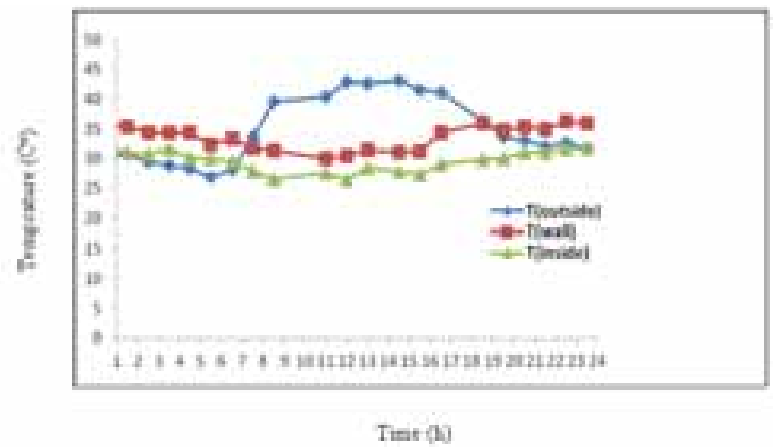


Fig.2: Thermal performance of heat reflective Paint during summer

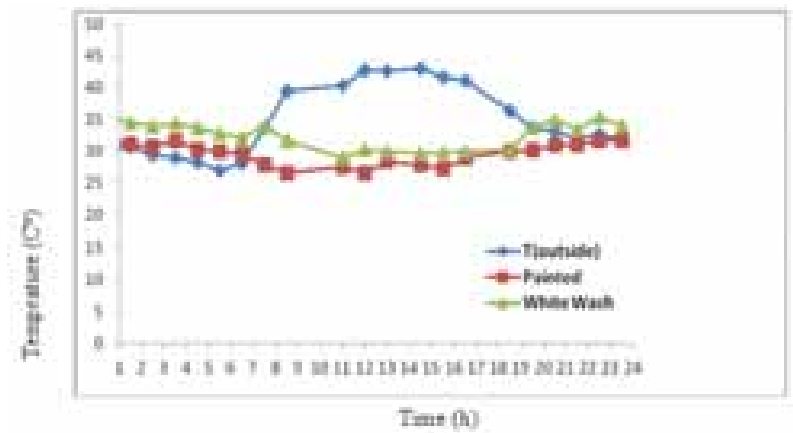


Fig.3: Comparison between Thermal Performance of heat reflective paint and Whitewash in summer

Development of Eco-Friendly Component for Fungi Management on Exterior and Interior Surface of Buildings in Sub Tropical Region of India

(EMPOWER OLP 354)

Rajesh Kumar Verma & Mrs. Leena Chaurasia

Development of Eco-Friendly anti-fungal component to be added to coating for fungi management in buildings.

Progress Highlights/Significant Achievement:

Analysis Essential oils using GC-MS

Few essential oils were analyzed by GC-MS spectra for their main chemical composition. The main chemical constituent of selected essential oils on GC-MS Spectra was recorded as follows:

— *Eucalyptus globulus*: Eucalyptol
— *Syzygium aromaticum*: Eugenol
— *Mentha piperita*: Menthol
— *Ricinus communis*: Ricinoleic acid

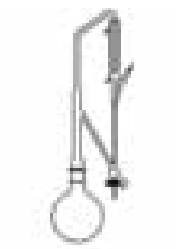


Fig. 1 (a): Clevenger's apparatus

Fig.1 (b): Flask filled with 1 Kg leaves

New facility created:

Fabricated and installed a pilot scale process unit

During experimentation the yield of essential oils isolated by using Clevenger's apparatus Fig. 1(a) & 1(b) was very less (0.5-1.5 ml), which was insufficient to carried out application studies on the surfaces of buildings. To enhance the yield of isolated essential, a pilot scale processing unit (Fig.2) of 50 Kgs capacity was fabricated and installed, which have produced substantial amount (25-30 ml) of essential oils in one batch for application studies.

Fig.2: Pilot Scale Process Unit

Study on Correlations among Fire Signatures for Detection

Rajiv Kumar and M.P. Singh

With the advent of smoke detectors, a fire can be detected at an early stage, just after ignition. However, problem of nuisance or false alarms associated with smoke detectors has been a serious concern for researchers. One way to overcome this problem is development and wider use of detectors based on multi-criteria/multi-signatures. A majority of work in this area has been focused in combining and correlating data from gas and smoke sensors. Appreciable interest has been expressed in having Carbon monoxide (CO) or Carbon dioxide (CO_2) gas sensors combined with smoke sensors. The present study has been carried out at CSIR-CBRI to determine the correlation and inter-dependence between various pairs of fire signatures like CO – OD (Optical Density), CO - CO_2 and CO_2 – OD during fire development. Twenty experiments with a range of fuels were carried out to record simultaneous generation of smoke, Carbon monoxide (CO) and Carbon dioxide (CO_2) signatures and to determine correlations between different pairs according to type of fuel/mode of combustion as per experimental detail given in Table 1. Based on correlation between two signatures, different combinations of sensors can be used for detection. Experiments were conducted by burning teak wood sticks in flaming (as per IS 11360) and smouldering (pyrolytic) mode (as per EN 54), burning heptanes (as per EN 54)/gasoline (as per IS 11360) /methanol (as per EN 54) in pool conditions, burning PU foam in flaming mode (as per IS 11360) and cotton wicks in glowing mode (as per EN 54) in a compartment measuring 7 m (L) x7 m (W) x 4.2 m (H) keeping doors and windows closed. These fires represent the broad spectrum of building fires and are important for characterization of response and acceptability testing of fire detectors.

During experiments, fire plume rose vertically upward to the ceiling and spread radially in all directions before hitting the walls and descending downward. The hot gas layer consisting of combustion products such as CO, CO_2 and smoke is formed below the ceiling. These parameters were measured just beneath the ceiling in the hot layer. The variation of these parameters with time for different seven fires, has been plotted in graphical form. Only one graph for flaming wood fires (Experiments 1 - 4) has been given here (Fig.1). Also comparison of Optical Density of smoke and CO concentration generated in flaming and smouldering fires have been shown in Fig.2 and Fig.3, respectively.

Correlation between Fire Signatures (CO_2, CO and OD)

The most familiar measure of correlation / inter-dependence between two quantities is the Pearson product – moment correlation coefficient, which is finite if standard deviation of both the data set is finite and non-zero. Calculated values of Correlation coefficients (r) between Fire Signatures (CO_2, CO and OD), are given in Table 2.

CONCLUSIONS

The results are summarized in Table 3. The results show that the fire signatures have inter-relationship and inter - dependence among each other. This property of the fire signatures can be utilized for design of multi-signatures/multi-criteria detection system. The study shows that concentration / generation of fire signature depends upon the type of fuel and mode of burning. So different combination of fire signatures can be used for designing the detection system based on the fuel and fire type. It is evident from Table 3 that OD-CO_2 dual signature detectors are most suitable for flaming fires and pool fires of fuels such as

n-heptane, gasoline which give smoky combustion gases. OD-CO dual signature detector are found to be suitable for smouldering, PU-Foam and cotton wicks glowing fires. But for pool fire using methylated sprit, which on burning gives transparent flames, only single signature CO_2 detector will be suitable as other two signatures are not strong enough to be detected. CO/CO_2 ratio criterion for design of dual signature detectors may also be utilized. This criterion is found to be most suitable for detecting the glowing cotton fires in present study. The experiments have been carried out in the room/conditions as per IS 11360 or EN-54. However, more experiments are required to be done in the rooms of smaller and bigger size using different fire sizes as room configuration and fire size etc will influence the generation of combustion products and fire signatures.

It is also found that smouldering mode generates more smoke out of a given mass than that in flaming mode, as observed peak values of Optical Density in smouldering fires are approximately 2.5 times as compared to the peak values in flaming fires (Fig.2). Generation of CO in smouldering and flaming modes is almost comparable initially but later on it increases in flaming fires as shown in Fig.3.

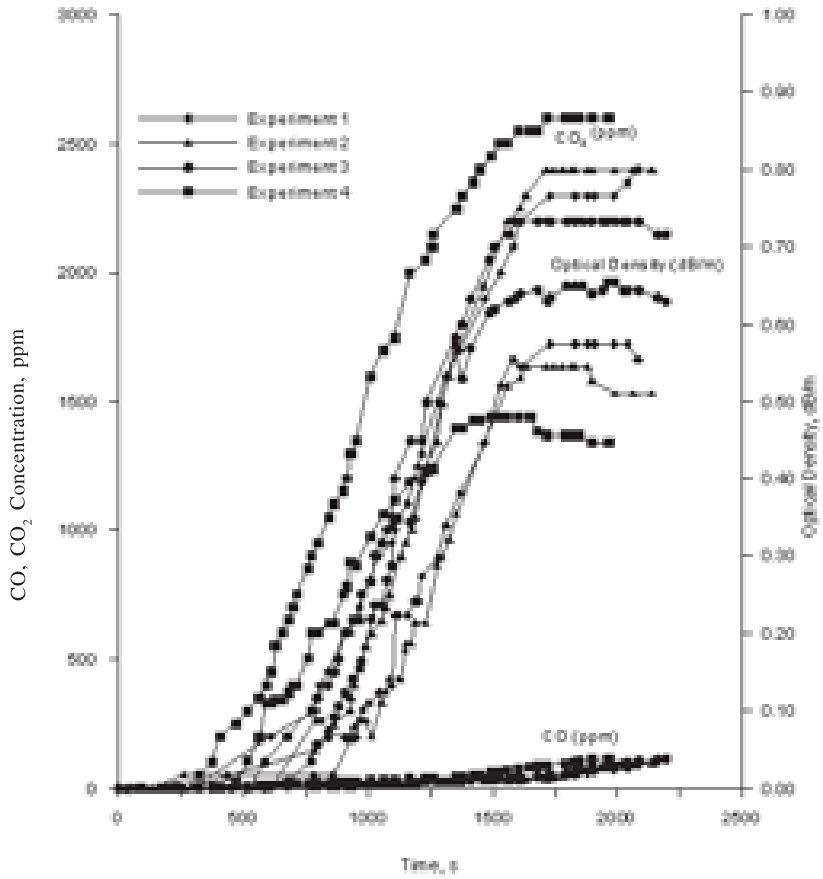


Fig.1: CO, CO_2 and Optical Density in Flaming wood fire

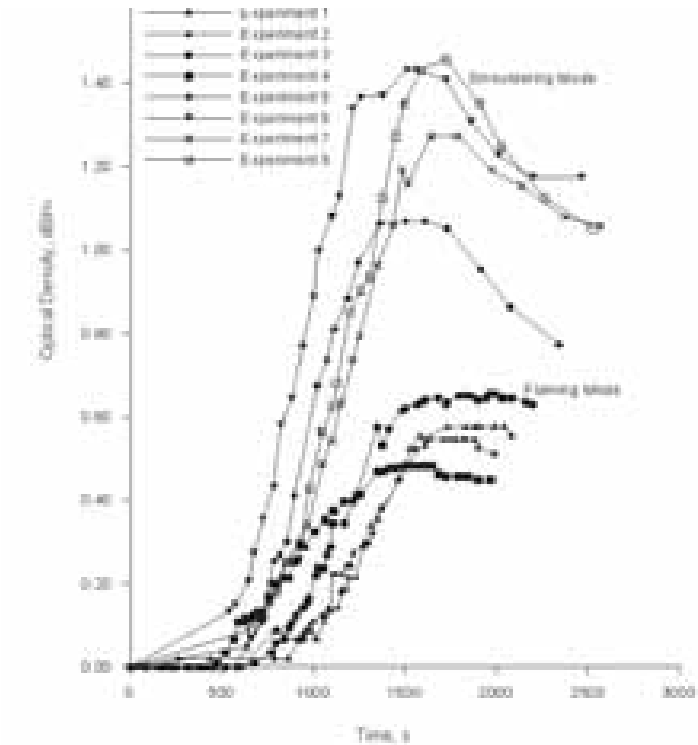


Fig.2: Comparison of Optical Density in smoldering and flaming modes

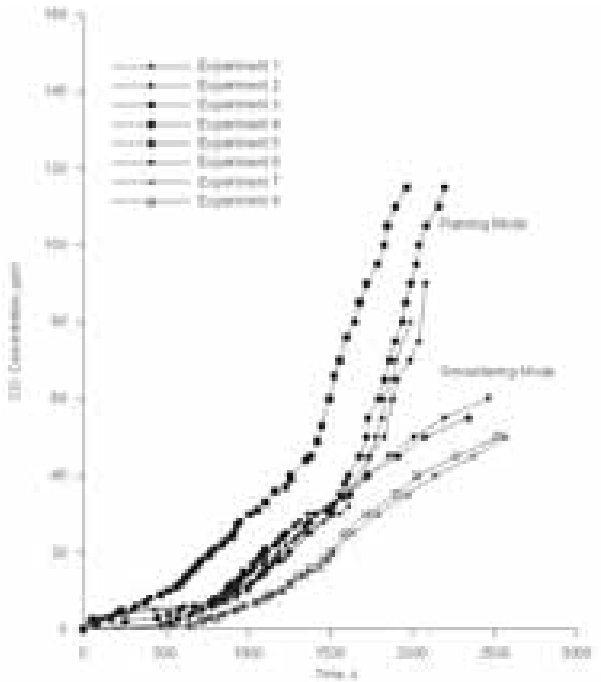


Fig.3: Comparison of CO concentration in smoldering and flaming modes

Table 1: Experimental Details

Experiment No.	Mode of Burning	Fuel	Size* Width (mm)	Thickness (mm)	Height/ length	No of wood sticks	Ignition source	Duration of fire (s)
1	Flaming	Teak wood	20	20	250	28	5ml Methylated Sprit	2081
2	Flaming	Teak wood	20	20	250	28	5ml Methylated Sprit	2138
3	Flaming	Teak wood	20	20	250	28	5ml Methylated Sprit	2195
4	Flaming	Teak wood	20	20	250	28	5ml Methylated Sprit	1965
5	Smouldering	Teak wood	20	20	60	10	Hotplate	2340
6	Smouldering	Teak wood	20	20	60	10	Hotplate	2460
7	Smouldering	Teak wood	20	20	60	10	Hotplate	2565
8	Smouldering	Teak wood	20	20	60	10	Hotplate	2520
9	Pool Fire	n-Heptane	200	200	50	400 ml	Match sticks	720
10	Pool fire	n-Heptane	200	200	50	400 ml	Match sticks	720
11	Pool fire	Gasoline	100	100	50	200 ml	Match sticks	900
12	Pool fire	Gasoline	100	100	50	200 ml	Match sticks	900
13	Pool fire	Methylated Sprit	300	300	50	400 ml (360 ml Ethanol +40 ml Methanol)	Match sticks	860
14	Pool fire	Methylated Sprit	300	300	50	400 ml (360 ml Ethanol +40 Methanol	Match sticks	860
15	Foam Fire	PU Foam	500	400	25	3	Candle	720
16	Foam Fire	PU Foam	500	400	25	3	Candle	720
17	Foam Fire	PU Foam	500	400	25	3	Candle	720
18	Glowing Fire	Cotton Wicks	-	-	800	50	Hotplate	2475
19	Glowing Fire	Cotton Wicks	-	-	800	50	Hotplate	3090
20	Glowing Fire	Cotton Wicks	-	-	800	50	Hotplate	2990

*Sticks (Flaming / smouldering Fires), Tray (Pool Fires), Foam sheet (Foam Fire), Cotton Wick (Glowing Fires).

Table 2: Correlation Coefficient

Experiment No.	Mode of Burning	Fuel	Correlation Coefficient		
			Optical Density-CO	CO_2 – CO	CO_2 – Optical Density
1	Flaming	Teak Wood	0.89	0.90	0.98
2	Flaming	Teak Wood	0.84	0.85	0.99
3	Flaming	Teak Wood	0.81	0.81	1.00
4	Flaming	Teak Wood	0.83	0.90	1.00
Average	**Flaming**	**Teak Wood**	**0.84**	**0.87**	**0.99**
5	Smouldering	Teak Wood	0.79	No Correlation	No Correlation
6	Smouldering	Teak Wood	0.74	No Correlation	No Correlation
7	Smouldering	Teak Wood	0.80	No Correlation	No Correlation
8	Smouldering	Teak Wood	0.83	No Correlation	No Correlation
Average	**Smouldering**	**Teak Wood**	**0.79**	**No Correlation**	**No Correlation**
9	Pool Fire	n-Heptane	0.95	0.97	0.98
10	Pool Fire	n-Heptane	0.97	0.96	0.98
Average	**Pool Fire**	**n-Heptane**	**0.96**	**0.97**	**0.98**
11	Pool Fire	Gasoline	0.99	0.99	0.99
12	Pool Fire	Gasoline	0.68	0.99	0.70
Average	**Pool Fire**	**Gasoline**	**0.84**	**0.99**	**0.84**
13	Pool Fire	Methylated Sprit	0.88	0.85	0.82
14	Pool Fire	Methylated Sprit	0.46	0.76	0.77
Average	**Pool Fire**	**Methylated Sprit**	**0.67**	**0.80**	**0.80**
15	Foam Fire	PU Foam	0.98	0.86	0.91
16	Foam Fire	PU Foam	0.99	0.93	0.91
17	Foam Fire	PU Foam	0.93	0.85	0.84
Average	**Foam Fire**	**PU Foam**	**0.97**	**0.88**	**0.89**
18	Glowing Fire	Cotton Wicks	0.96	0.86	0.71
19	Glowing Fire	Cotton Wicks	0.88	0.92	0.76
20	Glowing Fire	Cotton Wicks	0.93	0.86	0.67
Average	**Glowing Fire**	**Cotton Wicks**	**0.93**	**0.88**	**0.71**

Table 3: Conclusions from Present Study

S. No.	Mode of Burning	Fuel	Signatures			Remarks	CO/CO_2 Ratio Detector
			Optical Density - CO	CO-CO_2	Optical Density - CO_2		
1	Flaming	Teak wood	Grows simultaneously, significant	Grows simultaneously, significant	Grows simultaneously, Strong	All three signatures correlated and detectable but OD-CO_2 dual detector will be most effective as r is 0.99	Suitable
2	Smoldering	Teak wood	Significant	Insignificant. CO_2 Negligible so undetectable	Insignificant. CO_2 Negligible so undetectable	Only OD-CO dual signature is suitable	Not suitable
3	Pool Fire	Heptane	Only OD grows fast and low / undetectable CO conc	Only CO_2 grows fast and low / undetectable CO conc	Grows simultaneously, ( ) significant	Only OD-CO_2 dual signatures detector will be most effective	Not suitable
4	Pool fire	Gasoline	low / undetectable CO conc	low / undetectable CO conc	Grows simultaneously, significant	Only OD-CO_2 dual signatures detector will be most effective	Suitable
5	Pool fire	Methylated spirit	Poor correlation but low / undetectable CO conc	Only CO_2 grows fast and low / undetectable CO conc	Significant correlation but very low OD	CO_2 dominates, so single signature CO_2 detector are most suitable	Not suitable
6	Foam Fire	PU Foam	Grows simultaneously, strong	Grows simultaneously, Significant	Grows simultaneously, Significant	All three signatures correlated and detectable but OD-CO dual signature will be most suitable	Not suitable
7	Glowing Fire	Cotton Wicks	Grows simultaneously, (r) significant	Significant but CO_2 concentration is low and undetectable in initial stage of growth (not simultaneous growth)	Insignificant correlation and CO_2 concentration is low and undetectable in initial stage of growth (not simultaneous growth)	Most suitable detector will be OD-CO dual signature detector	Most suitable

Critical Evaluation of Durability and Response of FRP Upgraded and Rehabilitated Reinforced Concrete Beams

(OLP-0371)

Harish Chandra Arora

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 repairing 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 affected structures and also for 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.

A large number of field application results of FRP are still awaited and more research work is being done to assure the suitability of these materials under different loading and environmental conditions. More number of experimental and analytical data is still needed before comprehensive guidelines are available for using these materials more confidently from the design stage itself.

Durability and long term performance of repaired/rehabilitated/strengthened structures is a crucial element governing the life-cycle cost of FRP applied reinforced concrete structures. The research into this aspect of FRP strengthening and repair is a relatively new field, and the information currently available is consequently rather limited. Thus the experience on the long-term properties and characterization of FRP strengthened structural systems is limited, which is important for structural members requiring a very long design life. Considering this fact the present in-house R & D project was initiated which will indeed be beneficial for construction and repair society. Getting test results through a new extensive research program by investigating the effects of different parameters on the long term performance aspects of FRP strengthened reinforced concrete structural elements are planned. Study is expected to contribute to guidelines for FRP-strengthened concrete members, to ensure better long-term performance under service loads and environmental effects

In the previous in-house project, a sustained loading system was installed for performing corrosion studies on RC beams. The system is shown in Fig.1 and Photo 1. This system will be used in one of the planned experimental phase of the project.

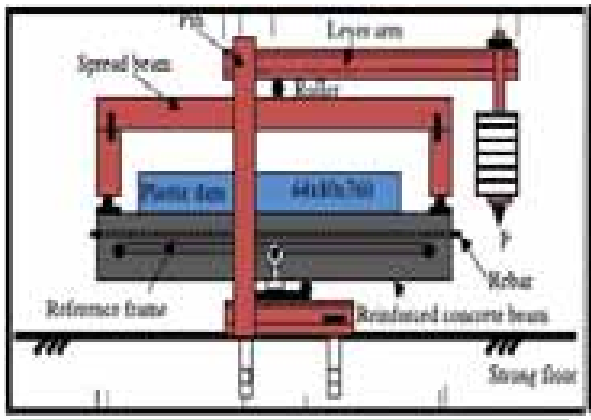


Fig.1: Schematic view of test set-up for application of Sustaned load on test beams

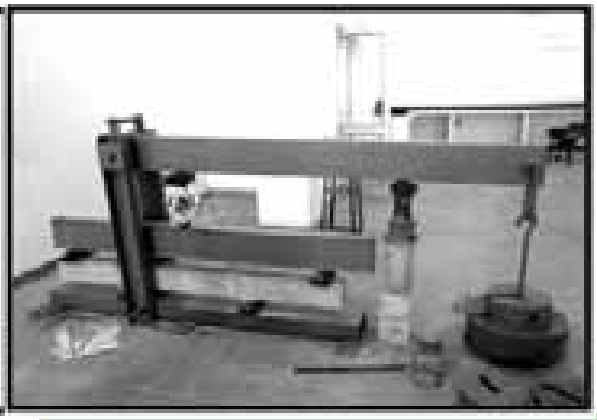


Photo 1: Installed sustained loading series experimental set up

So far in this research program, concrete mix design has been done for target strengths. The mix proportions used are as shown in Table 1. Concrete beams have been structurally designed for desired failures. A few RCC beam specimens have been cast till date. Structural drawings of the beams are shown in Fig 2.

Table 1: Concrete Mix Proportions

Concrete Type / Materials	Type I*		Type II**	
	Weight in Kg/m^3	Mix Proportions	Weight in Kg/m^3	Mix Proportions
Cement	400	1	400	1
FA (Sand)	663	1.65	607	1.52
CA < 20 mm < 10 mm	1231 369 862	3.078	1234 617 617	3.086
Water w/c Ratio	156 --	-- 0.39	210 --	-- 0.525
SP (% ofwt. of cement)	0.25	--	--	--

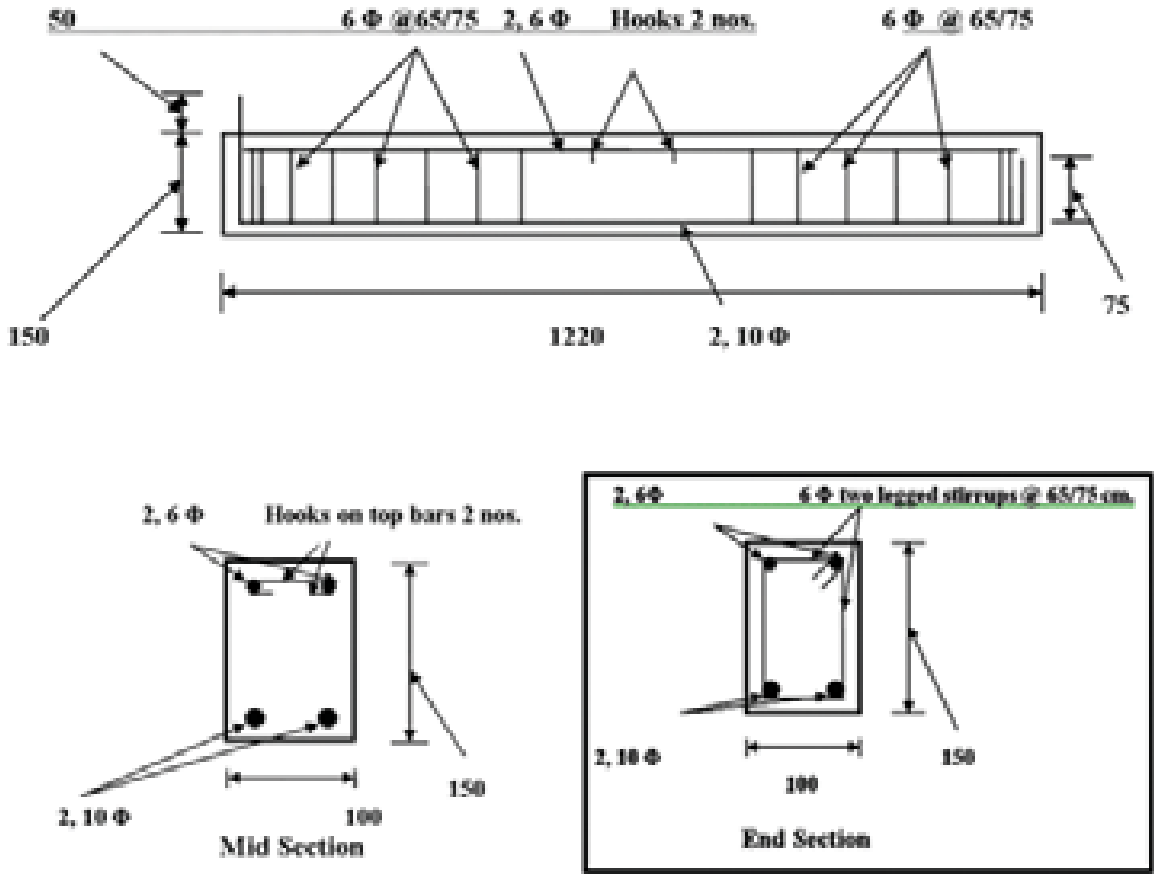


Fig.2: Beam details

The accelerated corrosion set-up has been planned which is schematically shown in Fig.3.

FRP strengthening design on beams for their up-gradations is being performed.

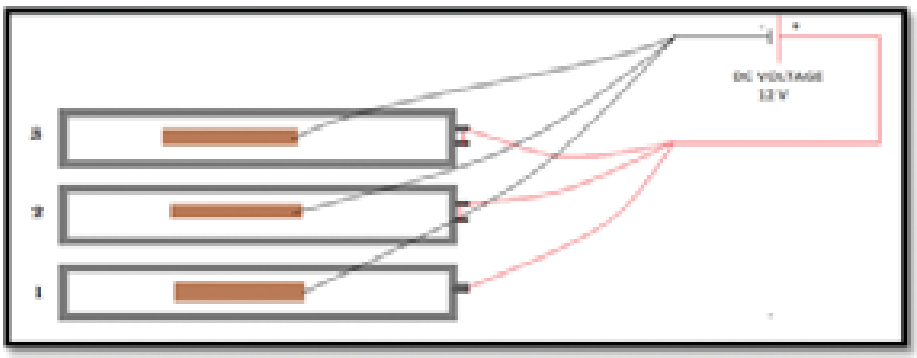


Fig.3: Scheme for corrosion acceleration

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

(CLP-0110)

S.R. Karade

Several repair and protection techniques against corrosion of reinforcing steel bars are used such as coatings on concrete or steel bars, overlay and use of corrosion inhibitors. However, in chloride affected concrete structures Cathodic Protection (CP) is considered to be the most effective technique. In spite of this, CP is not implemented in India because of lack of expertise, awareness and skills. To develop expertise and awareness in India, this project was undertaken in collaboration with M/s BDS Projects Ltd., Mumbai, who has a tie-up with Vector Corrosion Technologies (UK and Canada).

Under this project, different techniques for corrosion protection were used to compare the relative effectiveness of each method in preventing corrosion. Reinforced concrete specimens based on ASTM G109 were cast and put for 28 days curing. Nine of these samples were provided with galvanic XP anodes and compared with the specimens treated using other corrosion control methods (coatings and inhibitors) and with those without any treatment (control). The specimens were exposed to wetting and drying cycles by alternatively exposing to salt solution (3% NaCl in Water) for 4 days and drying for 10 days. The effectiveness was measured by continuously monitoring the change in potential and current between the reinforcing steel bars. After 56 cycles, the controlled specimens showed a sharp hike in the half cell potential (HCP) values amid 5-10 cycles followed by an almost constant value hovering between -450 and -550 mV. The presence of corrosion inhibitor delayed the increase of the HCP up to 20 cycles. A steep increase is observed after 20 cycles which remained constant floating between -350 to -400mV till 34 cycles and then again slightly slowed. The specimens containing anode XP and XP4 did not show much variation in HCP values ranging from -150 to -250 mV without any noticeable sharp changes. The total charge passed through controlled specimens crossed 1050 coulombs after 56 cycles. The charge passed reached a maximum of 344 coulombs in the presence of inhibit or compared with other specimens subjected to different treatments. Thus, the anodes XP2 and XP4 have shown slightly better performance

At the end of the experiment, all the specimens were broken down and chloride content was determined at various depths. The results shown in Table 1 indicate that chloride penetration has been reduced in the specimens with galvanic anodes significantly in comparison to other treatments. The mass loss in the top bar also showed similar trend (Fig.1). Thus, among all the treatments studied, the CP seems to the best option and XP4 showed best performance among different anodes.

Table 1: Chloride content by weight percentage of cement

Treatment	Depth (mm)		
	0-5	10-15	20-25
Control	2.149	1.756	1.129
Epoxy	1.560	1.182	0.624
Acrylic	1.637	1.254	0.624
Corrosion inhibitor	1.917	1.564	0.811
XP anode	1.492	1.180	0.573
XP2 anode	1.502	1.013	0.398
XP4 anode	1.200	0.827	0.222

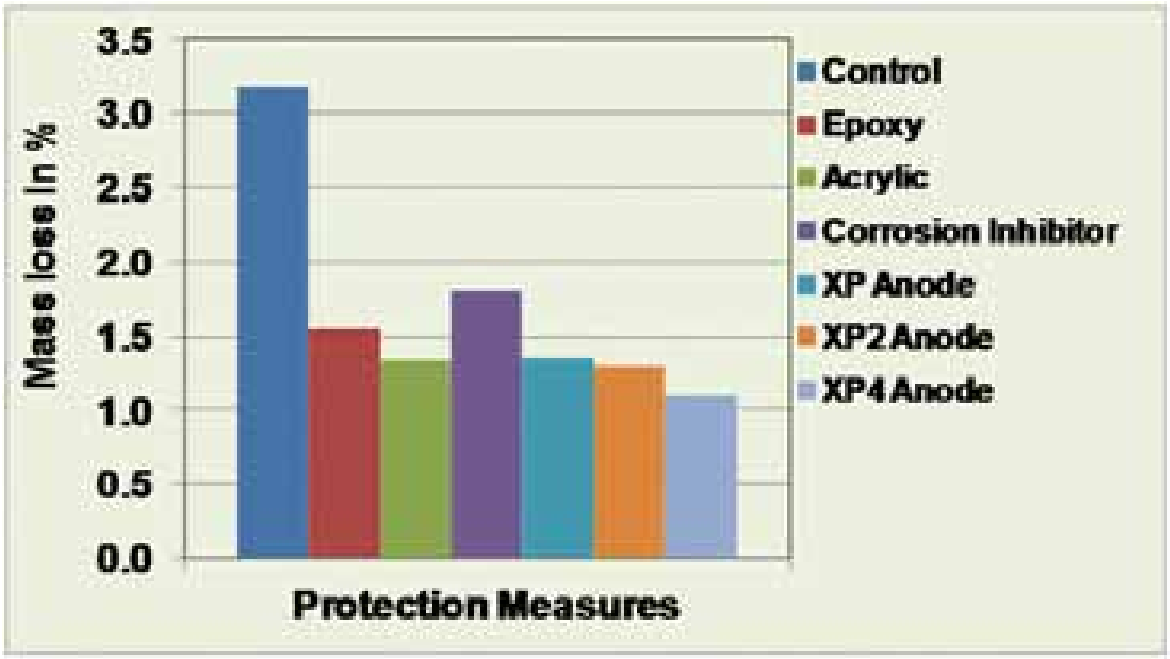


Fig.1: Mass loss of the top bar due to corrosion after 56 cycles exposure

Wettability and Visco-Elastic Behaviour of Lignin-Isocyanate Prepolymer Adhesives

Monika, M. Gupta & B. Singh

Polymer blends were prepared using functionalized lignin and isocyanate prepolymer (NCO/OH ratio: 3.5). The blends were characterized for their wettability, phase miscibility and other properties. As the lignin content increased in the prepolymer, the contact angle of probe liquids on the resulting substrate increased. The work of adhesion between the water/formamide and adhesive film decreased with the increase of lignin content in the blends. This decrease was attributed to the lowering of Lifshitz-Vander walls component of intermolecular attraction from 28.5 to 23 - 25 mJm^{-2} and also acid-base interaction at the interface of a solid and a liquid. The base tension of acid-base interaction of isocyanate prepolymer was reduced from 19.70 to 8-13 mJm^{-2} after lignin addition at various levels while acid tension has slightly changed. Increasing lignin content, the polar component of surface-free energy of the resulting blends decreased significantly while dispersive component was affected marginally. The presence of surface functional groups on the lignin-prepolymer blends was analyzed by FTIR. The isocyanate prepolymer exhibited intense –NH band at 3384 cm^{-1}, urethane unconjugated and conjugated carbonyl split absorption bands between 1735 cm^{-1} and 1611 cm^{-1} and –NCO peak at 2270 cm^{-1}. Upon addition of functionalized lignin into isocyanate prepolymer, the intensity of –NH band decreased considerably while –NCO peak disappeared probably due to its interaction with lignin/moisture. The occurrence of relatively increased peak intensity of urethane at 1616 cm^{-1} was noticed with respect to the parent prepolymer. At higher lignin content, the blends exhibited free –OH/lignin –OH groups between 3800 cm^{-1} and 3600 cm^{-1} indicating the existence of non-hydrogen bonded groups. The involvement of functional groups in the reaction resulted in a reduced surface polarity and thereby, affecting its wettability with the substrate surface.

Fig.1 shows wettability of lignin-prepolymer blends assessed by Zisman plot between the cosine of the contact angle and liquid surface tension using four probe liquids (water, formamide, xylene and diidomethane). It was found that the critical surface energy of isocyanate prepolymer and its lignin blends was negative at solid-liquid interface favouring wetting of liquids with the substrate thermodynamically. The critical surface tension of lignin blends was slightly higher (–27 to –29 mJm^{-2}) than that of the corresponding parent system (–30 mJm^{-2}) probably due to the variations in the end groups of oriented layer. The surface composition of isocyanate prepolymer has changed after blending with functionalized lignin through the formation of graft networks. The packing of outermost groups in the surface could be responsible for the wetting of liquid to the substrate.

Fig.2 shows DMA traces of isocyanate prepolymer and its blends with functionalized lignin. It was observed that with the onset of the glass transition temperatures, the drop in storage and loss moduli was sudden and nearly to complete for both samples. The rate of decrease in the moduli was more rapid in the case of parent prepolymer than the lignin-prepolymer blends indicating its faster curing. At temperature below the glass transition, the blend containing 5 wt% functionalized lignin exhibited highest storage and loss moduli. A cross-over point between storage and loss moduli was observed above the glass transition temperature in the flow region for lignin blends as against to parent prepolymer. With increasing lignin content, the cross-over point of the resulting isocyanate prepolymer blends moved upwards due to their higher viscosity and large molecular weight distribution. The material became solid like because

of reversal in the trend from viscous to elastic. The presence of entanglement affected the viscous behavior (spreadability) and prevents the chain slippage. The tan delta peak of isocyanate prepolymer had two distinct peak maxima corresponds to hard and soft segments whereas its lignin prepolymer blends showed a broad single damping peak that is a combination of the peaks associated with the glass transition and cure. The larger peak area of tan delta indicated that the blends containing high lignin content (10 - 15 wt%) had slow curing than the parent prepolymer. The occurrence of transitions in the loss modulus curves also supported biphasic nature of blends.

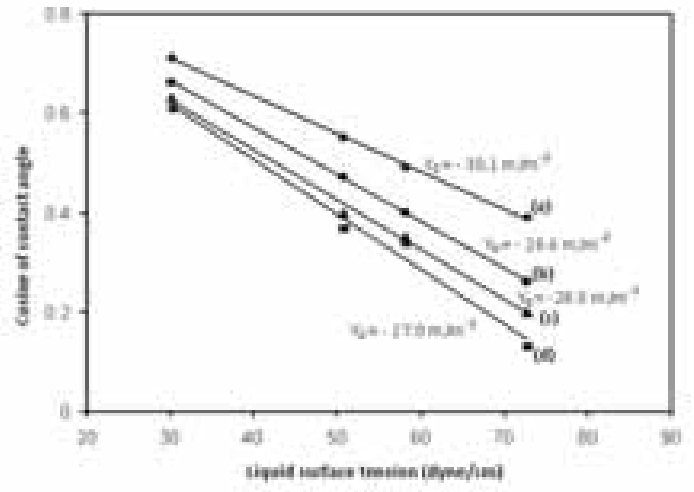


Fig.1: Zisman plots of lignin-isocyanate prepolymer blends (a) 0% (b) 5 wt % lignin (c) 10 wt% lignin, and (d) 15 wt% lignin.

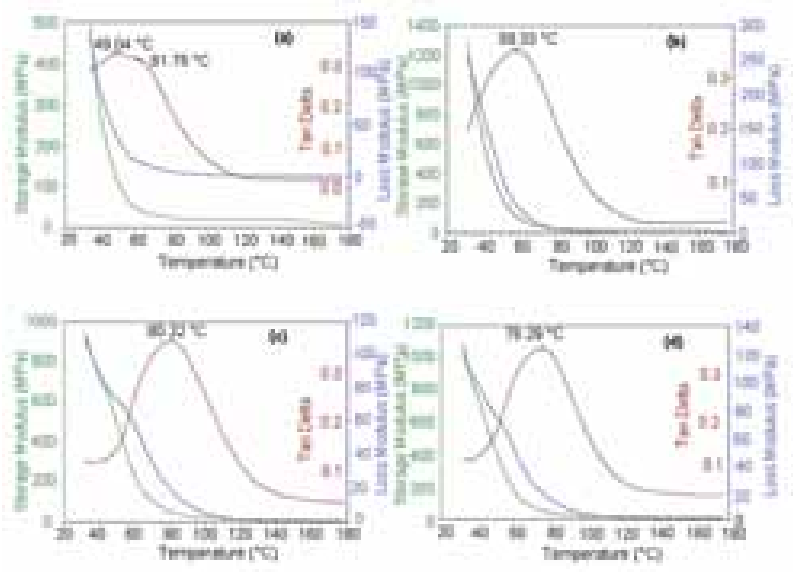


Fig.2: DMA traces of isocyanate prepolymer and its lignin blends (a) Control (b) 5 wt% lignin (c) 10 wt% lignin, and (d) 15 wt% lignin.

It was noticed that in the first DSC scan, an intense endothermic peak was observed while in the second scan, only shallow region appeared. The lignin-prepolymer blends had higher glass transition temperature than the isocyanate prepolymer because of lignin urethanes and cross-links formation. As the lignin content increased, the endothermic region of the resulting prepolymer blends shortened, dipped and shifted towards higher temperature. An additional endothermic peak at 190ºC in the blends was also appeared with respect to parent prepolymer probably due to the lignin constituent. This indicates that microphase heterogeneity in the blends existed at higher temperature. SEM micrographs also showed that isocyanate prepolymer exhibited phase separated morphology - hard and soft segments as observed in DMA. Contrary to this, the blends containing low lignin showed a smooth and uniform surface along with scattered small cavitation. At higher lignin loading, the surface was layered with the existence of several large cavities in which lignin particles are segregated. Depression in the microstructure was noted probably due to polyurethane domains. The cavitation in the microstructure was very pronounced at 15 wt% lignin content which affected mechanical properties of the blends.

Documentation of R&D efforts/achievements of CBRI

(OLP 0369)

K.L. Chhabra, Rajeev, P. K. Yadav and Naresh Gupta

There was no comprehensive information available on the CBRI R&D works carried out by the various groups of the Institute since its inception in documented form. Information on achievements was available in annual reports, building research & technical notes, building digests, data sheets, project completion reports available with PME, books titled: 'Three Decades of Building Research in India', 'Advancements in Building Materials & Construction Technologies', 'History of CBRI' etc. It was difficult to retrieve R&D information from such scattered sources. Information regarding R&D Efforts/achievement of CSIR-CBRI have been compiled from the period 1950 to 2010, in the form of five documents. Contents of Compilation are Project numbers allotted, Title of the project, Duration of the project, Objectives of the project, Salient Features & Achievement, References, and Disciplines. This work has been done in Excel format for easy retrieval of information in several possible desired forms.

Status of Process/Technology vis-a-vis national and International scene

Data of CBRI R&D Efforts/ achievements available in annual reports, building research & technical notes, building digests, data sheets, books titled: 'Three Decades of Building Research in India', 'Advancements in Building Materials & Construction Technologies', 'History of CBRI' and Project Completion Reports available with PME was compiled. It was difficult to find old information from such scattered sources of information.

Under the project, a document covering CSIR-CBRI R&D work and achievements from 1950 to 2010 has been compiled in five volumes in the following fields:

- Shelter Planning
- New Materials
- Structures and Foundation Engineering
- Disaster Mitigation &
- Process Development

The compilation gives quick information about CSIR-CBRI R&D work and achievements in concise form for immediate reference and also gives a source from where more detail information can be obtained. It is thus a very useful compilation and systematic resource of information about CBRI covering a span of 60 years of existence of CSIR-CBRI.

Outcome of the project

The Institute has made a comprehensive record on R&D work carried out in the last sixty years (1950 to 2010).

Strengthening of Stone Masonry Housing Constructions against Earthquakes

(OLP-372)

Navjeev Saxena

To improve seismic resistance of stone masonry houses.

Scope of Work

To carryout numerical assessment of existing integral box action (IBA) methodologies using prestressing, and (ii) To develop improved methodologies providing IBA using prestressing.

Deliverable

A new methodology to improve seismic resistance of stone masonry constructions.

Progress

The literature review found that the existing IBA methodology using prestressing utilizes anchor plates and steel rods to prestress the walls (Fig.1). The critical appraisal of existing methodology emerged with the deficiencies such that (i) The roof slab is simply supported on walls, hence expected diaphragm action is not achieved, (ii) The prestressing method adds stiffness and strength locally and (iii) most likely chances of non-uniform prestress at strengthening level.

The progress was made to address these deficiencies and a new scheme was proposed (Fig.2) that resolved all deficiencies except stated at (iii). It involved angles at all outside and inside corners of the masonry with a mechanism to tie them together using anchor plates and tie rods. The scheme however expected to be effective but not that much efficient due to not being easy in implementation involving number of members and expensive.

The proposed scheme has further been improved to be more workable and cheaper by reducing number of strengthening members as well as ensuring uniform prestress at strengthening levels. The internal angles have been removed. The tying of angles at external corners of the building has been simplified by wrapping and prestressing the high strength steel rope at roof level (to integrate roof slab with walls through angles), lintel level and plinth level through a mechanism of post tensioning (Fig.3).

The project is now progressing to carryout numerical experimentation using FEM by modeling stone units, contacts between units & roof slab subjected to seismic loading to predict seismic behavior of existing and proposed schemes. The developed methodology would be applicable to historical / monumental buildings (where cost is not a concern) as well as to normal housing constructions.

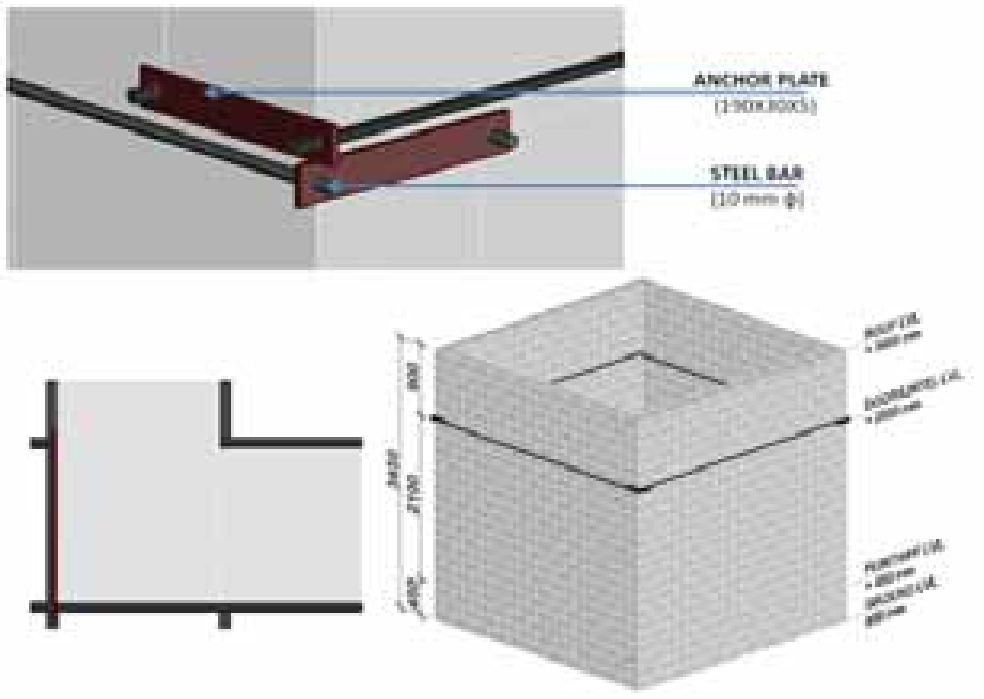


Fig.1: Existing IBA methodology using prestressing

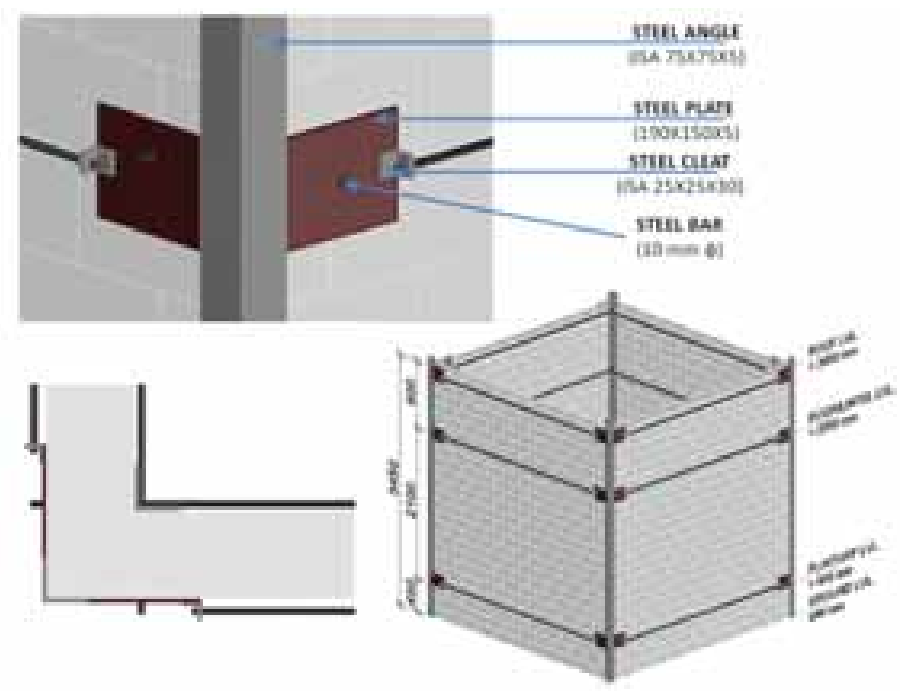


Fig.2: Improved IBA methodology using anchor plates and rods

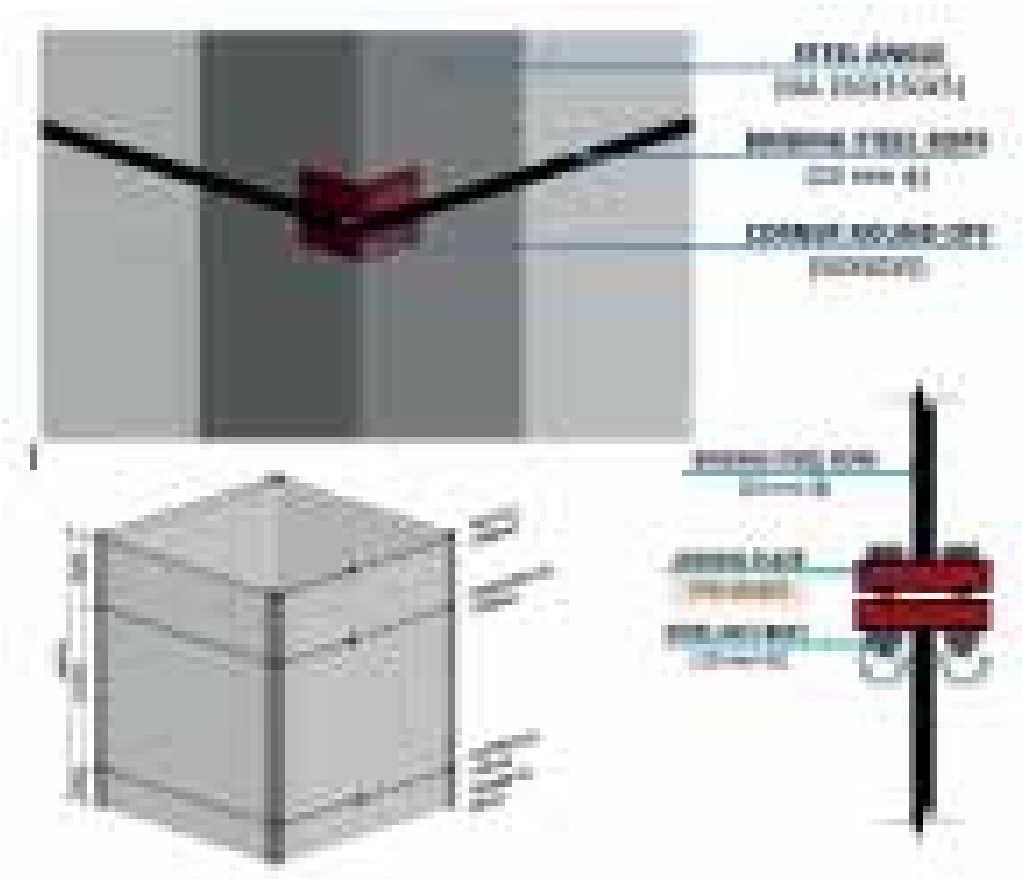


Fig.3: Improved IBA methodology using high strength steel rope

Investigations of Foundation System through Borehole Radar

(OLP-374)

Ajay Dwivedi, A.K. Sharma & Achal Mittal

The ground penetration radar is used for engineering and environmental site investigations very extensively with accurate information. Due to high cost it was till date used only at large scale projects like underground repositories and mining activities.

For delineation of foundations of heritage building, an effort could be made through dipole mode and cross borehole mode. This can prove to be an effective tool where the excavation of inspection pit around the building is not possible like protected monuments and densely populated areas.

International/National Status

Zhou et al had attempted to map subsurface cavity by cross hole radar (2004). Borehole GPR was used for detection of water filled fractures by Motoyuki SATO et al (2005). It was also used for locating the buried pipe by Kazunori et al (2006). Borehole Radar was also used for the detection of changes at underground by Kenneth Ranney et al (2006). Sixin Lu et al (2010) attempted to detect metal ore using Borehole Radar. Gordan et al (2012) had attempted to map the basalt formation under the Northern Greenland Ice sheet.

Institutional Status

Works have been carried out in the institute on ground penetration radar techniques for detection of subsurface anomaly extensively. Some attempts have been made to ascertain the depth and type of foundation system of heritage buildings but has not resulted in any fruitful conclusion. The present study can fulfill that gap and present methodology can help to detect the foundation system where excavation in the vicinity of the structure is prohibited.

Borehole Radar

Borehole radar is based on the same principles as ground penetrating radar systems for surface use, which means that it consists of a radar transmitter and receiver built into separate probes. The probes are connected via an optical cable to a control unit used for time signal generation and data acquisition (Fig.1&2).

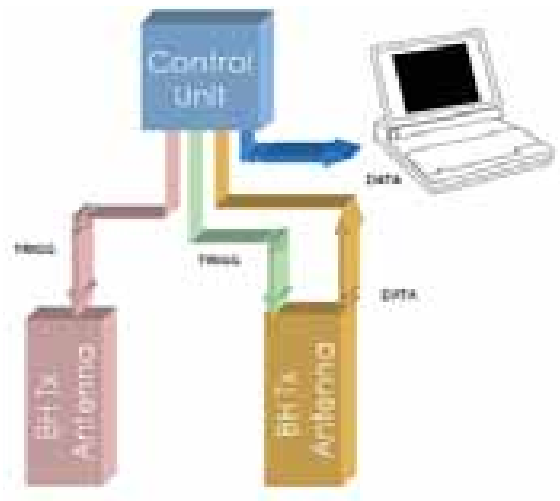


Fig.1: Borehole radar setup

Fig.2: Borehole antenna probes with fibre optic cables

Dipole Reflection mode

In reflection mode, the radar transmitter and receiver probes are lowered in the same borehole with a fixed distance between them (Fig.3). An optical cable for triggering of the probes and data acquisition is connected to a control unit. The most commonly used antennae are dipole antennae, which radiate and receive reflected signals from a 360-degree space (omni-directional).

Cross-hole Investigations

Cross-hole mode, the transmitter and the receiver are lowered into different boreholes. In order to minimize noise and other problems, the two boreholes must be in the same 2-dimensional plane. The investigated section is the medium between the boreholes. In cross-hole investigation, the transmitter is fixed at one position in one borehole and the receiver scans the complete length of the other borehole. Then, the transmitter is moved one step and the receiver scans the complete adjacent borehole again. This procedure is repeated until the transmitter has covered the whole length of the first borehole (Fig.4).

The cross-hole survey mode is also referred to as the tomography mode. Tomography inversion can be made using two types of recorded data, the amplitude of the first arrival and/or the ratio between the time it takes for the first wave to arrive in the other borehole and the calculated arrival time in homogeneous media. Travel time tomography is an excellent surveying and processing method to determine areas between the boreholes containing high water content (e.g. water filled fractures and cavities). This happens because the travel time is heavily affected by the high dielectric constant of water.

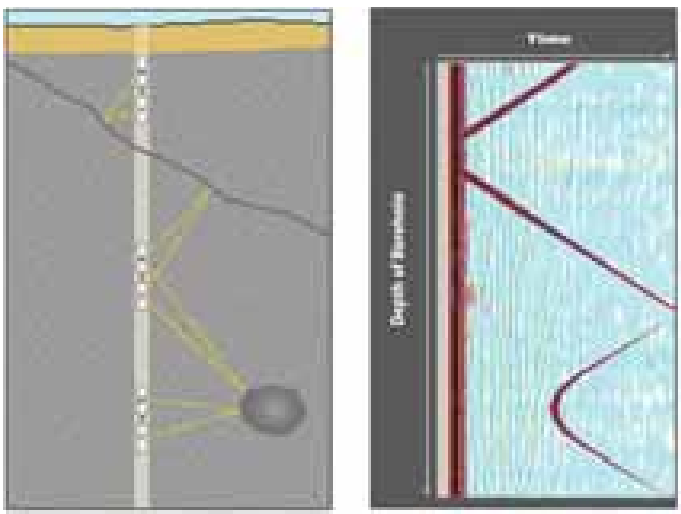


Fig.3: Borehole radar investigations in dipole reflection mode and its radargram

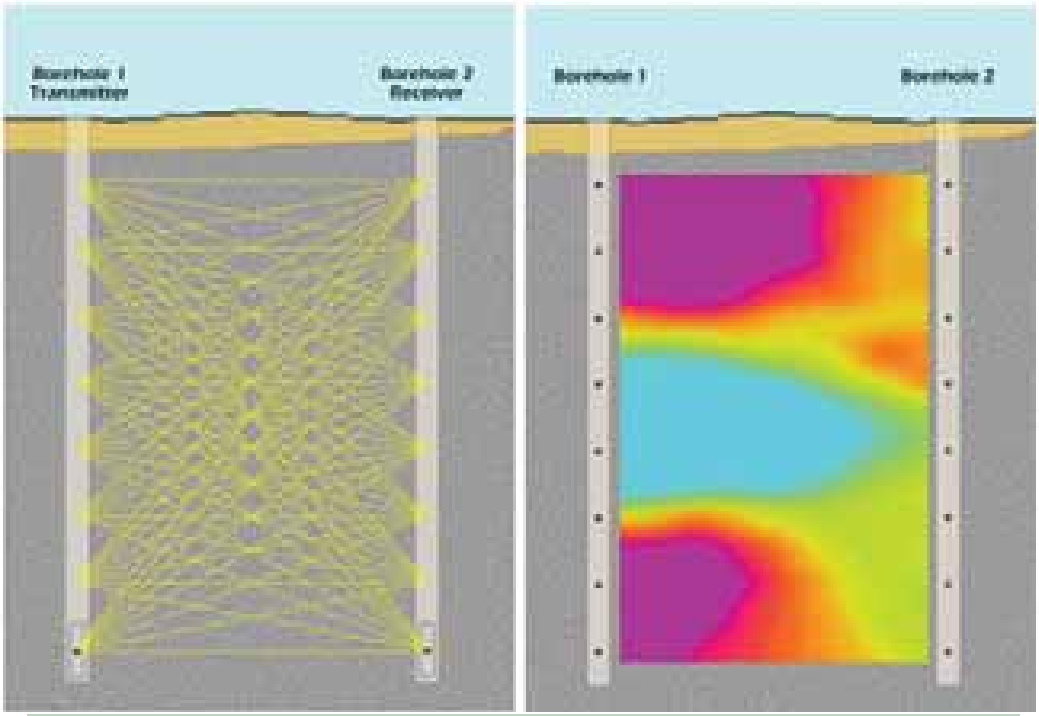


Fig.4: Method to carryout radar investigations in cross borehole mode and its interpreted result

Methodology

The following work has been envisaged in the project for developing this technique at our institute.

- Sinking of 04 bore holes upto 20 m depth one in front of efficiency of buildings group and other three behind Fire group building in the institute campus.
- Radar survey both in dipole mode and cross borehole mode.
- Preparation of borehole tomography and Data interpretation.

Anticipated Outcome

The knowledge so developed will help to investigate the Heritage Building foundation system and also can be utilized to investigate the foundation of other civil structures.

Study of Flow Behaviour around Building, Fire Propagation Characteristics and Health Monitoring of Building

(MLP-0510)

S.K. Bhattacharyya, Abha Mittal, Ajay Chaurasia, Shorab Jain

Health Monitoring of 8-Storied Steel Building

The feasibility of implementing damage detection tools of the information collected in dynamic monitoring studies relies on the type of building structure, non-structural components and environmental condition at the time of data acquisition. In this regard, experimental validation of observed dynamic characteristics with finite element analysis has been carried out on eight storied steel frame structure. Discritization of 8-storied steel frame building using 3-noded linear element has been carried out in FE software ABAQUS/CAE 6.10-1 as a shear beam model which followed by Timoshenko beam theory (Fig.1). Frequency of different mode shape has been carried out by the energy method.

For an assumed mode shape $\overline{u}(x)$, of a structural system with mass *[M]*; stiffness, *EI* (Young's modulus, *E*, multiplied by the second moment of intertia, *I*); and applied force, *F(x)*:

$$\text{Equivalent mass, } M_{eq} = \int M\overline{u}^2 du$$

$$\text{Equivalent stiffness, } k_{eq} = \int EI\left(\frac{d^2\overline{u}}{dx^2}\right)dx$$

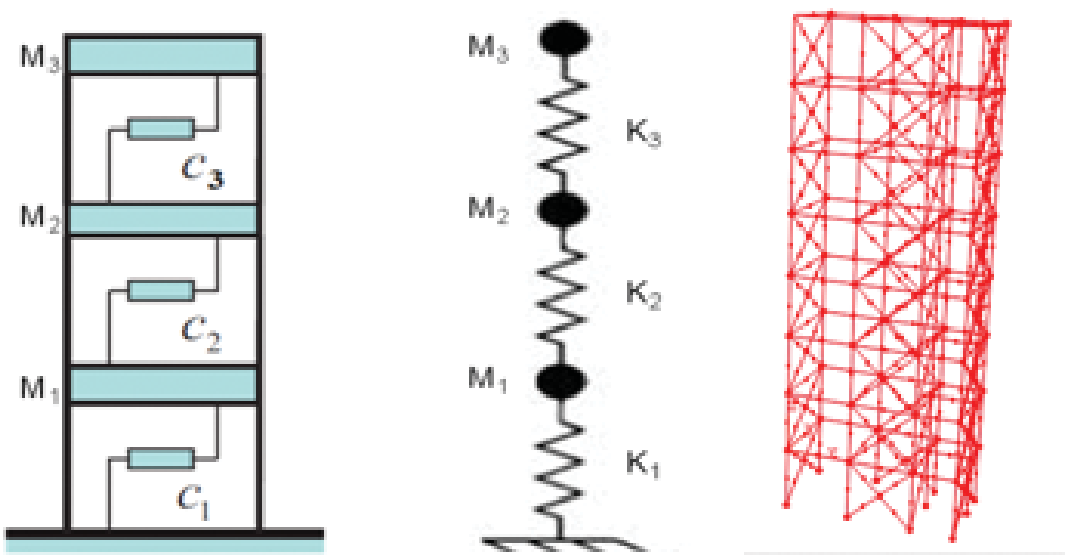


Fig.1: Shear beam model & Discritization of 8-storied steel frame

Damages are introduced in the FE model of building by reducing stiffness of structural components at different storey. The storey stiffness is reduced by 20% and 50% at second and sixth floor respectively by reducing its flexural rigidity. Modal analyses results thus obtained are presented in Table 1 and Fig.2. The comparsion of frequencies and mode shapes for undamaged and damage state, do not show any significant change in frequencies while mode shape also fails to identify the damage.

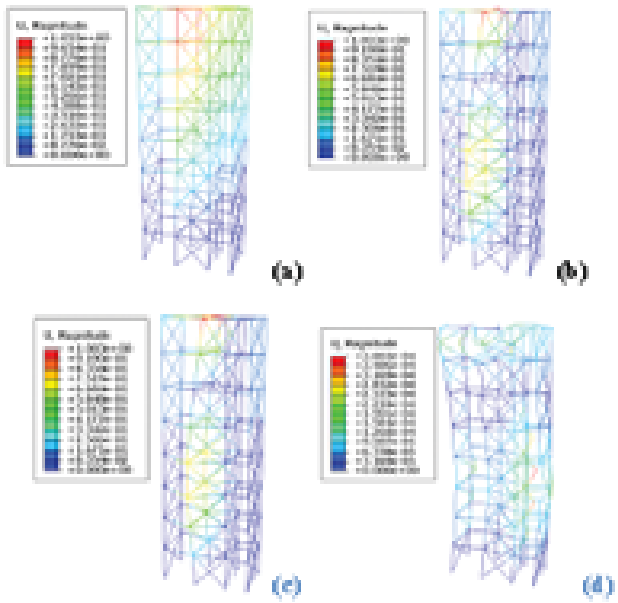


Fig.2: First and Second Mode shapes for undamaged (a,b) and damaged (c,d) state

Table 1: Frequencies of undamaged & damaged state

Modes/Frequencies	1st Mode	2nd Mode	3rd Mode	4th Mode	5th Mode	6th Mode	7th Mode	8th Mode
Undamaged	2.302	6.829	11.111	15.002	18.367	21.096	23.104	24.331
Damaged	2.183	6.118	10.762	14.084	16.755	20.894	22.030	23.139
Modal Mass	70123.2	7172.2	2395.4	1027.5	474.69	181.42	94.59	15.01
Modal contribution of various Modes	86.1 %	8.8%	2.9%	1.3%	0.6%	0.02%	0.01%	0.0%
Cumulative Modal contribution of various Modes	86.1 %	94.9%	97.8%	99.1%	99.7%	99.9%	100%	100%

The modal displacements computed from output data of FE analysis for undamaged and damaged condition and mode shapes is shown in Fig.3.

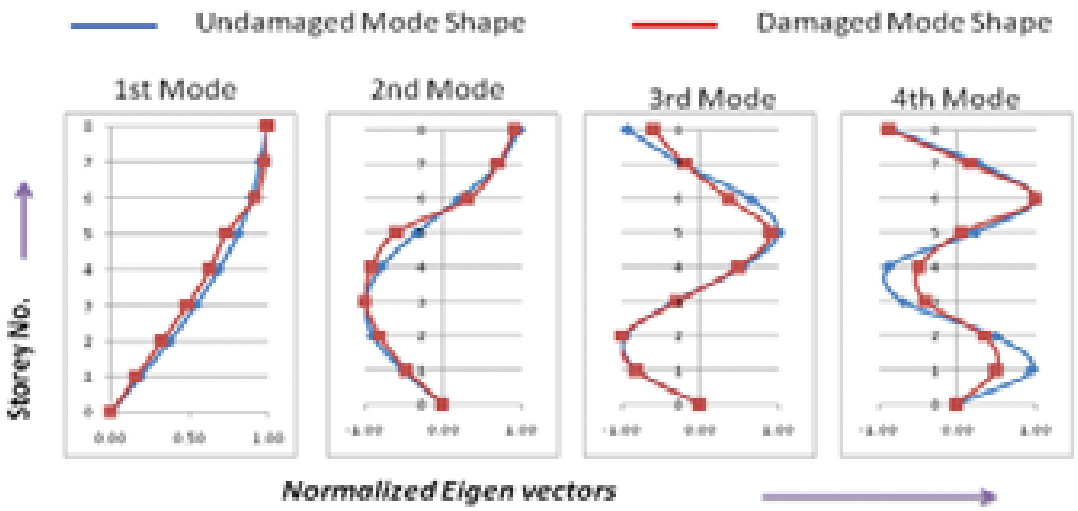


Fig.3: Comparison of first four mode shape of building in undamaged & damaged state

Academy of Scientific and Innovative Research (AcSIR)

AcSIR

Integrated M.Tech - Ph.D Programe on"Building Engineering & Disaster Mitigation (BEDM)"

CSIR-CBRI had started the two year post-graduate research programme on "Engineering of Infrastructure and Disaster Mitigation (Buildings / Roads)" under the Academy of Scientific and Innovative Research (AcSIR) in 2010 to impart training to the young Civil Engineering professionals.

The first batch of the M.Tech students (2010-12) joined the course on 9th August 2010. All the six students of this first batch have successfully completed the course with more than 8.0 CGPA in June 2012. The M.Tech degree was conferred to them by Prof. R. A. Mashelkar, Chairman, AcSIR in a convocation ceremony held while celebrating 70th Foundation Day of CSIR on 26th September 2012 at Vigyan Bhawan, New Delhi.

The 2nd batch of students (2011-13) of the M.Tech Programme joined the course at CSIR-CBRI on 9th August 2011. After completing the 1st Semester in December 2011, 7 students have joined CSIR-Central Road Research Institute, Delhi for further study and the remaining 8 students are continuing their study at CSIR-CBRI, Roorkee. In the third and fourth semesters,

The convocation ceremony of the first batch of M.Tech students

students have taken up dissertation work on live projects of the institute. The dissertation topics selected by the students of the 2011-2013 batch are as follows:

1. Koushik Pandit - Numerical analysis of underground coal mines and strengthening strategies for coal pillars.
2. Debdutta Ghosh - Dissipation strategies of tsunami wave on buildings -A numerical study.
3. Md. Suhaib Ahmad - Behaviour of reinforced concrete beams exposed to fire.
4. Md Yousuf. M - Studies on preparation and applications of nanosilica in high strength concrete.
5. Riya Bhowmik - Response of piled-raft foundation under combined loading in stone column improved ground.
6. Ishwarya G. - Development of geopolymer concrete cured at ambient temperature.
7. Monalisa Behera - Studies on recycled aggregate concrete using different cementitious materials.
8. Venkatesan J. - Behaviour of cold-formed steel load bearing wall panel under static and fire load.

From the Academic Year 2012, the name of the course has been changed to Integrated M.Tech – Ph.D. Programe on "Building Engineering & Disaster Mitigation (IMP-BEDM)", being offered exclusively by CSIR-CBRI. This is a 2 + 3 years programme which has two parts: (i) M.Tech programme of four semesters (2 years) and (ii) Ph. D programme (3 years) after successful completion of M.Tech. This integrated programme has been designed to facilitate the students to obtain both M.Tech and Ph.D. degrees.

On 9th August 2012, eight students of 2012-2014 batches joined the course. In this batch 6 students are in the category of Trainee Scientists and 2 are in the category of Quick Hire Fellow. The two year M.Tech. programme consists of 7 core subjects and 3 elective subjects. The following students joined the programme:

1. Reshmita Palla
2. Dharmendra Singh
3. Rajesh Kumar
4. Md. Reyazur Rehman
5. Eldho C A
6. Rakesh Paswan
7. Chanchal Sonkar
8. Santha Kumar

Students of 2011-13 batch (standing) and 2012-14 batch (sitting)

The faculty members for teaching the above course are the scientists of CSIR-CBRI, and CSIR-CIMFR. A few guest lectures from the experts of different fields outside CSIR were also organised. Dr Mashelkar, Chairman, AcSIR addressed the students on 6th December 2012 and released the Annual Magazine '"Abhivyakti", A compilation of four issues of the wall magazine contributed and published by the students.

Dr Mashelkar addressing the students

The students had participated in different cultural programmes and sports activities organised by the institute. They were also engaged in several other activities of the institute like publication of the Wall Magazine '"Abhivyakti" etc.

Release of the Wall Magazine "Abhivyakti"

Students performing cultural activities

From August 2012, CSIR-CBRI has started Ph.D. Programme in Civil Engineering, Geology and Chemical Sciences and eight students have already been registered for Ph.D. The following students have joined for the Ph.D. programme:

1. Mrs. Usha Sharma – Chemical Sciences
2. Mr. Davinder Singh – Geology
3. Mr. Piyush Mohanty – Civil Engineering
4. Mr. Anindya Pain – Civil Engineering
5. Mr. Siddharth Behera – Civil Engineering
6. Mr Micky Mecon Dalbehera – Civil Engineering
7. Miss Tarannum Meraj – Civil Engineering
8. Mr Randhir Choudhary – Civil Engineering

Information, Extension & Project Management

Development, Construction & Extension Group

The Development, Construction and Extension Group is an important link between R&D scientists and user agencies. The group is engaged in creating awareness through exhibitions & mass media, imparting training to field agencies and enhancing market for the innovative technologies and expertise of the Institute. The Group also undertakes activities of societal importance and is contributing to the CSIR-800 programme.

Construction technologies and materials developed by CSIR-CBRI like Concrete Masonry Blocks, Precast Roofing Components for Roofs and Under Reamed Pile Foundation in Black Cotton Soil are repeatedly being used in construction of thousands of houses by NGOs, Central and State Government Departments and private builders at various rural and urban locations of the country. Several Building Centres and Rural Building Centres are in regular production of precast concrete/ferro cement components by engaging local artisans and labour. CSIR-CBRI licensees at Yamuna Nagar & Ahmedabad are regularly manufacturing CSIR-CBRI designed clay brick extrusion machines of 2500 to 4000 bricks per hour. Fixed Chimney Brick Kilns and Gravity settlement chamber have been adopted by more than 30,000 brick manufactures to reduce consumption of fuel and environmental pollution.

Under the technical guidance of CSIR-CBRI, Delhi State Industrial Infrastructure Development Corporation (DSIIDC), New Delhi is using CSIR-CBRI knowhow in the construction of thousands of houses in and around Delhi and Faridabad.

CSIR-CBRI has agreed in principle to provide technical guidance in the design and construction of 1000 low cost houses in Bur-kina Faso, Africa to be funded by Govt. of India.

CSIR-CBRI is providing technical assistance to CSIR labs in the design and development of Vigyankutir under CSIR-800 programme in remote villages of Orissa & M.P. The efforts of the group have made significant achievements in the following areas:

- Savings in material, cost and time of building construction
- Efficient use of local materials and skills
- Human resource development
- Employment generation
- Entrepreneurship development
- Enhancement of quality of life
- Poverty alleviation through skill upgradation
- Affordable and quality housing for the EWS & LIG section of society.

Training Programmes :

- Coordinated Practice School II training of six month duration for a batch of 6 Civil Engineering (3 M Tech & 3 B. Tech) students from BITS Pilani at the Institute. Another group of 10 students from BITS , Pilani completed their PS-I.
- Organized summer vocational training for about 46 students at the Institute.
- Arranged orientation cum Technical Exposure programme for 50 school students of Central School No.1, Roorkee and 10 MSc. students of K. L. D.A.V. Degree College, Roorkee along with their faculty as a part of interactive visit on National Technology Day i.e. on 11th May 2012 .
- 37 B.Arch. Students along with faculty from MM University Sadopur, Ambala visited the Institute on 05.02.2013.
- 60 Civil Diploma Students from Mehar Chand Polytechnic, Jalandhar with their faculty visited the Institute on 14.02.2013.

Orientation cum Technical Exposure:

- Arranged orientation cum Technical Exposure programme for a group of **8 polytechnic teachers from various polytechnics** on 17th July, 2012 who were participating in a short term training programme on 'Earth-quake Risk Management' at K.L. Polytechnic Roorkee.
- About **50 Science students** from Central School Roorkee and KLDAV Degree College Roorkee were taken around CSIR-CBRI Labs and provided them an opportunity to interact with scientists on 26th September, 2012 as a part of celebrations of CSIR Foundation Day. The Day was treated as Open Day for visit of students to the various labs of the Institute.
- A visit of 129 civil engineering students from Dept. of Engineering Studies, University of Petroleum and Energy Studies, Dehradun was conducted on 7.11.2012
- 50 civil engineering students from Jodhpur National University, Jodhpur visited the Institute on 18.12.2012 to learn about new building technologies and materials developed by the Institute.

Other items of Significance:

- All India Radio, Delhi recorded an interview of Shri S.G. Dave, Chief Scientist on '**Newer Disaster Resistant Housing Technologies**' and 'CSIR-800 programme'. The interview was aired in the afternoon News bulletin of AIR, New Delhi of 3rd May, 2012 both in English and Hindi.
- Shri R.K. Srivastava, Addl. General Manager, Unitech Limited, Gurgaon visited CSIR-CBRI on May 13, 2012 and had a meeting at DCE to discuss possibilities of association of CSIR-CBRI in their future low cost housing projects and rural housing societal projects in Raipur, Chhatisgarh.
- Shri S.G. Dave visited AMPRI, Bhopal to collect information about first CSIR-Tech Village site in M.P. and discussed with authorities about Gram Vigyan Kutir from 3rd to 8th July, 2012.

Compiled and documented achievements of CSIR-CBRI under the following categories :

- Highest Industrial Impact making technologies
- Outstanding science
- Most valuable patents
- Social transforming S&T interventions
- अप्रैल 2011 से मार्च, 2012 तक की समयावधि में विकास, निर्माण व प्रसार ग्रुप द्वारा तकनीकी क्षेत्र में हिन्दी के सराहनीय प्रयोग के लिए ग्रुप के श्री राजीव को प्रथम पुरस्कार से सम्मानित किया गया।
- The DCE Group Members contributed in the production of a special technical video covering An overview of CSIR-CBRI with details of the activities and achievements of the Geo Technical Engineering Group for the International Conference of the IGS held at IIT, Delhi from 13-15 December, 2012
- Guidance was provided to three groups of Six M.Sc. (Physics) students in their developmental project under CSIR Faculty Training and Motivation of Science Students.
- Technical inputs were provided in the design and development of display materials for display in the conference exhibition of the International Conference of the Indian Geotechnical Society on the following topics :

- Reclamation of Abandoned Flyash ponds
- Building Materials using flyash
- Studies on Solid Industrial Wastes
- Remote Sensing & GIS Applications
- Landslide Hazard Zonation
- Landslide Modelling and Control
- Pile Foundation Technology
- Prefabricated Building Components & Systems
- Sub-surface Investigation
- Substitute of Timber in Building

CSIR-800, RSWNET Programme 'Dissemination, on Training and Demonstration of Appropriate Rural Housing Technologies'.

- To enhance the image of CSIR- CBRI among different housing stake holders a brochure on CSIR-800 RSWNET programme, on "Dissemination, Training and Demonstration of Rural Housing Technologies" was printed. The same has been released for distribution to public. The brochure has been sent to over 100 organizations including CSIR labs, state agencies associated with housing sector participating organizations and others.
- Held interaction with authorities of Himachal Pradesh, M.P. and NGO's for planning of CSIR-800 activities under 12th Plan programme
- The Institute received a request from Agha Khan Foundation, Afganistan and District Management Authority Hardwar for training of their engineers in the area of 'Quality Control and Earth Quake Resistant Technologies'.

Workshops/Seminars/ Conferences/Get-togethers

Institute Participated in the following events:

- Workshop on Affordable Housing – IAY & other Projects by NAREDCO, Delhi at Jaipur during 18-20 July, 2012
- National Seminar on 'Emerging Building Materials and Construction Technologies' organized by BMTPC, Delhi from 31st July to 1st August, 2012 at Delhi.
- International Training Programme on Rural Housing organized by NIRD, (MORD) , Hyderabad. and presented a paper on 22nd August, 2012 on ' Appropriate Disaster Resistant Rural Housing Technologies'.
- सी.एस.आई.आर. की हैदराबाद स्थित तीन प्रयोगशालाओं आई. आई सी.टी., सी.सी.एम.बी. एवम् एन.जी. आर.आई द्वारा संयुक्त रुप से दिनांक 22 अगस्त, 2012 से 24 अगस्त, 2012 तक आयोजित की गयी संयुक्त राष्ट्रीय वैज्ञानिक हिन्दी संगोष्ठी में भाग लिया।
- सी.एस.आई.आर.–केन्द्रीय भवन अनुसंधान संस्थान, रुड़की की ओर से **'सभी के लिए आवास की व्यवस्था में सी.एस.आई.आर. – केन्द्रीय भवन अनुसंधान संस्थान का योगदान'** विषय पर पॉवर पोइन्ट के माध्यम से तकनीकी पेपर प्रस्तुत किया गया। उपरोक्त लेख को संगोष्ठी के अवसर पर प्रकाशित की गयी **स्मारिका** में शामिल किया गया है।

S&T Progress made under Network Project/Activities under STS-0004/0008 Projects:

- Prepared alternate set of plans estimate and specifications for Gram Vigyan Kutir, Tumda-Kheda, Riasena, M.P. under CSIR-Tech Village Project and submitted to CSIR/AMPRI for approval.
- Compiled requisite information & posters for institute's achievements and CSIR- 800 programme for inclusion in the list of 70 selected CSIR contributions on the occasion of 70th CSIR Foundation Day celebrations.

Exhibitions

The group utilized the opportunity of publicize CSIR-CBRI technologies & expertise by participating in exhibitions organized during the following:

- In the National Conference on **" Emerging trends of Energy Conservation in Buildings (EECB 2012) "** 01-03 November 2012 at CBRI Roorkee
- In **National Workshop in Engineering Geo-physics for Civil Engineering & Geo- hazards** on 22-23 November 2012 held at Roorkee.
- In **Annual convention of Indian National Academy of Engineering** for the delegates during 6 -7 December 2012 held at CSIR-CBRI Roorkee.

- In **Indian Geotechnical** Conference 2012 during 13-15 December 2012 at Delhi.
- Exhibition Koraput, Orissa on **Rural Housing Technologies**. The exhibition was visited by DM Koraput, villagers and participants from CSIR-IMMT, Bhubaneshwar at Tribal Museum, Koraput, Orissa during 19-20 February, 2013. CSIR-CBRI training video '**Unnat Gramin Awas**' was also screened.

Under CSIR 800 an exhibition cum workshop was organized by CSIR-IMMT Bhubneshwar at Tribal Museum Koraput, Orissa during 19–20 Feb 2013.

The Inaugural Programme

District Magistrate Koraput was the chief guest of the workshop. Shri S.K. Mishra Chief Scientist CSIR-IMMT Bhubneshwar started the programme and briefed about the participating labs. Apart from CSIR-CBRI Roorkee other labs such as CSIR-CFTRI, Mysore, CSIR-NEIST Jorhat, CSIR-IMMT Bhubneshwar were also present. Dr. D.P. Sandha, Programme Coordinator, CSIR-800 briefed about the programme. Prof. B.K. Mishra, Director, CSIR-IMMT, Bhubneshwar focused on CSIR-800 programme and told that lab is adopting a village in Koraput district and will demonstrate the CSIR technologies suitable for the region. Shri K.C. Panigrahy, Director Tribal Museum Koraput, the guest of honour was willing to donate some land for demonstration and the chief guest gave his blessings for successful implementation of CSIR technologies. Shri Sachin R. Jadhav, District Magistrate Koraput inaugurated the Exhibition.

In the beginning of technical session a technical film on Unnat Gramin Awas was screened to the audience. Shri S.K. Negi, Sr. Principal Scientist delivered his talk on Planning of Rural housing in Koraput district. Shri Rajeev, Senior Technical Officer presented his lecture

on Improved Rural Houses and various construction technologies developed by the institute.

On 2nd day formal discussions and a brain storming session was held to find out suitable technologies for region. From CSIR-CBRI the following technologies were selected for field implementation.

- Low Cost Rural Latrine
- Fire Retardant thatch with ferrocement treatment
- Concrete block

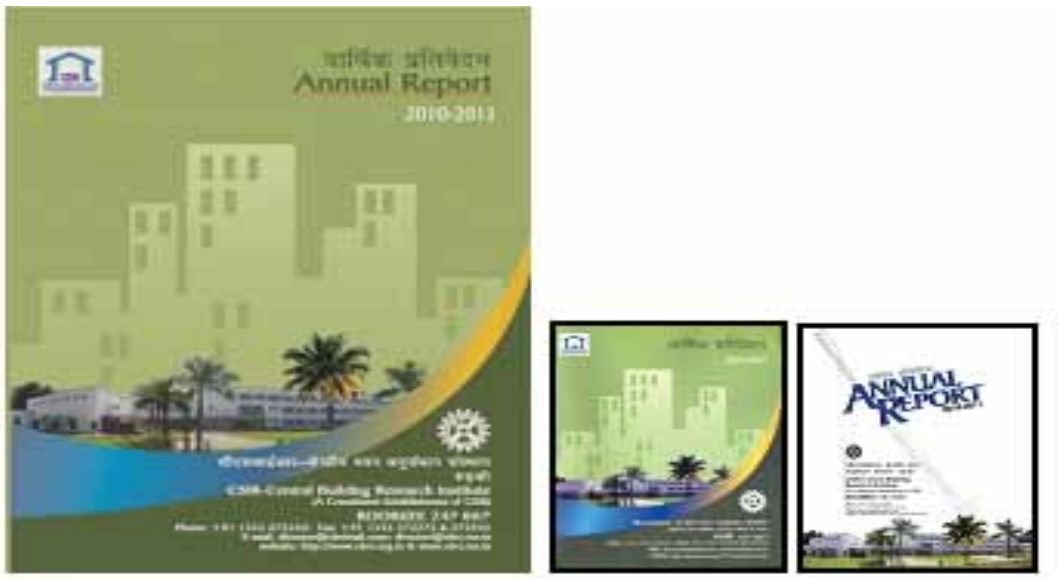
Scientists discussing CBRI technologies

Publication Group

The Publication Group continued to serve as the nerve center of the Institute conducting and coordinating 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 (Newsletter in Hindi) periodically, publication of Building Research Notes, Project Profile, Technical and Divisional Brochures etc., preparation of other scientific/technical reports, 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.

1. CSIR- CBRI Annual Report (In Hindi & In English)

- R&D Highlights
- Information, Extension & Project Management
- Research Output
- Glimpse of Activities
- R&D Projects
- Consultancy Projects
- Sponsored Projects
- Honors & Awards
- CBRI Family
- Date Line



Tasks involved: Manuscript evaluation, Editing, Proof-Reading, Graphic Design, Layout, Illustration, Print Production, Binding, Publishing, Dissemination and Feed-back.

2 **CSIR-CBRI Newsletters** (April-June 2012, July-September 2012, October-December 2012, January- March 2013)

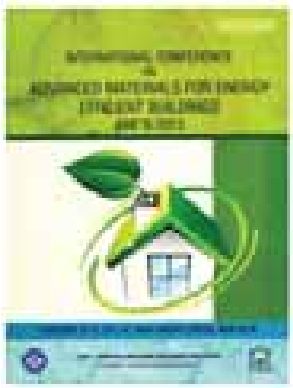
3 भवनिका - CSIR-CBRI Newsletters in Hindi (April-June 2012, July-September 2012, October-December 2012, January- March 2013)

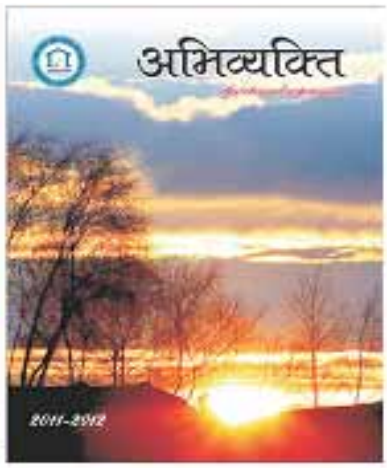
4 Group Brochures on **Architecture & Planning** and **Organic Building Materials**

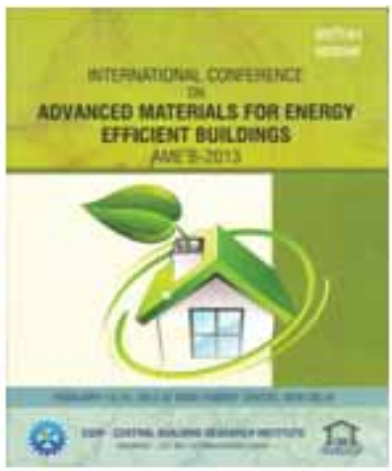
5 Building Research Notes

6 R&D highlights/Research output of CSIR-CBRI in **CSIR Annual Report**

7 Conference – Brochures, Proceedings, Advt. and Souvenir etc.







8 ENVIS Newsletters- 2 issues (Jan-June 2012 & July-Dec 2012)

9 Plan, schedule & organize the publication of highlights of CBRI achievements /activities in: सीएसआईआर समाचार and CSIR News

CBRI in सीएसआईआर समाचार

CBRI in CSIR News

10 News-items/R&D Stories in Media covering functions, events, Conferences, Workshops etc.

Knowledge Resource Centre (Library)

CSIR-CBRI Library, now known as '**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 77 Hindi books. **Journals:** The library has subscribed 103 (61 foreign +42 Indian) journals. 159 volumes of journals were got bound during the reporting period.

Library Statistics: Books including reports; standards; conference proceedings; theses & maps: 43734; Bound Periodicals: 20099

Institutional Membership: KRC renewed 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; News Letters; Technical Reports; Reprints and other materials in exchange from National and International Organizations.

Resource Sharing and Local Networking: KRC is maintaining continuously good relationship with the libraries of different Institutes located in Roorkee viz. Indian Institute of Technology; National Institute of Hydrology library and providing resource sharing through inter library loan. Besides the local network, KRC is maintaining the liaison and relationship with the KRC's of CSIR Laboratories/DST Labs 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 of nine no. of newspapers in English and Hindi. 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:** KRC is bringing out a quarterly list of latest arrivals of books for the general awareness of library users.
- **Bibliographic Service:** KRC 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:** KRC 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, Pate state: a database of CSIR patents; 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 2000 full text of e-journals of leading S&T publisher's viz., AR, full text of ASTM Standards, Elsevier, Emerald, IEEE, OUP, RSC, Sage, T&F, Wiley as well science & patent databases like Web of Science and QPAT/ORBIT are available online under National Knowledge Resource Consortium (CSIR-DST E-journals Consortium) as well as direct subscription.
- **Knowledge Repository:** KRC has created Institutional Repository (IR) through dspace software. 1023 records has already uploaded. These contains full text database along with metadata of published research papers of S&T staff members of the institute as well as all Building Research Notes (BRN), Project Profiles, Annual Reports of CSIR-CBRI since 1953 and conference proceeding volumes, organized by CBRI. This database can be accessed at http://krc.cbri.res.in/dspace.

Research Planning and Business Development

The Research Planning and Business Development (RPBD) Group of CBRI enhance financial resources of the institute by coordinating business activities. The Group provides a bridge between the institute and the outside agencies by supporting in existing areas of proven technologies and attracting new companies towards the technological development. The Group identifies and analyzes new areas of business in a planned and systematic manner for commercialization of technologies to public sector and private entrepreneurs. The institute lays considerable emphasis on the quality of its services to the stakeholders, mainly on deliverables against the externally funded projects. This activity is a measure to determine level of the service or product meeting the customer expectations. The activities of RPBD group are primarily focused in following areas:

Technology Transfer

Basically there are two ways of acquiring technology: either develop or buy. The later is called technology transfer process. The seemingly simple technology transfer process is indeed non linear. Starting with negotiations it continues with exchanges and feedbacks. No two technologies follow the same process. Pressure of limited resources and need for maximizing the profits create a need for careful portfolio management. RPBD has maintained a database of all technologies, which have potential for commercialization. The activities regarding transfer of technologies developed at CBRI involve:

- Liaison with NRDC, PPD, CSIR.
- Negotiations, exchanges and feedbacks from entrepreneurs showing interest in CBRI technologies.
- Drafting and finalizing license agreement.
- Establishing license fee of processes.

In the year 2012-13 the following two technologies were transferred resulting in a premium of Rs. 25 Lakhs.

Technology	Clients
Cable Firestop System	M/s Superon Schweisstechnik (i) Ltd. 15-16 Old Sewa nagar Market Lodhi Road, New Delhi-110 003
Liquid Extinguishment fire Extinguisher	M/s Aska Equipments Ltd., R-483, New Rajendra Nagar, Sri Ganga Ram Hospital Square, Shankar Road, New Delhi-110 060

Externally Funded Project

The task of making correspondence with the clients related to undertaking of projects by the Scientists of the Institute lies with RPBD group. The group has regularly maintained the data of the externally funded projects taken by the Institute. RPBD has also been involved in collection of service tax, TDS and filing of service tax returns. RPBD assisted the audit teams from Service Tax Department, CAG and CSIR Internal Audit team at the time of their visit in the Institute. During 2012-13 the total ECF

of Rs 675.96 lakh has been generated from the various sources.

Customer Satisfaction Evaluation

Customer satisfaction is the fulfillment of the stated or implied need of a customer. The customer satisfaction evaluation measures the extent to which the need has been fulfilled. The purpose of evaluating customer satisfaction is to improve it. The improvement is essential to keep and create new customers. RPBD keep the Liaison with customers through writing the letters or email to get their valuable feedback on a five point scale questionnaires for evaluating the Customer Satisfaction Index (CSI). This year feedback on customer satisfaction was sought from 30 customers and a response was received from 17 of them. Average CSI for the period is 4.48

Planning Monitoring and Evaluation (PME)

The Planning Monitoring and Evaluation (PME) group acts as the main facilitator of the institute for effective planning, monitoring, evaluation and project budgeting of all the R&D and externally funded projects such as consultancy projects, sponsored projects, grant–in-aid projects etc. Important documents like annual plan document of the institute, manpower deployment document, MC agenda for externally funded projects and R&D agenda for the Research Council are also dealt with by PME Group.

PME monitors and compiles the monthly and quarterly progress of the research activities of the institute as well as the research utilization data for onward processing at PPD, CSIR. The group regularly maintains & monitors the project folder of all the projects and maintains the records in terms of physical and financial recommendations of internal monitoring committees, Research Council & Management Council.

R&D Projects

Internal review meetings and meetings with external experts are organized for selection of new R&D projects. The ongoing projects are monitored for progress and/ or mid-course corrections. Comments of experts are conveyed and it is ensured that the same are incorporated before the projects are placed before Research Council. Nine In-house R&D projects were processed under the four R&D areas of the Institute, namely, new construction material, health monitoring rehabilitation and strengthen, disaster management and energy efficient system. One collaborative project and one MLP were ongoing projects.

In addition to the above, CSIR-CBRI proposed and was awarded two major projects under the 12th Five Year plan. They being -one supra institutional network project entitled "Innovative Materials & Technologies For Next Generation Green Buildings" with four work packages and a total of 18 tasks under them. The other major project is a Network Project entitled "Engineering of Disaster Mitigation & Health Monitoring for Safe & Smart Built Environment" where CSIR-CBRI is the nodal laboratory. The project has 6 work packages comprising 29 tasks. The participating Laboratories are: CSIR-CRRI, CSIR-CSIO, CSIR-CMMACS, CSIR-NEERI, CSIR- NEIST, CSIR- CMERI, CSIR- CGCRI, CSIR-CEERI

CSIR-CBRI is also participating in 06 Network Projects which are being coordinated by other sister laboratories.

Project Evaluations & Peer Reviews

Internal and external peer review meetings and project evaluation meetings were organized for new and on-going In-house R&D projects as well as for the 12th Five Year Plan Projects during the year. PME group coordinated the scheduling of presentations & interacted with the project leaders for putting up the relevant documents. The inputs as an outcome of the meetings were incorporated in the projects prior to placing the same before the Research Council.

Research Council Agenda

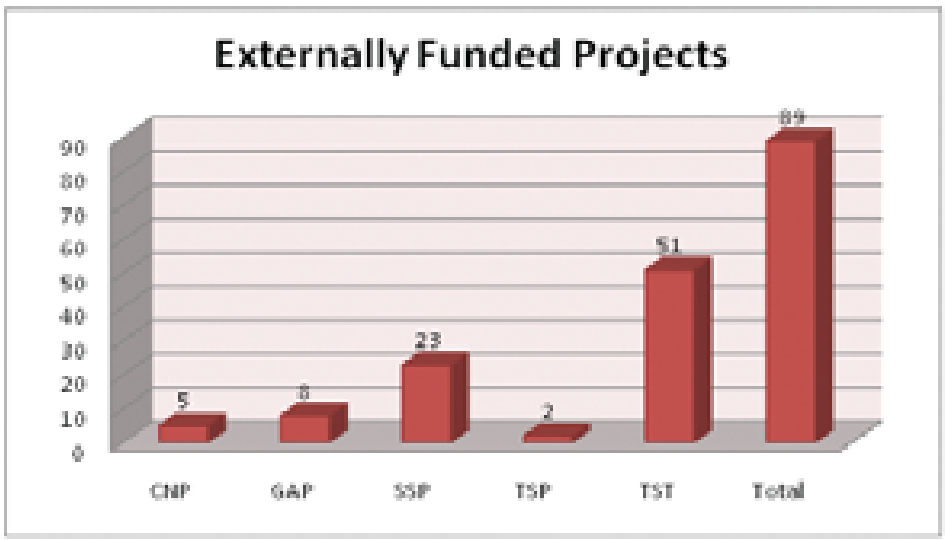
Research Council Meetings are held twice in a year to monitor the progress of R&D projects of the Institute. The R&D agenda of 46th & 47th RC meeting was prepared. The agenda covers the progress of ongoing projects as well as completed projects during the period and new projects taken by S&T staff. The outcome in terms of suggestion/ direction/guidance was communicated to the concerned project leaders.

Manpower Planning & Deployment Document

Human Resource Management lays special emphasis on planning for optimal deployment of the scientific, technical, non-technical and administrative staff of the Institute. The group gathers information regarding deployment from various groups for the preparation of manpower planning and deployment document. Reporting and reviewing officer are also identified for the staff members as per CSIR norms.

Management Council Agenda & Other Documents

Prepared agenda items related to externally funded projects and action taken for MC meeting. The group also coordinated replies to various audits (CAG, CSIR and Service Tax), attended to RTI and Parliament questions.



Budget and ECF

Budget

CSIR Resource Input

		E.C.F	
Revenue	1034.510 Lakh	Private	111.01 Lakh
Capital	508.207 Lakh	Government	375.42 Lakh
Special Projects	204.570 Lakh	Testing	189.53 Lakh
Total	**1747.287 Lakh**	**Total**	**675.96 Lakh**

Special Events

National Technology Day – 11th May

CSIR-Central Building Research Institute, Roorkee celebrated National Technology Day on 11th May, 2012 by arranging series of daylong activities.

Dr. Rajendra Dobhal, Director General, State Council for Science and Technology and Director, Science Education and Research Centre Uttarakhand witnessed the programmes as the Chief Guest and delivered a special lecture of **Science vs Technology – A critical phase of Indian Science**. He highlighted various scientific achievements and motivated the students for taking interest in understanding the principles and practical applications of science so that the future of our country may be shined. The Chief Guest further

stressed that science should be explored for the benefit of the mankind so as to improve health, income and living standard of the common masses.

The Technology Day celebration started with the lighting of lamp by the Chief Guest Dr. Rajendra Dobhal, DG, UCOST and Prof. S.K. Bhattacharyya, Director, CSIR-CBRI followed by the introductory remarks of Shri S.G. Dave, Chief Scientist and the convener of the programme.

Shri Dave informed about various programmes planned for a day with a special emphasis on visit of 60 Science Students from Kendriya Vidhyalaya-1 and M.Sc. students from K.L.D.A.V. Degree College alongwith their faculty. The students were taken around of the laboratories and technology park. He also highlighted on CSIR-800 activities organized by the institute of XIth plan period and about future plan of action programme planned for 12th Plan period.

Prof. S.K. Bhattacharyya, Director CSIR-CBRI, Roorkee talked about the importance of National Technology Day. He remarked that May 11 is annually observed as National Technology Day all over India to commemorate technological breakthroughs like mastering of nuclear weapons technology (Pokharan II) through a series of controlled tests at Pokharan, test firing of the indigenously developed Trishul missile and test flight of the indigenous aircraft Hansa-3. These achievements of Indian technology got a further boost with the test firing of indigenously developed Trishul, Agni and Prithvi missile. He also highlighted R&D achievements of CSIR and it's contribution in improvement of economy, health and living standard of the masses.

A technical film on Incredible India Incredible Engineering brought out as a part of Silver Jubilee celebration of Indian National Academy of Engineering (INAE) was screened in the auditorium. The film highlights history of Indian achievements in the field of engineering. Dr. Prakash Chand Thapliyal Senior Scientist made a brief presentation on Modified epoxy cardinal based coating for concrete structure highlighting its important applications, which won a CSIR-CBRI Diamond Jubilee Technology Award for the year 2011.

On this occasion, the Chief Guest released the CSIR-CBRI Annual Report 2010-2011, CSIR-800 RSWNET Achievements, Brochures of Polymer, Plastic & Composites and Structural Engineering Groups, CSIR-CBRI Newsletter issue, Jan-March 2012

Shri S.G. Dave, Chief Scientist introduced the Chief Guest and proposed a vote of thanks.

Release of CSIR- CBRI Annual Report

World Environment Day – 5th June

The CSIR-Central Building Research Institute (CBRI) Roorkee and The Institution of Engineers (India) Roorkee Local Centre Roorkee, celebrated the **World Environment Day** (WED 2012) on 5th June 2012. The theme for this year was **Green Economy: Does it include you?** to stimulate awareness of the environment and enhance the political attention and public action. Green Economy which cover one third of the earth's land mass and plays a key role in our battle against climate change, releasing oxygen into the atmosphere while storing carbon dioxide.

Prof. V.K.Jain, Vice Chancellor , Doon University, Dehradun , Prof. Satya Prakash Chairman Institution of Engineer (India), RLC Roorkee & Prof. S.K. Bhattacharyya Director CSIR-CBRI planted trees as a gesture of harmonious living with nature. Prof. Bhattacharyya mentioned that unlike the previous years, the tree chosen for plantation, this year, in CBRI Campus was **Neem** because of the special significance it bears.

Prof. V.K.Jain, Chief Guest, delivered his speech on the occasion & expressed his happiness to be amongst the distinguished scientists and mentioned that every human being should contribute a little in their own personal way to protect the environment and in this connection he appreciated the initiatives taken by CSIR-CBRI for taking environmental issues seriously. Prof. Satya Prakash welcomed the Chief Guest.

Prof. S.K.Bhattacharyya Director CSIR-CBRI in his presidential address, mentioned that CSIR-CBRI will continue its activity to develop environment friendly technologies and pursue research to protect the environment and work for conservation of biodiversity of the region as also proposed that both CBRI and Doon University can have joint projects on environmental problems of the Uttarakhand.

Dr. A.K.Minocha Senior Principal Scientist in his introductory address pointed out that World Environment Day is an annual event that is aimed at being the biggest and most widely celebrated global day for positive environmental action. On this occasion CBRI Bhavnika- Newsletter in Hindi was also released.

The programme ended with vote of thanks proposed by Prof. B.R. Gurjar, Hon. Secretary, Institution of Engineer (India), Roorkee Local Chapter, Roorkee

Sadbhavna Diwas- 17th August

The institute observed Sadbhavna Diwas on August 17, 2012 with a view to promote harmony amongst people of all religions, languages and states and goodwill towards everyone.

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

Hindi Week- 14-20th September

The Institute celebrated Hindi Week during September 14-20, 2012. The inauguration function was presided over by the Director Prof. SK Bhattacharyya and Dr. Bichar Das, Former Director, Central Translation Bureau, New Delhi graced the occasion as Chief Guest.

During the period an Hindi Book Exhibition and a workshop on *'Unicode Pranali se Computer par Hindi main Karya'* was organized on 17th September 2012, which was open for all groups of personnel and to make it feasible. About 40 employees were motivated in the workshop. Hindi Noting, Drafting and Translation Competition were held on 18th September 2012. First, second and third winners of the Competition were Sri Naresh Yadav, Sri Aman Kumar and Shri Sharad Kumar respectively. On 19th September, 2012, a Hindi Writing Competition was also held for non Hindi speaking employees, in which, First, Second and Third prizes were won by Sri Kaushik Pandit, Km. Riya Bhaumik and Km. Monalisa Behera, respectively.

The closing ceremony of the week-long event was organised on 20th September, 2012. Dr. Sudha Rani Pandey, Vice Chancellor, Sanskrit Vishwavidyalaya, Haridwar graced as Chief Guest and the Director, Prof. SK Bhattacharyya presided over the function.

The entire programme of the Hindi Week was organized under the chairmanship of Dr. B. Singh and convener Sri R.C. Saxena, Sr. Hindi Officer.

CSIR Foundation Day – 26th September

70th Anniversary of CSIR was celebrated with great enthusiasm at CSIR-Central Building Research Institute, Roorkee on September 24, 2012. Prof. Pradipta Bannerji, Director IIT, Roorkee graced as Chief Guest and Prof. Prem Krishna, Vice President, Indian National Academy of Engineering and Chairman, CSIR-CBRI Research Council as Guest of Honor. Prof. S.K. Bhattacharyya, Director, CSIR-CBRI presided over the function. The superannuated staff of CBRI and all the staff members of the institute graced the occasion besides other dignitaries. Welcome address was given by Sri S.G. Dave, Chief Scientist and the chairman of the CSIR Foundation Day Committee.

Prof. S.K. Bhattacharyya, Director addressed the gathering and highlighted the glorious past of CSIR, establishment of five labs in the year 1942 and CBRI in 1947. Since then it has grown covering almost all the areas of science and technology, contributing in the development of the country. He mentioned that CSIR is celebrating this year as Green Operation Initiative. He also talked about the major focus areas of R&D activities for the Twelfth Five Year Plan, CSIR 800 - Tech Vill. Project, under which CSIR technologies will be demonstrated covering the whole country and the role of CBRI in this project. He also mentioned about the activities of AcSIR in the institute and enrollment of M.Tech. and Ph.D. students this year.

Prof. Prem Krishna, Chairman, Research Council CSIR-CBRI, talked about the need for environment friendly buildings in present scenario and said that CBRI has a bigger role to play as there is a growing awareness about the newly developed technologies. He expressed satisfaction on the activities undertaken under twelfth plan by CSIR-CBRI.

Prof. Pradipta Banerji, Director IIT, Roorkee emphasized that energy efficiency in buildings is very important and quoted the example of Mughal period buildings, having adequate light and ventilation. He suggested the future R&D in the area of building physics and reuse of waste materials for construction.

Shri Pramod Adlakha, Architect, Consultant & Managing Director, M/s Adlakha Associates Pvt Ltd., New Delhi was felicitated for his notable contributions in promoting CBRI technologies from lab to land. He also delivered CSIR Foundation Day lecture in the afternoon session.

On this occasion 'CBRI News Letter' and 'Bhavanika' were released. Two brochures for 'Architecture and Planning' and 'Organic Building Materials' groups were also released.

There have been a number of activities including essay competition for staff children, visit of school students providing platform for scientist-student interaction and generating interest among the youth for science and technology. The Chief Guest also gave away the prizes to the essay competition wining children of CSIR-CBRI employee's i.e. Km Vidhi Arora & Pranjal Bansal in I group (class VI to VIII), Km Anusha Agarwal & Km Prachi Mishra in II group (class IX & X), Paras Bansal & Km Anushka in IIIrd group (class XI & XII). CSIR prize for getting admission in IIT and securing more than ninety percent marks in three science subjects in XII standard to the wards of the staff were also given.

On this occasion, the Chief Guest presented mementoes (wrist watches) to the employees of the institute who had completed their 25 years of service and a wrist watch, shawl and appreciation

certificate to those who have retired during the year. A cultural programme was organized in the evening which was enjoyed and appreciated by one and all. Sri R.K.Garg, chief scientist proposed a vote of thanks.

The Institute won Silver Icon Award for exemplary performance in promoting digital work culture at CSIR-CBRI. The award was given by Hon'ble Minister of S&T and VP CSIR on 25th September 2012 at CSIR, New Delhi.

Prof. Prem Krishna, Prof. P.Banerji, Prof. S.K.Bhattachayya, Ar. P.Adlakha sitting in I row

Address by Prof. S.K.Bhattacharyya,

Prof. Prem Krishna addressing the gathering

Address by Prof. P.Banerji, Director IITR

Prof. Prem Krishna presenting shawl, wrist watch and Certificate to superannuated scientist

Release of CBRI publications

Vigilance Awareness Week 29th Oct. - 2nd Nov.

The Institute celebrated Vigilance Awareness Week during 29 October to 2 November, 2012. Different programmes which include special lectures, slogan writing competition, essay competition, poster competition for school children of staff wards, extempore speech competition for staff members etc. have been organized during the week. The valedictory functions were organized in the Rabindra Nath Tagore Auditorium on 2nd Nov. 2012. Prof S K Bhattacharyya, Director, CSIR-CBRI presided over the function. Shri Ashok Kumar Gupta, General Manager (Incharge), BHEL, Haridwar was the chief guest and gave away the prizes to the winners of different competitions. Dr Suvir Singh, Sr. Principal Scientist, 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 R K Garg, Chief Scientist.

Republic Day – 26th January

The Republic Day of the nation was celebrated with a deep sense of patriotism combined with gaiety on January 26, 2013. Prof S.K. Bhattacharyya, Director, hoisted the National Flag and addressed the gathering and took the salute at the March Past performed by the security Guards. The school children from Bal Vidya Mandir presented various cultural programmes on patriotic themes. A cricket match was also arranged.

CBRI Foundation Day – 10th February

67th CSIR-CBRI Foundation Day 2013 was celebrated at Central Building Research Institute, Roorkee on February 10, 2013. The whole campus had a festive look and the main function was organized in the morning. On this auspicious occasion Mr. Mangu Singh, Managing Director, Delhi Metro Rail Corporation Ltd. (DMRC), New Delhi graced the occasion as chief guest and Prof. Prem Krishna, Vice President, Indian National Academy of Engineering & Chairman, Research Council, CSIR-CBRI as the guest of honour while Prof. S.K.Bhattacharyya, Director, CSIR-CBRI presided over the function. Many dignitaries and superannuated staff of CBRI also witnessed the occasion. Mr. R.K.Garg, chief scientist and chairman of the committee welcomed all the dignitaries and highlighted glorious past of the institute.

Prof. S.K.Bhattacharyya, Director, CBRI addressed the gathering and touched upon the considerable achievements to the credit of the institute in the area of Building Science and Technology since its inception. He remembered the words of Pandit Nehru during one of his visits to CBRI and stated that, *'It is science alone that can solve the problem of hunger and poverty....who indeed could afford to ignore science today? At every turn we have to seek its aid.... The future belongs to science and to those who make friends with science'*. Prof. Bhattacharyya said in line with this, what is practiced today at CSIR is science for engineering and engineering for science. He also said that CSIR-CBRI, always in its endeavour, extended its cooperation and support to different states of the country in order to propagate its proven technologies for upliftment of rural and semi-urban

poor under various plans and projects of Government of India. The applications of technologies developed at CBRI have brought down the construction cost considerably. Keeping the national missions in mind, the focus areas of R&D have been identified namely Development of advanced construction materials; Health monitoring of building structures, diagnostics & retrofitting; Engineering of disaster mitigations- fire, landslide, earthquake & cyclone; and Energy efficient building systems. He hoped that CSIR-CBRI may be able to serve the society in an effective manner through the generation of new knowledge, new ideas with the help of new generation of people.

Mr. Mangu Singh, Managing Director DMRC, Chief Guest of the programme appreciated the work done by CSIR-CBRI and stressed the need to develop clean technologies that are cost effective and affordable in the rapidly changing scenario. He shared his experience of Delhi Metro project highlighting the successful Clean Development Mechanism (CDM), the only successful project in Railway Transportation Sector in the world and various steps taken in achieving the energy efficiency and use of such technologies.

Prof. Prem Krishna, Guest of Honour expressed his satisfaction over the R&D efforts made by the institute and stressed on the right mix of enthusiasm and experience in achieving the desired results.

Dimond Jubilee Director's Award for development of best Technology which had maximum impact on the society was given on "Development of Cable Penetration Seal System (Cable Fire Stop)" jointly to Dr. Suvir Singh, Dr. N.K.Saxena, Mr. Sushil Kumar and Mr. Rajiv Bansal.

Diamond Jubilee Director's Award for best research paper which had maximum impact on the society was given on ''Composite Boards from Isocynate Bonded Pine Needles" jointly to Dr. Manorama Gupta, Ms. Monika Chauhan, Ms. Naseeba Khatoon & Dr. B.Singh.

On this occasion 'CBRI News Letter' and 'Bhavanika' were released by the chief guest and the guest of honour. Sri R.K.Garg, chief scientist proposed a vote of thanks.

There have been a number of activities, organized to celebrate CSIR-CBRI Foundation Day 2013 including outdoor games such as badminton, volleyball and indoor games like table tennis, chess and carom. Also, a friendly cricket match was organized on 26th January 2013. A cultural programme was organized on 10. 02.13 (evening) by the staff club and CBRI ladies club and the prizes were distributed. The illumination of the main building, auditorium and rangoli made especially for this occasion were highly appreciated beside the cultural evening programme.

Arrival of the Chief Guest, Guest of Honour and Director CSIR-CBRI

Address by Prof. Prem Krishna, Chairman RC, CSIR-CBRI

Address by Prof. S.K.Bhattacharyya, Director, CSIR CBRI

Release of 'CBRI News Letter' and 'Bhavanika'

Mr. Mangu Singh, Chief Guest, presenting the Diamond Jubilee Tehnology Award 2013 to CSIR-CBRI scientists.

National Science Day - 28th February

The CSIR-Central Building Research Institute has celebrated National Science Day on 28th February, 2013 to commemorate Raman Effect of the Nobel Laureate Sir C.V. Raman. The day celebration offers an opportunity to bring issues of science to the centre stage and provide awareness to the public of immediate concern.

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 under the theme of "**Genetically Modified Crops and Food Security"**. 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 the occasion of National Science Day, an ***Innovative Exhibition*** on new ideas in building science and technology was organized at the Institute. The posters of various ideas were exhibited at the Display Center of RABINDRANATH TAGORE auditorium. Prof. Pradipta Banerjee, Director, IIT Roorkee graced the ceremony. He along with Prof. Bikas Mohanty and Prof. S.K. Bhattacharyya, Director, CSIR-CBRI evaluated the posters and screened the ideas through presentation for taking them up as a project. Prof. Banerjee appreciated the initiatives of Prof. Bhattacharyya in this direction and also praised the exhibited ideas of the participants. The final short-listed projects were: 1.Structures on Living Ground by Sri Anindya Pain, 2. Foldable Portable Structures by S/Sri Soju Alexander, Subash Gurram and Ravindra Bisht, 3. Silk Wall by S/Sri Subham Dastidar and Soumitra Maiti, 4.Carbon Nanotube/ Fiber by Sri B.Srinivas Rao Naik. Prof. S.K. Bhattacharyya and Prof. Bikas Mohanty encouraged the young scientists and students to come up with new ideas and to develop new work culture in the institute.

Mr. Nagesh expressing his INNOVATIVE IDEA in front of the jury in the forenoon session.

Mr. Anindya Pain presenting his idea on "Structures on Living Ground"

Mr. Ravindra Bisht presenting his idea on "FOLDABLE PORTABLE STRUCTURES" in the afternoon session.

Annual Flowers & Vegetables Show

CSIR-CBRI Staff Club organized 46th Annual Flowers & Vegetables Show at CSIR- CBRI premises on 17th March, 2013. CSIR-CBRI and various Organisations located in Roorkee such as IIT Roorkee, NIH Roorkee, BEG&C Roorkee, Power Grid, Puhana, Nurseries located in Roorkee etc, participated in the Flower Show. In addition to this, many individuals' participants and staff members of CSIR-CBRI participated in the Annual Flowers & Vegetables Show. Six types of categories were made for participants covering gardens, pot plants, cut flowers, vegetables and flower arrangements etc.. The provision of category (i) for all institutions, offices, clubs and nurseries; category (ii) for all individuals' participants; category (iii) exclusively for CBRI staff; category (iv) for Mallies; category (v) for Queen & King of the Show and category (vi) for flower arrangement were made for participants. More than 1500 entries in various categories of pot plants, cut flowers and vegetables were received.

The show was inaugurated by Prof. S.K.Bhattacharyya, Director CSIR-CBRI and the prizes were distributed by the Chief Guest Mr. P.K.Gupta, Chief General Manager, BSNL (Uttarakhand) and the Guest of Honour Mrs. Kajal Bhattarcharya, Patron, CBRI Ladies Club. Prof. Gopal Ranjan, Director General CoER, Prof. D.K.Gautam, Director General, Roorkee College of Engineering, Mr. Isam Singh, GM (BSNL) Hardwar and many other dignitaries visited the Flower Show. Family members of staff of CBRI, their friends and relatives were also present on this occasion.

Chief Scientist and Convener of the show Dr. P.K.Bhargava told that Mrs. Aruna Bhargava won the Dinesh Mohan Trophy for best overall performance in all categories of the show and thus won the maximum prizes of the Flower & Vegetable Show. The overall trophy in institution category and individual category was awarded to Director NIH Roorkee and Prof. Pradipta Banerji, Director IIT Roorkee respectively. Mrs. Aruna Bhargava also won the Shankar Kapse Memorial trophy restricted to CBRI staff for best performance in cut flower & pot plants and vegetable garden. Mrs. Laxmi Rao w/o Dr. B.K.Rao won the large flower garden trophy. Km Mahalaxmi won the Rangoli trophy in children category and Mrs. Madhu Yadav won the trophy of miniature flower arrangement.

The flower Dahelia of Prof. Pradipta Banerjee, Director IIT Roorkee and flower Rose of Mr. Amit Chatkara won the prizes of King & Queen of the show respectively.

The judges who judged the beauty of flowers and gardens include Mrs. Pratibha Arya, Mr. T.C.Phatak, Mr. K.D.Dhariyal, Mrs & Mr. A.Siddiqui and Prof. P.N.Agarwal.

The event was also sponsored by Vijaya Bank Roorkee, State Bank of India, CBRI Roorkee, branch), State Bank of Patiala, Roorkee and Punjab National Bank, IIT Roorkee.

Conferences

Conference on Emerging Trends of Energy Conservation in Buildings (November 1–3, 2012)

National Conference on Emerging Trends of Energy Conservation in Buildings, (EECB 2012) was organized during November 01-03, 2012 at CSIR-CBRI Roorkee. The Conference provided a platform for building energy professionals, researchers, architects, industrialists, academicians and students to interact and deliberate on various issues related to energy conservation in buildings. The Conference was attended by more than seventy delegates from industries like UP Twiga, Bayer Materials, BASF, Berger Paints, Lloyd Insulation Ltd, Keltech Energies, Supreme Petrochem Ltd, BG Shirke Construction Technologies, Indian Oil Corporation; IITs and Universities like Centre for Energy Studies IIT Delhi, IIT Kharagpur, IIT Roorkee, IIT Guwahati, IIT-Madras, MNIT Allahabad, TERI University, Guru Nanak Dev University, Ansal University, BITS Mesra, Aayojan School of Architecture, Amity School of Architecture and Planning, , GGS Indraprastha University, Manipal University, Engineers India Ltd,; Institute like TERI, SERC-Chennai and the host CSIR-Central Building Research Institute, Roorkee.

There were eight technical sessions in the Conference covering the following themes:

- Building insulation materials,
- Energy conservation in production of building materials,
- Energy conservation measures, strategies and case studies,
- Renewable energy technologies,
- Energy efficient lighting,
- Integration of energy efficient passive technologies in building design,
- Low energy building design for different climatic zones of India and
- Modelling techniques.

The conference was sponsored by several industries in addition to CSIR, New Delhi and UCOST, Dehradun. As energy efficiency is necessary in every field and the topic of the conference was so relevant that number of participants from industries was very high. Out of forty nine received papers, forty papers were presented in various technical sessions of the conference.

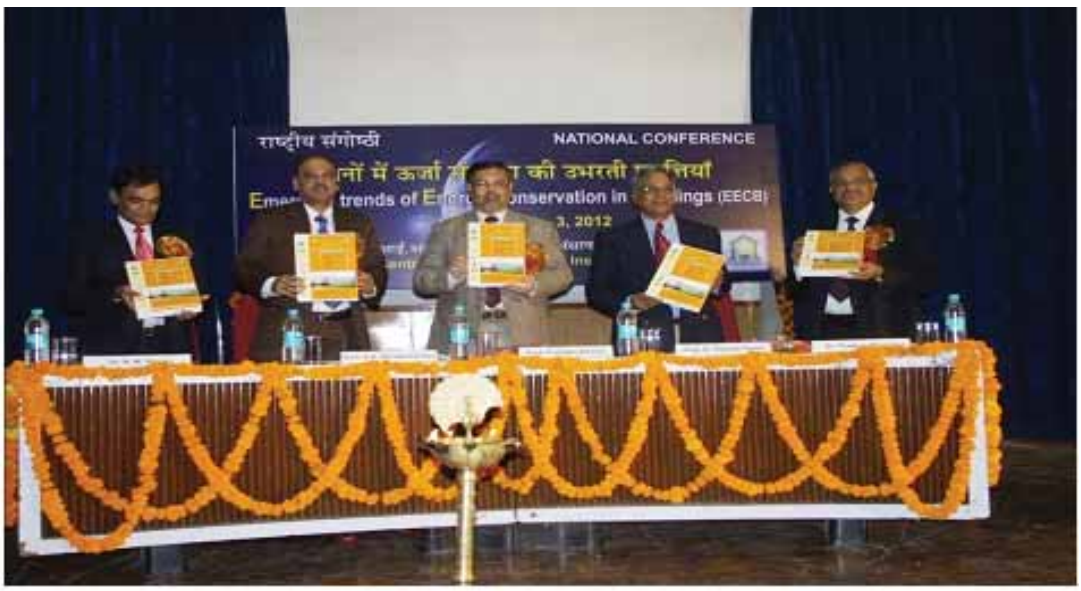
The inaugural function of the conference was held on 1st Nov 2012 at CBRI Roorkee auditorium. Prof. Pradipta Banerji, Director IIT Roorkee as Chief Guest inaugurated the conference. Prof. K. Ganesh Babu, IIT Chennai and former Director CBRI Roorkee graced as Guest of Honour and Prof. S.K. Bhattacharyya, Director CSIR-CBRI Roorkee presided over the function.

Dr. P.K.Bhargava, Chief Scientist and Convener of the conference briefed the delegates and guests about the conference and Prof. S.K.Bhattacharyya delivered his Presidential address. Prof. K. Ganesh Babu Ex- Director, CSIR-CBRI, Roorkee also addressed the audience as Guest of Honour of the function. Prof. Pradipta Banerji, Director IIT Roorkee delivered the inaugural address. Dr. Vinod Gupta, Architect and Space Design Consultants, New Delhi spoke about the latest techniques to be used in building for energy efficiency. Prof. S. K. Bhattacharyya, Director CSIR-CBRI Roorkee also delivered a key note address on Energy conservation measures, strategies and case studies. Prof. B.V.V. Reddy,

IISC Bangalore gave a plenary talk on, Construction Materials and Sustainability - An Overview.

Prof. H. P. Garg, Ex Prof. & Head, CES, IIT Delhi and chief guest addressed the August gathering in Valedictory function and also delivered keynote address. Recommendations were finalized in valedictory function in consultation with the Chairman of different session's viz., Prof. B.V.V. Reddy, Dr. B. K. Saxena, Prof. S.K. Bhattacharyya, Dr. Ishwar Chand and the delegates.

Inaugural Function



Release of Proceedings during Inaugural function

Dignitories on dias during Valedictory function

National Workshop on Engineering Geophysics for Civil Engineering & Geo-hazards (EGCEG-2012)

CSIR-CBRI has organized a National Workshop on **Engineering Geophysics for Civil Engineering & Geo-hazards (EGCEG-2012)** during November 22-23, 2012, at CBRI Roorkee. The Workshop was inaugurated by **Prof. V.K. Gaur,** Honorary Professor, Indian Institute of Astrophysics, Bangalore and Former Secretary, Govt. of India on 22nd November 2012. Prof. S. K. Bhattacharyya, Patron of the workshop highlighted the importance of Engineering Geophysics in the area of Civil Engineering and Geo-hazards. He emphasized upon the use of geophysical tools in the areas of heritage buildings and mega civil engineering projects. The organizing secretary Dr. P.K.S. Chauhan formally welcomed the delegates and the Chief Guest. Dr. Shantanu Sarkar, Chairman of the Workshop briefed the gathering about the workshop and its importance in the present scenario. Prof V.K. Gaur delivered his inaugural lecture on "**Safe Seismic Design of Critical Structures".** During his talk he pointed out the future challenges in the area of Earth-sciences. The function was presided over by Prof. S.K. Bhattacharyya, Director, CSIR-CBRI, Roorkee and the Patron of the Workshop.

Release of Abstract Volume by the Chief Guest

Dr. Shantanu Sarkar briefing the gathering

The Workshop was attended by the delegates from all over the country. In total 35 papers were received from IIT Guwahati; ISM Dhanbad; CIMFR, Dhanbad; NIT Bilaspur; CWPRS Pune; NEERI, Nagpur; NGRI, Hyderabad; RITES, New Delhi; CMMACS, Bangalore; NGF, Dehradun; JNV University Jodhpur, Allahabad University, WIHG, Dehradun and IIT Roorkee. Five Keynote lectures were delivered in five technical sessions.

Key Note Lectures

GPS Geodesy for Seismic Vulnerability of Indian Subcontinent - *Dr*. Sridevi Jade

The art of data inversion – Prof. *P.K. Gupta*

Integrated geophysical approach for site investigation - Dr Sanjay Rana

Electrical Imaging for landslide studies – Prof. R. G. S. Sastry

Geophysical Investigations for Civil Engineering and Urban Risk Reduction – Prof. D.K. Paul

The following themes were covered under the workshop:

1. GPS & Geo-informatics for Geo-hazards
2. Seismic Methods for Site Investigation
3. GPR for Ground & Building Investigation
4. Electrical Methods for Sub-surface Evaluation
5. Advanced Geophysical Techniques for Geo-hazards

During the workshop, five papers were presented by CBRI Scientists.

The two day workshop ended with the valedictory function held on 23rd November 2012. The Chief Guest for the function was Shri K.K. Razdan, Chief Engineer, Project Siwalik, Border Road Organisation. He emphasized the need of detailed studies for the geo-hazards in the hilly region of Uttarakhand especially for the pilgrimage routes.

Dignitories during Velidictory Function of the workshop

Participant expressing his views on the workshop

Prof. S.K. Bhattacharyya addressing the gathering during Valedictory Function of the workshop

Annual Convention of the Indian National Academy of Engineering

The Indian National Academy of Engineering (INAE), founded in 1987, comprises India's most distinguished engineers, engineer-scientists and technologists covering the entire spectrum of engineering disciplines. INAE functions as an apex body and promotes the practice of engineering & technology and the related sciences for their application to solving problems of national importance. The Academy provides a forum for futuristic planning for country's development requiring engineering and technological inputs and brings together specialists from such fields as may be necessary for comprehensive solutions to the needs of the country. INAE is an autonomous institution supported partly through grant-in-aid by Department of Science & Technology, Government of India. As the only engineering Academy of the country, INAE represents India at the International Council of Academies of Engineering and Technological Sciences (CAETS).

The Annual Convention of the Indian National Academy of Engineering (INAE) was held during December 6-7, 2012 at Rabindranath Tagore Auditorium, CSIR-CBRI, Roorkee jointly organized by CSIR-Central Building Research Institute and IIT Roorkee under the Presidentship of Dr. Baldev Raj, President of the Academy and President-Research, PSG Institutions, Coimbatore. Prof S K Bhattacharyya, Director CSIR-CBRI Roorkee, President of INAE Local Chapter Roorkee briefed about the major scientific and engineering highlights of the Convention. Technical presentations by ten eminent new Fellows of the Academy who were admitted to the Fellowship during Induction ceremony includes "An Extended Principle of Pseudo-Stochastic Filtering for Structural Optimization and Control" by Prof. Debasish Roy; "Mega Hydro Structures – Bold, Innovative and Impressive Solutions for a Large Dam with engineering challenges : Tehri Dam" by Mr. M Gopalakrishnan; "Power Converters with Improved Performance" by Dr. HM Suryawanshi; "A Computational Perspective on the Regulatory Network of TFs, microRNAs and genes" by Prof. S Bandyopadhyay; "Self Reliance in Manufacturing and Service of Nuclear Power Plant Equipment" by Mr. Anil V. Parab; "Order Reduction in Some Dynamic Systems" by Prof. Anindya Chatterjee; "Design of Efficient Catalysts for Auto Exhaust Purification and other Applications" by Dr. BM Reddy; "Advanced Electromagnetic and Coupled Field Computations For Improving Performance and Reliability of Power Transformers" by Prof. SV Kulkarni; "Compiling for Heterogeneous Accelerator-Based Multicore Architectures" by Prof. Govindarajan Ramaswamy; and by Dr. SV Joshi.

In addition to above, the following technical presentations by INAE Young Engineer Awardees 2012 were also given.

"Development of MEMS based Low Temperature, Low Power Methane Sensor for Underground Coalmine Environment" by Dr. Partha Bhattacharyya; "Modelling, Analysis and Control of Electro-Pneumatic Brakes for Commercial Vehicles" by Dr. C. S. Shankar Ram; "Strategies for Long Duration Aided Inertial Navigation" by Dr. Brajnish Sitara; "Algorithms for Computational Social Science" by Dr. Animesh Mukherjee; "Improving Seismic Performance of Existing Deficient RC Frames using Aluminum Shear Yielding Devices" by Dr. Dipti Ranjan Sahoo; "Studies on Treatment of Wastewater by Physico-Chemical snd Electrochemical Methods, and

Desulphurization of Liquid Fuels" by Dr. VC Srivastava; "Real Parameter Optimization with Differential Evolution – New Variants and Analyses" by Dr. Swagatam Das; "Interfacial Flows: Instabilities during Adhesion, Dewetting, Film Boiling and Atomization" by Dr. Gaurav Tomar; "Novel Carbon Nanomaterials" by Dr. VVSS Srikant.

Every year, the Academy recognizes excellence in Engineering through its awards. This year, Life Time Achievement Award in Engineering was presented to **Prof. P Rama Rao** , Chairman, Governing Council, International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Hyderbad; and **Dr. RA Mashelkar**, National Research Professor, National Chemical Laboratory, Pune; Chancellor, AcSIR & President Global Research Alliance during Award Function on December 6, 2012. Professor Jai Krishna and Professor SN Mitra Memorial Awards 2012 were presented. **Prof. Amitabha Ghosh**, INSA Senior Scientist, Bengal Engineering and Science University, Howrah and **Prof. N Viswanadham**, Formerly Professor of Mechanical Engineering, National University of Singapore, Singapore and Deputy Executive Director, Logistics Institute Asia Pacific, and Former Executive Director, Center for Global Logistics respectively, delivered award lectures on Dec 6, 2012.

Ten young engineers below the age of 35 years were presented INAE Young Engineer Award for excellence in design and technology transfer, innovative development and engineering research work. Innovative Student Projects Award 2012 was also presented at B.Tech level (6), Master's level (5) and Doctoral level (5).

At the Award Function both Prof. P Rama Rao and Dr. RA Mashelkar delivered special lectures.

Dr. R.A. Mashelkar, Chancellor, AcSIR & President Global Research Alliance, National Chemical Laboratory, Pune and Ex Director-General, CSIR, New Delhi was shown important work of various Laboratories of CSIR-CBRI, Roorkee. An interactive session was also arranged with young scientists and students of M.Tech. Programme with Dr. R.A. Mashelkar. On this occasion Abhiwyakti- a magazine prepared by the students was also released.

Inauguration of INAE Annual Convention

Dr. Mashelkar Chancellor, AcSIR, addressing the students

National Conference on Wind Engineering

The two days 6th National Conference on "**Wind Engineering**" was jointly organized by Indian Society for Wind Engineering (ISWE) and CSIR-Central Building Research Institute, Roorkee at New Delhi during Dec. 14-15, 2012.

The conference on "**Wind Engineering**" was inaugurated on Dec., 14th 2012 by Prof. Yukio Tamura, President IAWE, Tokyo Polytechnic University, Japan **(Chief Guest)**, Prof. Prem Krishna, Former President, IAWE & Chairman RC, CBRI, Roorkee and Dr. S. Gangopadhyay, Director, CSIR-Central Road Research Institute, New Delhi graced as **Guests of Honour**. Prof. S. K. Bhattacharyya, Director, CSIR-Central Building Research Institute, Roorkee **presided over** the function. Dr. A.K. Mittal, Organizing Secretary proposed a vote of thanks to the delegates. Eminent speakers as well as chief guest Prof. Yukio Tamura delivered inaugural lecture on the topic of **"Extreme Winds"** and the proceedings of the conference were also released during the inaugural ceremony.

More than 70 delegates from Govt. and private sectors attended the conference and presented technical papers during the conference. Engineers/Professionals from many organizations like CSIR-CBRI, Roorkee, CSIR-SERC, Chennai, CSIR-CRRI, New Delhi, DST, Ministry of Earth Science, Jaypee Associates Ltd., RWDI Consulting Engineers, Mahagun India Pvt. Ltd., ESCOM consultants Pvt. Ltd., and HUDCO attended the conference. Faculty members from IIT Roorkee, SVNIT Surat, Thapar Institute, Patiala and research scholars also participated in this conference.

The key-note lectures were delivered during the conference by Prof. Yukio Tamura, Dr. Suresh Kumar, Prof. S. K. Bhattacharyya, Prof. Kishor C Mehta, Dr. S. Arunachalam, and Prof. Mahesh Tandon on the following topics:

- Extreme Winds
- Wind Tunnel Studies on Tall Buildings
- Health Monitoring of Structures
- Impact of Wind Storm on Urban Centre
- Issues of Wind Loading on Chimneys
- Issue of Wind in the Design of Bridges

Annual General Meeting of ISWE, India was also conducted on Dec., 15th 2012 AN. The AGM was chaired by Prof. P. D. Porey, President ISWE, India.

The valedictory function of the conference was celebrated on Dec., 15th 2012. Prof. Kishor C. Mehta, Texas Tech University, USA, graced the occasion as **Chief Guest**, Dr. Nagesh R. Iyer, Director, CSIR-Structural Engineering Research Centre; Chennai was the **Guests of Honor**. Prof. P. D. Porey, President ISWE, India **presided over** the function. Dr. A.K. Mittal, Organizing Secretary proposed a vote of thanks.

Glimpses of the Conference

Inaugural Function

Valedictory Function

International Conference on Advanced Materials for Energy Efficient Buildings (AME²B–2013)

The international conference on **Advanced Materials for Energy Efficient Buildings (AME²B-2013)** was organized by CSIR-Central Building Research Institute, Roorkee during Feb. 13-15, 2013 at New Delhi. The conference was inaugurated by Prof. Samir K. Brahmachari, DG-CSIR, New Delhi. Prof S P Shah Northwestern University, USA was the Guest of Honour and Prof SK Bhattacharyya, Director CSIR - CBRI, Roorkee presided over the function. The three days long conference had deliberations on advanced materials so as to achieve energy efficiency in buildings. Different thematic sessions such as Nanotechnology based Advanced Materials, Energy Efficient Coatings, Energy Efficient Building Materials & Technologies, Composite Building Materials, Waste to Wealth, Nanotechnology based Cementitious Materials, Sustainable Concrete etc. had presentations by distinguish speakers viz., Prof. I. Manna, Director, IIT Kanpur; Prof. Mark Irle, France; Prof. Chi-sun Poon, Hong Kong; Prof. K. Sobolev, USA; Prof. P. Rohatgi, USA; Prof. LI Zongjin, Hong Kong; Prof. J. Provis, UK; Prof. S.H. Kwon, South Korea etc.

Since Materials and Energy are the core research areas for sustainable growth the conference was organized at the time when the construction of energy efficient building to save energy is at the core in the country's long term growth planning. In recent years awareness of environment aspects has grown up for building construction sector too. Manufacturing process of building material contribute Green House Gasses such as CO_2 to the atmosphere to a great extent. Therefore, there is a great concern and necessity in reducing the GHG emission into environment in order to control adverse ecological effect. Energy requirement of building in developed and developing countries are just opposite to each other. In developed countries a large quantity of energy is used for heating and cooling thus, energy is a recurring requirement whereas, in developing countries most of the energy of a building is in the form of embodied energy of materials and manufacturing processes. Therefore, the research gap for both developed as well as developing countries are different but ultimately leading to energy conservation only. This conference had speakers/delegates from both the segments thus, provide an excellent opportunity to discuss and share their views.

In the rapidly changing scenario of building sector planners, architects, engineers and builders are looking for new materials and technologies to adopt

in future constructions that benefits like energy efficiency, resources & water conservation, improved indoor air quality, life cycle cost reduction and durability. Therefore, to attain these objectives, application of the latest advancements in various technologies including developments in material science, use of environment friendly building materials, obtaining energy efficiency while producing such materials are of prime concern. Considering the devastating effect of climate change the government has launched one approach to reduce the magnitude of these problems is to construct "Green Buildings" that ensure basic living requirement without imposing stress on non-renewable resources. These buildings should be cost effective and time-efficient, while also being environmental friendly with maximum use of "Green Materials".

For last six decades CSIR-CBRI has been engaged in research work on various aspects of building technology. In the process, the institute has developed its core strength in the development of alternative building materials and technologies besides significant contribution in other areas. Over the years, several technologies related to building materials have been developed and successfully commercialized, such as wood substitute, building products, protective coatings for concrete & steel structures, bricks from inferior soils, energy efficient brick kilns, brick making machines, building products and components from argillaceous and siliceous industrial wastes etc. Accordingly, it is essential to develop advanced construction materials using technologies such as nanotechnology, bio-materials, cement-free geopolymer concrete, high performance composite technologies and energy conservation concepts. Further, it is important that the work on use of industrial solid wastes for making green materials and sustainable construction.

Projects

In-house R&D Projects (2012-13)

Sl. No.	Project No.	Title of the Project	Principal Investigator/ Co-Investigator	Duration
New Construction materials				
1.	OLP-0354 (EMPOWER)	Development of Eco-Friendly Component for Fungi Management on Exterior Surface of Building in Sub Tropical Region of India.	Dr. R. K. Verma Dr. Leena Chaurasia	1010-0912
Health Monitoring, Rehabilitation & Strengthen				
2.	OLP-0371	Critical Evaluation of Durability and Response of FRP Upgraded and Rehabilitated Reinforced Concrete Beams.	Sh. H. C. Arora	1012-0914
3.	OLP-0374	Investigations of Foundation System through Borehole Radar.	Sh. Ajay Dwivedi	1012-0514
Disaster Mitigation				
4.	OLP-0373	Across-wind response of high-rise building models of vertically varying rectangular cross sectional shapes with corner chamfered and corner cut (side ratios 1:2 and 1:3).	Dr. Amrit Roy	1012-0913
5.	OLP-0372	Strengthening of stone masonry housing constructions against earthquakes.	Dr. Navjeev Saxena	1012-0914
Energy Efficient System & Other Projects				
6.	OLP-0369	Documentation of CBRI R&D efforts/ achievements of CBRI	Sh. K. L. Chabra	0611-0912
7.	OLP–0375	Development of a process of improving indoor thermal comfort by exchanging heat with under ground water.	Sh. H. K. Jain Dr. P. K. Bhargava Er. Nagesh Babu Balam	0113-0614
8.	OLP-0370	Evolution of publication in the area of duct explosion hazard evaluation, prevention and mitigation based on analysis and compilation of information experimental and theoretical work and knowledge from CSIR-CBRI work and relevant uptodate world wide searched work.	Dr. Manju Mittal	1012-0915
Collaborative Project				
9.	CLP-0110	Infrastructure creation and development of expertise in the area of Cathodic Protection (CP) for RCC Structures	Dr. S. R. Karade	0410-0912
Major Lab Project				
10.	MLP-0501	Study of Flow Behaviour around Building, Fire Propagation Characteristics and health Monitoring of Building	Prof. S. K. Bhattacharyya Dr. Abha Mittal Dr. Ajay Chourasia Dr. Shorab Jain	0710-0912

12th Five Year Plan Projects

S.No.	Project	Project Title, PI & Details
01	ESC 0301 (SINP)	INNOVATIVE MATERIALS & TECHNOLOGIES FOR NEXT GENERATION GREEN BUILDINGS WP-1: Performance Enhancement of Materials through Nanotechnology. PI: Dr. L. P. Singh Task: 04 Nos. 1 Nano-Engineered Cementitious Materials 2 Multifunctional Coating using Nano-Technology Enhancing the Fire Retardancy of Polymeric Materials using Nano-Composites 3 Phase Change Materials WP-2: Next Generation Concrete for Sustainable Construction. Er. S. K. Singh Task: 04 Nos. 1 Cement free Geopolymer Concrete 2 Bio Concrete as Self Healing Material 3 Hybrid Fibre Reinforced Concrete 4 Pervious Concrete for Tropical Climate WP-3: Green Building Technologies. PI: Ar. Ashok Kumar Task: 06 Nos. 1 Green Retrofit Strategies for Office Buildings 2 Demolition Wastes 3 Solar Thermal Air Conditioner 4 Solid Industrial Waste-Resource Geo-Material 5 Technology Packages for Mass Housing 6 Robust Foundation for Difficult Soils WP-4: Materials & Technologies for Hazard Reduction. PI: Dr S.R. Karade Task: 04 Nos. 1 Indigenous Cathodic Protection System 2 Impact Behaviour of RCC 3 Fire Safe Polymeric Composite Panels 4 Improved Ventilation System
02	ESC 0102 Network Project	ENGINEERING OF DISASTER MITIGATION & HEALTH MONITORING FOR SAFE & SMART BUILT ENVIRONMENT WP-1: Engineering of Landslide Disaster Mitigation. PI: Dr. S. Sarkar & Dr. D.P. Kanungo Task: 08 Nos. 1 Landslide Hazard and Risk Assessment of Chamoli-Joshimath Region, Garhwal Himalaya (CSIR-CBRI) 2 Early Warning Instrumentation & Decision Package for a Landslide in Chamoli-Joshimath Region, Garhwal Himalaya (CSIR-CBRI)

12th Five Year Plan Projects

S.No.	Project	Project Title, PI & Details
02	ESC 0102 Network Project	3 GPS based Integrated Landslide Modeling for Hazard Assessment in Chamoli-Joshimath Region, Garhwal Himalaya (CSIR-CMMACS) 4 Landslide Monitoring using SAR Interferometery (CSIR-CSIO) 5 Development of Optical Fibre based Multiplex Sensor Network System for Landslide Monitoring (CSIR-NEIST) 6 Comprehensive Geo-Investigation and Control Measures of Landslide in Chamoli-Joshimath Region, Garhwal Himalaya (CSIR-CBRI) 7 Landslide hazard Information System and Design of Innovative Measures for Landslide Control (CSIR-CRRI) 8 Bio-Engineering – A Phytoremediation Option for the Mitigation of Landslide and Slope Stability Problems in the Hilly Regions (CSIR-NEERI) WP-2 : Engineering of Earthquake Disaster Mitigation PI: Dr. P.K.S. Chauhan & Er. Ajay Chourasia: Task: 03 Nos. 1 Sesmic Microzonation of Srinagar, Uttarakhand (CSIR-CBRI) 2 Sesmic Behaviour of Piles Under Dynamic Lateral Loading (CSIR-CBRI) 3 Sesmic Resistance of Confined Masonary Construction Under Different Axial Stress (CSIR-CBRI) WP-3 : Engineering of Fire Disaster Mitigation PI: Er. R.S.Chimote & Dr. Suvir Singh Task: 03 Nos. 1 Development of Innovative Fire Suppression System (CSIR-CBRI) 2 Fire Performance Evalution of Structural Elements and Rehabiliation Measures (CSIR-CBRI) 3 Development of Fire Resistant Coating on Structural Element (CSIR-CGCRI) WP-4 : Post Disaster Shelter Planning PI: Er. S.K. Negi Task: 02 Nos. 1 Design and Development of Disaster Resistant Intermediate Shelters for Western Himalyan Region (CSIR-CBRI) 2 Post Disaster Management- Design and Development of Transitory Houses for Disaster Vulnerable Rural Sectors in North Eastern Region (CSIR-NEIST) WP-5: Health Monitoring of Buildings Using Wireless Sensor Network. PI: Ajay Chourasia & Er. Soju Alexander Task: 05 Nos. 1 Development of Fiber Bragg Grating (FBG) Sensors and Interrogator System for Buildings (CSIR-CGCRI) 2 Development of Wireless Sensors, Interrogator System and Technnique for Wireless Link for Buildings (CSIR-CSIO)

12th Five Year Plan Projects

S.No.	Project	Project Title, PI & Details
02	ESC 0102 Network Project	3 Design and Development of ARM and FPGA Processor and Sensor Placement Optimization (CSIR-CEERI) 4 Development of Statistical/ Artificial Intelligence (AI) Models to Quantify the Damage State of Buildings (CSIR-CEERI) 5 Collection & Validation of Data Using Developed Sensor, Numerical Modelling, Model Updation and Field Implementation for Building System (CSIR-CBRI) WP-6: Intelligent Building System For Model Residential Unit. PI: Dr. A.K. Mittal & Er. R.S. Bisht Task: 08 Nos. 1 Architectural Planning and Design of a Residential Unit for Integrating Intelligent Building Features (CSIR-CBRI) 2 Intellegent HVAC and Lighting Control in Response to Ambient Environment (CSIR-CBRI) 3 Glass Façade Cleaning Robotics System (CSIR-CBRI) 4 Development of Building Energy Management System Software and Interface Instrumentation (CSIR-CSIO, Chennai) 5 Remote Control of Home Appliances using Mobile or Web Connectivity (CSIR-CMERI) 6 Design and Development of a Communication, Safety and Security System (CSIR-CEERI) 7 Design and Implementation of Robot for Automatic Floor Cleaner Using Wireless Technologies (CSIR-CEERI) 8 Communication Network Architecture for Intelligent Buildings (CSIR-CEERI)
03	Network Projects CSIR-CBRI Participating Laboratory	Removal of heavy metals from waste water using fly ash & secured disposal of the sludge, PI: Er. S. Maiti ***[CSIR-NEERI, "Clean Water: Sustainable Options"]*** Estimation of Crustal Deformation of Garhwal Himalaya, PI : Dr. S. Sarkar ***[CSIR-CMMACS, Advance Research in Engineering & Earth Sciences (ARiEES) : Data Intensive Modelling & Crowd Sourcing Approach]*** Energy Efficient Seed Storage Structures, PI: Er. Nagesh B. Balam ***[CSIR-CSIO, Advanced Instrumentation Solutions for Health Care and Agro – based Applications - ASHA]*** Development of artificial pillars for optimal extraction of locked-up coal, PI: Er. Ajay Chourasia ***[CSIR- CIMFR, Dhanbad]*** Service Robot for Building and other Structures, PI: Er. Ravindra S. Bisht ***[CSIR-CMER, Micro Machines and Robotics]*** Dr. S. K. Senapati ***[CSIR-NISCIR, New Delhi, CSIR Knowledge Gateway & Open Source Private Cloud Infrastructure (KNOWGATE)]***

R&D SUPPORT ACTIVITIES

(Decision Unit 06) ***2012-2013***

S.N.	Activity No.	Activity	Coordinator
1	STS 0001	**Knowledge Resource Centre (KRC)** Library Services, Documentation, Books, Publication and Institutional Depository	Dr. B. Singh Sh. S.K. Senapati
2	STS 0002	**Planning, Monitoring & Evaluation (PME) & ERP Management Services** R&D Projects, RC Agenda (R&D), Project Deployment & APAR, Project Evaluation, Plan Documents, Project Costing, Accounting & Budgeting, Expert Panel, QPR, RUD & Monthly Reports, Parliament, CSIR HQ & Audit Replies, Information Collection, Compilation and Backward & Forward Linkages and Management of Scientific & Technical Queries, Externally Funded Projects & Service Tax	Dr. Sunil K. Sharma Sh. Nadeem Ahmad
3	STS 003	**Research Planning & Business Development (RPBD)** Technology Transfer (Licensing, Patents, etc), Legal Agreements, Trend Assessment Including Feedback, Marketing, Industrial Liaison, etc and Parliament, CSIR HQ & Audit Replies	Dr. Sunil K. Sharma Dr. P.K. Yadav
4	STS 004	**Development Construction & Extension (DC&E)** Inland Liaison Including Exhibitions, Displays, Special Functions & Visitors, Development, Technical Guidance/Aid, & Films, Demonstration, Constructions, Feedback, Information Dissemination & Documentation, Human Resource Management, Overseas Collaboration & Deputation and Liaison with BIS & others and Photography Services	Er. S.G. Dave Sh. H.K. Jain
5	STS 0005	**Extension Centre, Delhi**	Sh. Rajendra Kumar
6	STS 0006	**Computer Laboratory Group**	Dr. Abha Mittal
7	STS 0007	**Institute Publications and Public Relation**	Dr. Atul K. Agarwal
8	STS 0008	**ICT & NKN (IT Support Activities)**	Dr. P.K. Bhargava Sh. Amit Kush

R&D SUPPORT ACTIVITIES

Administrative Support Activities (Decision Unit 08)		**Coordinator**
General Administration & House Keeping		**Director**
1.	Director's Secretariat (DTS)	Director
2.	Administration	COA/AO
3.	Finance & Accounts	F&AO
4.	Store & Purchase	S&PO
5.	Security	Security Officer
6.	Hindi Unit	Hindi Adhikari
7.	Medical Services	Chairman, Medical Committee, Dr. M.K. Sinha (MO I/C)
8.	Divisional Activities including Maintenance of Equipment & Photo Copying Machines, etc	Advisor/Group Leader
9.	Staff Club	Sec. Staff Club
10.	Estate (Civil Works) Civil Works, New Construction, Maintenance, Cleaning & Sanitation Institute Cleaning Services Horticulture Services Water Supply related Services	Dr. S.R. Karade Er. Ajay Singh (Al) Ar. S.K. Negi Dr. P.K. Bhargava Dr. Pradeep Kumar-I
11.	Technical Services Group (TSG) Electrical Services, Air Conditioning, Workshop and Audio System Maintenance of Vehicles PABX System	 Er. D.K. Sehgal Dr. P.K. Bhargava Dr. A.K. Mittal

Externally Funded Projects

Project No.	Project Title	Project PI	Sponsoring Agency
CNP0030	Health Assessment And Remedial Measures For The Repair Of Cooling Towers Of NTPC Simhadri	S. R. Karade	General Manager (PE- Civil), NTPC, Engg Office Complex, A- 8a, Sector- 24, Noida- 201301
CNP0272	Proposed Renovation Of Ancestral Homes Of Late Sh. Hemwati Nandan Bahuguna At Bughani, Srinagar, Pauri Garhwal, Uttarakhand	S. K. Negi	Sanshkriti Vibhag Uttarakhand, MDDA Colony, Chandan Road, Daalanwala, Dehradun
CNP0372	Active Fire Protection Measures For National Institute Of Hydrology, Roorkee	R. S. Chimote	Director, National Institute of Hydrology, Roorkee- 247667
CNP0381	Investigation Of The Distressed Parts/Components Of Parliament House Building And Suggestions For Repair And Rehabilitation	Rajesh Deoliya	Executive Engineer, CPWD, Parliament House Division II, New Delhi 110001
CNP0421	Rehabilitation Of Fire Damaged Collectorate Building At Nainital	Suvir Singh	M/S Executive Engineer Public Work, Department, Nainital
GAP0032	Performance Enhancement Of Cementitious And Polymeric Materials Through Nanotechnology	Lok Pratap Singh	Uttarakhand State Council For Science & Technology (UCOST), Dehradun-248001
GAP0062	Health Monitoring Of Buildings Using Wireless Sensor Network	A. P. Chourasia	Department of Science & Technology, Technology Bhawan, New Mehrauli Road, New Delhi
GAP0072	Demolition Wastes As Raw Materials For Low Cost Construction Products	A. K. Minocha	Department of Science & Technology, Technology Bhawan, New Mehrauli Road, New Delhi
GAP0132	Development Of Technology For Making Flooring And Wall Tiles Using Kota Stone Waste	Rajni Lakhani	Department of Science & Technology, Technology Bhawan, New Mehrauli Road, New Delhi

Externally Funded Projects

Project No.	Project Title	Project PI	Sponsoring Agency
GAP0251	Development of Landslide Prediction Models Using Numerical And Statistical Approaches	Shaifaly Sharma	Department of Science & Technology, Technology Bhawan, New Mehrauli Road, New Delhi
GAP0451	Real Time Surface Movement Instrumentation And Its Integration With Existing System (ARMOL) At Tangni Landslide Site	Y. Pandey	Defence Terrain Research Laboratory (DTRL), DRDO, Ministry of Defence, Metcalfe House, Delhi
GAP0529	Development Of Building Components From Sponge Iron Waste.	Lok Pratap Singh	BMTPC, Core 5A,First Floor, India Habitat Centre, Lodhi Road, New Delhi-110003
GAP3522	Capacity Enhancement Programme On Flyash Utilisation	Lok Pratap Singh	Environmental Management Capacity Building Technical Assistance Project (EMCBTA Project) Ministry of Environment & Forests New Delhi
SSP0071	Assessment Of Residual Strength In Basement Columns & Raft Foundation Of Mega Housing Project Gr1 & Gr2 At Basant Kunj, New Delhi, & Suggesting Strengthening Measures	S. K. Singh	Executive Engineer SWD-4, C/O SE, CC-15, DDA, Sarita Vihar, New Delhi
SSP0152	Spalling Behaviour Of Tunnel Lining Concrete Under High Temperature Loading	Suvir Singh	M/S Addl Gen. Manager (Civil) Ircon International Ltd. JKRL Project Banihal 146182 Distt. Ramban, J & K
SSP0162	Investigation At Sun Temple Konark	A. K. Mittal	Superintending Archaeologist, Archaeological Survey of India, Bhubaneshwar Circle, Bhubaneshwar
SSP0171	Design Of Foundation For Mounded Storage Vessels At IOCL-LPG Plant Cochin	S. Karthigeyan	Mr. R. Gopalkrishnan Deputy General Manager (LPG-Engg.) Indian Oil Corporation Limited Indian Oil Bhavan, G-9, Ali Yavar Jung Marg, Bandra(East), Mumbai-400051
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., 14 & 15 Swarnamoyee Rd., PO Botanic Garden, Howrah - 711103

Externally Funded Projects

Project No.	Project Title	Project PI	Sponsoring Agency
SSP0181	Design And Construction Monitoring Of School Buildings Under Sarva Shiksha Abhiyan	A. K. Mittal	State Project Officer, Sarva Shiksha Abhiyan, Dehradun, Uttarakhand
SSP0182	Capacity Augumentation Of RMP-4 At Muri Works, Hindalco Muri	A. Ghosh	Mr. Bhagwati Sharma, Sr. Manager, M/S Hindalco Industries, Renukut
SSP0190	Study On Effect Of Bulk Density On Thermal Transmission Through Twiga RB Fiberglass For Five Different Temperatures.	B. M. Suman	Asstt. Manager Marketing , UP Twiga Fiberglass Ltd, Twiga House, 3 Community Centre , East of Kailash, New Delhi-65
SSP0211	Studies On Fire And Thermal Behavior Of Prototype RIBS Building Components	Suvir Singh	M/S Reliance Innovative Building Solution Pvt. Ltd., A-3, Mohan Co-Operative Industrial Area, Mathura Road, New Delhi-110044
SSP0231	Suggesting Repair Measures For Rehabilitation Of Pant Sadan, Residence Of Honarable Chief Justice, Uttarakhand	A. K. Mittal	Executive Engineer, Construction Division, PWD, Tallitaal, Nainital
SSP0242	Energy Simulation of Potato Cold Storage Using Different BASF Insulation Products And Recommendation Of Measures For Reducing Energy Consumption	B.M. Suman	Mr. Udipt Agarwal, BASF India Limited, Plot No. 37, Chandivali Farm Road, Andheri(E), Mumbai - 400072
SSP0290	Physical Structural And Material Study Of Qutub Minar	Y. Pandey	Superintending Archaeologist, Archaeological Survey of India, Delhi Circle, Safdarjang Tomb, New Delhi
SSP0302	Comprehensive Geotechnical And Structural Investigation Of Tajmahal	Achal Kumar Mittal	Superintending Archaeologist, Archaeological Survey of India, Agra Circle, Agra 282001
SSP0362	Study On Thermal Behavior Of Twiga RB Fiber Glass With Increasing Temperature At Six Densities Taking As Fix Parameter	B. M. Suman	Mr. S. C. Nathani, Assistant Manager Marketing, UP Twiga Fiberglass Limited, Twiga House 3, East of Kailash, New Delhi-110065

Externally Funded Projects

Project No.	Project Title	Project PI	Sponsoring Agency
SSP0382	Bio Efficiency Studies Of Premise Foam Lmidacloprid (0.05%) For Termite Management In Buildings	B. S. Rawat	Dr. Ashish Dokras, Bayer Cropscience Ltd., BG Bayer Environmental Science, Bayer House, Central Avenue, Hirnandani Gardens, Powai, Mumbai-400076
SSP0392	Fire Extinguishment Studies Of Murli Techno Water-Mist Fire Extinguishers	R. S. Chimote	Mr. Dinesh Chavan M/S Murli Techno Pvt. Ltd. 47, Asiatic Arcade, 2nd Floor, Vartak Nagar, Thane(W) 400606
SSP0401	Remaining Service Life And Health Assessment Of Stage I, Steel And Concrete Structures	A. K. Pandey	M/S NTPC Limited, Rihand Super Thermal Power Station, Rihand Nagar, District Sonebhadra
SSP0440	Studies On Effect Of Natural Exposure For 1 Year On Performance Of Funder Max Panel- A New Project	S. P. Agarwal	Mr. Chandra Shekhar Technical Head, Funder Max India, Brigade Towers, 135 Bridge Road Bengaluru-560025
SSP0461	Repair Of Rain Damaged Embankment Of The Main Ash Pond At Renusagar	A. Ghosh	M/S Hindalco Industries Ltd., Aditya Birla Group, Renusagar Power Division, Renusagar, Sonebhadra
SSP0491	Technical Advice On Ongoing Rehabilitation And Strengthening Work Of Janak Setu Flyover New Delhi	S. K. Singh	Executive Engineer, (Project-II), Municipal Corporation of India, WZ Under Zakhira Flyover, New Delhi
SSP0510	Post Fire Investigation Of Fire Damaged Area Of Collectorate Building And Remedial Measures	Suvir Singh	M/S Executive Engineer Public Works Department Nainital
SSP0570	Performance Evaluation Of Recron 3s Polyester Micro Fiber Reinforced Concrete In Structures	S. K. Singh	Sri Rajiv Gauri, General Manager, Reliance Industries Ltd. (Fiber Marketing Division) A-3 Mohan Cooperative, 2nd Floor, Mathura Road, New Delhi-110044
SSP0939	Comprehensive Study For Rehabilitation Of People Affected By Max Pond Level Of 1108m Joshiyara Barrage, Uttarkashi	A. K. Sharma-I	DGM(Const)., Office of The Dy. General Manager (Const)., Pala Maneri Project(480 Mw) Bhatwari, Uttarakhand Jal Vidyut Nigam Limited, Camp Office, Maneri- Uttarkashi Pin 249194

Externally Funded Projects

Project No.	Project Title	Project PI	Sponsoring Agency
TSP0281	Performance Evaluation Of Ip-Net Paints To Be Used In Gauge Conversion Of Mayiladuthurai-Thiruvarur-Karaikkudi	P. C. Thapliyal	Executive Engineer(Gauge Conversion) Office of The Executive Engineer Southern Railway Mayiladuthurai Thiruchirappali, Tamilnadu
TSP0481	Performance Evaluation Of Ipnet Paints To Be Used In Godavari Bridge At Rajahmundry, Andhra Pradesh By South Central Railway Vijayawada	P. C. Thapliyal	M/S Kotson Engineering Corporation 18-12-16, Andhra Ratna Road, Tenali-522201, Andhra Pradesh
TST0012	Fire Performance Assessment Of Fire Rated Doors	Suvir Singh	M/S Ahlada Engineers Pvt. Ltd. Sy#66-68, Bahadurpally (V), Qutubullapur Mandal, R.R. Distt., Hyderabad 500043
TST0022	Fire Performance Assessment Of Fire Dampers	Suvir Singh	M/S MSD Technologies, R-169, Jalvayu Vihar, Sector-30, Gurgaon-122001, Haryana
TST0042	Reaction To Fire Characteristic Studies On PUF Panel	A. A. Ansari	M/S Pal System India Pvt. Ltd., Gate No. 457 & 458, Village: Shindewadi-Shirwal, Sub District-Khandala, Distt. Satara Near Pune-412808
TST0052	Fire Performance Assessment Of Fire Doors	Suvir Singh	M/S Shakti Met-Door Limited, Plot No. 20, Sripuri Colony Karkhana, Secunderabad
TST0082	Fire Performance Assessment Of Steel Fire Door	Suvir Singh	M/S Ahura Mazda Mfg Co. Pvt. Ltd. Mazda House, Behind L.B.S. Marg Ghatkopar(W), Mumbai.
TST0092	Fire Performance Assessment Of Fire Door	Suvir Singh	M/S Delhi Estate Industrial & Infr. Development Corporation Ltd. Technical Center Building, Wazipur Industrial Area, Delhi
TST0102	Fire Performance Assessment Of Fire Door	Suvir Singh	M/S Futura Door Products Pvt. Ltd. Gut No. 209, Borate Vasti Moshi, Moshi-Dehu, Pimpri,Pune-412105

Externally Funded Projects

Project No.	Project Title	Project PI	Sponsoring Agency
TST0111	Burglary Resistance Assessment Of Safe-Class-Bb	Suvir Singh	M/S Methodex Systems LTD. 35-A Fort Industrial Estate Indore-452006
TST0112	Fire Performance Assessment Of Fire Door	Suvir Singh	M/S Air Master Equipment India(P) Ltd. #1 C.K. Palya Road Ommadevanahalli Bangalore-560083
TST0121	Reaction To Fire Characteristic Studies On PIR Panels	A. A. Ansari	M/S Aasawa Insulations Pvt. Ltd. Plot No. 52 & 53, Arkose Industrial Estate, Sajgaon, Takai, Adoshi Road Khalapur, Khapoli (Distt. Raigarh), Maharashtra State
TST0122	Fire Performance Assessment Of Fire Doors	Suvir Singh	M/S Airport Authority of India, AAI, Project Site Office, NSCBI Airport, Kolkata-700052
TST0131	Fire Performance Assessment Of Fire Doors	Suvir Singh	M/S Delhi Metro Rail Corporation Office of CPM(S), NBCC Campus, Mehrauli, Gurgaon Road Ghitorni, Delhi-110030
TST0141	Fire Characteristic Studies On Slat (Wood Panel)	A. A. Ansari	Anutone Acoustic Ltd. 231/2, 7th Cross, Indiranagar, 1st Stage Bangaluru - 560038
TST0142	Fire Performance Assessment Of Motorised Rolling Shutter	Suvir Singh	M/S Avions Innovations Tec. Pt. Ltd., 615/25 Pradhikaran, Nigdi, Pune-44
TST0151	Fire Performance Assessment Of Fire Doors	Suvir Singh	The Executive Engineer INA Project Division, CPWD, New Delhi-110023
TST0172	Reaction To Fire Characteristic Studies On MFMB	Sunil K Sharma	M/S U.P. Twiga Fiber Glass Limited, Twiga House, 3 Community Center, East of Kailash, New Delhi-110065

Externally Funded Projects

Project No.	Project Title	Project PI	Sponsoring Agency
TST0191	Fire Performance Assessment Of Uninsulated Fire Door	Suvir Singh	M/S Shakti Met-Door Limited, Plot No 20, Sripuri Colony, Karkhana, Secunderabad-500015
TST0192	Fire Performance Assessment Of Fire EC 43 Ablative Coated Cable	Suvir Singh	M/S Stanvac Chemicals(I) Ltd., 15-16, Old Seva Nagar Mkt., Lodhi Road, New Delhi
TST0202	Fire Performance Assessment Of M.S. Fire Door	Suvir Singh	M/S Decora Paint Pvt. Ltd., 110, 1st Floor, Earth Complex, Nr. Seema Party Plot, 100 Ft. Road, Satelite, Ahmedabad-380015
TST0212	Fire Performance Assessment Of Fire Door	Suvir Singh	M/S Radiant Safedoors Pvt. Ltd., 539 Phase II, GIDC Vatva, Ahmedabad-382445
TST0221	Fire Performance Assessment Of Steel Tech Fire Door	Suvir Singh	M/S Steel Tech Industries R.S. No. 60, Pattanpur Village Pondy-Tindivanam Main Road, Auroville P.O. Tamilnadu - 605101
TST0222	Fire Performance Assessment Of Elevator Door	Suvir Singh	M/S Kone Elevators India Pvt. Ltd., India Land Tech Park Tower B, 3rd Floor No. 14, 3rd Main Road, Ambattur Industrial Estate, Chennai 600058
TST0232	Fire Performance Assessment Of S.S. Fire Door	Suvir Singh	M/S Radiant Safedoors Pvt. Ltd., 539 GIDC Ph. II, Vatva, Ahmedabad-382445
TST0241	Study On Density Effect Of Thermal Performance Of Perlite And Perlite Products	B. M. Suman	Mr. Sudhakar Shenoy G.M. Production And Technical Keltech Energies Ltd., 32/1-2, 6th Floor, Crescent Tower, Crescent Road, Bangaluru-560001
TST0252	Fire Performance Assessment Of Penetration Seal System	Suvir Singh	M/S Vijay System Engineers Pvt. Ltd., 35, Chandivali Village, Off. Sakivihar Road, Andheri(E), Mumbai-400072

Externally Funded Projects

Project No.	Project Title	Project PI	Sponsoring Agency
TST0262	Fire Performance Assessment Of Fire 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. Mahatama Gandhi Rd., Secunderabad-500003
TST0282	Fire Performance Assessment Of Fire Door	Suvir Singh	M/S Swadeshi Civil Infrastructure Pvt. Ltd., 302 DLF Towers B, Jasola, New Delhi 110025
TST0291	Fire Performance Assessment Of Fire Check Door	Suvir Singh	M/S Navair International Ltd. 56/17, 2nd Floor Kalkaji Extension, Guru Ravidas Marg New Delhi - 110019
TST0292	Fire Performance Assessment Of Fire Door	Suvir Singh	M/S Tecno Doors Pvt. Ltd., Plot No. LI, SIPCOT Industrial Park,Mambakkam & Pondur A Village, Sriperumbudur Taluk, Kancheepuram District 602106
TST0311	Fire Performance Assessment Of Fire Check Door	Suvir Singh	M/S Air Master Equipment India (P) Ltd. #11, C.K. Palya Road Ommadevanahalli Gottigere, Post Bannerghatta Road, Bangalore 560083
TST0312	Fire Performance Assessment Of Fire Door	Suvir Singh	M/S Ahura Mazda Mfg. Co. Pvt. Ltd., Mazda House Behind LBS Marg, Ghatkopar(W), Mumbai-400086
TST0321	Fire Resistance Evaluation Of Gunnebo Strong Room Doors	Suvir Singh	M/S Gunnebo India Pvt. Ltd. Plot No. 1302/1306 GIDC Industrial Estate Halol Distt. Panchmahals Gujarat
TST0322	Fire Performance Assessment Of Fire Rated Doors	Suvir Singh	M/S Kutty Flush Doors And Furniture Co. Pvt. Ltd., 1167, Poonamalle High Road,, Koyambadu, Chennai-600107
TST0332	Fire Performance Assessment Of Wooden Fire Door	Suvir Singh	M/S Kindle Fire Protection, D-293 C, Gali No. 5, Mangle Bazar Road, Near Kaushal Timber & Plywood Store, Sangam Vihar, Opp. Batra Hospital, New Delhi-62

Externally Funded Projects

Project No.	Project Title	Project PI	Sponsoring Agency
TST0341	Fire Performance Assessment Of RIBS Building Components	Suvir Singh	M/S Reliance Innovative Building Solutions Pvt. Ltd. A-3 Mohan Co-Operative Industrial Area Mathura Road New Delhi
TST0342	Fire Performance Assessment Of Fire Door	Suvir Singh	M/S Synergy thrislington, P.O. Manjholi, Vill. Bedplasi, Tehsil-Nalagarh, Distt. Solan, H.P.
TST0351	Fire Performance Assessment Of Fire Check Door	Suvir Singh	M/S Saviour Fire Retardent Systems 15, Nisang Bunglows, Near Amar Complex Behind Nav Rachna School Sama Road Vadodra 380008
TST0352	Fire Performance Assessment Of Fire Dampers	Suvir Singh	M/S Ruskin Titus India Pvt. Ltd.
TST0361	Fire Performance Assessment Of M.S. Check Door	Suvir Singh	M/S Decora Paint Pvt Ltd. 110 1st Floor, Earth Complex Nr. Seems Party Plot. 100 Ft Road Satellite, Ahmedabad 380015
TST0371	Fire Performance Assessment Of Fire Door	Suvir Singh	M/S Airport Authority of India Jaipur Airport Project, Jaipur - 302011
TST0391	Reaction To Fire Characteristic Studies On Paint On Cement Concrete Panel	A. A. Ansari	M/S Berger Paints India Limited Berger House, 129, Park Street, Kolkata 700017
TST0402	Fire Performance Assessment Of Elevator Door	Suvir Singh	M/S Kone Elevators India Pvt. Ltd., India Land Tech Park, Tower B, 3rd Floor, No. 14, 3rd Main Road, Ambattur Industrial Estate, Chennai - 600058
TST0411	Fire Performance Assessment Of Elevator Door	Suvir Singh	M/S Kone Elevators India Pvt. Ltd. India Land Tech Park, Tower B, 3rd Floor, No. 14, 3rd Main Road, Ambattur Industrial Estate, Chennai - 600058

Externally Funded Projects

Project No.	Project Title	Project PI	Sponsoring Agency
TST0412	Fire Performance Assessment Of Protected Steel Sections	Suvir Singh	M/S Carboline(I) Pvt. Ltd., 516/517 D Wing III Floor, Vashi Plaza Sector 17, Vashi, Navi Mumbai-400703
TST0431	Fire Performance Assessment Of Fire Door	Suvir Singh	M/S Nicomac Clean Rooms Far East(P) Ltd. Plot No. 10 I.D.A. Bollaram, Near Miyapur Medak Dist. Hyderabad 502325
TST0432	Performance Evaluation Of Ipnet System To Be Used In PSC Girders Across Godavari Bridge At Vijaywada-Vishakhapatnam Section, Andhra Pradesh By South-Central Railway, Rajahmundry	P. C. Thapliyal	M/S Kotson Engineering Corporation, 18-12-16, Andhra Ratna Road, Tenali-522201, Andhra Pradesh
TST0441	Fire Performance Assessment Of Fire Door	Suvir Singh	M/S Omega Elevators 5/C, Archana Industrial Estate Opp. Ajit Mills Rakhial Ahmedabad 380023
TST0471	Fire Performance Assessment Of Fire Door	Suvir Singh	M/S Gmpp Technical Solutions Pvt. Ltd. Gunai Road, Mandala, Via Barotiwala Dist. Solan H.P.
TST0501	Fire Resistance Evaluation Of Gunnebo Safe	Suvir Singh	M/S Gunnebo India Pvt. Ltd. Plot No. 1302/1306 GIDC Industrial Estate Halol, Distt. Panchmahals Gujarat
TST0511	Fire Performance Assessment Of Ceiling System	Suvir Singh	M/S Promat International Asia Pacific II Rm 1010, C.C. Wu Building 302-308, Hennessy Road, Wanchal Hongkong
TST0521	Fire Performance Assessment Of Mortice Lock Door	Suvir Singh	M/S Kansen New Zealand Limited, 827 Manukau Road Royal Oak Auckland-1061 Po Box 24-157 Auckland-1345, New Zealand

Colloquium

COLLOQUIUM

4th April 2012, Protective Coatings- Present Scenario & Future Challenges	Dr. P.C. Thapliyal, Principal Scientist, CSIR-CBRI, Roorkee
13th April 2012, Strategies for Effective Patent Search	Dr. S R Karade, Principal Scientist, CSIR-CBRI, Roorkee
18th April 2012, Advances in Mobile Robotics: Current Research & Applications	Shri Ravindra Singh Bisht, Scientist, CSIR-CBRI, Roorkee
2nd May 2012, Bio-degradable Eco-pots from Forest Waste	Dr. S. P. Agrawal, Chief Scientist, CSIR-CBRI, Roorkee
9th May 2012, Service Life Prediction of RC Structures in Aggressive Environment	Dr.Rajesh Deoliya, Principal Scientist, CSIR-CBRI, Roorkee
16th May 2012, Landslide Research – Excerpts from 2nd World Landslide Forum	Dr. S. Sarkar, Sr. Principal Scientist, CSIR-CBRI, Roorkee
30th May 2012, Concrete Sustainability & Recycling of C & D Waste	Shri S. K. Singh, Principal Scientist, CSIR-CBRI, Roorkee
6 th June 2012, Programme on S &T Communication and Presentation Skills	Dr. R. K. Verma, Senior Scientist, CSIR-CBRI, Roorkee
20th June2012 ,Piles for Stabilization of Slopes	Dr. S. Karthigeyan Principal Scientist, CSIR-CBRI Roorkee
26th June 2012,Wind Loads on Tall Chimneys due to Vortex Shedding	Dr. S.Arunachalam Advisor CSIR-SERC, Chennai
18th July 2012 , Indoor Air Pollution – Threat or Hype?	Shri S. Ibrahim Sohel, Scientist, CSIR-CBRI, Roorkee
1st August 2012, Health Monitoring of Structural systems	Dr. S. K. Panigrahi, Sr. Scientist, CSIR-CBRI, Roorkee
24th September 2012 ,CBRI Cost Effective Technologies: Case Study (CSIR Foundation Day Lecture)	Shri Promod Adlakha, Architect, Consultant & Managing Director, M/s Adlakha Associates Pvt Ltd., Delhi
19th December 2012, Smart Sensors	Mr. Soju Alexander, Scientist, CSIR-CBRI, Roorkee
02nd January 2013, Tall Buildings: Research Issues	Prof. S.K. Bhattacharyya, Director, CSIR-CBRI Roorkee
09th January 2013, Cable Roof- An Overview	Prof. Prem Krishna, Chairman, RC: CSIR-CBRI, Roorkee
30th January 2013 Architecture and Engineering of Taj Mahal	Prof. S.C. Handa, DG, Quantum Globlal Campus, Roorkee
06th Feburary 2013, Phase Change Materials for Energy Efficient Buildings.	Sh. Srinivasarao Naik, Scientist, CSIR-CBRI,Roorkee
13th March 2013,Pervious Concrete	Sh. Subhas Chandra Bose Gurram, Scientist, CSIR-CBRI,Roorkee

CBRI Family

CBRI Family as on 31 March 2013

Group-IV-Scientific Staff

Sl.No.	Name	Designation
1	Prof. S.K. Bhattacharyya	Director
2	Dr. B.K. Rao	Chief Scientist
3	Sh. A. Ghosh	Chief Scientist
4	Dr. Sunil K. Sharma	Chief Scientist
5	Dr. P.K. Bhargava	Chief Scientist
6	Sh. R.K. Garg	Chief Scientist
7	Dr. S.P. Aggarwal	Chief Scientist
8	Sh. Y. Pandey	Chief Scientist
9	Dr. A.K. Minocha	Chief Scientist
10	Sh. R.S. Chimote	Chief Scientist
11	Dr. Brijeshwar Singh	Chief Scientist
12	Dr. (Ms.) Manju Mittal	Sr. Principal Scientist
13	Dr. (Mrs.) Abha Mittal	Sr. Principal Scientist
14	Dr. Suvir Singh	Sr. Principal Scientist
15	Dr. N.K. Saxena	Sr. Principal Scientist
16	Dr. Shailash K. Aggarwal	Sr. Principal Scientist*
	On lien in BMTPC, New Delhi w.e.f. 16.01.2008	
17	Dr. A. K. Pandey	Sr. Principal Scientist
18	Smt. Neeta S. Mittal	Sr. Principal Scientist
19	Sh. Ashok Kumar	Sr. Principal Scientist
20	Sh. S.K. Negi	Sr. Principal Scientist
21	Dr. Shantanu Sarkar	Sr. Principal Scientist
22	Dr.(Ms.) Mridul Garg	Sr. Principal Scientist
23	Dr. Harpal Singh	Sr. Principal Scientist
24	Dr. Manorama Gupta	Sr. Principal Scientist
25	Dr. Atul Kumar Agarwal	Sr. Principal Scientist
26	Dr. Pardeep Kumar-I	Principal Scientist
27	Dr. R. Dharma Raju	Principal Scientist*
	*On deputation in Disaster Management Centre, Mysore w.e.f. 09.4.2008	
28	Sh. A.K. Sharma-I	Principal Scientist
29	Sh. Rajendra Kumar	Principal Scientist
30	Sh. A. A. Ansari	Principal Scientist
31	Dr. Rajni Lakhani	Principal Scientist
32	Dr. D.P. Kanungo	Principal Scientist
33	Dr. Achal Kumar Mittal	Principal Scientist
34	Sh. S.R. Karade	Principal Scientist
35	Sh. Nadeem Ahmed	Principal Scientist
36	Dr. Sujit Kumar Saran	Principal Scientist
37	Dr. Rajesh Deoliya	Principal Scientist
38	Dr. Navjeev Saxena	Principal Scientist
39	Sh. S.K. Jain	Principal Scientist
40	Sh. A.P. Chourasia	Principal Scientist
41	Sh. S.K. Singh	Principal Scientist
42	Dr. P.C. Thapliyal	Principal Scientist
43	Dr. B.S. Rawat	Principal Scientist
44	Dr. Pradeep Kumar II	Sr. Scientist
45	Dr. Rajesh K. Verma	Sr. Scientist
46	Sh. Shorab Jain	Sr. Scientist
47	Dr. S.K. Panigrahi	Sr. Scientist
48	Sh. H.C. Arora	Sr. Scientist
49	Dr. P.K.S. Chauhan	Sr. Scientist
50	Dr. Leena Chourasia	Sr. Scientist
51	Dr. L.P. Singh	Sr. Scientist
52	Dr. Neeraj Jain	Sr.Scientist
53	Sh. Vineet Kumar Saini	Scientist
54	Sh. Syed Ibrahim Sohel	Scientist
55	Sh.Subham Dastidar	Scientist
56	Sh. Ravindra Singh Bisht	Scientist
57	Sh.Nagesh Babu Balam	Scientist
58	Sh. Manojit Samanta	Scientist

59	Sh.Soju Joseph Alexander	Scientist
60	Sh. Somitra Maiti	Scientist
61	Sh. Srinivasa Rao Naik B	Scientist
62	Sh. Subash Chandra Bose Gurram	Scientist
63	Dr. A. Aravind Kumar	Scientist
64	Ms.Parvathi A.V.	Scientist
65	Sh.Anindya Pain	Scientist
66	Sh.Micky Mecon Dalbehera	Scientist
67	Sh.Piyush Mohanty	Scientist
68	Sh.Randhir Kumar Choudhary	Scientist
69	Sh.Siddharth Behera	Scientist
70	Ms. Trannum Meraj	Scientist

Group III Technical Staff

71	Dr. Rajiv Kumar	Principal T.O.
72	Sh. H.K. Jain	Principal T.O.
73	Sh. Ramesh Chandra	Principal T.O.
74	Sh. D.K. Sehgal	Principal T.O.
75	Sh. Sudhir Sharma	Principal T.O.
76	Sh. Narendra Kumar	Sr.T.O. (3)
77	Dr. B.M.Suman	Sr.T.O. (3)
78	Sh. Rajesh Kumar	Sr.T.O. (3)
79	Sh. Prakash Chand	Sr.T.O. (3)
80	Sh. Rajeev	Sr.T.O. (3)
81	Sh. Jaswinder Singh	Sr.T.O. (3)
82	Dr. P.K. Yadav	Sr.T.O. (3)
83	Sh. Bhupal Singh	Sr.T.O. (3)
84	Sh. S.K. Senapati	Sr. T.O. (3)
85	Sh. Dalip Kumar	Sr.T.O. (3)
86	Sh. S.K. Gupta	Sr.T.O. (2)
87	Sh. Rajeev Kumar Sharma	Sr.T.O. (2)
88	Dr. M.K. Sinha	Sr.T.O. (2)
89	Sh. Sushil Kumar	Sr. T.O. (2)
90	Sh. Zamir Ahmad	Sr. T.O. (2)
91	Sh. A.K. Jain	Sr. T.O.(1)
92	Sh. Rakesh Kumar –II	Sr. T.O.(1)
93	Sh. Vivek Sood	Sr. T.O.(1)
94	Sh. Jalaj Prashar	Sr. T.O.(1)
95	Sh. Naresh Kumar	Sr. T.O.(1)
96	Sh.Ram Ashray Rai	Sr. T.O.(1)
97	Sh. Bharat Bhushan	Sr. T.O.(1)
98	Sh. Rajesh R. Ghadse	Sr.T.O.(1)
99	Sh. B.K. Kalra	T.O.
100	Sh. Itrat Amin Siddiqui	T.O.
101	Sh. Amit Kush	T.O.
102	Mrs. Deepti Karmakar	T.O.
103	Sh. Ajay Dwivedi	T.A.
104	Mrs. Gayatri Devi	T.A.
105	Sh. Sameer	T.A.
106	Sh.D.S. Dharamshaktu	T.A.

Group II

107	Sh. Shiv Dass	Sr. Tech.(2)
108	Sh. Virendra Singh	Sr. Tech.(2
109	Sh. R.P. Gupta	Sr. Tech.(2)
110	Sh. Rizwanul Hasan	Sr. Tech (2)
111	Sh. Rajinder Kumar	Sr. Tech. (2)
112	Sh. Kirpal Singh	Sr. Tech. (2)
113	Sh. Govind Singh	Sr. Tech. (2)
114	Sh. Gopal Chand	Sr. Tech .(2)
115	Sh. Bishan Lal	Sr. Tech. (2)
116	Sh. Har Sagar Sharma	Sr. Tech. (2)
117	Sh. P.K. Yadav	Sr. Tech .(2)
118	Smt. Neelam Gupta	Sr. Tech. (2)
119	Sh. Prem Singh	Sr. Tech.(2)
120	Smt. Sangeeta Sharma	Sr.Tech.(1)
121	Sh. Sheeraj Ahmad	Sr. Tech.(2)
122	Smt. Saroj Rani	Sr. Tech.(2)
123	Sh. Anil Kumar Sharma	Sr.Tech.(1)
124	Sh. Manmeet Singh	Sr.Tech.(1)
125	Smt. Urmila Kotnala	Sr.Tech.(1)
126	Sh. Rishi Pal Singh	Sr.Tech.(1)
127	Sh. Sushil Kumar	Sr.Tech.(1)
128	Sh. Himanshu Sharma	Sr.Tech.(1)

129	Sh Amar Singh	Tech. (2)
130	Sh Shiv Prakash Tyagi	Tech. (2)
131	Sh B.S. Bisht	Tech. (2)
132	Sh Rajeev Bansal	Tech. (2)
133	Sh Pradeep Kr. Kapooria	Tech. (2)
134	Sh Arvind Saini	Tech. (2)
135	Sh Ashwani Kumar Mishra	Tech. (2)
136	Sh Harish Kumar	Tech. (2)
137	Sh Sukhbir Sharma	Tech. (2)
138	Sh Arvind Kumar	Tech. (2)
139	Sh Kedar Nath	Tech. (2)
140	Sh Santosh Kumar Mishra	Tech. (2)
141	Sh Sharad Kumar	Tech. (2)
142	Sh Mam Chand Agarwal	Tech. (2)
143	Sh.Arvind Kumar Sharma	Tech.(2)
144	Sh Tahir Husain	Tech. (2)
145	Sh Ghanshyam Mittal	Tech. (2)
146	Sh Francis Charles	Tech. (2)
147	Sh Iqubal Ahmed	Tech. (2)
148	Sh Manoj Kumar Tyagi	Tech. (2)
149	Sh Jai Pal	Tech. (2)
150	Sh Shorab Khan	Tech. (2)
151	Sh Jameel Hasan	Tech. (2)
152	Sh U.C. Bhatnagar	Tech. (2)

Group I Supporting Staff

153	Sh Harpal Singh	Lab. Asstt.
154	Sh D.P. Yadav	Lab. Asstt.
155	Sh Sita Ram	Lab. Asstt.
156	Sh Yakub Ali	Lab. Asstt.
157	Sh Amar Singh (SE)	Lab. Asstt.
158	Sh Deepak Singh	Lab. Asstt.
159	Sh Vijay Kumar(SE)	Lab. Asstt.
160	Sh Shyam Lal(SE)	Lab. Asstt.
161	Sh Gurucharan Singh	Lab. Asstt.
162	Sh Rajeshwar	Lab. Asstt.
163	Sh Rishi Pal (SE)	Lab. Asstt.
164	Sh Vijay Kumar	Lab. Asstt.
165	Sh Jai Pal Singh	Lab. Asstt.
166	Sh Vishwas Kumar	Lab. Asstt.
167	Sh Abhay Dass	Lab. Asstt.
168	Sh Jagdish Pal	Lab. Asstt.
169	Sh Deepak Kumar	Lab. Asstt.
170	Sh Hira Lal	Lab. Asstt.
171	Sh Subhash Chand	Lab. Asstt.
172	Sh Shiv Kumar (SE)	L. A. Gr.I (4)
173	Sh Rajender Kumar Arya	Lab. Attd.
174	Sh Rajesh Kumar	Lab. Attd.

House-Keeping/ Administrative Staff

175	Sh Anil Kumar	A.O.
176	Sh S.P.Singh	S&PO
177	Sh R.C. Saxena	Sr. H.O.
178	Sh Saluddin Ansari	S.O. (S&P)
179	Sh Babu Ram	S.O. (F&A)
180	Sh J.K. Chaurasia	S.O. (F&A)*

*On deputation from 13.12.2012 for 3 years in NIH Roorkee

181	Sh. Dheeraj	S.O. (F&A)
182	Sh. Alok Sharma	S.O. (G)
183	Sh. S.K. Jakhwal	S.O. (G)
184	Ms. Rashmi Devi	S.O. (G)
185	Sh. Amarjeet Singh	S.O. (G)
186	Sh. S.P. Kapil	P.S.
187	Sh. K. Arora	P.S.
188	Sh. V.P.S. Rawat	Sec. Officer
189	Sh.B.K. Sharma	Sec. Officer
190	Sh. Satya Pal	Sr.Seno
191	Sh. Naresh Yadav	Sr.Steno
192	Sh. Rajinder Kumar	Sr.Steno
193	Mrs. Archana	Sr.Steno
194	Sh. Arvind Kumar	Sr.Steno
195	Sh. Dalpat Singh	Sr.Steno

196	Sh. Dharam Singh Negi	Sr.Steno
197	Mrs. Padma Kumary S	Sr. Steno
198	Sh. V.K. Sharma	Asstt. (G) Gr.I
199	Sh. Constan Kujur	Asstt. (G) Gr.I
200	Smt. Nisha Tyagi	Asstt. (G) GR.I
201	Sh. Saroj Sethi	Asstt. (G) GR.I
202	Mrs. Sarita Khanna	Asstt. (G) GR.I
203	Mrs. Sheema Farhat	Asstt. (G) GR.I
204	Sh. R.K. Johar	Asstt. (G) GR.
205	Sh. Sudhir Kumar	Asstt. (G) GR.I
206	Sh. Yogesh Kumar	Asstt. (G) GR.I
207	Sh. Shiv Kumar	Asstt. (G) GR.I
208	Mrs. Sunita	Asstt. (G) GR.I
209	Sh. Pawan Kumar	Asstt. (G) GR.I
210	Mrs. Mamta Sharma	Asstt. (G) GR.I
211	Sh. Virendra Singh	Asstt. (F&A) GR.I
212	Sh. Aman Kumar	Asstt. (F&A) GR.I
213	Sh. Vipin Kumar Sharma	Asstt. (F&A) GR.I
214	Sh. Suraj Pal Singh	Asstt. (F&A) GR.I
215	Sh. Satyarth Prakash	Asstt. (F&A) GR.I
216	Smt. Rubina Zaidi	Asstt. (F&A) GR.I
217	Sh. Sanjeev Bansal	Asstt. (S&P) GR-I
218	Mrs. Anju Rani Simon	Asstt. (S&P) GR.I
219	Sh. Arpan Maheshwari	Asstt. (S&P) GR.I
220	Sh. Kalam Singh Chauhan '	Asstt. (S&P) GR.I
221	Sh. Vishwash Tyagi	Asstt. (S&P) GR.I
222	Sh. Mehar Singh	Sr.Trans.
223	Sh. Suba Singh	Sr.Trans.

Group C

224	Sh Dhram Pal Singh	Asstt.(G) GR.II
225	Smt.Arun Lata	Asstt.(G) GR.II
226	Sh Sushil Kumar	Asstt.(G) GR.II
227	Sh Sanjay Kr. Tyagi	Asstt.(G) GR.II
228	Smt. Seema Ahuja	Asstt.(G) GR.II
229	Sh Ravinder Kumar	Asstt.(G) GR.II
230	Sh Vijay Kumar-II	Driver (NT)
231	Sh Rajendra Singh	Driver (NT)
232	Sh Radhey Shyam	Driver (NT)
233	Sh Sushil Kumar	Driver (NT)
234	Sh M. Ramakrishna	Driver (NT)
235	Sh. Satya Pal	Daftri
236	Sh.Naresh	Safaiwala
237	Sh.Sant Ram	Farrash
238	Sh.Nanak Chand	Safaiwala
239	Sh.Ram Samajh	JSG
240	Sh.Raj Kumar	JSG
241	Sh.Lakshmi Chand	Chowkidar
242	Sh.Kailash Chand	Peon
243	Smt.Usha	Farrash
244	Sh.Mukesh Kumar	Peon
245	Smt.Kusum Lata	Peon
246	Smt. Bala	Safaiwali
247	Sh.Subhash Chand	Peon
248	Sh.Inder Pal (ACP)	Peon
249	Sh.Desh Raj	Peon
250	Sh.Rakesh Kumar	Peon
251	Sh.Ramesh Kumar	Peon
252	Sh.Santosh Kumar	Peon
253	Sh.Rakesh Kumar	Peon
254	Sh.Krishna Gopal Thakur	Peon
255	Sh Mani Ram	Peon
256	Sh.Rohitash Kumar	Peon
257	Mohd Naem	Peon
258	Sh.Radhey Shyam	Peon
259	Sh.Ranbeer Singh	Peon
260	Sh.Devendra Kumar	Farrash
261	Smt. Prakash Kaur	Farrash
262	Smt. Anju	Farrash
263	Sh.Khalil Ahmead	Farrash
264	Sh.Subhan Singh	Peon
265	Sh.Anit Kumar Pal	Peon
266	Sh.Pritam Giri	Peon
267	Sh.Pooranvassi	Farrash
268	Sh.Kirat Pal	Peon

269	Sh.Kiran Pal	Peon
270	Sh.Rajesh Kr. Yadav	Group-D (NT)
271	Sh.Jai Prakash	Group-D (NT)
272	Sh.Ranjeet Singh	Group-D (NT)
273	Sh.Satya Pal	Group-D (NT)
274	Sh.Satya Pal Singh	Group-D (NT)
275	Sh. Satish Kumar	Group-C (NT)
276	Sh.Mehraj Deen Khan	Group-C (NT)
277	Sh.Dharam Pal	Group-D (NT)
278	Sh.Sunil Kumar	Group-D (NT)
279	Sh. Dharam Singh	Group-D (NT)
280	Sh.Baljeet Singh	Counter Clerk-ACP-II
281	Sh.Rakesh	Tea Maker (ACP-I)
282	Sh.Arun Kumar	Bearer ACP-II
283	Sh.Ravinder Kumar	Bearer-ACP
284	Sh.Dil Bahadur	Bearer-ACP
285	Sh.Rajender Pal	Bearer-ACP
286	Sh.Malkhan Singh	Wash Boy / Bearer
287	Sh.Dheer Singh	Wash Boy-ACP

Superannuation

Following Staff members superannuated from CSIR-CBRI family during the year

Sh. C.S. Mayal	Sr. Tech. 2	31.05.2012
Sh.M.P. Singh	Chief Scientist	31.07.2012
Dr.S.K. Agarwal	Sr. Principal Scientist	31.07.2012
Sh.Surender Singh	P.S.	31.08.2012
Sh.Kuldeep	Sr. Tecnnician	31.08.2012
Sh.Dinesh Chandra	Sr. Technician	31.08.2012
Sh.S.G. Dave	Chief Scientist	30.09.2012
Sh.Akhtar	Tech. Gr. I	30.09.2012
Sh. K L Chabbra	Principal T.O.	31.10.2012
Sh. Suresh Pal	Safaiwala	31.10.2012
Sh Ashok Kr. Sharma II	Principal T.O.	30.11.2012
Sh. Ajay Singh	Principal T.O.	28.02.2013

Transfer

Sh. Satish Kumar (From CSIR-IIP Dehradun to CSIR-CBRI, Roorkee)	Group (C)	21.09.2012
Sh. Dheeraj (From CSIR-CRRI, New Delhi to CSIR-CBRI, Roorkee)	Section Officer (F&A)	05.11. 2012
Sh. Mehraj Deen Khan (From CSIR-CBRI, Roorkee to CSIR-IIIM Jammu)	Group C (Non.Tech)	31.10.2012

Sh. Neeraj Kumar	Assistant (Gen)	16.11.2012
(From CSIR-CBRI, Roorkee to CSIR- CIMFR, Dhanbad)		
Sh. Mehraj Deen Khan	Group C (Non.Tech)	01.03.2013
(From CSIR-IIIM Jammu to CSIR-CBRI, Roorkee)		

Promotion

Dr. A.K. Minocha	Chief Scientist	01.03.2011
Dr. Manorama Gupta	Sr. Principal Scientist	20.06.2010
Dr. Harpal Singh	Sr. Principal Scientist	03.07.2010
Dr. Atul Kr. Agarwal	Sr. Principal Scientist	30.03.2012
Dr. P.C. Thapliyal	Principal Scientist	23.03.2011
Dr. B.S. Rawat	Principal Scientist	01.01.2012
Dr. Neerej Jain	Sr. Scientist	15.11.2011
Smt. Mamta Sharma	Assistant (G) Gr. I	27.12.2012

Appointment

Mr. Nagesh Babu Balam	Scientist	08.08.2012
Mr. Srinivasarao Naik B.	Scientist	08.08.2012
Mr. Ravindra Singh Bisht	Scientist	08.08.2012
Mr. Soju.J. Alexander	Scientist	08.08.2012
Mr. Soumitra Mati	Scientist	08.08.2012
Mr. Subham Dastidar	Scientist	08.08.2012
Mr. Syed Ibrahim Sohel	Scientist	08.08.2012
Mr. Manojit Samanta	Scientist	13.08.2012
Mr. Subash Chandra Bose Gurram	Scientist	16.08.2012
Dr. A. Aravind Kumar	Scientist	05.09.2012
Ms. Parvathi G.S.	Scientist	10.09.2012

Resignation

Dr. S.Karthigiyan	Principal Scientist	28.09.2012

Obituary

Sh. Surendra Kumar	Sr. Tech II	01.04.2012
Sh. Shiv Kumar	Peon	29.07.2012

Research Papers

Research Papers Published

1. Ashok Kumar, Rajni Lakhani, S. K. Bhattacharyya & Sapna Ghai, Low cost construction technology for cold climate: case study of Ladakh region, International Journal of Science Technology and Management, Vol. 3, Issue 1, April 2012
2. Ashok Kumar & B. M. Suman, Experimental evaluation of insulation materials for walls and roofs and their impact on indoor thermal comfort under composite climate, International Journal of Building & Environment, Vol. 59, 635-643, 2013
3. A. K. Pandey, Discussion paper 108/M48, Factors affecting bond between new old concrete, ACI Materials Journal, Vol.109 (3), May 2012
5. B. Singh, L. Kumar, M. Gupta, M. Chauhan & G. S. Chauhan, Effect of activated crumb rubber on the properties of crumb rubber modified bitumen, Journal of Applied Polymer Science, Vol. 129, 2821-2831, Published Online-2012, USA. DOI: 10.1002 /app. 38991.
4. B. M. Suman & V. K. Sharma, Thermal behaviour of EPS concrete, The Indian Concrete Journal, Vol. 86, No. 6,56-59, June 2012
6. B. Singh, L. Kumar, M. Gupta & G. S. Chauhan, Polymer modified bitumen of recycled LDPE and maleated bitumen, Journal of Applied Polymer Science, Published Online 2012, Vol.127, 67-78, 2013, USA, DOI: 10.1002 /app. 36810
7. B. S. Rawat, Scope of green termiticide in buildings, Pestology, Vol. XXXVI (7), 25-28, July 2012
8. B. S. Rawat, Search of suitable physical barrier for termite management in buildings, Ann. Entomol, 30(2), 1-8, April 2012
9. B.S. Rawat, Effectiveness of fipronil 2.5 E.C. for termite management in buildings, Pestology, XXXVI (8), 19-24, July 2012
10. D. P. Kanungo, A. Pain & S. Sharma, Finite element modelling approach to assess the stability of debris and rock slopes-A case study from the Indian Himalayas, Natural Hazards, 2013, DOI:10.1007/s11069-013-0680-4
11. Harpal Singh, Advances in halogen-based fire retardant additives for polyurethane foams, Polyurethanes Today, Vol. 6(2), 36-39, June 2012
12. Harpal Singh, Characterization of smoke and toxicity from burning polyurethane foams, Fire Engineer, Vol. 37(2) , 19-23, April 2012
13. *Harendra Kumar, M. P. Singh & P. K. Yadav,* Optimal tasks assignment for multiple heterogeneous processors with dynamic re-assignment, International Journal of Computers & Technology, Vol. 4, No 2, 528-535, March 2013
14. K. B. Ladhane, Pradeep Kumar & V. A. Sawant, Field investigations on GAP system subjected to tensile force, Entire Research, Vol. 4(2), 1-4, April 2012
15. L. P. Singh, S. K. Bhattacharyya, P. Singh & S. Ahalawat, Granulometric synthesis and characterisation of dispersed nanosilica powder and its application in cementitious system, Advances in Applied Ceramics, Vol. 111, No.4, 220-227, May 2012

16. L. P. Singh, S. K. Bhattacharyya, G. Mishra & S. Ahalawat, Reduction of calcium leaching in cement hydration process using nanomaterials, Journal of Materials Technology, Vol. 27, No.3, 233-238, July 2012

17. L. P. Singh, S. K. Bhattacharyya & S. Ahalawat, Preparation of size controlled silica nano particles and its functional role in cementitious system, Journal of Advanced Concrete Technology, Vol. 10, 245-352, 2012

18. Manju Mittal, Dust explosion violence measurement with 20-L spherical vessel, Chemical Products Finder, Vol.31, No.5, Oct. 2012

19. Manju Mittal, Electrostatic ignition hazards in industries, Chemical Engineering World, Vol. 47, No.11, 47-49, Nov. 2012

20. Manju Mittal, Explosion hazards in maize starch plant and safety measures, Chemical Engineering World, Vol.47, No.12, 74-78, Dec. 2012

21. Manju Mittal, A. A. Ansari, Rakesh Kumar & Sushil Kumar, Safety in pneumatic transport of powder, Chemical Engineering World, Vol.47, No.4, 58-65, April 2012

22. Monika Chauhan, M. Gupta, B. Singh, A. K. Singh & V. K. Gupta, Pine needle/isocyanate composites- Dimensional stability, biological resistance, flammability and thermo- acoustic characteristics, Polymer Composites, Vol. 33(3), 324-335, 2012, USA

23. Monika Chauhan, M. Gupta, B. Singh, S. K. Bhattacharyya, A. K. Singh & V. K. Gupta, Pre-treatment of pine needles/wood particles and their composites with isocyanate prepolymer adhesive, Polymer Engineering and Science, Published online- 22nd Dec., 2012, USA.DOI: 10.1002/pen.23436

24. Mridul Garg & Aakanksha Pundir, Comprehensive study of fly ash binder developed with fly ash-alpha gypsum plaster- Portland cement, Construction and Building Materials, Vol. 37, 758-765, 2012

25. Neeraj Jain, A. K. Minocha & J. Singh, Air dispersion modelling of brick kilns: Sitting criteria and good housekeeping practices for brick industry in Uttar Pradesh, Indian J. Environmental Protection, Vol. 32 (4), 276-282, April 2012

26. P.K.S. Chauhan. & Y. Pandey, Feasibility of seismic alert system in India, NED University Journal of Research, Karachi, Thematic Issue on Earthquake 2012, 35-44,Oct. 2012

27. P. Pal & S. K. Bhattacharyya, Slosh dynamics of liquid filled composite containers- A two dimensional mesh less local Petrov-Galerkin approach, Journals of Fluids & Structures, March 2013, Available online, http://dx.doi.org/10.1016/j.fluidstructs.2013.02.002

28. Pratima Dhoke, Ravi Bhargava & Shorab Jain, A comparative analysis of the provisions of smoke control systems in buildings of national building code of India with other international building codes, International Journal of Engineering and Scientific Research, Vol. 4(2), Feb. 2013, Houston, TX, USA

29. Ramkrishna Dandapat, Arghya Deb & S. K. Bhattacharyya, Localised failure in fibre reinforced-Polymer wrapped cylindrical concrete columns, Journal of ACI, Structural Engg. , Vol. 109, Issue.4, July 2012

30. Rajiv Kumar & Vatsal Agarwal, Species concentrations-Temperatures and velocities in fire plumes, Journal of Applied Fire Science, Vol. 22(3), 239-258, March 2013

31. Rajiv Kumar, R. K. Sharma, P. K. Yadav & A. K. Gupta, Use of fire models in post fire investigations-A case study, Journal of Applied Fire Science, Vol. 22(3), 259-277, March 2013

32. Sagar Gulati, P. K. Yadav & K. Bhatia, A reliability model for the task scheduling in distributed systems based on fuzzy theory, CIIT International Journal of Networking and Communication Engineering, Vol. 4 (11), 684-688, August 2012

33. S. K. Senapati & Jagtar Singh, Ethical concerns in librarianship- Basic issues, PEARL- Journal of Library & Information Science, Vol. 6, No. 2, 65-69, June 2012

34. S. K. Panigrahi, S. Chakraverty & B. K. Mishra, Damage identification of multi storey shear structure from sparse modal information, ASCE-Journal of Computing in Civil Engineering, Vol. 27, No. 1, 1-9, Jan 2013

35. S. K. Agarwal, Vivek Sood & L. P. Singh, Chemically activated blended cements as sustainable cements, NBM&CW, 196-201, Nov. 2012

36. S. Kanodia & P. C. Thapliyal, Green synthesis of thiophenyl-1,4-naphthoquinones, J. Ind. Chem. Soc. , Vol. 89(6), 833-836, 2012

37. S. Sarkar, D. P. Kanungo & S. Kumar, Rock mass classification and slope stability assessment of road cut slopes in Garhwal Himalayas, India, Geotechnical and Geological Engineering, Vol. 30 (4), 827-840, 2012

38. Subham Dastidar, Ravi Chahar, Vivekananda Bal, Satyendra Kumar & Siddhartha Panda, Fabrication of meso and nanotextured silica surfaces for tuneable densities of functionalized molecules, Colloids and Surfaces- A Physicochemical and engineering aspects, Volume 412, 38-46, 2012

39. Vivek Sood, S. K. Agarwal & A. Diwedi, Comparative study of pozzolanic activity of ultra fine pozzolana, International Journal of Multi Research Academy, Vol. 2, 512-524, Oct. 2012

40. Vivek Sood & S. K. Agarwal, Hydration behaviour of fly ash/slag based composite cement, International Journal of Multi Research Academy, Vol. 02, 195-212, Oct. 2012

41. V. K. Gupta, L. P. Singh, R. Singh & S. P. Kaur, A novel copper (II)- PVC membrane potentiometric sensor based on Dimethyl 4,4' -(o-phenylene) bis (3- thioallophanate), Journal of Molecular Liquids, 174, 11-16, 2012

Paper Presented in Conferences/seminar/ workshops

1. Amit Kush, Amod Krishna & P. K. Bhargava, Energy efficiency through ICT adoption for sustainable habitat, National Conference on Emerging Trends of Energy Conservation in Buildings, Nov. 1-3, 2012 , 120-125, CSIR-CBRI, Roorkee
2. A. D. John, A. K. Roy & A. Gairola, Wind loads on walls of low-rise building, 6th National Conference on Wind Engineering (NCWE), December 14-15, 2012, CSIR - CRRI, New Delhi
3. Abha Mittal, Gayatri Devi, PK.S. Chauhan & S. Karthigeyan, Site Response Analysis based on V_{s30} for Chandigarh City, National Workshop on Engineering Geophysics for Civil Engineering & Geo-hazards (EGCEG-2012), November 22-23, 2012, CBRI Roorkee
4. A.Ghosh, P. K. S. Chauhan and Zameer Ahmed, Geophysical Investigation For Habitat Development, National Workshop on Engineering Geophysics for Civil Engineering & Geo-hazards (EGCEG-2012), November 22-23, 2012, CBRI Roorkee
5. A. Ghosh, P. K. S. Chauhan, S. K. Jain, Dalip Kumar & Z. Ahmed, Holistic study on site characterization for habitat development, Indian Geotechnical Conference (IGC 2012), Dec. 13–15, 2012, New Delhi
6. Achal Mittal, Rajeev Kumar Sharma, I. A. Siddiqui, Deepak Dharamshaktu & P. K. Yadav, State of the art wind tunnel facility – A review for up-gradation, 6th National Conference on Wind Engineering (NCWE-2012), Vol. 2, December 14-15, 2012, 525-539, CSIR-CRRI, New Delhi
7. Ajay Chourasia, S. K. Singh & Jalaj Parashar, Health assessment of building using vibration characteristics ,28th National Convention of Civil Engineers & National Seminar on Role of Infrastructures for Sustainable Development, Oct. 12-14, 2012, IEI, Roorkee
8. Ajay Chourasia, S. K. Singh & S. K. Bhattacharyya, Failure analysis of structures: Case studies, 28th National Convention of Civil Engineers & National Seminar on Role of Infrastructures for Sustainable Development, Oct. 12-14, 2012, IEI, Roorkee
9. Ajay Chourasia, S. K. Singh & Jalaj Parashar, Seismic rehabilitation of heritage structures, Problems & prospects, 15th Sym. on Earthquake Engineering, ISET, Oct. 20-21, 2012
10. Ajay Chourasia, Jalaj Parashar, S. K. Bhattacharyya & S. K. Singh, Non-destructive tests for masonry structures, 15th Sym. on Earthquake Engineering, ISET, Oct. 20-21, 2012
11. Ajay Chourasia, Y. P. Kajale & J. Parashar, Prefab building construction for sustainable development, National Conference on Trends and Recent Advances in Civil Engineering (TRACE-2012), September 27, 2012, Amity School of Engineering & Technology, New Delhi
12. A. K. Roy & P. K. Bhargava, CFD modelling of wind flow around building for wind energy conversion, National Conference on Emerging Trends of Energy Conservation in Buildings (EECB-2012), Nov. 1-3 , 2012, 370-379, CSIR– CBRI, Roorkee

13. A. K. Roy, Nagesh Babu & P. K. Bhargava, Atmospheric boundary layer air flow through CFD simulation on pyramidal roof of square plan shape buildings, 6th National Conference on Wind Engineering (NCWE), December 14- 15, 2012, CSIR - CRRI, New Delhi

14. A. K. Pandey & R. S. Bisht, Numerical modelling of in-filled clay brick masonry under blast loading , First International Conference on Performance Based & Life Cycle Structural Engineering (PLSE-2012), December 5-7, 2012, Hong Kong, China

15. Ashok Kumar, P. S. Chani & Rajesh Deoliya, The estimation of energy consumption due to building construction in India- Present status & future directions, International Conference on Advanced Materials for Energy Efficient buildings, , Feb. 13-15, 2013, 140-142, New Delhi

16. Ashok Kumar, P. S. Chani & Rajesh Deoliya, Comparative analysis of building sustainability assessment tolls & identifying key attributes for green retrofits, Published in National Seminar held at The Institution of Engineers (India), Oct. 12-14, 2012, 209-220, Roorkee

17. Ashok Kumar, P. S. Chani, Rajesh Deoliya, Rajni Lakhani & Naresh Kumar, Comparative assessment of energy requirements and carbon footprint for different types of building materials and construction techniques, National Conference on Emerging Trends of Energy conservation in Buildings, Nov.1-3, 2012, 63-71, CSIR-CBRI, Roorkee

18. B. M. Suman, Energy simulation for sustainable building with application of roof and wall insulation, National Conference on Emerging Trends of Energy Conservation in Buildings, Nov. 1-3, 2012, CSIR-CBRI, Roorkee

19. B. Singh, M. Gupta & Monika Chauhan, Pine needles- An alternate raw material for board manufacturing, International Conference on Advanced Materials for Energy Efficient Buildings, 13-15 Feb. 2013, New Delhi

20. Debdutta Ghosh & Achal Mittal, A review on pedestrian wind comfort around tall buildings, 6th National Conference on Wind Engineering (NCWE-2012), Vol. 2, December 14-15, 2012, CSIR-CRRI, New Delhi

21. D. P. Kanungo, A. Pain, S. Sarkar, S. Sharma, S. K. Jain, & Z. Ahmad, Field investigation and finite element modelling of a progressive debris slide in the Indian Himalayas, International Conference on Debris Flow 2012, May 29-31, 2012, Dubrovnik, Croatia

22. D.V.M. Bhaskar & S. R. Karade, Corrosion monitoring of reinforced concrete structures, Proc. 28th National Convention of Civil Engineers, Oct. 2012, IEI, Roorkee

23. Harpal Singh, Additives filled rigid polyurethane foam- A fire retardant and energy efficient building material, Proceedings of National Conference on Emerging Trends of Energy Conservation in Buildings, Nov. 1-3, 2012, CSIR-CBRI, Roorkee

24. H. K. Jain, P. K. Bhargava & Shiv Lal, Passive cooling of buildings, National Conference on Emerging Trends of Energy Conservation in Buildings, Nov. 1-3, 2012, CSIR-CBRI, Roorkee

25. I. A. Siddiqui, R. K. Sharma & D. S. Dhramshaktu, Planning and fabrication of model for wind tunnel study– A Technical Approach, 6th National Conference on Wind Engineering, December 14-15, 2012, CSIR-CRRI, New Delhi

26. Koushik Pandit, Ajay Chourasia & S. K. Bhattacharyya, Pillar design practices in coal mines, 28th National Convention of Civil Engineers & National Seminar on Role of Infrastructure for Sustainable Development, October 12-14, 2012, IEI, Roorkee

27. K. C. Panda, S. K. Bhattacharyya & S. V. Barai, Experimental investigation on shear strengthening of RC T-beams with GFRP sheet in shear zone, International Conference on Sustainability Challenges & Advances in Concrete Technology (SCACT 2012), May 2-4, 2012, Coimbatore, Tamilnadu

28. K. C. Panda, S. K. Bhattacharyya & S. V. Barai, Strain analysis of RC T-beams side bonded in shear with GFRP sheet, Proceedings of International Conference on Rehabilitation and Restoration of Structures (BTCM 2013), February 13-16, 2013, Building Technology and Construction Management division, Department of Civil Engineering, IIT Madras, Chennai

29. K. C. Panda, S. K. Bhattacharyya & S. V. Barai, FRP strengthened reinforced concrete beams - A brief overview on shear strength models, UKIERI Concrete Congress Innovations in Concrete Construction (UCC 2013), March 5-8, 2013, NIT, Jalandhar

30. L. P. Singh, S. K. Bhattacharyya, U. Sharma, G. Mishra & S. Ahalawat, Role of silica nanoparticles on early stage reactivity of cementitious system, 7th Uttarakhand State Science Technology Congress - 2012, November 21-23, 2012, Dehradun

31. L. P. Singh, S. K. Bhattacharyya & S. Ahalawat , Comparative mineralogical and morphological aspects of C-S-H using silica nanoparticles, 4th International Symposium on Nanotechnology in Construction (NICOM4), May 20-22, 2012, Greece

32. M. P. Singh, P. K. Yadav & A Aggarwal, Response time optimization of grid computing system using genetic approach, National Conference on Recent Advances in Mathematics and its Applications (RAMA-2013), Feb. 14-16, 2013,171-179, Department of Applied Mathematics, Indian School of Mines, Dhanbad

33. Mridul Garg & Aakanksha Pundir, Energy-efficient high strength binder from by-product gypsum, 7th Uttarakhand State Science Technology Congress-2012 (7th USSTC), Nov. 21-23, 2012, 158, Dehradun

34. Mridul Garg, A. K. Minocha, S. Maiti & A. Pundir, Development of energy efficient and eco-friendly construction materials from gypsum cement, International Conference on Advanced Materials for Energy Efficient Buildings, Feb 13-15, 2013, 81, CSIR-CBRI, Roorkee

35. Mridul Garg, A. K. Minocha, J. Singh, N. Jain, S. Maiti & A. Pundir, Recycling and reuse of construction and demolition waste in tiles, International Conference on Advanced Materials for Energy Efficient Buildings, Feb 13-15, 2013, 74, CSIR-CBRI, Roorkee

36. Nikhil Aggarwal, Achal Mittal & V. K. Gupta, Comparison of steel quantity for gable frame based on wind forces from a few International wind codes, 6th National Conference on Wind Engineering (NCWE-2012), Vol. 2, December 14-15, 2012, CSIR-CRRI, New Delhi

37. Nikhil Aggarwal, Achal Mittal & V. K. Gupta, Along wind interference effects on tall building, 6th National Conference on Wind Engineering (NCWE-2012), Vol. 1, December 14-15, 2012, CSIR-CRRI, New Delhi

38. Nagesh B. Balam & P. K. Bhargava, Solar energized liquid desiccant air conditioning –A review, National Conference on Emerging Trends of Energy Conservation in Buildings, Nov 1-3, 2012, CSIR-CBRI, Roorkee

39. Narendra Kumar, S. K. Saini & Sameer, Partial replacement of heat energy by solar energy in the production of Gypsum Plaster, National Conf. on Emerging Trends of Energy Conservation in Buildings, Nov 1-3, 2012, CBRI, Roorkee

40. Omna Suman & B. M. Suman, Thermal insulation materials for energy efficient building, National Conference on Emerging Trends of Energy Conservation in Buildings, Nov 1-3, 2012, CSIR-CBRI, Roorkee

41. P.C. Thapliyal & S. R. Karade. Studies on Physico-Mechanical behaviour of thermal insulating coatings for Buildings. International Conference on Advanced Materials for Energy Efficient Buildings (AME^2B-2013), Feb. 13-15, 2013, 52, India Habitat Centre, New Delhi

42. P.C. Sharma, Rajeev Goel, S. K. Singh & Suraj Parkash, Construction of large shankh shaped ferro cement structure: A case study, 28th National Convention of Civil Engineers & National Seminar on Role of Infrastructures for Sustainable Development, Oct. 12-14, 2012, IEI, Roorkee

43. P. K. Bhargava, Nagesh Babu Balam & A. K. Roy, Passive design features for energy conservation in residential buildings, National Conference on Emerging Trends of Energy Conservation in Buildings (EECB-2012), November 1-3, 2012, 293-302, CSIR – CBRI, Roorkee

44. P. K. Bhargava, Nagesh B. Balam & H. K. Jain, Climate change assessment due to buildings & construction industries and its impact on water resources, 3rd Annual Int. Symposium on Response of Asian Rivers to Climate Change- Past, Present and Future Scenario, Nov. 14-16, 2012, CSIR- NGRI, Hyderabad

45. P. K. Bhargava & Nagesh B. Balam, Studies on wind climate in India, 6th National Conference on Wind Engineering (NCWE), Dec. 14-15, 2012, CSIR-CRRI, New Delhi

46. P. K. Yadav & B. M. Suman, Prediction of indoor thermal comfort level using fuzzy logic, National Conference on Emerging Trends of Energy Conservation in Buildings, Nov. 1-3, 2012, 380-388, CSIR-CBRI, Roorkee

47. P.K.S. Chauhan, Gayatri Devi, Y.Pandey and Abha Mittal, Micro-tremors for Seismic Hazard estimation, National Workshop on Engineering Geophysics for Civil Engineering & Geo-hazards (EGCEG-2012), November 22-23, 2012, CBRI Roorkee

48. P.K.S. Chauhan, J. N. Vaish and Ajay Dwivedi Ground distress investigation through GPR, National Workshop on Engineering Geophysics for Civil Engineering & Geo-hazards (EGCEG-2012), November 22-23, 2012, CBRI Roorkee

49. P.K.S. Chauhan, Ajay Dwivedi and JN Vaish GPR investigations at TAJ, National Workshop on Engineering Geophysics for Civil Engineering & Geo-hazards (EGCEG-2012), November 22-23, 2012, CBRI Roorkee

50. Rajni Lakhani, S. P. Agrawal & Sapna Ghai, Development of energy efficient material from vermiculite, National Conference on Emerging Trends of Energy Conservation in Buildings, Nov. 1-3, 2012, CSIR-CBRI, Roorkee

51. Rajiv Kumar & Vinod Kumar, Development of integrated solar photovoltaic-thermal system, Proceedings-National Conference on Emerging Trends of Energy Conservation in Buildings, Nov. 1-3, 2012, CSIR-CBRI, Roorkee

52. R. S. Chimote, Shashi & Surendra Kumar, Liquid hydrocarbon pool fire suppression: Part-I:- experiments using direct foam injection (DFI)-methodology in a $5m^2$ x 2m-cylindrical tank, International Conference on Safety, Oct. 12-13, IIT, Gandhinagar.

53. S. K. Singh, Post fire investigations and rehabilitation of structure- A case study, International Workshop on Innovations in Repair and Rehabilitation of Structures, Dec. 17-18, 2012, ICI, Ghaziabad

54. S. K. Singh & S.K. Bhattacharyya, Hybrid fibre reinforced concrete- A paradigm shift, International Conference on Advanced Materials for Energy Efficient Buildings, Feb. 13-15, 2013, IHC, New Delhi

55. S. K. Singh, Ajay Chourasia, M. M. Dalbehra & S. K. Bhattacharyya, Hybrid fibre reinforced concrete- A review, 28th National Convention of Civil Engineers & National Seminar on Role of Infrastructures for Sustainable Development, Oct. 12-14, 2012, IEI, Roorkee

56. S. K. Singh, M. M. Dalbehra & S. K. Bhattacharyya, Behaviour of hybrid fibre reinforced concrete exposed to Fire, 28th National Convention of Civil Engineers & National Seminar on Role of Infrastructures for Sustainable Development, 2012, IEI, Roorkee

57. S. K. Panigrahi, V. P. Kommula & C. Ketlogetswe, A mathematical model for assessment of physical properties of flyash-sand-cement bricks, Proceedings of the IA STED International Conference Modelling and Simulation (Africa MS 2012), Sept. 3-5, 2012, Botswana, Africa

58. S. K. Panigrahi, Narendra Kumar & Sameer, Underground horizontal drilling-A trenchless technology, 28th National Convention of Civil Engineers & National Seminar on Role of Infrastructure for Sustainable Development, Oct. 12-14, 2012, IEI, Roorkee

59. S. K. Agarwal, Vivek Sood & Ashok Kumar, Composite cement-A step towards reduction in green house gas emission, 2nd International Conference on Green Buildings Technologies & Materials (GBTM 2012), Dec. 27-28, 2012, Wuhan, China.

60. S. K. Bhattacharyya, Health monitoring of buildings subjected to wind loads, 6th National Conference on Wind Engineering (NCWE-2012), 79-84, December 14-15, 2012, CSIR-CRRI, New Delhi

61. S. K. Bhattacharyya & Ajay Chourasia, Experiences on 2011: Sikkim post-earthquake damage assessment-Strategies for risk reduction, ISET Golden Jubilee Symposium, October 20-21, 2012, Roorkee

62. S. R. Karade, Investigation of concrete structures in thermal power plants: Some case studies, Proc. International Workshop on Innovations in Repair and Rehabilitation of Structures, Dec. 17-18, 2012, ICI, Ghaziabad

63. S. R. Karade, Corrosion control in steel reinforced concrete structures for sustainability, Proc. 28th National Convention of Civil Engineers, Oct. 2012, Roorkee

64. S. R. Karade & P. C. Thapliyal, Energy efficient corrosion control measures in steel reinforced concrete structures, International Conference on Advanced Materials for Energy Efficient Buildings (AME^2B-2013), Feb. 13-15, 2013, 24, India Habitat Centre, New Delhi.

65. S. P. Agrawal, B. M. Suman & Rajni Lakhani, Comparative studies on two different methods of thermal conductivity measurements, National Conference on Emerging Trends of Energy Conservation in Buildings, Nov. 1-3, 2012, CSIR-CBRI, Roorkee

66. S. P. Agrawal & B. M. Suman, Value added R&D insulating materials from waste, Proc. National Conference on Emerging Trends of Energy Conservation in Buildings, Nov. 1-3, 2012, CSIR-CBRI, Roorkee

67. Somitra Maiti, Mridul Garg, Aakanksha Pundir & A. K. Minocha, Flue gas desulfurization gypsum for production of building components, International Conference on Advanced Materials for Energy Efficient Buildings, Feb 13-15, 2013, 83, CSIR-CBRI, Roorkee

68. Sriniwasrao Naik B, L. P. Singh, P. C. Thapliyal & Ashok Kumar, Studies on phase change materials for energy efficient buildings, International Conference on Advanced Materials for Energy Efficient buildings, Feb. 13-15, 2013, 30-32, New Delhi.

69. Siddharth Behera & Achal Mittal, A comparative study of wind forces of tall building and towers as per IS 875-Part-III (1987) and draft code (2011) using gust factor method, 6^{th} National Conference on Wind Engineering (NCWE-2012), Vol. 2, Dec. 14-15, 2012, CSIR-CRRI, New Delhi

70. Suvir Singh, Fire safety in high rise buildings, National Seminar on Disaster Management, Nov. 2012, RGEC,Meerut

71. Shiv Lal, S. C. Kaushik & P. K. Bhargava, A study on stack ventilation system and integrated approaches, National Conference on Emerging Trends of Energy Conservation in Buildings, Nov. 1-3, 2012, CSIR-CBRI, Roorkee

72. Vivek Sood, Ashok Kumar & S. K. Agarwal, Impact of sustainable cements on conservation of energy in buildings, National Conference on Emerging Trends of Energy conservation in Buildings, Nov.1-3, 2012, 88-95, CSIR-CBRI, Roorkee

73. Y. P. Kajale, J. Parashar & Ajay Chourasia, Energy efficient building technologies: An approach towards sustainable development, Conference on Emerging Trends on Energy Conservation in Buildings, November 1-3, 2012, CSIR-CBRI, Roorkee.

Lectures

1. Prof. S. K. Bhattacharyya delivered :

- An invited talk on 'Achieving Sustainability in concrete technology'– in the colloquium on Nano Technology in concrete, 13th February, 2013, held at SGIT Bangalore
- A Key note lecture 'Research on Advanced Materials at CSIR-CBRI: An overview,' International conference on Advanced Materials for Energy Efficient Buildings held at New Delhi ,10-12 February 2013, organized by CSIR-CBRI.
- An invited talk on 'Health Monitoring of Buildings subjected to Wind Loads, 6th National Conference on Wind Engineering (NCWE-2012) at CSIR-CRRI, New Delhi, 14-15th December 2012.
- A Key note lecture 'Energy Efficient Building System, National conference on Emerging trends in Energy conservation in buildings at CSIR-CBRI, Roorkee, November 2012.
- An invited talk on 'Advances in concrete Technology – Sustainable Approach,' National Conference on Sustainable Infrastructure organized by the Institution of Engineers (I), Civil Engineering Division at Roorkee, October 2012.

2. Dr. S. R Karade delivered:

- A lecture 'Durability of Reinforced Concrete Structures' in a course on "Latest Trends in Building Materials and Construction Techniques" organized by IIT, Roorkee held during 16-18 May, 2012.
- A lecture 'Corrosion & Cathodic Protection in Reinforced Concrete Structures' in a course on "Advanced Techniques in Corrosion Testing and Protection of Materials" organized by IIT, Roorkee held during 18-22 Feb, 2013.
- An invited lecture 'Investigation of Concrete Structures in Thermal Power Plants: Some Case Studies' in an International Workshop on 'Innovations in Repair and Rehabilitation of Structures' December 17-18, 2012, Ghaziabad, India.

3. Ajay Chourasia delivered:

- A lecture 'Prefabricated Construction Technology –Evaluation of Two storied prefab system to establish behavior of joints under seismic condition at MHADA', Mumbai, Jan. 24, 2013.
- A lecture 'Seismic vulnerability assessment of existing building stocks' at NDMA, New Delhi, July 5, 2012.
- A lecture 'Seismic resistant design of structures' to PWD engineers of Bihar and WB at Department of Continuing Education, IIT Roorkee, July 2012.

Awards

Vishwakarma Award

Shri Amitava Ghosh, Chief Scientist, CSIR–Central Building Research Institute, Roorkee has been awarded the prestigious Construction Industry Development Council (CIDC) 5th Vishwakarma Award. The ceremony was held at India Habitat Centre. Dr. Pronab Sen Chairman of the Jury, Chairman, National Statistical Commission & Former Principal Adviser, Planning Commission, Government of India was the Chief Guest for the ceremony. Shri Ghosh received the award in the category of Scientists / academician/ innovator.

Recognising the achievements and contributions made by Shri Ghosh through his R&D efforts on the utilization of solid industrial wastes as resource geo-material and its implementation in the field through the construction industries, the award was conferred to Shri Ghosh. The award carries certificate, citation and a trophy.

National Geoscience Award

Dr Shantanu Sarkar, Senior Principal Scientist, CSIR-Central Building Research Institute, Roorkee has been awarded the prestigious National Geoscience Award by the Ministry of Mines, Govt. of India. The award was conferred by the Hon'ble Minister of Mines, Shri Dinsha Patel at Vigyan Bhawan, New Delhi. The National Geoscience award which was previously known as the Mineral Award was instituted in the year 1966. The objective of the award is to honour individuals and teams of scientists for their extraordinary achievements and outstanding contributions in the field of fundamental/ applied geosciences, mining and allied areas.

In recognition of his significant contribution in the field of Disaster Management, the award was conferred upon Dr S. Sarkar. Dr Sarkar has contributed extensively towards landslide studies with special reference to hazard and risk assessment, geological investigation, database creation, slope monitoring and stability assessment. The award carries a certificate, citation, trophy and cash prize of Rs. 2,00,000/-.

Ph.D. Awarded

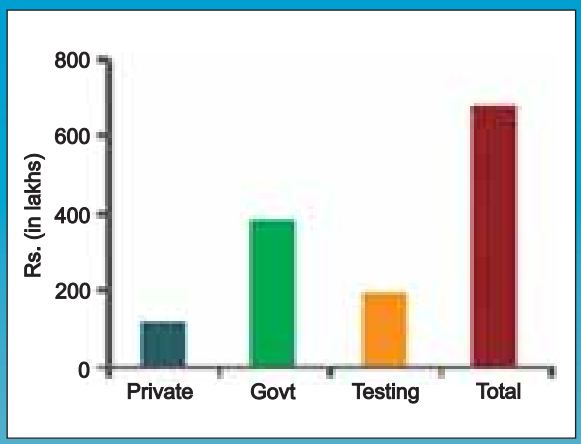
Sri Susanta Kumar Senapati, Library Officer has been awarded Doctor of Philosophy by Punjabi University, Patiala for his Thesis on "Bibliographic Control of Periodical Literature on Building Materials Published in India: A Scientometric Study" in the faculty of Education and Information Science on December 11, 2012.

Date Line

DATE LINE

S.No.	Date	Salient Details
1.	May 11, 2012	National Technology Day.
2.	June 5, 2012	World Environment Day.
3.	August 15, 2012	Independence Day.
4.	August 17, 2012	Sadbhavna Diwas.
5.	September 14-20, 2012	Hindi Week.
6.	September 24, 2012	C .S.I.R. Foundation Day.
7.	October 29-02 Nov. 2012	Vigilance Awareness Week.
8.	November 01-03, 2012	National conference on Engineering Trends of Energy Conservation in Buildings.
9.	November 22-23, 2012	National Workshop on Engineering Geophysics for Civil Engineering and Geo-hazards.
10.	December 6-7, 2012	Annual Convention of the Indian National Academy of Engineering.
11.	December 14-15, 2012	National Conference on Wind Engineering.
12.	January 26, 2013	Republic Day.
13.	February 10, 2013	C.S.I.R.- C.B.R.I. Foundation Day
14.	February 13-15, 2013	International Conference on Advanced Materials for Energy Efficient Buildings.
15.	February 28, 2013	National Science Day.
16.	March 17,2013	Annual Flower and Vegetables Show.

Performance/Projects/Human Resource



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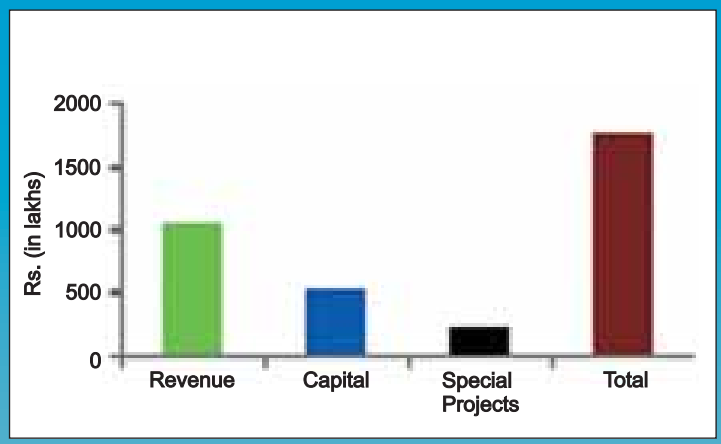
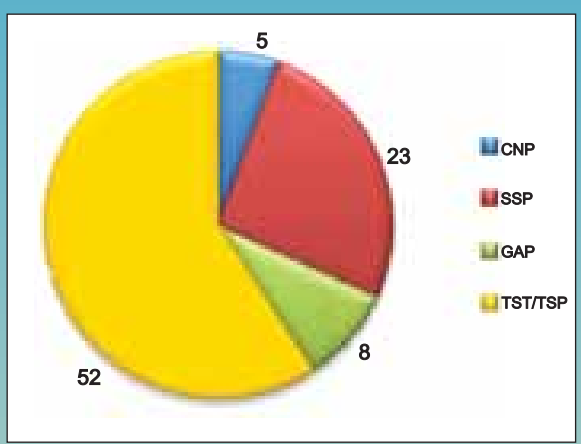
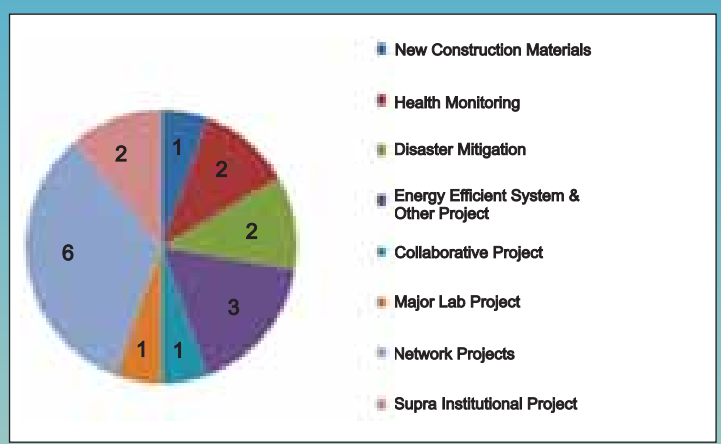


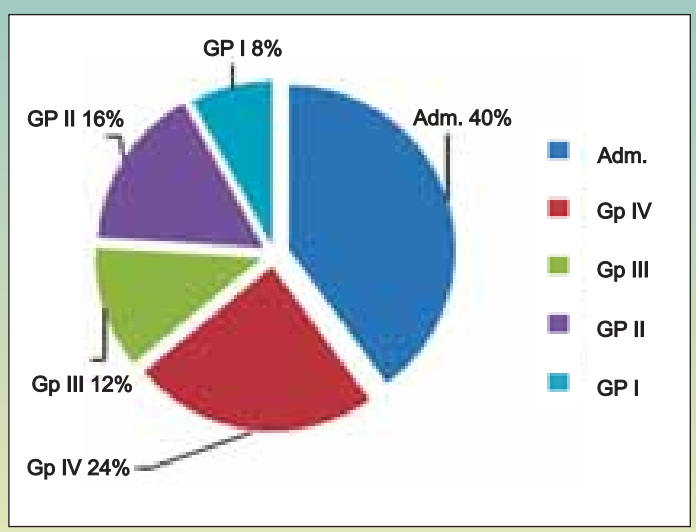
CSIR Resource Input



Externally Funded Projects



In-house R&D Projects



Human Resource

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