With Best Compliments from

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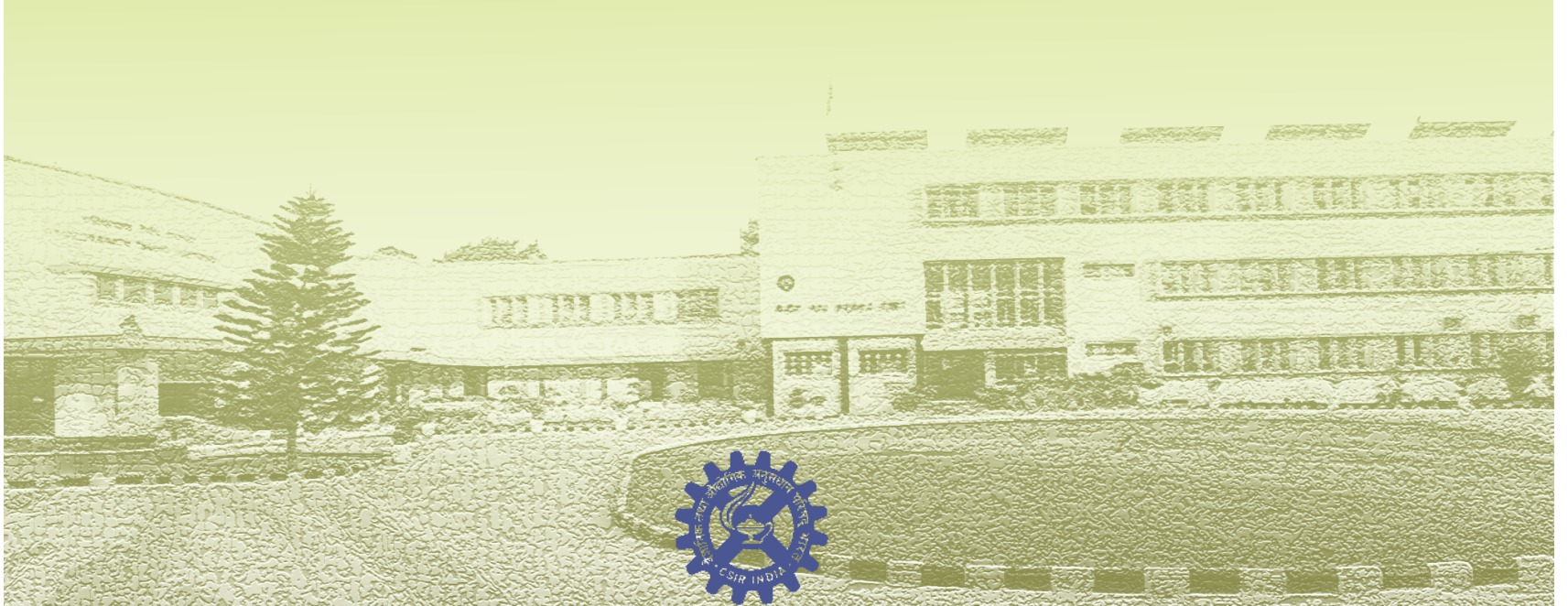
CBRI
केंद्रीय भवन अनुसंधान संस्थान, रुड़की
CENTRAL BUILDING RESEARCH INSTITUTE, ROORKEE
(A Constituent Establishment of CSIR)

वार्षिक प्रतिवेदन
Annual Report
2014-2015



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CONTENTS

Network Project (ESC 0102)

Network Projects

R&D Projects

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lh,lvkbvkj&dæh; Hkou vul/kku lLFkku] :Mdh dh o"k 2014&2015 dh okf"kd fjikV iLrr djr g, eÖk vR;r g"k gk jgk gA lLFkku fuek.k foKku rFkk ik|kfxdh d mRiknu] ifj"dj.k rFkk mldk c<kok ndj n'k lok e yxk g rFkk Hkou ,o fuek.k m|kxk d fgr e lLFkku u oKkfud vul/kku vkj fodkl] ik|kfxdh fodkl ,o ilkj] lkekftd xfrfof/k;k] ekuo lk/ku fodkl vkj Hkou vul/kku d fy, jk"Vh; fu;ktu e egRoi.k ;kxnku fn;k gA

viu vkjEHk dky l] lh,lvkbvkj&lhchvkjvkb] Hkou rFkk vkokl d LkHkh igyvk ij vul/kku ,o fodkl dk; dj jgk g RkFkk lHkh idkj d Hkouk e fer0;f;rk] l[knrk] dk;kRed n{krk] xfr] fuek.k e mRikndrk] i;koj.k lj{k.k RkFkk Åtk lj{k.k dk /;ku e j[kr g, vkink U;uhdj.k lfgr Hkou m|kx e fu;ktu] vfHkdYiu] uhok] lkefx;k RkFkk fuek.k e lgk;rk dj jgk gA lLFkku ,d gh mn'; Þfuek.k lkefx;k] fuek.k ik|kfxdh] Hkouk dk LokLF; ick/ku] vfXu bthfu;jh RkFkk vkink U;uhdj.k lfgr Hkou@vkokl fu;ktu rFkk fuek.k d ik;% lHkh {k=k e lek/kku miyC/k djku d fy, fo'o J.kh d Kku vk/kkj d :i e dk; djuk ß] dh ikflr d fy, dk;jr gA

bl vof/k e LkLFkku u nk egRoi.k ifj;ktukvk ij dk; fd;k g&,d **lik lLFkkxr uVod ifj;ktuk (SINP)**] tk LkLFkku dh ie[k leFkrk d {k= l lcf/kr g RkFkk nljh uVod ifj;ktuk d leUo; l lcf/kr g] ftle cgr lh lg;kxh i;kx'kkykvk u ifrHkkfxrk dh gA

lik lLFkkxr uVod ifj;ktuk (SINP) d vrxr fofHkUu od idtk d ek/;e l **'uDlV tuj'ku xhu fcfYMXl (INMATE)** gr uohu lkexh ,o ik|kfxd;k' ij dk; fd;k x;k gA *uuk ik|kfxdh d ek/;e l lkexh d fu"iknu e of}^] bl od idt d vrxr flfydk uuk d.kk dk feyku l Vkb dyf'k;e flfydV d 'k:vkrh ty;ktu voLFkk ij v/;;u] uuk ik|kfxdh d mi;kx l cg&dk;kRed yiuk dk fodkl] Åtk n{k Hkouk gr Qt pt lkexh ij v/;;u fd, x, gA ***l/kkj.kh; fuek.k d fy, uDlV tuj'ku ddhV^**] d bl idt e] lYQ ghfyx lkexh d :i e to ddhV d 0;ogkj ij v/;;u RkFkk io'; ddhV d fodkl dk dk; fd;k x;kA ^**xhu fcfYMXl ik|kfxdh^** d bl idt d vrxr] dk;ky;k d Hkouk d fy, xhu jVkfQV uhfr;k ij v/;;u] 'khr tyok; {k= d fy, lkyj foMk fLkLVe dk fodkl] l/kkj.kh; fuek.k mRiknk d fy, dPp eky d :i e fo/ol vif'k"Vk dk mi;kx] lkyj Fkey ,;j dMh'kuj] Bkl vk|kfxd vif'k"Vk&flfoy fuek.k mRiknk gr Hk&lkexh lk/ku] mMu jk[k@/kku dh Hkl h] lxejej dh /ky ij vk/kkfjr vk|kfxd vif'k"Vk d mi;kx l gYd Hkkj oky Cykdk dk fodflr dju dh nf"V l n'k d fofHkUu Hk&tyok; {k=k gr 'kgjh {k=k e tu vkoklk d fy, ik|kfxdh idt] Lopkfyr [kk[ky ftlle iuy cuku dh e'khu] i.k fojfpr iuyk RkFkk fpukb dk;k e ftlle lheV dk vui;kx] u, Hkouk d fy, nhed jk/kh cfj;j RkFkk gYdh feVVh d fy, etcr uho dk fodkl l lcf/kr dk; fd, x,A *tkf[ke e deh dju d fy, lkefx;k ,o ik|kfxd;k'] uked od idt e] LVhy icfyr ddhV ljpukvk d fy, Lon'kh dFkkfMd lj{k.k i.kkyh ij v/;;u] icfyr ddhV ?kVdk

dk 0;ogkj] Qk;j lQ ikfyefjd dEikftV iuy RkFkk fcYV ,uok;jueV 'olu d.kk dk de dju d fy, mUur lokru i.kkyh d vfHkdYi ,o fodkl dju d mn'; l Dyhuj fCkYV ,uok;jeV gr dk; fd, x, gA

fofHkUUk idtk d ek/;e l ***bthfu;fjx vkQ fMtkLVj fefVx'ku ,M gYFk ekuhVfjx Qkj lQ ,M LekV fcYV ,uok;jeV (EDMISSIBLE)** ij uVod ifj;ktuk ij dk; tkjh jgkA **bthfu;fjx vkQ yMLykbM fMtkLVj fefVx'ku** e db lg;kxh i;kx'kkyk, lfEefyr gA fofHkUUk ifrHkkxh i;kx'kkykvk }kjk dh xb xfrfof/k;k e pekyh&tk'kheB {k= ¼x<oky fgeky;½ dk HkL[kyu gr io prkouh midj.k ,o fu.k; idTk ¼lh,lvkbvkj&lhchvkjvkb½] pekyh&tk'kheB {k=] x<oky fgeky; e tkf[ke fu/kkj.k gr io prkouh midj.k ,o fu.k; idt ¼lh,lvkbvkj&lhchvkjvkb½] pekyh&tk'kheB {k=] x<oky fgeky; e tkf[ke fu/kkj.k gr thih,l vk/kkfjr lefUor HkdEi ekMfyx ¼lh,lvkbvkj&4 ihvkb½] ,l-,-vkj bVjQjkeVh d mi;kx l HkL[kyu ick/ku ¼lh,lvkbvkj&lh,lvkbvk½] HkL[kyu ick/ku d fy, vkflVdy Qkbcj vk/kkfjr eYVhlyDl llj uVod flLVe dk fodkl ¼lh,lvkbvkj&,ubvkb,lVh½] pekyh&tk'kheB {k= x<oky fgeky; e ogr Hk&vUo"k.k RkFkk HkL[kyu d fu;=.k mik; ¼lh,lvkbvkj&lhchvkjvkb½] HkL[kyu vkink lpuk i.kkyh rFkk HkL[kyu fu;=.k vfHkdYi d vfHkuo mik; ¼lh,lvkbvkj&lh-vkj-vkj-vkb½ ,o igkMh {k=k e HkL[kyu U;uhdj.k RkFkk <yku fLFkjrk LkeL;kvk d fy, Qk;VkjehfM,'ku vkl'ku ¼lh,lvkbvkj&Ukhjh½ }kjk ifrHkkfxrk dh xbA

'HkdEi vkink U;uhdj.k bthfu;jh'] d idt e Jhuxj d Hkdih; l{e vu{k= ij v/;;u] xfrd ik'oHkkj.k d vrxr ikbyk dk Hkdih; 0;ogkj RkFkk v/k LFkfrd fLFkfr d vrxr ifj:} fpukb Hkouk dk fu"iknu fd;k x;kA **'vfXu vkink U;uhdj.k bthfu;jh'**] d od idt e] yk vktku fMiy'ku ikVf'k;y bUukofVo Qk;j lijlu flLVe] Qk;j ijQkjel boY;,'ku vkQ LVDpjy ,fyeV ,M fjgfcfy,'ku mik;k ij dk; py jgk gA **'ikLV fMtkLVj 'kyVj lykfux'**] d od idt e] if'peh fgeky; e xkeh.k {k=k gr vkink d i'pkr vkJ; fu;ktu d vrxr if'peh fgeky; {k= e xkeh.k {k=k d fy, dk; ixfr ij gA **'gYFk ekuhVfjx vkQ fcfYMXl ;ftx ok;jyl llj uVod]'** od idt e] ok;jyl llj uVod dk mi;kx djr g, gYFk ekuhVfjx ,ikp d dk;kUo;u ij v/;;u] **jh;y&ykbQ fcfYMXl ij U;efjdy ,ukfyfll ,o ekMy viMfVx** rFkk **bVyhtV fcfYMx Qkj ekMy jftMfl;y ;fuV***] d od idt e bVxfVx bVyhtV fcfYMx Qhpl ,M Xykl QdM Dyhfux jkckfVd flLVe dk dk; ixfr ij gA

uVod ifj;ktuk ftle] lh,lvkbvkj&Lkhchvkjvkb ,d lgHkkxh i;kx'kkyk g] mMu jk[k dk mi;kx djd ikuh l Hkkjh /kkrvk dk gVkuk RkFkk bl mi;kxh Hkou ?kVdk d fuek.k e mi;kx djuk ¼ukMy i;kx'kkyk lh,lvkbvkj&uhjh½] Hkfexr [knkuk e Ql dk;y dh b"Vre fudklh gr df=e [kEHkk d fy, lefpr lgk;d i.kkyh dk fodkl ¼ukMy i;kx'kkyk lh,lvkbvkj&lhvkb,e,Qvkj½ ij v/;;u fd, tk jg gA dk;yk [knkuk e Ql dk;y dh fudklh dh ifj;ktuk d ijh gku ij] bl viuku l dkQh le; l pyh vk jgh jk"Vh; leL;k dk fujkdj.k gku dh vk'kk gA x<oky fgeky; dh Hki"Bh; fodfr dk v/;;u x<oky d igkMh {k=k d fy, fd;k tk jgk g ¼ukMy i;kx'kkyk lh,lvkbvkj&4 ihvkb½A flfoy ljpukvk d vuj{k.k ,o l{e fujh{k.k dh nf"V l Hkouk ,o vU; ljpukvk gr lfol jkckV ifj;ktuk ,d cgr gh mi;kxh ifj;ktuk g ¼ukMy i;kx'kkyk lh,lvkbvkj&lh,ebvkjvkb½A vPNh x.koŸkk oky chtk dh cjcknh o [kjkc gku l cpku d fy, fu;f=r i;koj.k d lkFk Åtk n{k cht HkMkj.k Hkou dk fodflr dju dk dk; Hkh fd;k tk jgk g ¼ukMy i;kx'kkyk lh,lvkbvkj&lh,lvkbvk½A

lLFkku ‘Hkou bthfu;jh ,o vkink U;uhdj.k’ ¼ ch-b-Mh-,e ½ d {k= e lefUor LukrdkŸkj&ih-,p-Mh dk;de pyk jgk gA dk;de d pkFk cp d Nk= ’kk/k ic/k r;kj dj jg gA vxLRk 2014 e ih-,p-Mh- d fy, bthfu;jh foKku e 05 RkFkk tuojh 2015 e jlk;u foKku e ,d Nk= lfEefyr fd;k x;kA

Lkh,lvkbvkj&lhchvkjvkb u fiNy o"kk dh Hkkfr vud viu lkLFkkfud ¼bugkÅl½ vul/kku ,o fodkl dk;dek d lkFk&lkFk cgr lh lfonk vul/kku ifj;ktukvk ij ik"k.kh;rk ¼lLVufcfyVh½ d LkHkh igyvk dk /;ku e j[kr g, dk; fd;k gA lLFkku u 14 bugkÅl vul/kku ,o fodkl ifj;ktuk,] 3 ijke’kh] 8 lgk;rk vunku] 26 ik;kftr RkFkk 79 ijh{k.k ifj;ktukvk ij dk; fd;k gA

lLFkku u o"k 2014&15 d nkjku ljdkjh] lkotfud ,o futh {k= dh ,tfl;k@lxBuk dk lfonk vul/kku ,o fodkl] lgk;rk vunku] ijke’kh dk; RkFkk rduhdh lok, inku djd 5-80 djkM :i, dh /kujkf’k vftr dhA bl vof/k e] lEeyuk dh dk;okgh ¼ikflfMX½ d lkFk&lkFk fofHkUu tuyk e dy 72 ’kk?k i= idkf’kr fd, x,A bl o"k lLFkku e bu&gkÅl lEHkk"k.k ¼dkykfDo;e ½ cBdk e 31 0;k[;ku fn, x,A 12oh ipo"kh; ;ktuk d vrxr x<oky fgeky; e HkL[kyuk d fy, vyh okfux flLVe fodflr dju d fy, lh,lvkbvkj&lhchvkjvkb] :Mdh }kjk ok;j yl llj uVod dk mi;kx djr g, x<oky fgeky; dh vydunk ?kkVh e ihiydkfV d fudV ik[kh e lHkkfor HkL[kyuk d okLrfod le; dk ekuhVju dju d fy, HkL[kyu o/k’kkyk dh LFkkiuk dh xb gA

lLFkku u jk"Vh; foKku fnol] fo’o i;koj.k fnol] jk"Vh; ikn;kfxdh fnol] lh,lvkbvkj LFkkiuk fnol RkFkk lh,lvkbvkj&lhchvkjvkb LFkkiuk fnol ij lLFkku dh vul/kku ,o fodkl xfrfof/k;k d fo"k; e fo|kfFk;k RkFkk tulkekU; dk tkudkjh nu d fy, bu fnolk ij ‘vkiu&M’ euk;kA lLFkku dk vke turk d fy, [kyk j[ku d vfrfjDr bu voljk ij fofHkUu dk;dek] LFkkiuk fnol 0;k[;kuk] fofHkUu jk"Vh; fnolk ij bu fnolk d egRo dh tu lkekU; dk tkudkjh nu d mn’; l ifrf"Br 0;fDr;k d 0;k[;ku djk, x,A lLFkku e] LkHkh /kek] Hkk"kkvk RkFkk jkT;k e lnHkkouk dk c<kok nu d mn’; l lnHkkouk fnol dk vk;ktu fd;k x;kA xk/kh t;rh d volj ij] lh,lvkbvkj&LkhchvkjvkbunHkkjr ljdkj }kjk pyk, x, LoPN Hkkjr vfHk;ku ¼Dyhu bfM;k fe’ku½ e lfd; :i l Hkkx fy;k RkFkk bldk tu LokLF; l lcf/kr djr g, ykxk e LoPNrk d ifr tkx:drk ink dhA flrEcj ekg e lLFkku e fgUnh i[kokM dk vk;ktu fd;k Xk;kA fgUnh llrkg d nkjku fgUnh fVli.k ,o vky[ku ifr;kfxrk] fgUnh fuc/k y[ku ifr;kfxrk] fgUnh i’ukrjh ,o fgUnh y[ku ifr;kfxrk ¼vfgUnh Hkkf"k;k d fy,½ dk vk;ktu fd;k x;kA lrdrk tkx:drk llrkg d nkjku depkfj;k] fo|kfFk;k] vke turk rFkk lekt dk cMh ek=k e mRlkfgr dju d fy, fofHkUu dk;de vk;kftr fd, x, vkj Hk"Vkpkj l yMu e ik|kfxdh dk mi;kx fdl idkj fd;k tk ldrk g] ij eFku fd;k x;kA

n’k&fon’k d ykxk d lkFk fujrj lokn ,o lpkj cuk, j[ku d de e lLFkku u cMh l[;k e Hkou ,o fuek.k {k= dh fofHkUUk leL;kvk lc/kh iNrkN d mŸkj fn,A Hkou] fuek.k d {k= e] u, vul/kku ,o ik|kfxfd;k d fo’k; e vke Tkurk d chp tkx:drk ink dju d mn’; l in’ku lg if’k{k.k dk;dek] rduhdh in’kfu;k vkfn dk vk;ktu fd;k x;kA LkLFkku u fnYYkh fLFkr viu ilkj dn d lkFk feydj n’k Hkj e dnh;] jkT;] lkotfud@futh {k=k d lxBuk d lkFk lEid cuk, j[kkA

lh,lvkbvkj&lhchvkjvkb u bMk&;,l foKku RkFkk ik|kfxdh QkmM’ku RkFkk fe’khxu LVV ;fuoflVh] ; ,l d lkFk feydj ekp eghu d nkjku ‘LVDpjy ,M iflo Qk;j l¶Vh bu fCkfYMX l% b’;t ,M pyft t’ fo"k; ij fopkj&fofue; lEeyu dk vk;ktu fd;kA lLFkku u foKku RkFkk ik|kfxdh foHkkx] ub fnYyh rFkk jk;y lkslkbVh] ynu] bXyM d lkFk

feydj bfM;k gfcVkV lVj ub fnYyh e lLVucy fcYV ,uok;jueV dh ryuk e xhu fuek.k lkexh d {k= e vk/kfud ixfr rFkk iofRr;k dh tkudkjh rFkk Hkfo"; e mHkjrh pukfr;k dk lk>k dju d mn'; l ,d lx"Bh dk vk;tu fd;kA ;|fi ;g o"k gekj fy, pukfr;k RkFkk miyfC/k;k l Hkjk jgk g] fQj Hkh ge viuh miyfC/k;k l vkRelr"V ugh g cfYd ge Hkfo"; e vku okyh pukfr;k ,o ftEenkfj;k dk lkeuk dju d fy, rRij gA

Ek>] lh,lvkbvkj&lhchvkjvkb dh okf"kd fjikV 2014&2015 dk iLrr djr g, xo dh vuHkfr gk jgh g tk gekj oKkfud vul/kkuk RkFkk lcf/kr miyfC/;k dk n'kkrh gA bl fjikV e n'kk;k x;k mPp x.krk oky dk; dk J;] lkFkh oKkfudk] rduhdh vf/kdkfj;k RkFkk i'kklfud dkfedk d dr0;fu"B ,o bekunkj i;klk dk tkrk g] ftUgku viu dk; dk lQyrk iod dju d fy, dfBu ifjJe fd;k gA Ek mu lHkh dh gkfnd i'klk djr g, mUg 'kHkdkeuk, nrk gA gekjh vul/kku ifj"kn d v/;{k vkj lnL;x.k viu veY; ijke'k] ekxn'ku ,o lgk;rk d fy, fo'k"k /kU;okn d ik= gA e lh,lvkbvkj d egkfun'kd RkFkk lh,lvkbvkj e[;ky; d viu lkfFk;k dk] mud fujrj lg;kx ,o ekxn'ku d fy, lnHkkoiod /kU;okn nrk gA e viu LkHkh lkfFk;k dk mud lg;kx d fy, vkHkkj 0;Dr djrk g] ftUgku e> ej nkf;Rok dk fuHkku e ejh enn dh gA

bl okf"kd ifronu d fy, vko';d lpuk miyC/k djku oky lgdfe;k RkFkk bldh mŸke iLrfr d fy, lEiknd dk Hkh /kU;okn nrk gA vr e] viu eY;oku xkgdk] ik;ktdk] 'kHkfprdk RkFkk lh,lvkbvkj&LkhchvkjvkbD lokfuoŸk dkfedk d lg;kx RkFkk lgk;rk dk Lej.k djuk ej fy, ilUurknk;d iy gA

Hkou fuek.k ,o voljpkuRed m|kx e of} d lkFk ge mTToy Hkfo"; dh vkj vxlj gA

एस॰के॰ भट्टाचार्य

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From the Director's Desk

It is my immense pleasure & privilege to present the Annual Report of CSIR-Central Building Research Institute, Roorkee for the year 2014-2015. The Institute has been vested with the responsibility of generating, cultivating and promoting building science and technology in the services of the country and has contributed immensely in scientific research and development, technology development, technology dissemination, social activities, human resource development and national planning for building research in order to sustain the building and construction industries.

Since its inception, CSIR-CBRI has laid emphasis on carrying 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. The Institute has worked to attain a single objective, "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, health monitoring, fire engineering and disaster mitigation".

During this period, the Institute pursued two important projects- One Supra Institutional Network Project (SINP) in core competency area of the institute and the other as Network project being coordinated by the institute and being participated by number of other sister laboratories.

A **Supra Institutional Network Project (SINP)** on 'Innovative Materials & Technologies for Next Generation Green Buildings **(INMATE)**' was continued through different work packages. In work package, '**Performance Enhancement of Materials through Nanotechnology**', Studies on early stage hydration of tricalcium silicate incorporating silica nano particles, development of multifunctional coatings using nanotechnology, studies of phase change material for energy efficient buildings were carried out. In work package, '**Next Generation Concrete for Sustainable Construction'**, studies on bio-concrete as self-healing material, development of pervious concrete was 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, 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 gypsum cement in prefabricated panels and masonry works, development of anti-termite barrier for new buildings and 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 composite panel, impact behavior of reinforced concrete elements and improved ventilation system for cleaner built environment

with an objective to design & develop improved ventilation system to reduce inhalable particles in built environment have been carried out.

Network Project on **'Engineering of Disaster Mitigation & Health Monitoring for Safe & Smart Built Environment' (EDMISSIBLE)** was continued through different work packages. Under **Engineering of Landslide Disaster Mitigation**, different sister laboratories are participating. The activities taken up by different participating laboratories include landslide hazard & risk assessment of Chamoli-Joshimath region, Garhwal Himalayas (CSIR-CBRI), Early warning instrumentation & decision package for a landslide in Chamoli-Joshimath region, Garhwal Himalayas (CSIR-CBRI), GPS based integrated landslide modelling for hazard assessment in Chamoli-Joshimath Region, Garhwal Himalaya (CSIR-4PI), Landslide monitoring using SAR interferometry (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**', Studies on seismic microzonation of Srinagar, Uttarakhand, seismic behaviour of piles under dynamic lateral loading, and performance of confined masonry buildings under quasi-static condition were continued. In work package, '**Engineering of Fire Disaster Mitigation**', development of low ozone depletion potential innovative fire suppression system and fire performance evaluation of structural elements and rehabilitation measures are progressing. In work package, '**Post Disaster Shelter Planning',** shelter planning for rural areas in the Western Himalayan region was continued. In work package, '**Health Monitoring of Buildings Using Wireless Sensor Network', i**mplementation of health monitoring approach using wireless sensor network, numerical analysis & modal updating on real-life buildings & under work package, '**Intelligent Building System for Model Residential Unit',** studies on architectural planning and design of a residential unit for integrating intelligent building features & glass facade cleaning robotic system 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 of locked up coal from underground mines is expected to resolve a long standing national problem, if made operational. Estimation of crustal deformation of Garhwal Himalaya (Nodal lab CSIR-4PI) is being carried out in the hilly regions of Garhwal. Service robot for building and other structures (Nodal lab CSIR-CMERI) is also very useful project for precise inspection and maintenance of civil infrastructure. Studies to develop energy efficient seed storage structure with controlled environment to avoid spoilage and deterioration of quality of seeds (Nodal lab CSIR-CSIO) are also being carried out.

The Institute is offering Integrated Masters-Ph.D. programme in the area of "Building Engineering and Disaster Mitigation" (BEDM). The fourth batch of the programme is currently carrying out their dissertation. Five students have joined for Ph.D. in Engineering Sciences in August 2014 and one student in Chemical Sciences in January 2015.

CSIR-CBRI as in the previous years has handled a number of its own in house R&D programmes and many other contract research projects giving due consideration to all aspects of sustainability. The Institute handled 14 in-house R&D projects, 3 consultancy, 8 grant-in-aid, 26 sponsored and 79 testing projects.

The Institute registered an external cash flow of nearly Rs. 5.80 crore during 2014-15, earned through contract R&D, grant-in-aid, consultancy assignments and technical services, carried out for government, public & private sector agencies/organization. During the period, a total of 72 research papers have been published in various journals as well as conference proceedings. As many as 31 lectures were delivered in colloquia meetings in-house during the year. A Landslide Observatory for real time monitoring of a potential landslide at Pakhi near Pipalkoti along the Alaknanda valley of Garhwal Himalayas using wireless sensors network was put in place by the initiative of CSIR-CBRI, Roorkee under 12th Five Year Plan activity to develop an early warning system for landslides in Garhwal Himalayas.

The Institute observed open days on the occasion of National Science Day, World Environment Day, National Technology Day, CSIR Foundation Day and 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 observed Sadbhavna Diwas with a view to promote harmony amongst people of all religion, languages and states and goodwill towards everyone. On the occasion of Gandhi Jayanti, CSIR-CBRI actively participated in the **Swachh Bharat Abhiyan** (Clean Indian Mission), a national level campaign by the Government of India and generated awareness among the citizens about sanitation and its linkages with public health. The Institute also celebrated Hindi Pakhwara 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. During Vigilance Awareness weak, various programmes were organized to sensitize the employees, students, public and society at large about how technology can be used in combating corruption.

To maintain regular interaction and communication with the people of India and abroad, the Institute attended various inquiries 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.

CSIR-CBRI in association with Indo-US Science and Technology Foundation and Michigan State University, USA organised an Exchange Meet on Structural and Passive Fire Safety in Buildings: Issues & Challenges during the month of March. The Institute in association with Department of Science and Technology, New Delhi and Royal Society, London, UK organized a Seminar at India Habitat Centre, New Delhi to cover the recent advancements and trends in the area of green construction materials vis-à-vis sustainable built environment to share and networking on the emerging and futuristic challenges. Though this has been a year of challenges and achievements, we are not complacent with our attainments but are ever keen to meet the forthcoming challenges & responsibilities.

I am honoured to present this CSIR-CBRI Annual Report 2014-2015, which reports the scientific research output and related achievements. The volume of high quality work reported goes to the credit of the sincere and honest efforts made by fellow scientists, technical officers 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 Director General, CSIR and other colleagues from CSIR Head quarters for their continuous support and guidance. I wish to acknowledge with gratitude the unstinted co-operation of my colleagues which has helped me to discharge my duties to the best of my ability.

I thank my colleagues for providing the necessary inputs and editor 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.

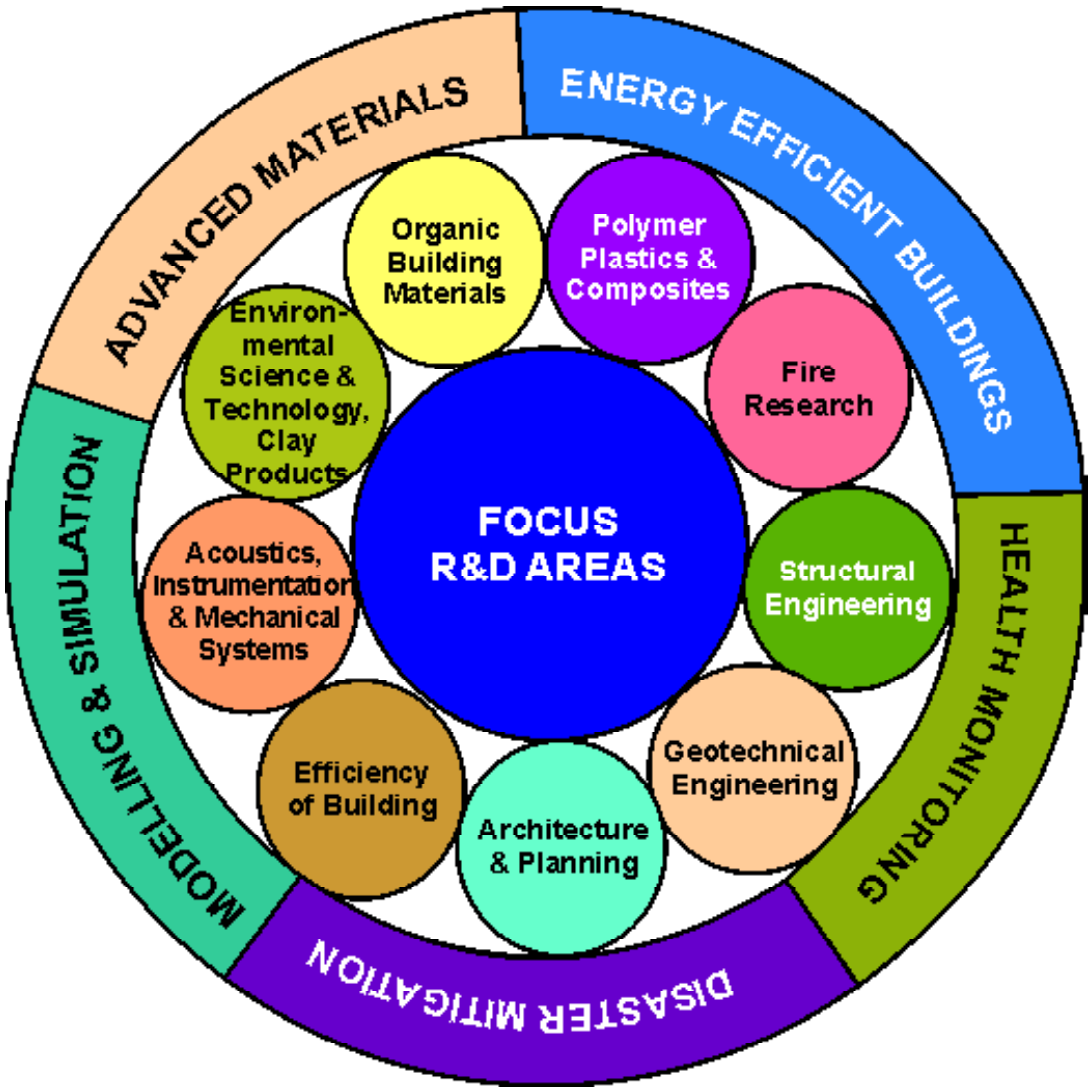
With the unprecedented growth in the building and infrastructure industry, we are looking forward to an exciting future.

Dated: 30/04/2015

(Prof. S. K. Bhattacharyya)

OUR VISION

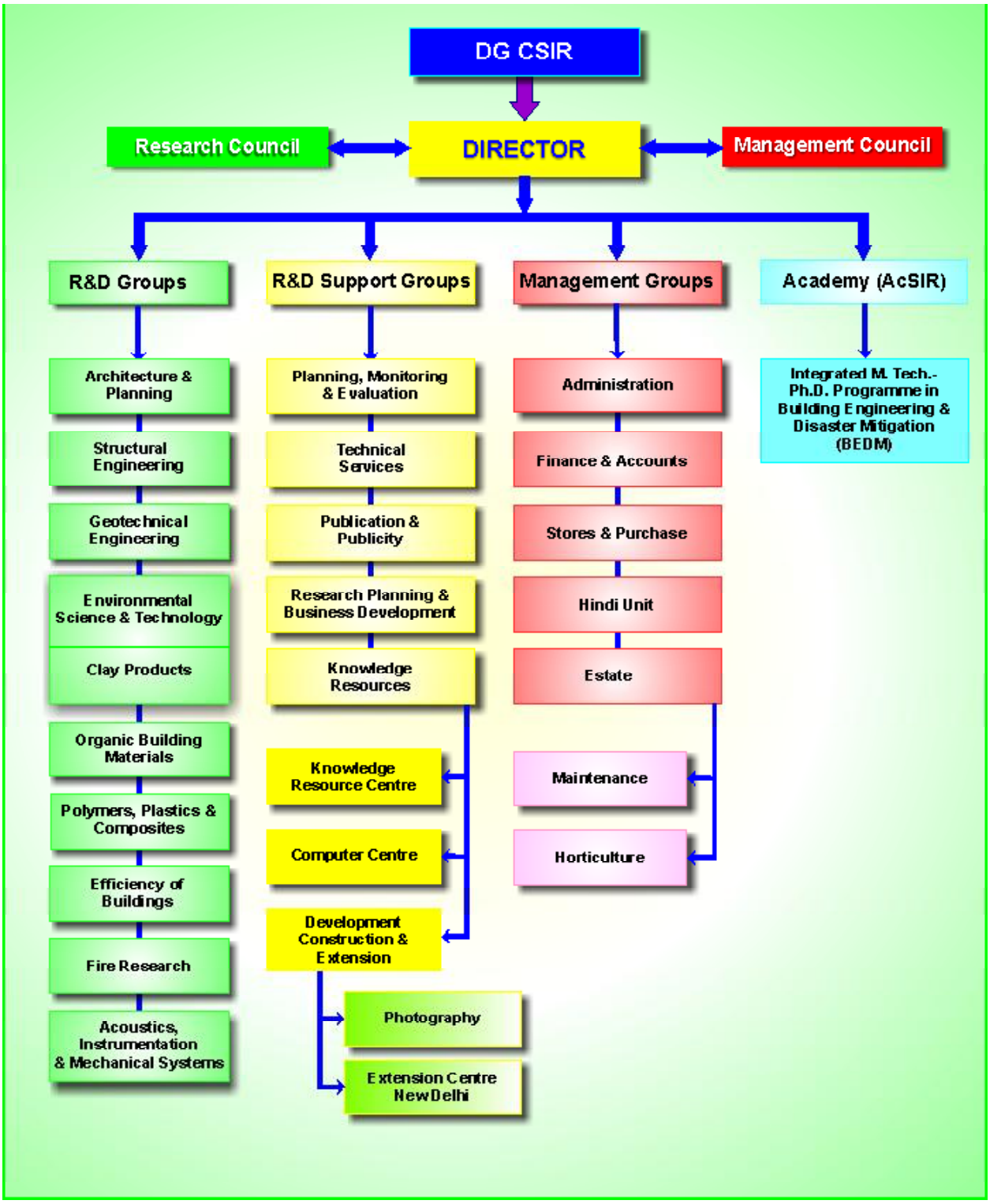
CSIR-CBRI to work as world class knowledge base for providing solutions to almost all area of Building / Habitat planning and construction including building materials, construction technology, fire engineering and disaster mitigation.



OUR MISSION

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.

CSIR-CBRI ORGANOGRAM



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MEMBER-SECRETARY

Administrative Officer
CSIR - CBRI, Roorkee

R&D Programme

Supra Institutional Network Projects (ESC 0301)

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: L. P. Singh

- Nano-Engineered Cementitious Materials PI: L. P.Singh & Team
- Multifunctional Coating using Nano-Technology, PI: P.C.Thapliyal & Team
- Phase Change Materials PI: Srinivasarao Naik B, & Team

WP-2: Next Generation Concrete for Sustainable Construction.

PI: S. K. Singh

- Bio-Concrete as Self Healing Material PI: Leena Chourasia
- Pervious Concrete for Tropical Climate PI: R. Deoliya & S. C. Gurram

WP-3: Green Building Technologies.

PI: Ashok Kumar

- Green Retrofit Strategies for Office Buildings,PI: Ashok Kumar, & Team
  - Development of Solar Window System for Cold Climatic Region, PI: Neeta Mittal & B.M.Suman
- Demolition Wastes, PI: A. K. Minocha, & Team
- Solar Thermal Air Conditioner, PI: Nagesh B. Balam
- Technology Packages for Mass Housing in Urban Areas, PI: Ashok Kumar, & Team
  - To Develop Light Weight Blocks using Different Industrial Wastes based on flyash/rice husk ash/ marble dust, PI: Vivek Sood & Ashok Kumar
  - Development of an Automatic Hollow Gypsum Panel Making Machine, PI: S.K.Panigrahi & Team
  - Development of Anti Termite Barrier for New Buildings, PI: B.S.Rawat & Team.
- Robust Foundation for Difficult Soils, PI: Pradeep Kumar

WP-4: Materials & Technologies for Hazard Reduction.

PI: S.R. Karade

- Indigenous Cathodic Protection System, PI: S.R. Karade & Team
- Impact Behaviour of RCC, PI: A.K. Mital & Team
- Fire Safe Polymeric Composite Panels, PI: Harpal Singh
- Improved Ventilation System, PI: Syed Ibrahim Sohel, & Team

WP-1 Performance Enhancement of Materials through Nanotechnology

L. P. Singh

Nano-Engineered Concrete: Studies on Early Stage Hydration of Tricalcium Silicate incorporating Silica nanoparticles

L. P. Singh & Team

The hydration of Portland cement is a complex phenomenon, which needs to be quantified as there is a coherent relationship between hydration process and various parameters such as porosity, heat of hydration, strength development and chemical shrinkage. Powers and Brownyard developed a model based on non-evaporable water (NEW) measurements and water vapour sorption isotherms. According to this model about 23% of water (by weight of cement) is required for the complete chemical reaction. The bound water is chemically combined with calcium-silicate-hydrate (C-S-H) and forms a definite part of hydrated compounds. Microstructure of cement paste consists of the capillary and gel pores of which capillary pores are long continuous pores that exist within the un-hydrated cement paste and the gel pores are of very small dimension that occurs within the reaction products i.e. C-S-H gel. One of the interesting materials currently being explored to produce high strength concrete is silica nanoparticles (SNPs). The addition of nanoparticles in cement improves the mechanical properties and results into the denser microstructure. In cement-based materials, there are large numbers of fine pores which cannot be observed by image analysis and there are very large pores (voids) which cannot be correctly determined by mercury porosimetry. From the measurements of the evaporable and non-evaporable water contents in the cement paste, the degree of hydration and porosity are estimated using relations which are based on known reaction stoichiometry and volumetric proportions of the reaction products.

In the present study, 43 grade OPC, Type I cement was used. Further, our laboratory prepared SNPs having particle size 30-70nm and specific surface area 116 m^2/g were added to cement paste with w/c 0.35. For the comparison purpose commercially available silica fume (SF) was also undertaken and samples were prepared in the similar manner. To evaluate NEW content, the core of the samples were crushed and immediately immersed in acetone for 2h to arrest the hydration at different time intervals. The powdered samples were dried in oven at 110ºC for 1h. Out of this dried sample about 2g was taken for ignition at 1000ºC for 1h. All chemically bound water is assumed to be lost on ignition of the sample at 1000ºC. NEW was calculated by taking weight difference between the temperatures 110 and 1000ºC and degree of hydration (DOH) was calculated by using following equation:

$$DOH\ (\%) = \frac{NEW(t)}{W(c)\times 0.23}\times 100 \qquad (1)$$

The total porosity of cement paste at different time interval was calculated by using the following equation:

$$PTot\ (\%) = \frac{w/c + 0.32\alpha}{w/c - 0.17\alpha}\times 100 \qquad (2)$$

Where, PTot is the total porosity of the cement matrix, and 0.32 is the specific volume of cement (cm3/g). The expression for calculating gel porosity is given in equation:

$$Pgel\ (\%) = \frac{0.19\alpha}{w/c + 0.32\alpha}\times 100 \qquad (3)$$

At 1d of hydration, NEW in plain cement, cement with SF and SNPs were 0.13, 0.23 and 0.29g respectively. The percentage increment in NEW with respect to control was found to be higher (~55%) in SNPs incorporated sample than the SF admixed cement (~43%), thereby, confirming to our earlier studies that SNPs accelerate the early stage of hydration (Fig. 1). In presence of SNPs more hydration products were formed, therefore higher NEW was observed. Further, from the quantification of hydration products, degree of hydration was determined. Fig. 2, showed that at 1h, DOH in plain cement was 8.6%, whereas in SF and SNPs added cement, it was 17.3 and 28%, respectively. This initial increase in hydration products was due to early hydration effect of SNPs The volumes of capillary and gel pores were calculated on the basis of degree of hydration. Fig. 3, illustrated that in plain cement at 1d the total porosity is 44.6%, where as in SF and SNPs added cement it is 38.7 and 35.2%, respectively. Due to the formation of more hydration product the gel porosity was 8.7%, in plain cement, whereas in SNPs incorporated cement the gel porosity was increased to 19.7% at 1d (Fig. 4). This increase in gel porosity at early stage of hydration is significant as more amounts of hydration products i.e. C-S-H gel formed. This increase in gel porosity revealed that SNPs has accelerated the hydration mechanism and nucleate more hydration sites, therefore more hydration products are formed. As well as due to pozzolanic reaction, CH was consumed regularly by SNPs and converted into C-S-H.

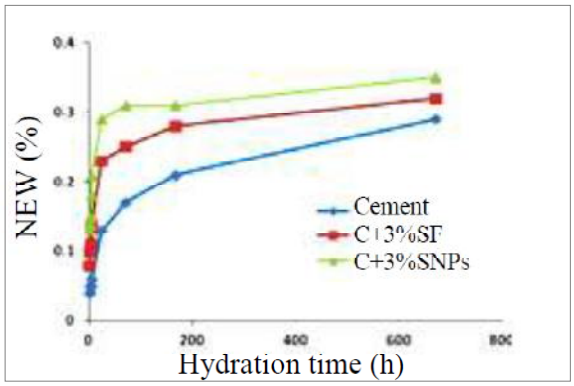


Fig. 1: Effect of additives on NEW content of cement paste

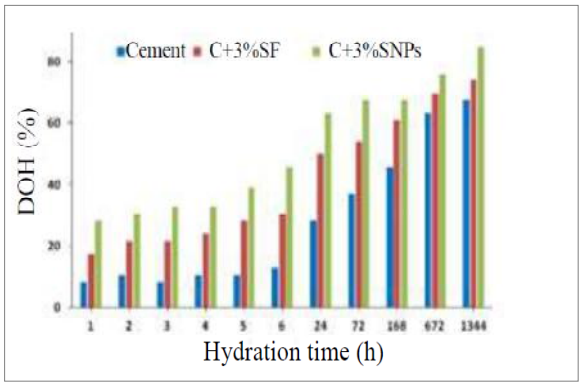


Fig. 2: Degree of hydration with SF and SNPs

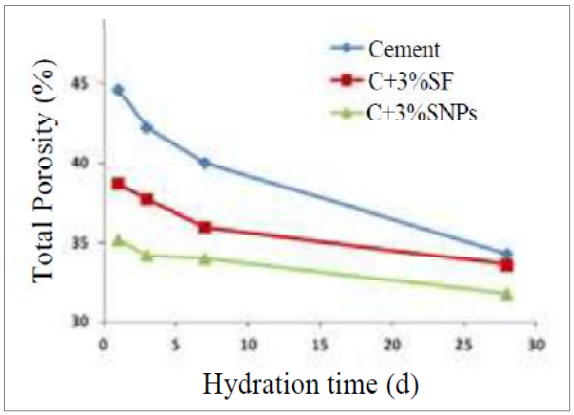


Fig. 3: Total porosity of SF and SNPs incorporated cement paste

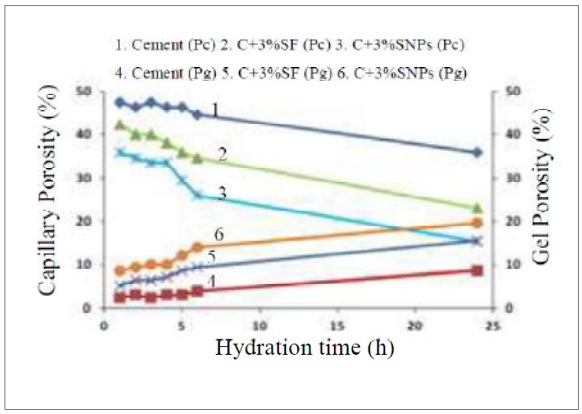


Fig. 4: Capillary and gel porosity in plain and blended cement paste

Development of Multifunctional Coatings using Nanotechnology

P.C. Thapliyal & Team

Objective

To develop multifunctional (water resistant, energy efficient, anticorrosive) coatings using nanotechnology.

Progress Highlights

Work on the preparation of acrylic coatings with / without nano-additives completed. A total of twelve formulations were prepared. Mineralogical, morphological and Physico-mechanical studies were carried out to establish coating structures. It is observed that addition of nano-additive was influencing the properties of coatings especially in terms of water vapour transmission and gloss (Figures 1 and 2). Water vapour transmission of coatings had decreased and gloss of coatings had increased on addition of nano-additives. Work on the determination of more properties such as R Values, Heat build-up, etc. is in progress.

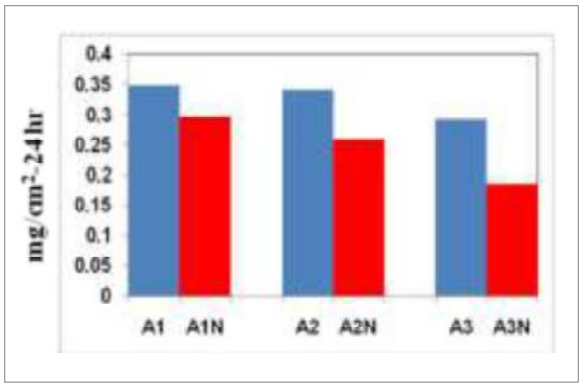


Fig. 1: Effect of nano-additive on water vapour transmission of coatings

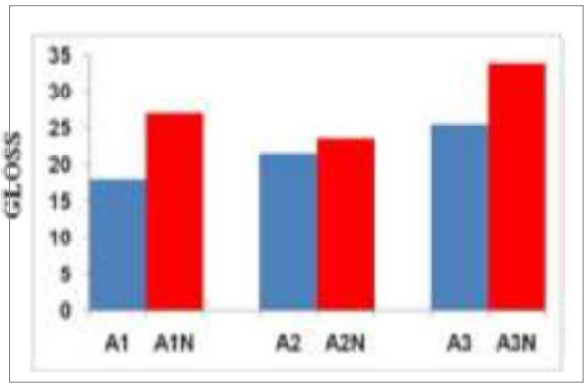


Fig. 2: Effect of nano-additive on gloss of coatings

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

Srinivasarao Naik B., & Team

Encapsulation of Phase Change Material

Eutectic mixture of Phase Change Material (EPCM) has been prepared with the composition of 60% lauric acid and 40% capric acid as per Schroder's equation.

PCMs are not easy to be used directly in the building because of leakage during phase change process from solid to liquid and reactivity towards outside the environment, etc. So micro/ nano capsules have been developed to overcome these difficulties. Various methods have been developed for encapsulation of PCMs such as complex coacervation, interracial poly condensation and in situ polymerization. The in situ polymerization method is a feasible technique to prepare encapsulation of PCMs

Encapsulation of PCM has been prepared by in situ polymerization technique, in that ''MF'' resin used as the shell and eutectic mixture as core. Prepared two types of solution such as MF pre polymer and PCM emulsion. Melamine - formaldehyde resin (MF), urea-formaldehyde resin (UF), polystyrene (PS), polyurethane (PU), Phenolic Resin and gelatin gum Arabic were usually used as the shell material. MF has unique inherent properties, such as good seal tightness, endurance, water resistance, alkali resistance and fire resistance.

Preparation of MF pre-polymer

Melamine, formaldehyde aqueous solution and distilled water were mixed together and adjusted to pH 8-9 with 10% solution of sodium carbonate. The mixer was stirred at 70 °C until the mixture becomes transparent, indicating the formation of MF pre-polymer

Preparation of PCM emulsion

Emulsifier plays important role in the preparation of EPCM. With the help of emulsifier, PCM and water emulsion can be stable and then the pre-polymer is adsorbed and deposited on the surface of the core material. Emulsifier

Fig. 1

Fig. 2

such as sodium dodecyl sulphate (SDS), the macromolecular emulsifier, styrene-Maleic anhydrate (SMA) possesses stronger absorbability and dispersibility in PCM and water emulsion. PCM and distilled water were emulsified mechanically with some amount of SDS.

The pH of PCM emulsion was adjusted to 3-4 by adding 5% sulphuric acid solution.

Preparation of E-PCM

The MF pre-polymer solution was slowly added into PCM emulsion. After all of the MF pre-polymer aqueous solution was added, it was continuous stirred with the temperature of 70°C. Microcapsules were filtered washed with distilled water and dried at temperature of 50° C. In PCM emulsion, PCM is partially ionized and carries negative charges on surface of emulsion droplets, it is partially ionized and carries negative charges, on the surface of emulsion droplets. The water - soluble MF pre-polymer molecules carry negative charges, during the dripping process of MF pre-polymer, Emulsion droplets attract MF molecules form microencapsulation of PCM as core and MF as shell. The surface morphology of microcapsules was observed by using the LEO Scanning Electron Microscopy. The experimental setup was designed for production of 500 grams encapsulation of PCM per day (Fig. 1). Fig. 2 shows Morphology of micro PCMs.

The surface morphology of microcapsules was observed by using the LEO Scanning Electron Microscopy. The morphology of the capsules obtained by Scanning Electron Microscope. showed that the capsules are almost circular with perfect periphery. It has been observed by SEM that the capsules are fused together. This may be due to the aggregation of the capsules at a high curing temperature of 100° C.

Thermal Analysis of E-PCM

Weight loss of encapsulation of PCM has been studied by using thermal gravimetric analysis (Fig. 4). 65% of weight loss observed between temperatures 140 °C to 220 °C due to evaporation of core material and 50% weight loss observed in commercially available encapsulated PCM from BASF, UK (Fig. 3). 22% of weight loss observed between the temperature 250 °C to 380 °C due to polymer degradation.

The amount of core material i.e. PCM is observed more in lab scale preparation of E-PCM than commercially available E-PCM.

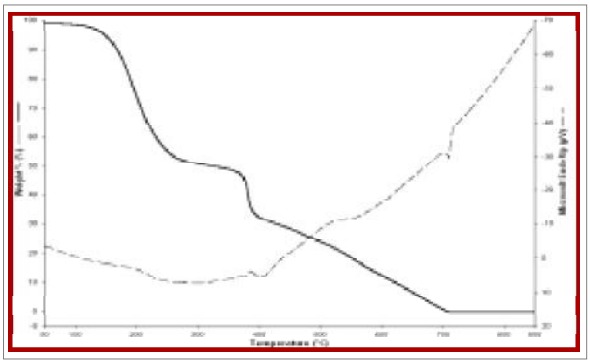


Fig. 3: Commercially available E-PCM

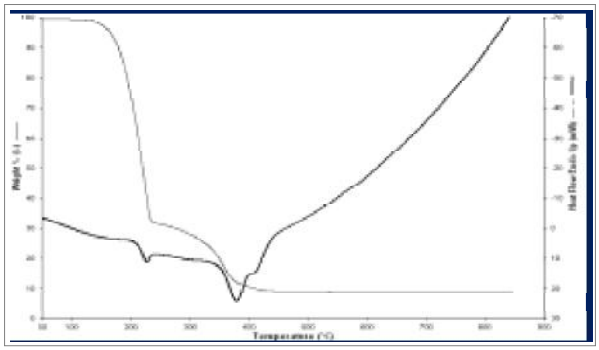


Fig. 4: Lab scale Prepared E-PCM

WP-2 Next Generation Concrete for Sustainable Construction

S. K. Singh

Bio-Concrete as Self Healing Material

Leena Chaurasia & Rajesh K. Verma

- Species of calcifying bacteria have been maintained for study.
- Standardization of dosage of bacteria & bacterial kinetics in concrete.
- Study extended from 25mm & 50 mm mortar cubes to 150 mm concrete cubes
- Prepared concrete cubes (150 mm) by using optimized dosage of bacterial broth / powder with & without chemical feed.
- Performed durability tests on prepared 150 mm cubes.
- Study of acid attack on bacterial mortar

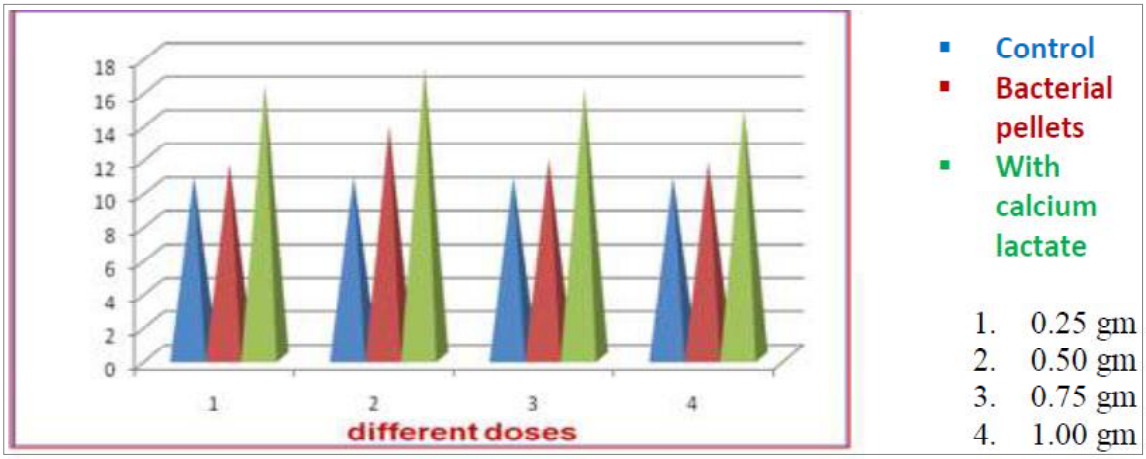


Fig. 1: Application of diferent dosage of bacterial biomass in concrete.

Fig. 2: Testing of 150 mm³ for compressive strength.

This study is under taken for 30, 60 & 90 days and bacterial specimen are showing significant results in comparison with control specimen.

Fig. 3: Bacterial and control specimens immersed in water and acid.

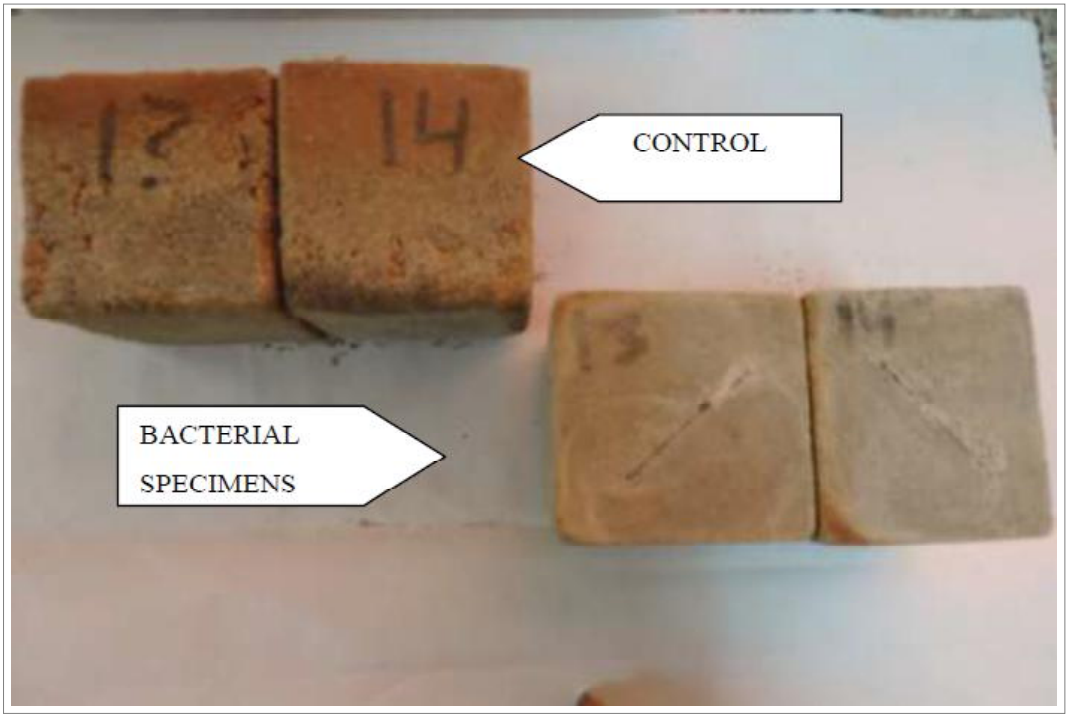


Fig. 4: Bacterial and control specimens immersed in acid.

- Study and determination of water absorption, % void analysis & bulk density of bacterial mortar
- Mortar cubes were analyzed for SEM – EDAX & XRD
- Bacteria & bacterial kinetics in concrete
- Established bio-concrete lab
- Inaugurated bio-concrete laboratory by RC chairman on 16-10-2014

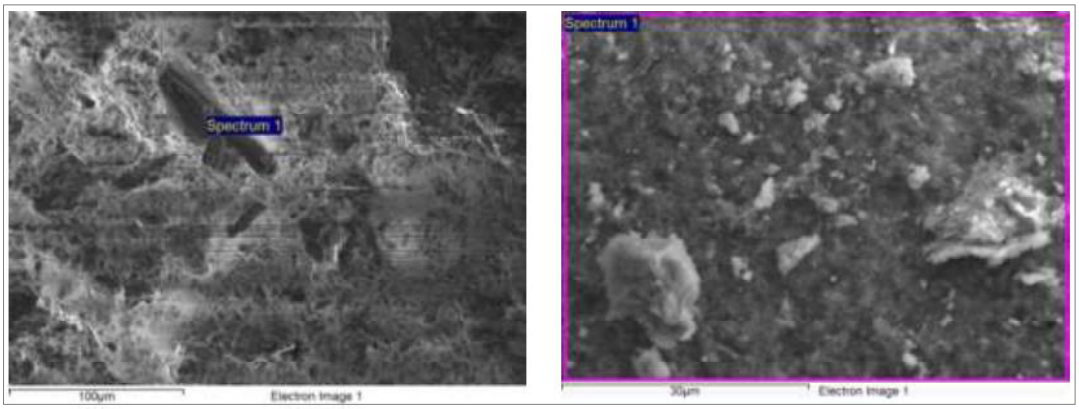


Fig. 5: SEM Images of specimens

Fig. 6: Bio-concrete laboratory and installed intruments.

Fig. 7: Inaurguration ceremony of Bio-Concrete lab

Development of Pervious Concrete

Rajesh Deoliya & Subhash Gurram

Pervious concrete is made mainly of coarse aggregate, cement, water, and admixture. Though fine aggregate is not used in making pervious concrete generally, some fine aggregate can be used so that increase in strength is achieved and permeability is not reduced significantly. Cement paste should be just sufficient enough to coat aggregate. Quality of the paste should be such that it would not accumulate at the bottom of the mould. The above factors facilitate interconnected pore structure and hence high permeability. Because of its high permeability, pervious concrete is being used widely in parking lots and pathways to allow rain/storm water runoff to permeate into the ground.

The main objective of the project is to develop pervious concrete having 10-25% porosity with 10-25 MPa compressive strength using locally available materials. Effects of mix parameters such as aggregate size, cement content, water-cement ratio and super plasticizer dosage on compressive strength and porosity have been evaluated. Abrasion resistance of pervious concrete specimen is evaluated for the mixes with different water-cement ratio and super-plasticizer content. Ordinary Portland cement is used throughout the experimental program. Aggregate has been made by mixing 6.35-10 mm and 10-12.5 mm in equal proportions by weight. Cement content and aggregate quantity are kept constant at 400 kg/m^3 and 1622 kg/m^3 respectively in this study. Standard cube and cylinder specimen have been cast. Compressive strength and porosity tests have been conducted as per IS 516 and ASTM C1754 respectively. Porosity is found to decrease, as expected, with increase in w/c ratio and super-plasticizer dosage because of increase in volume and flow ability of cement paste when all other mix parameters remained constant. The variation of compressive strength depends upon decrease in porosity and w/c ratio as seen in Fig. 1(a). Compressive strength decreases with increase in w/c ratio and increases with super-plasticizer dosage as seen in Fig. 1(b).

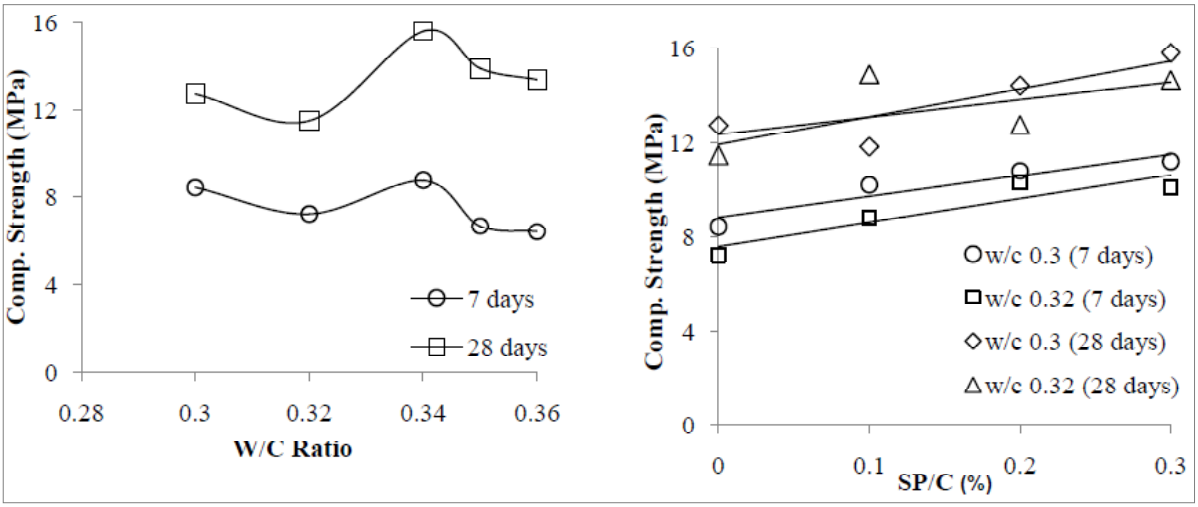


Fig. 1: (a) Variation of compressive strength with w/c ratio

Fig. 1: (b) Variation of compressive strength with super-plasticizer dosage

Cylindrical specimens of the above mixes have been tested for abrasion resistance as per ASTM C1747. They have been kept inside Los Angeles abrasion test machine without steel balls and are subjected to 500 rotations at 30 rpm. Then the weight of specimen is taken and mass loss is calculated. It is observed that mass loss decreases with increase in compressive strength and increases with increase in void space in the pervious concrete as shown in Fig. 2.

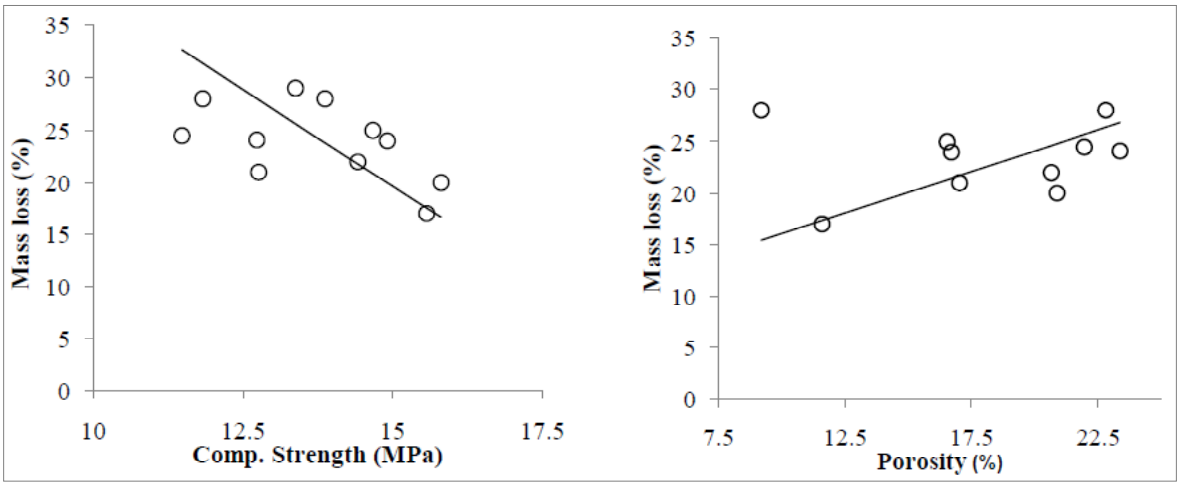


Fig. 2: (a) Variation of mass loss in abrasion test with compressive strength

Fig. 2: (b) Variation of mass loss in abrasion test with porosity

WP-3

Green Building Technologies

Ashok Kumar

Green Retrofit Strategies for Office Buildings

Ashok Kumar & Team

During the period, the focus of the research study has been on the development of green retrofit strategies for existing buildings for conservation of energy. Since the energy efficiency may be achieved through: i) Heat protection (micro – climate improvement through landscaping, natural vegetation, water body and solar control through optimizing window – to – wall ratios, shading, and gazing etc.); and ii) Heat dissipation (thermal mass, insulation and passive cooling etc.); the parametric analyses of the known factors that affect the heat loads of any building have been carried out. The publish literature shows that these attributes contribute significantly in reducing the heat loads. But how much each factor contributes and how much all the parameters contribute in any building is still not known for different climatic regions and / or countries. Hence, this research study is carried out for composite climate of India.

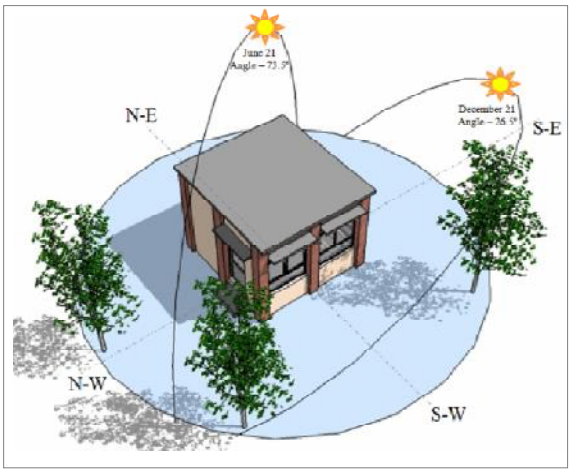


Fig. 1: Loction of Base Case Model

To quantify the impact of attributes, a Base Case Model Building located in CSIR- CBRI campus (Rural Park) Roorkee; Latitude - 29° 522 29.493 N & Longitude - 77° 532 23.743 E; Site orientation - 45° (entrance facing N-W) as shown in Fig. 1 is considered.

The study area Roorkee, located in the state of Uttarakhand (India) that lies in composite climate and where heat gain through roof is a main problem, has been chosen for the study because summer occurs for nearly 6 months and remaining period of the year is cold and rainy. The basic modeling for the experimental model consists of a room of size 3620 x 3620mm with 3000 mm clear (ceiling) height, RCC planks & joists roof and 229 mm thick brick masonary walls, WWR of 45% towards S-E and S-W with windows size of 1620 x 1950mm, sun shading protection of 450 mm along with a door of size 1030 x 2430 mm towards N-W.

Simulation Modelling using Design Builder is used for doing the analysis of the experimental models, as the tool is found to offer flexible geometry input and extensive material libraries and load profiles. Simulation data and results can be effectively displayed and analyzed in a comprehensive manner.

The modelling and simulation is carried out for different combinations by changing the variables without and with retrofit as it is very expensive and time consuming to try out all the options physically. Also it takes long time to grow trees and vegetation. Since grass carpets are easily available, green roof study has been carried out.

Conventional Model (without Retrofitting)

- Roof – 35mm thick Brick Tiles + 75mm Mud Phuska + 100mm RCC + 15mm Cement Plaster
- Walls – 229mm thick burnt clay bricks
- Air changes per hour = 5
- WWR to 45 % & Single glazing
- Sun shading projection of 500 mm

Retrofitted Model:

- WWR of 45 %
- Double glazing & Outer Glazing with Film in the vision panel
- Sun shading projection size of 500 mm
- Roof insulated with 100 mm thick PUF + 35 mm thick vermiculite tiles & white reflective paint
- Walls with 50 mm PUF insulation on all the sides
- Windows open from 18:00 to 9:00 hrs. (air changes per hour = 5) and exhaust fan

The simulated model results indicate that both wall and "roof insulation contribute significantly in improving the thermal performance indoors vis – a –vis energy efficiency. Similarly, the green roof contribute immensly as well. This infers that different parameters contributes individually and collectively in improving the energy efficiency in buildings and are important for developing green retrofit strategies.

Development of Solar Window System for Cold Climatic Region

Neeta Mittal & B. M. Suman

The objective of the project is, utilization of solar energy through solar window system for improvement of indoor environment in cold climatic region for residential buildings.

Solar passive window has been designed to enhance indoor air temperature during winter by trapping solar radiation inside the building. Result of the experimental studies show that proposed solar passive window is very much effective when it is provided on southern wall by increasing indoor air temperature. The view of ordinary window and solar passive window are shown in Fig. 1 and Fig. 2 respectively. Thermal performance of this Window has been already studied and verified in the field and ready for demonstration. The solar passive window is fabricated and will be installed in demonstration room for actual performance. The maximum solar radiation falls on southern wall of the building, therefore the passive window has been planned to provide on south wall of the demonstration room. The selective paint coated and perforated aluminium sheet, act as absorber, has been used in this solar passive window. The back side of the absorber is not coated because the uncoated back side of aluminium sheet has higher emissivity. After absorbing solar energy absorber becomes heated and its back side emits heat radiation into the room. Thus there is an increase in indoor room temperature and provides thermal comfort inside the room.

Fig.1: Untreated experimental window

Fig. 2: Treated experimental Solar Window inside view

Demolition Wastes as Raw Materials for Sustainable Construction Products

A. K. Minocha & Team

The concrete wastes utilized as recycled aggregates (RA) in construction sector is necessary to reduce the social and environmental problems against disposal of wastes and consumption of natural sources, but the main drawback is the presence of adhered mortar (AM) and cement paste (CP) on the surface of recycled coarse aggregates (RCA) and recycled fine aggregates (RFA).The AM consists of fine aggregates and CP (hydrated and un hydrated cement) which usually have minor cracks or fissures and pores that makes predominantly RA (represents both RCA and RFA) to be porous. Thereby, RA is characterized as high water absorption, lower specific gravity, and lower bulk density than conventional aggregates. Furthermore, the porosity of RA increases with an increase in the amount of CP. Hence the properties of the RFA are worse than RCA. Therefore, treatment process for removal of CP should be prominent to RFA to improve its quality.

Researchers have attempted several techniques to remove the AM from RCA. Meanwhile, very limited study has as yet been reported in the literature on the removal of CP from RFA. Moreover, there is no standard method for determining the cement paste on the surface of RFA. Keeping these concerns in view, the present paper addresses to study the thermo-chemical treatment for the purpose of surpassing the limitations of RFA performances. This study also elucidates the mechanical and micro structural behaviour of concrete made with thermo-chemically treated and untreated recycled aggregates.

As observed in this study, the thermal treatment itself enables to remove the minimal quantity of CP.As seen in Fig.1,the steep slope of the loss of CP increases with respect to molarity of acid in case of chemical treatment. It is attributed to that the reaction due to acid increases with an increase in surface area of RA, apart molarity of acid. It can also be visualized that the that the increase in loss of CP between the chemical treatment and pre-heating at 300°C with acid soaking was high as compared to others. It can be inferred that the thermo-chemical treatment makes a huge difference in removing the CP as compared to chemical and thermal treatment as well. As observed in this study, the treatment process particularly pre-heating at 600ºC with soaking in 0.4M of HCl for RFA samples removes the CP to a greater extent as well as satisfying the properties and micro structural aspects. Such treated RFA is used in concrete mixes to understand the effects on the properties of concrete.

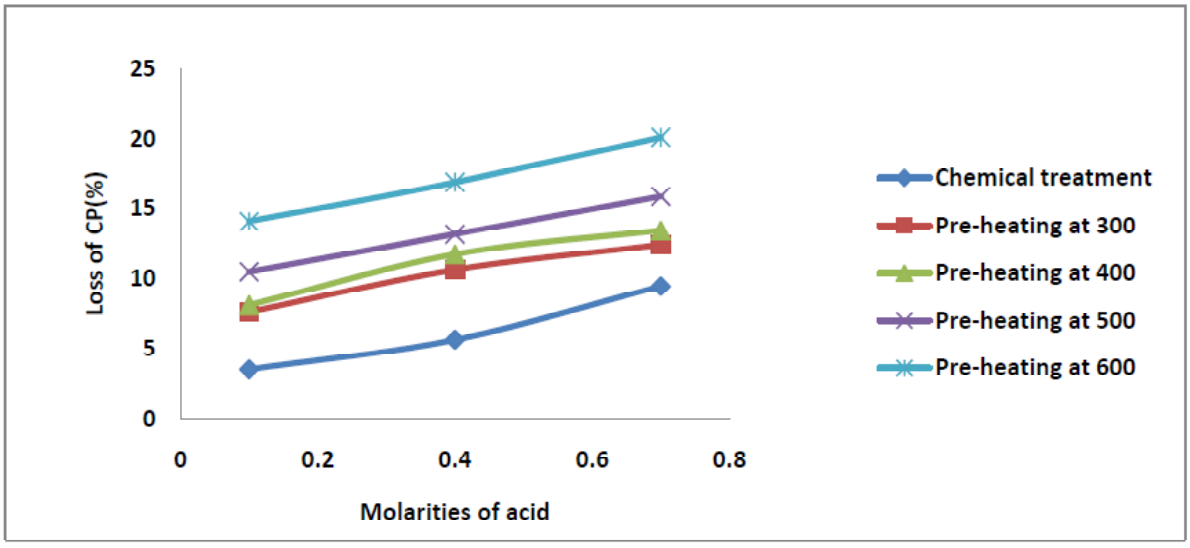


Fig. 1: Loss of CP under the influence of chemical and thermo-chemical treatment

Three different concrete mixes were prepared to assess its properties and mentioned in Table 1. The mix proportions are constant for all concrete mixes and presented in Table 2.The mix proportions of the concrete mixes were selected from a trail mix of concrete made with NCA and NFA on the basis of achieving the target strength of 50 MPa for 28 days. The maximum size of aggregates used in all concrete mixes was 12.5mm.

Table 1: Mix details of different types concrete mixes

S. No.	Mix details of concrete mixes	Mix designation
1	Natural coarse aggregates Natural fine aggregates	NCA+NFA (controlled concrete)
2	Natural coarse aggregates (100%) +Un treated recycled fine aggregates (100%)	NCA+UNT-RFA
3	Natural coarse aggregates (100%) +Treated recycled fine aggregates (100%)	NCA+TRT-RFA

Table 2: Mix proportion used in concrete mixes

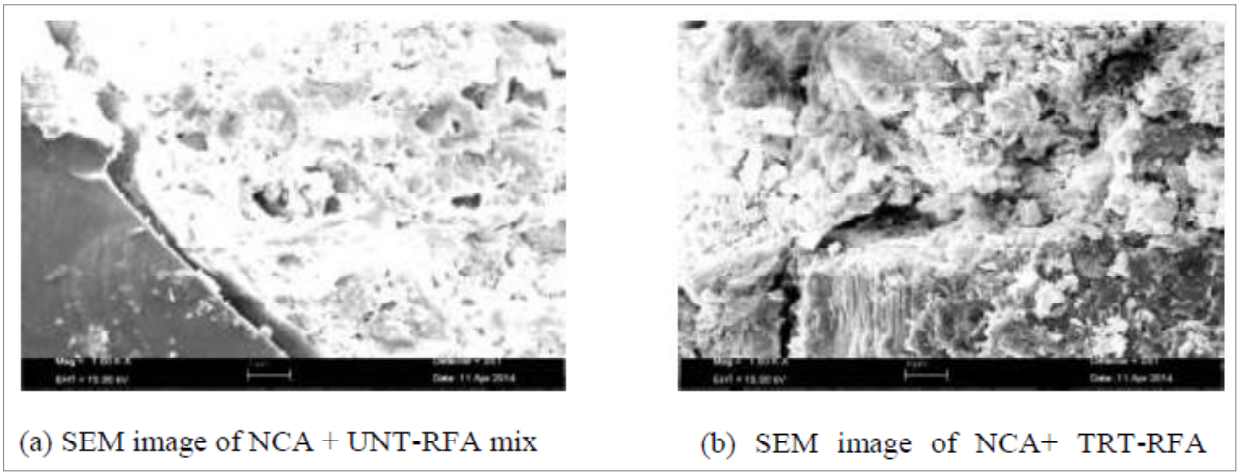
Materials used	Quantity
Cement	450kg/m^3
Fine aggregate	636kg/m^3
Coarse aggregates	1200kg/m^3
Super plasticizers	1% by weight of
Water-cement ratio	0.38

The mechanical properties of different concrete mixes are presented in Table 3.The UNT-RCA+UNT-RFA mix attains lower strength of 45.60%, 55.78% and 54.84 % with respect to 7, 28 and 56 days as compared to controlled concrete. However, the increase in strength in case of NCA+TRT-RFA mix is 11.40%, 16.70% and 27.50% with respect to 7 ,28 and 56 days as compared to NCA+UNT-RFA mix. It can be also observed that untreated RFA used in concrete results in to decrease the modulus of elasticity to the maximum extent as compared to others. In case of using untreated RFA in concrete, the stiffness of the mortar matrix may get lowered utmost due to the presence of CP, which is the crucial factor for decreasing the modulus of elasticity of concrete. In contrast to this, such treated RFA used in concrete results in to increase the modulus of elasticity to a considerable level.

Table 3: Mechanical properties of different concrete mixes

Mix proportions	Compressive strength (Mpa)			Tensile strength(Mpa)	Modulus of elasticity (Mpa)
	7 days	28 days	56 days		
NCA+NFA	41.5	55	60.5	3.47	38480
NCA+ UNT-RFA	31.04	33.13	34.65	2.75	21485
NCA+TRT-RFA	34.58	38.66	44.18	2.86	26653

As seen in Fig. 2 (a) and Fig. 2 (b), it can be inferred that the ITZ of NCA+TRT-RFA is somewhat dense than ITZ of NCA+UNT-RFA. The treated RFA used in concrete has the tendency in enhancing the hydration process, improving the bond between aggregate phase and mortar phase and reduction of the porosity of the matrix phase as compared to untreated RFA.



(a) SEM image of NCA + UNT-RFA mix (b) SEM image of NCA+ TRT-RFA

Fig. 2: Microstructure of different concrete mixes

Solar Thermal Air Conditioner

Nagesh Babu Balam

Air conditioner Test setup has been fabricated with the following specifications:

- Temperature : max 70 °C
- Humidity : max 90 %RH
- Air Flow Rate : max 2500 m^3/hour

Fig. 1: Air conditioner Test setup

Experiments have been conducted to measure the performance of this setup. One of them is to determine water-vapor to air mixing ratio and temperature relation which is described as follow:

Determination of water-vapor to air mixing ratio and temperature relation-

All climatic variables like air temperature, humidity etc. are affected by each other. The air temperature variation brings about a change in water evaporation and air saturation, leading to the change in air humidity. Furthermore, the air temperature differences between different locations will also cause air pressure differences, which in turn would produce air movement, thereby wind.

The water holding capacity of air depends sharply on the air temperature (i.e. the warmer the air is the more water it can hold). At a given temperature, air is saturated when it reaches the maximum water holding capacity that is also known as the dew point.

For a constant air flow rate, water vapor to air mixing ratio has been determined by varying the temperature of the inlet air.

Mixing ratio- Mixing ratio is the amount of water vapor that is in the air. Mixing ratio is the grams of water vapor per kg of dry air. It is an absolute measure of the amount of water vapor in the air.

- Humidity ratio expressed by mass:

$$x = m_w / m_a \quad (1)$$

where,

x = humidity ratio or mixing ratio ($kg_{water\ vapour}/kg_{air}$)

m_w = mass of water vapor (kg)

m_a = mass of dry air (kg)

- Humidity Ratio by Vapor Partial Pressure:

Humidity ratio can also be expressed with the partial pressure of water vapor-

$$x = 0.622\ p_w / (p_a - p_w) \quad (2)$$

where,

p_w = partial pressure of water vapor in moist air (Pa)

p_a = atmospheric pressure of moist air (Pa)

The maximum amount of water vapor in the air is achieved when $p_w = p_{ws}$ the saturation pressure of water vapor at the actual temperature. Equation (2) can be modified to:

$$x_s = 0.622\ p_{ws} / (p_a - p_{ws}) \quad (3)$$

where,

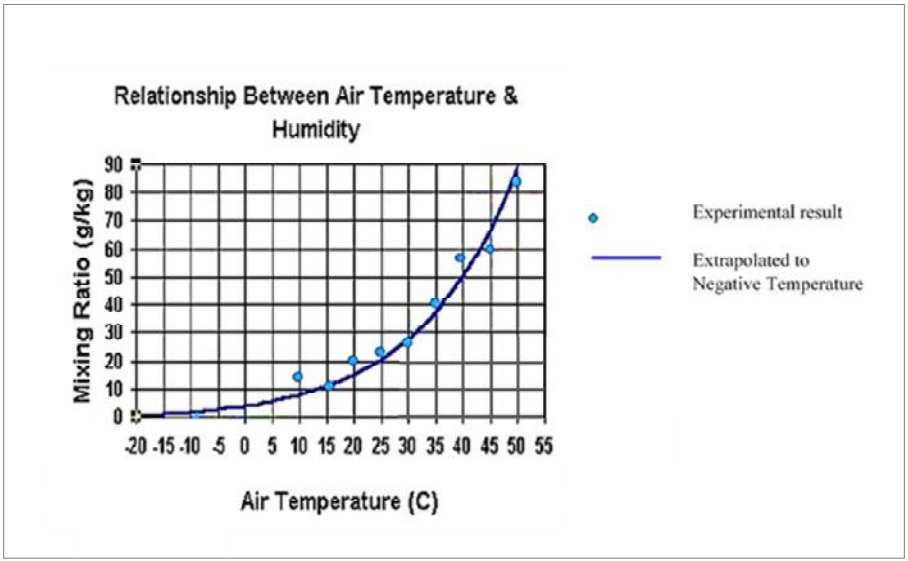
x_s = specific humidity at saturation (kg_{water}/kg_{air}, lb_{water}/lb_{dry_air})

p_{ws} = saturation pressure of water vapor = 611.2 *exp (t / (t + 243.5) *17.67)

where t is the temperature in degrees Celsius.
Relation between mixing ratio and temperature was obtained for environmental simulator by using data logger.

Result:
The result has been plotted below:

Comparing with the psychometric chart the experimental results have been closely simulated. It has been observed that with increase in temperature of the inlet mixing ratio also increases exponentially.



Technology Packages for Mass Housing in Urban Areas for Different Geo-Climatic Regions of the Country

Ashok Kumar & Team

During the period a critical appraisal of the emerging technologies approved by BMTPC and the mass housing projects undertaken elsewhere in Europe was carried out and is briefly discussed below below.

i. Industrialized 3-S System using Cellular Light Weight Concrete Slabs & Precast Columns.

The technology is based on factory mass manufactured structural prefab Components conforming to provisions of relevant Indian Standards by BG Shirke, Pune. The major precast elements are: RCC hollow columns with notches; RCC solid beams; Staircase; RCC precast slab; AAC precast block. In the system, precast dense concrete hollow column shell of appropriate sizes are used in combination with precast dense concrete. The hollow columns are grouted with in situ concrete. The components and jointing are accomplished through on-site concerting along with secured embedded reinforcement to ensure monolithic continuous resilient, ductile and durable behavior. Autoclaved Aerated Concrete slabs are used as floor / roof slabs. Joints are filled with 1:5 Cement Mortar and separate screed concrete of minimum 40 mm thick, grade M20 is put in the entire area of slab before flooring / water proofing. The technology has also been evaluated at CSIR-CBRI and lot of construction is going on in the country using the 3-S system.

ii. Monolithic Concrete Construction System using Aluminum Formwork

In this system, in place of conventional RCC framed construction of columns and beams; all walls, floors, slabs, columns, beams, stairs, together with door and window openings are cast in place monolithically using concrete in one operation on site by using specially designed, easy to handle modular formwork made up of Aluminum/ Plastic/Aluminum-Plastic Composite for rapid construction. The formworks are designed based on the structural requirements of building units. *The system is yet to be tested for wider applications in India.*

iii. Glass Fiber Reinforced Gypsum (GFRG)Panel Building System

Glass Fiber Reinforced Gypsum (GFRG) Panel known as Rapid wall is a building panel made-up of calcined gypsum plaster, reinforced with glass fibers. The panel was originally developed by GFRG Building System Australia. The panel is manufactured to a thickness of 124mm under controlled conditions to a length of 12m and height of 3m that contains cavities which may be unfilled, partially filled or fully filled with reinforced concrete as per structural requirement. GFRG panel can also be used as in-fills in combination with RCC framed columns and beams (conventional framed construction of multi-storey building) without any restriction on number of storey. Micro- beams and RCC screed (acting as T - beam) can be used as floor/ roof slab. *The system is yet to be tested for wider applications in India.*

iv. Advanced Building System –Expanded Polystyrene Core Panel System

The system is based on factory made panels, consisting of self extinguishing expanded polystyrene sheet with minimum density of 15Kg/m^3 and thickness not less than 60 mm, sandwiched between two engineered sheet of welded wire / fabric mesh, made of high strength galvanized wire of 2.5 mm to 3 mm dia. 3 mm – 4 mm diameter galvanized steel truss wire is pierced completely through the polystyrene core at the offset angle for superior strength and welded to each of the outer layer sheet of steel welded wire fabric mesh. The panels are finished on the site using coat of minimum 30 mm thick shotcrete (1:4). The building system gives full design flexibility as it offers a complete range of building elements such as load-bearing walls, floors and stairs. The panels are easy to use in the construction of any type of structure, and can be shaped to any geometric requirement by cutting

the panels. *However, it is yet to be tested for wider applications in India.*

Similarly, there are several other systems developed across the world that have limitations to be used in India. A comparison of the different types of building systems is discussed in Table 1.

A critical analysis of these systems reveals that most of the systems do not fulfill the performance criteria listed in NBC 2005 considering the primary and secondary attributes. *Similarly, the full –scale performance of these systems under different loading exposure like seismic, fire, wind as well as thermal loads is required for its wider applications. The feedback studies do not exist in India that requires further research.*

Table 1: Comparison of Different Types of Building Systems

System/Criterion	Skeletal RC Frame Construction with RC in-fill walls and slabs	Skeletal Steel Frame Construction with Lightweight Concrete in-fill walls or Sandwich Panels	Large Panel Type Construction	Construction with Tunnel Type of Form Work	Lift Slab System	Box Type of Construction
Overall Economy	More Economical	More Economical	Moderately Economical	Not Economical above 5 Floors	More Economical	Not Economical above 5 Floors
Speed of Construction	Moderate	High	Moderate	Low	High	High
Easy to Assemble at Site	Sufficient care has to be taken in Joints and Connections	Very easy to assemble at site	Some what difficult to assemble at site	Easy to assemble at site	Easy to assemble at site	Requires Heavy Machinery for Lifting and Placing
Transportability of Individual Elements	Moderately Easy	Very Easy	Very Difficult	-	-	Very Difficult
Durability of whole System	Very Durable	Preventive Measures have to be taken against the Corrosion of Steel	Very Durable	Depends on Quality of Concrete	Very Durable	Depends on Quality of Concrete
Conservation of Energy and the Natural Resources	Allows the use of Industrial by-products	Allows the use of Industrial by-products	Allows the use of Industrial by-products	Depends on the type of concrete used	Depends on the type of concrete used	Depends on the type of concrete used
Resistant to Earth Quake, Impact, and Wind Loading	Highly Resistant	Highly Resistant	Depends on the type of joints and connections	Depends upon Structural Design	Depends on Joints and Connections	Highly Resistant

Resistant to Different Aggressive Exposure Conditions	Highly Resistant	It requires protective measures	Highly Durable	Depends on the quality of Concrete used in the Construction	Highly Durable	Highly Durable
Resistant to Fire Hazards	Highly Resistant	It requires protective measures	Highly Resistant	Highly Resistant	Highly Resistant	Highly Resistant
Thermal Comfort and Noise Reduction	Very Comfortable	Very Comfortable	Depends on the type of Concrete	Depends on the type of Concrete	Depends on the type of Concrete	Highly Comfortable
The Cost Involved in the Periodical Maintenance	Minimum	Depends on the Exposure Conditions	Low	Depends on Quality of Concrete	Low	Very Minimum
Allowance for Change Floor Plan after Construction	There is some allowance	There is some allowance	There is no allowance	There is no allowance	There is a possibility	There is no possibility
Re-Use of Structural and the Non-Structural Elements	Possible	Possible	Possible	Not Possible	Possible	Possible

Based on the findings and fulfilling the primary as well as secondary attributes, a prefab system is conceptralized as shown in Fig. 1.

Fig. 1: View of Prefab Skeletal RC frame with joints and connections

To Develop Light Weight Blocks using Different Industrial Wastes- Fly ash/ Rice Husk Ash/ Marble Dust

Vivek Sood & Ashok Kumar

Objective:

To develop light weight blocks using different industrial wastes

Scope:

To develop blocks of different sizes using Fly ash, Rice husk ash and Marble dust

Work done:

The following activities have been carried out during the period:

- Casting and testing of light weight blocks (average density of 800 kg/m^3) of different sizes i.e. 600 x 300 x 200 mm and 600 x 200 x 150 mm using fly ash as an industrial waste has been carried out.
- Finalization of the composition using fly ash as a waste has beem done.
- Physical & Chemical analysis of rice husk ash has been carried out.
- Trial tests using rice husk ash as a waste is under progress.

Fig. 1: Photoplate showing light weight blocks of different sizes using Fly-ash

Development of an Automatic Hollow Gypsum Panel Making Machine

S. K. Panigrahi & Team

To design and develop an automatic machine for producing Hollow Gypsum Panels

Scope:

- To produce five Gypsum panels in one batch
- Automation of the machine
- The machine to be flexible for any changes in panel geometry

Work done till date:

The following activities have been carried out

- Fabrication of pressure plate and vibrator assembly
- Fabrication of cores with needle vibrator
- Modification in hydraulic jack fixing arrangement

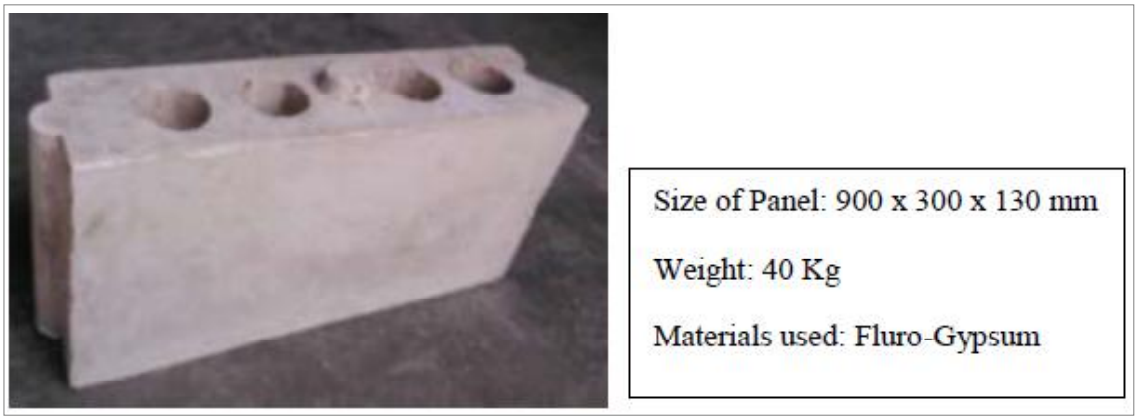


Fig. 1: Fluro-Gypsum Panel

Development of Anti-Termite Barrier for New Buildings

B. S. Rawat & Team

Termites are by far the most destructive building pest and are responsible for causing the greatest economic losses of timber and other properties in several parts of the world. Many approaches have been tried by various researchers for protection of buildings from termites such as use of insecticide, pesticide impregnated rubber and plastic sheets, PVC, coating, stainless steel wire mesh sieve, fibre glass, metal wool, gypsum, quartz, wollastonite, pesticide mixed polymer, acrylic polymer, graded silica ,diatomaceous earth, metal shield, flange or rings, glass particles, sealant, sticky adhesives, boric acids, foaming material, tubing and baiting system, resin coated felt layer, fabric sheet and latex etc. Every method has its own merits and demerits. The demerits includes- environmental and health threats, re-application, fast decomposition and degradation in soil, complexity of use in critical points of construction, corrosion, adverse effect on workers health, cost aspect and availability of material, short effective life, requirement of special fittings and attachments etc.

In the present project, an anti-termite physical barrier is developed with industrial waste using no pesticide or insecticide in it. It is designed to protect a structure and to isolate the termite colony from building. It will not kill termites in the soil near your home but it inhibits termites from gaining access to structure at ground level. Some of the countries like US and Australia are also using other non –chemical physical barrier made of steel and plastic. Because these methods do not involve an insecticide or pesticide, EPA does not regulate them. Termites can breach non-pesticidal physical barriers easily, if it is not installed correctly. It can be easily applied during construction and could save the building from destruction. However, expert professional is required for installation of anti-termite barrier. This barrier protects buildings by blocking concealed termite access. It do not require replenishment or repairs unless the barrier has been disturbed, during renovations or plumbing repairs in building. Being a once-only treatment, the efficiencies of termite barriers multiply over time as other systems require re-application or replenishment frequently.

The novelties of present invention are as follows: It is environment friendly and does not employ any toxic chemicals, highly durable, non-compressive, neither degrades nor decomposes, it is engineered to give life-long protection, it is permanent and does not require retreatment or reapplication, it does not substantially increase the complexity and cost of construction, plays an important role to minimize industrial waste, raw material is freely available, cheaper than any other alternative, it supports superstructure and helps in Radon mitigation, it can be installed with the original building or retrofitted, flexibility to adapt to different engineering designs etc. An Indian patent is filed for this invention.

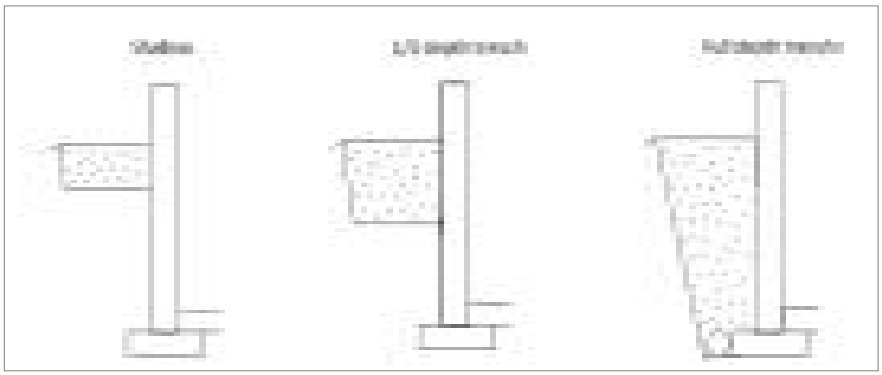


Fig. 1: Showing details for retrofitting of anti-termite physical barrier

Robust Foundation for Difficult Soils

Pradeep Kumar

Proposed foundation technique, namely- Granular & Anchor Pile (**GAP**) System. This technique is eco-friendly and cost effective having all advantages of Granular piles. GAP's may also control liquefaction in loose sands by providing effective drainage conditions. Lower costs, short construction time, and ability to resist tensile or compressive forces immediately after construction are the added advantages. The technique is innovative & effective for resisting the uplift pressure exerted on the foundation in loose sands as well as in expansive or reactive clay beds. In Granular Anchor Piles, mild steel anchor is embedded at the base of a granular pile in the soil through a mild steel rod fastened to a mild steel plate of diameter equal to the pile diameter at its base (Fig. 1). In this project, GAP's are initially tested in the Laboratory before their application to the actual field conditions. From review of previous literature, initiation of present study was felt necessary as only few attempts were made earlier, & that too on expansive clayey soils (cohesive soils) only and pile material used was a mixture of metal chips & stone aggregates. Therefore proposed study was carried only on soils (cohesion less soils). Pile material used was - mixture of locally available sand & well graded crushed stone aggregate to provide better shear strength. Subsequently, Numerical study using PLAXIS-3D software to validate the experimental results and to investigate the effect of important parameters shall also be carried out.

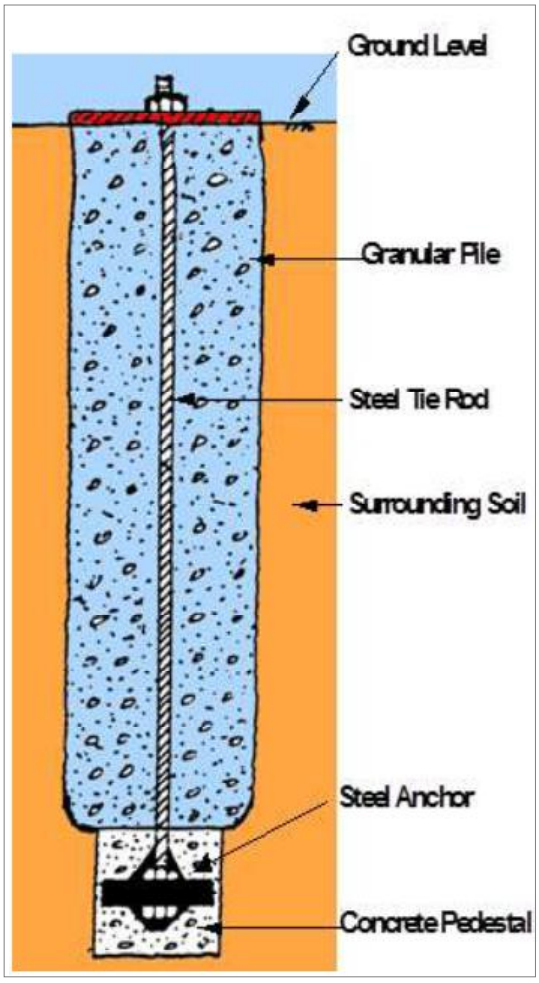


Fig. 1

Experimental Investigation

Laboratory test set up was designed and fabricated in the institute before conducting the lab testing. Fig. 2 shows the main components of the Lab Testing set up.

Fig. 2: Lab. Testing set up for testing Granular Anchor Pile System

Preparation of Test Bed

To carry out pull-out tests on the proposed GAP system(s) of predefined sizes (length & diameters), a test bed of soil (Solani sand for the present study) was prepared in the MS tank. The size of the tank and the test bed was 1.25m x 1.25m x 1.00 m for all the tests. The diameter of pile was 100 mm. For soil deposition in the tank - Rainfall Technique was used. A corelation graph has been prepared between the height of free falling sand and quantity of sand. Accordingly, corresponding unit weight of sand w r to its relative density was calculated. To ensure the homogeneous deposition of sand in the testing tank, the rain fall technique was found to be the best. Filling of soil in the tank was carried out in layers of 5 cm each keeping the same height of strainer / sieve corresponding to the desired relative density of the soil in the test bed. Similar methodology has been adopted for all other tests. Subsequently, after filling of tank the individual GAP's with pre-decided length and diameters were installed in the test bed with a defined procedure. The Pile material (well-graded crushed stone aggregate) used for the construction of GAP in the testing bed having the soil (sand) and the typical MS Anchors (The MS plate & the tie rod) are connected through the threads provided at each end to form the MS anchors. Threaded end on the other side of rod is connected to the loading jack with the help of specially designed and fabricated attachment provided at its top to provide pull-out force to the GAP system.

After the test bed is ready and GAP installed in the soil, Pull-out load is applied through the remote controlled Hydraulic Pump (HP) and Jack (J) of 5.00 Ton capacity placed at the loading/top girder of the MS frame. The applied incremental loads were noted from the display screen (LD) on the Load cell. The corresponding uplift movements were recorded through the 2 dial gauges fixed at the top of the Pile on a MS Strip mounted on the datum bar and through the tie rod of the GAP. The average displacement found from the 2 dial gauges is considered to be the final uplift movement. Corresponding to each incremental pull-out load applied, the uplift movements were recorded till the soil failed in bulging at its bottom, i.e near the point of application of load. The test results are shown in the following graphs. Different tests carried out on Sand Anchors (column filled up with only sand) of 2 sizes i.e 75 cm and 100 cm lengths keeping the diameters same as 100 mm. Similarly, the result of GAP (column filled up with crushed stone aggregates) of the same lengths i.e 75 cm and 100 cm respectively were presented in these graphs as follows –

Based on the present study, it may be concluded that the ultimate uplift capacity of GAP is a function of L/D ratio & soil properties. Pullout capacity increases with the increase of L/D ratio only upto about 10 beyond which it does not provide any effect.

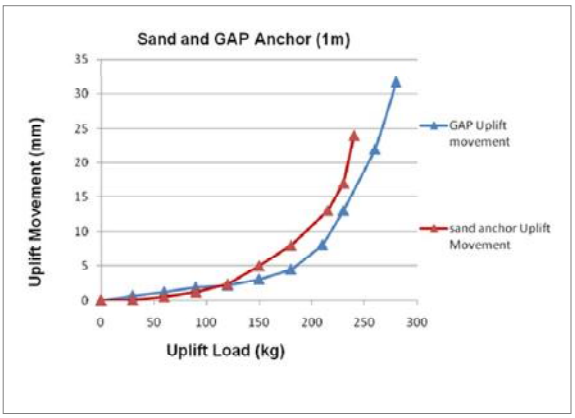


Fig. 3: Comparison between GAP & Sand Anchor of Length L=1m

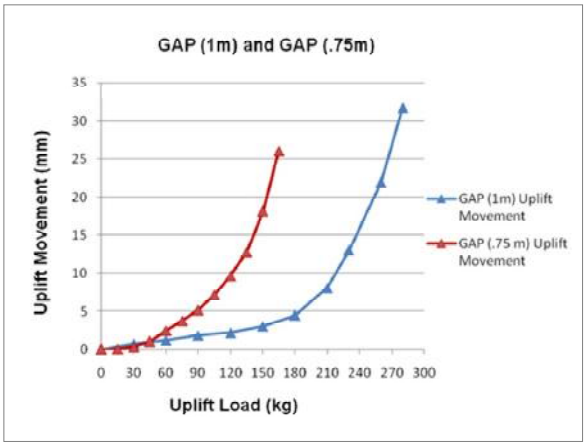


Fig. 4: Comparison between GAPs of Lengths L=1m & L= 0.75m

Numerical Analysis

A numerical model has been used to analyse & validate result of GAP system as reported above. A software finite element program PLAXIS is used to solve the problem depending on the adopted non-linear elasto-plastic models. A brief parametric analysis was performed to calculate the ultimate pull-out capacity & elasto-plastic response of GAP in homogenous & non-homogenous soft ground by Vidyaranya et. al. (2010) & Rao et.al. (2010) performed a multi linear regression analysis to determine swelling potential of soil reinforced with GAP system. Numerical solution is predicted to study the response of single granular anchor pile in weak subsoil condition (Sawant and Kumar 2010). Mostafa and Shahin (2012), Ibrahim et. al. (2014), performed parametric analysis in finite element method by using PLAXIS 2D software on GAP system for expansive soils and loose sands. From the critical review of the above study so far, it was observed that no research work (parametric analysis) by using PLAXIS 3D software on loose sands has been carried out. PLAXIS 3D is a three-dimensional finite element program, developed for analysis of deformations, stability & groundwater flow in geotechnical engineering.

Through the present study, a numerical model is being developed to validate the above laboratory results of GAP system using PLAXIS 3D. The model deals with shallow circular footing rest on the loose sand layer reinforced with GAP models with different lengths & constant diameter. For comparison, the granular pile is filled with sand only is also modelled here. The purpose of model is to calculate the maximum uplift movement or ultimate uplift load of GAP system. In the model a loose dry sand of 1.25 m thickness bed is used. The loose sand & GAP are modelled by using Mohr-Coulomb (MC) model & assumed to behave both in a drained manner. The 'E' values required for the analysis is calculated or assumed as same as documented in Rao (1985). The rigid mild steel is used as a material for both anchor plate, anchor rod and shallow footing and assumed to behave as a linear elastic model. The shallow footing and anchor plate are modelled using plate element, while the anchor rod is modelled using node-to-node anchor element. The flexural rigidity of anchor plate, anchor rod and footing assumed as very high to avoid unnecessary buckling and deformation. The footing diameter was fixed as 2m, and the GPA length was varied from .75-1 m and diameter was 100 mm. The simple global finite element mesh model is generated by using the medium mesh option in settings to allow a more accurate stress distribution. The soil parts are modelled using 15-node triangular element. The maximum uplift load is calculated in PLAXIS analysis by giving a pre-described displacement vice-versa. The results obtained from the PLAXIS software is compared/validated by laboratory results. The values used in parametric analysis are given in the following table:

Table 1: Material Properties of Soil and Pile

Parameter	γ (kN/m^3)	E (kN/m^2)	ν	c (kN/m^2)	?	K_0
Soil	17	2000	0.3	0	29	0.52
pile	22	11000	0.3	0	31	.485

The plate element is modelled using an elastic modulus of 200GPa, a thickness of 25mm and Poisson's ratio of 0.15. The anchor was modelled as a node to node anchor of 15mm diameter and young's modulus of 200GPa. The boundary conditions of the model is base of the model is fixed in all directions but the vertical directions is free to move in Z direction or vertical direction and remaining to directions are fixed.

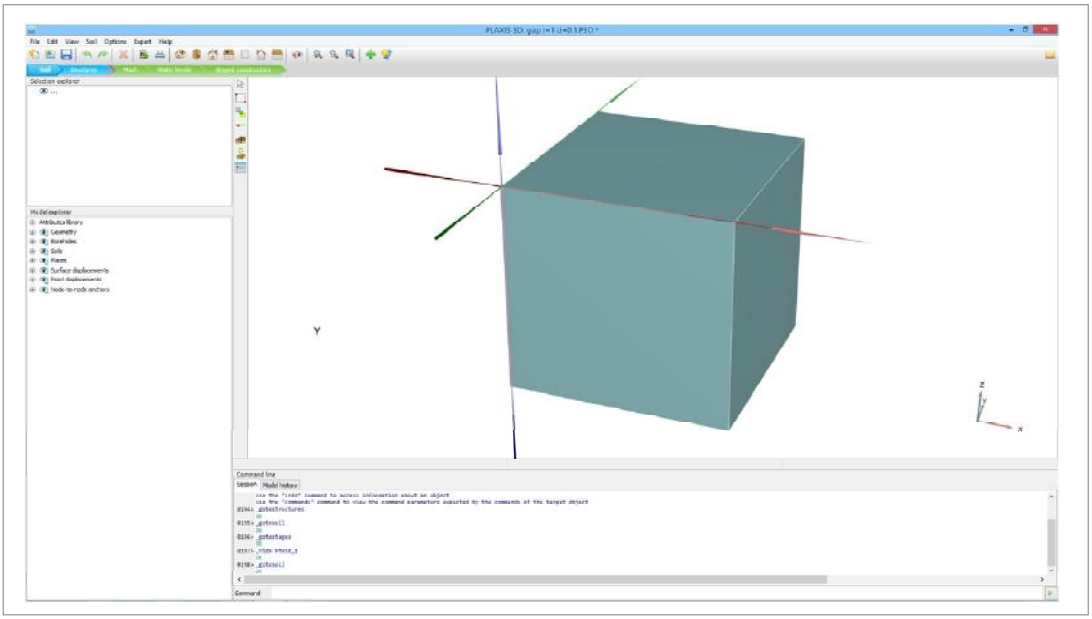


Fig. 5: Model showing the Soil Strstigraphy

The above model shows the Soil Stratigraphy of the loose dry sand before the construction of the Granular Anchored pile (GAP) system.

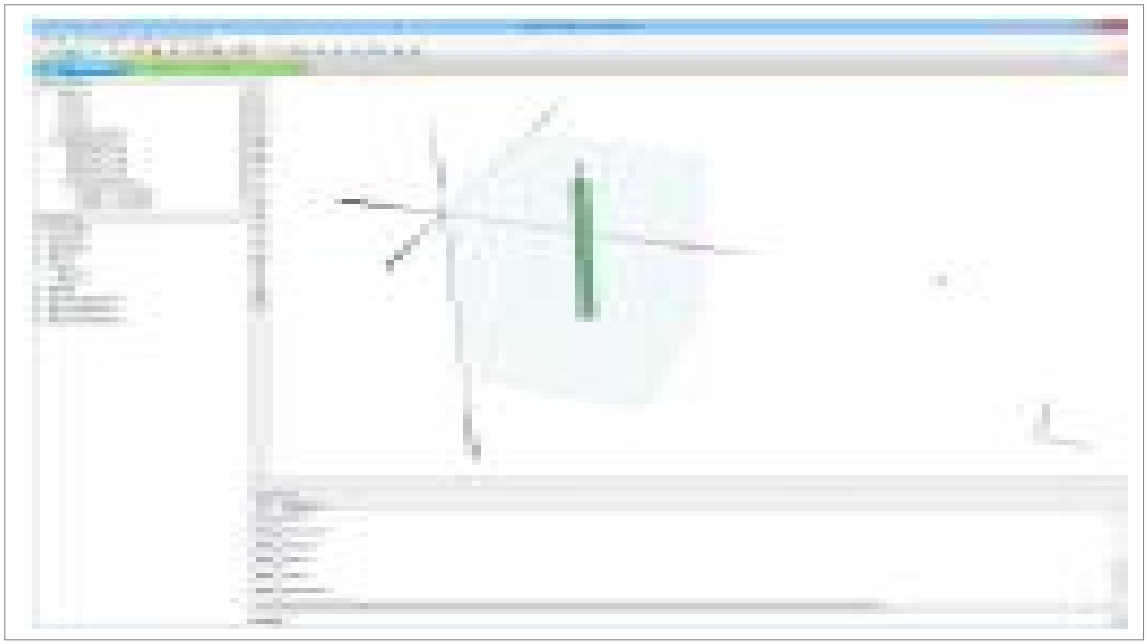


Fig. 6: Defining Granular Pile in Structural Mode

After defining the soil stratigraphy, next step is defining GAP. These 2 models shows the GAP system.

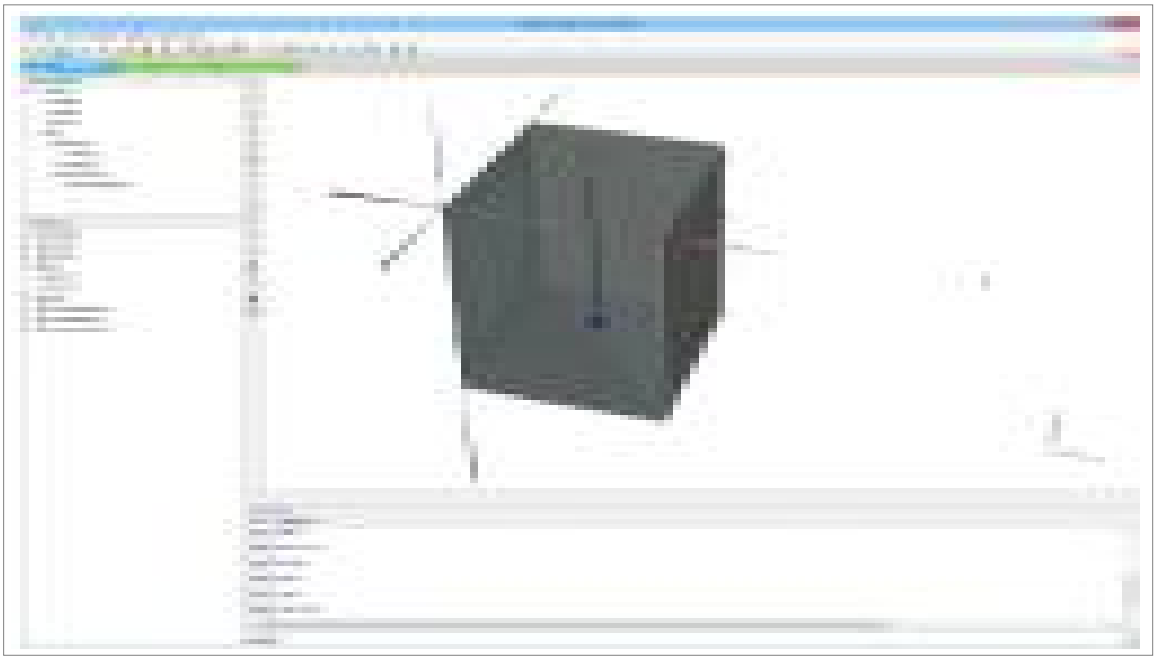


Fig. 7: Defining Anchor Plate & Rod, Boundary Conditions in Structural Mode

After Granular pile construction, next define mesh generation. In mesh generation, the soil & GAP system a coarse mesh of fineness factor of 1 is generated. After mesh generation next step is stage construction. In stage construction steps for calculation is to be defined. Results & failure of the model is shown in below:

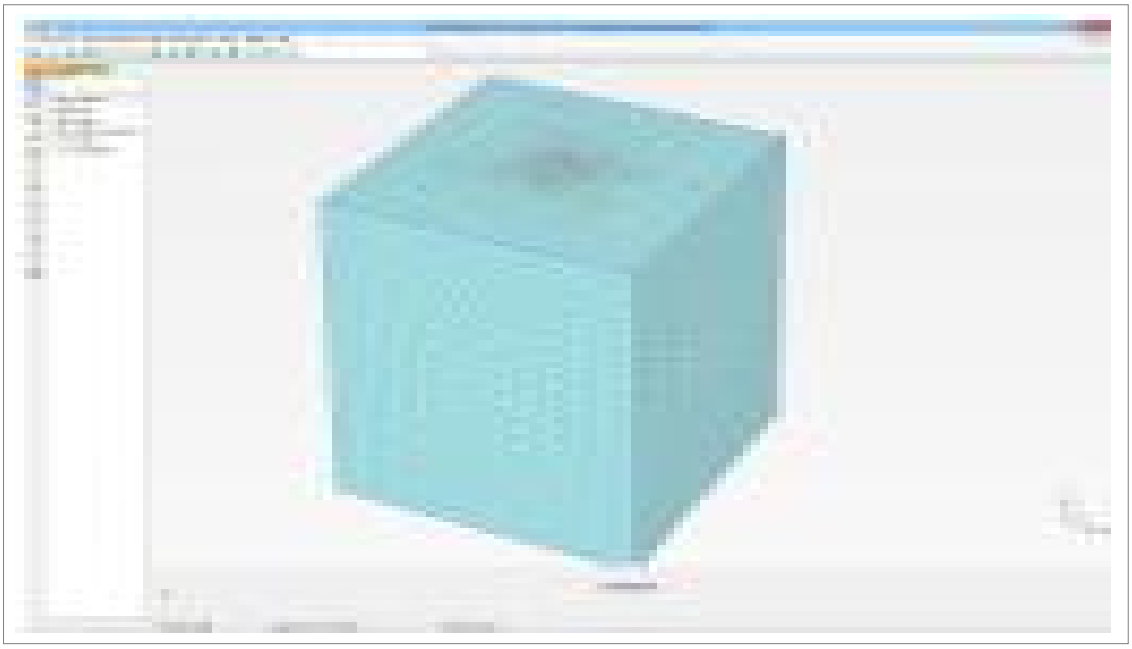


Fig. 8: Mesh Generation of GAP System

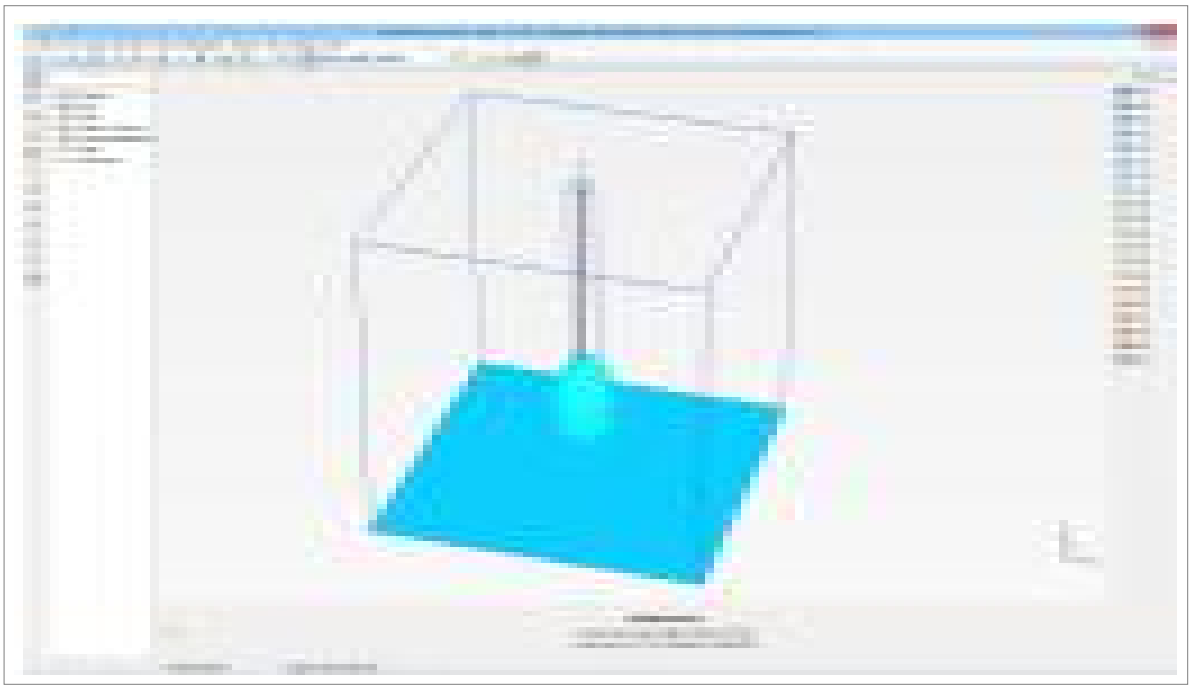


Fig. 9: Bulging Failure of the GAP System

The blue colour lines in the model (on the plot - Fig. 10) show the bulging diameter of the Granular Anchor pile system. The bulging failure occurs at the bottom of the GAP system.

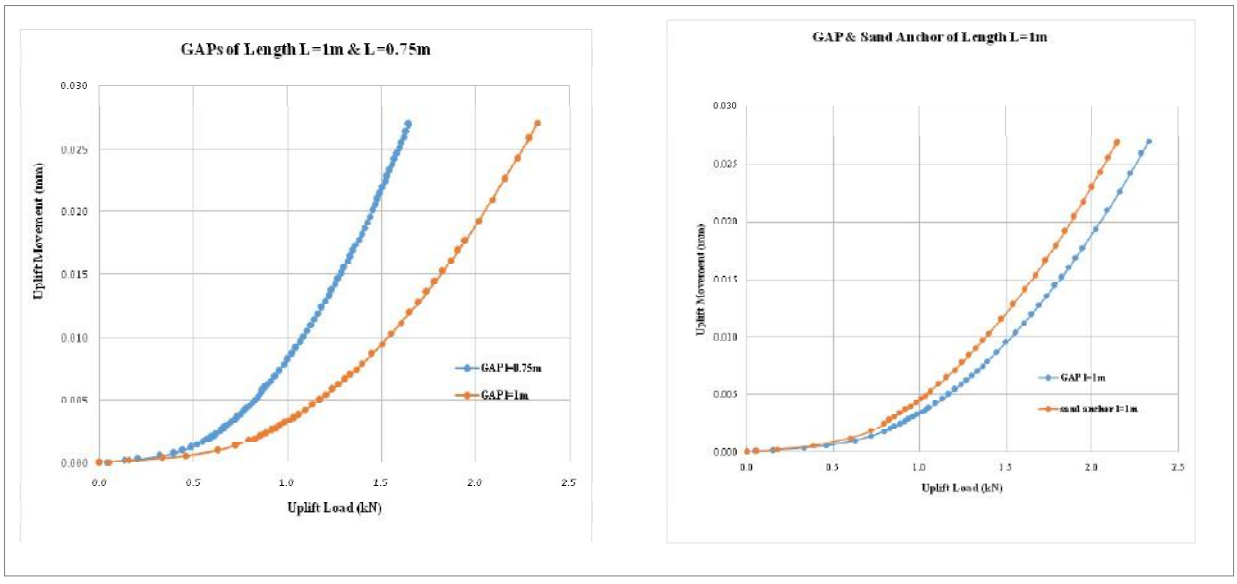


Fig. 10: Comparision between GAPs of Length L=0.75 m & L=1 m

Conclusions shall be reported subsequently after completion of the proposed field testing at CBRI site.

WP-4 Materials & Technologies for Hazard Reduction

S. R. Karade

Indigenous Cathodic Protection System for Steel Reinforced Concrete Structure

S. R. Karade & Team

Corrosion is an inherent natural electrochemical process leading to deterioration of almost all metals. In steel reinforced concrete (RC) structures, corrosion of steel bars is a major issue worldwide. Various electrochemical repair techniques such as cathodic protection (CP), cathodic prevention, electrochemical chloride removal and electrochemical realkalisation are used in developed countries as a remedial measure for corrosion plagued structures. Cathodic protection is most effective considered to be the corrosion mitigation technique for chloride affected RC structures, but its expertise is mainly available in the developed countries. This technique involves application of electric current to force electrons to move towards steel rebar thereby steel behaves as a cathode and thus reduces corrosion. There are two types of cathodic protection; sacrificial cathodic protection and impressed current cathodic protection are widely used. In galvanic system, more reactive metal (anode) with respect to steel bar get consumed to protect rebar. The potential difference between anode and steel bar is a driving force to make steel as cathode. Whereas, impressed current cathodic protection requires a power supply or rectifier and permanent anode to protect the metal or structure by making it a cathode. A low voltage direct current is driven from the anode through the concrete to the surface of the steel.

Anodes are the most important components and expensive in cathodic protection system. The main function of an anode is to provide uniform distribution of current to the reinforcing steel through electrolyte (concrete). Therefore, anode selection is one of the most important criteria for successful protection of reinforced steel by cathodic protection. Cost of cathodic protection depends on the type of anode used in the system. To develop a low cost and effective CP system, conductive cementitious anode made up of conductive fillers like carbon fibre (CF), graphite powder (GP), coke breeze (CB) and pyrolytic carbon black (PCB) for impressed current cathodic protection studies carried out. Along with the mechanical and electrical properties of the conductive mortar, studies have been conducted to understand the hydration, microstructure development, anodic polarization, current distribution and bond of cementitious anode with the substrate concrete.

It has been found that the addition of carbonaceous fillers considerably decreases resistance of the composite. Carbon fibre is found to be the most effective filler to be used in the conductive cement mortar composite. Electrical resistivity of the composite reduces with increase in the fillers content. Mechanical properties of the conductive mortar composites such as compressive strength and flexural strength was found to be decreasing with increase in conductive filler content but carbon fibre reinforced specimens showed an improved performance in the flexural testing. Furthermore, current distribution and electrochemical studies were conducted to check the performance of conductive cementitious anodes in CP system.

Anodic polarization test was carried out to understand the electrochemical behaviour of conductive mortar (0-1% CF) in aggressive surroundings as shown in Fig.1. A current density of 100mA/m^2 was applied and anodic potential against a copper - copper sulphate reference electrode and EIS measurements were taken periodically.

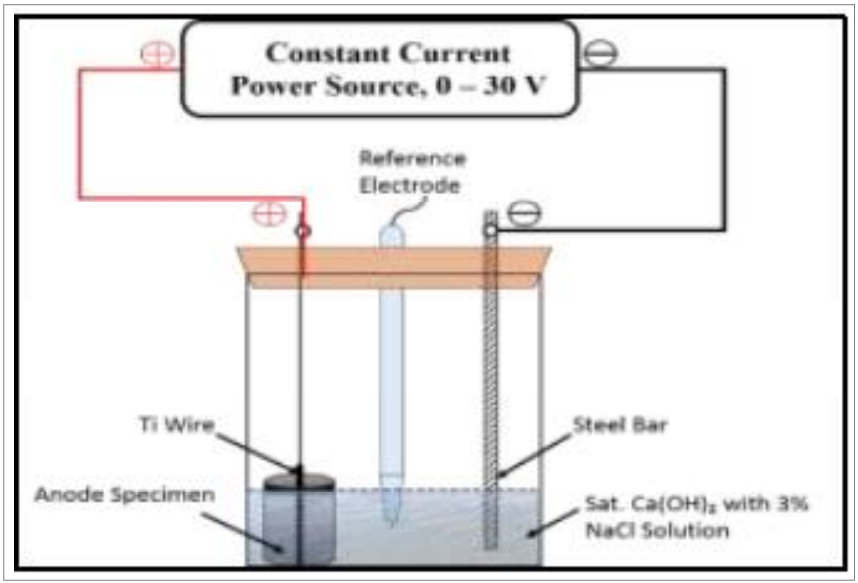


Fig. 1: Anodic Polarization Setup for Evaluation of Anodes

As shown in Fig. 2, during early stages anode potential rapidly increases and then decreases for specimens with carbon fibre content less than 0.6%. This rapid increase of anode potential in the early stage can be attributed to the consumption of conductive component during anodic reaction. Thereafter, decrease in anode potential values may be due to the formation of extra conductive paths as the result of the increase of porosity of matrix due to anodic reaction. The specimens without carbon fibre addition were severely damaged after some time when subjected to a current density of 100mA/m^2 and the required voltage supply to maintain the constant current density reached beyond the limit of the power source(0 – 30 V). During current supply penetration of chloride ions into the mortar caused the initiation and propagation of pitting corrosion of the titanium primary anode of control specimen.

Evolution of oxygen and chlorine occurring on surface of fibre may be the reason for carbon fibre consumption. Pore formation and fibre consumption were also confirmed from EIS studies. During initial period of test, R_f values increases which indicates loss of carbon fibre whereas R_{ct} values decrease in later stages of test which indicates the formation of connecting pores.

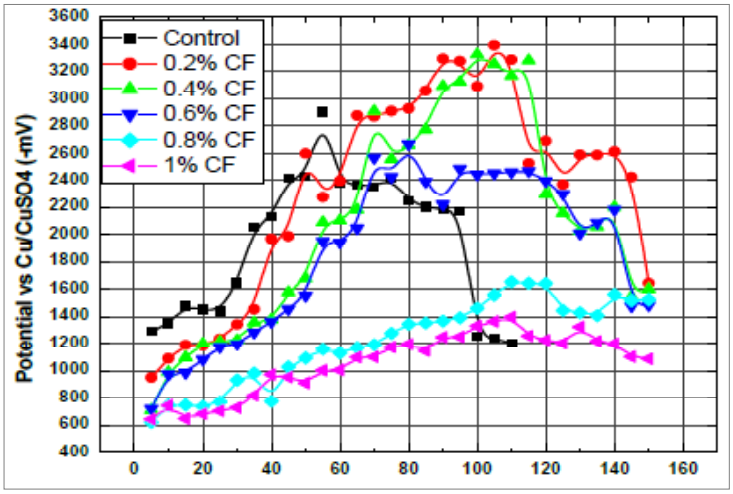


Fig. 2: Anode Potential of Different Carbon Fibre Conductive Mortar

From the results, it can be concluded that to make cementitious anode for cathodic protection, CF more than 0.6% is required. Anodic polarization tests for cementitious anodes other than CF are in progress.

In accelerated corrosion technique (ACT), performance of each cementitious anode was evaluated by applying100 mA/m^2 current density to the steel bar to increase corrosion rate in short duration. In ACT steel bar behaves as an anode connected to the positive terminal and titanium wire to the negative terminal of power supply. After ACT, cathodic protection (CP) was applied to the same steel bar at a constant current density of 10mA/m^2. Electric connections were inverted in accelerated corrosion technique. Corrosion potential (E_{corr}) and corrosion current density (I_{corr}) has been monitored during ACT and CP with half cell potential (HCP) and linear polarization resistance (LPR) techniques, respectively.

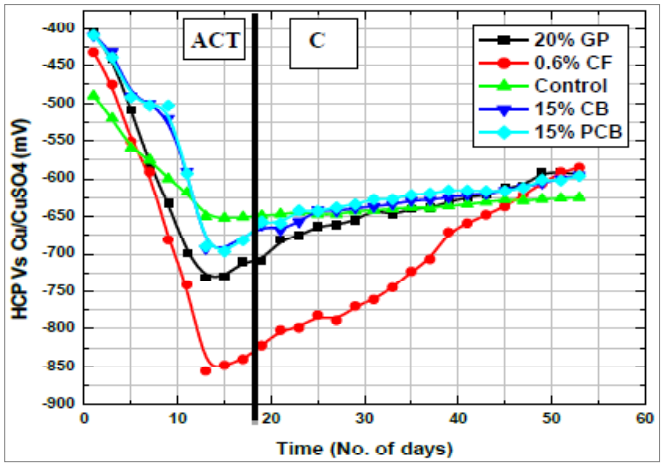


Fig. 3: Corrosion potential in both accelerated corrosion state and CP protected steel

Corrosion potentials (E_{corr}) shift towards passive state and corrosion current density (I_{corr}) values decrease during cathodic protection as shown in Fig. 3 & 4. From the results, 0.6% CF conductive cementitious anode found to be more efficient to bring from active corrosion state to passive state.

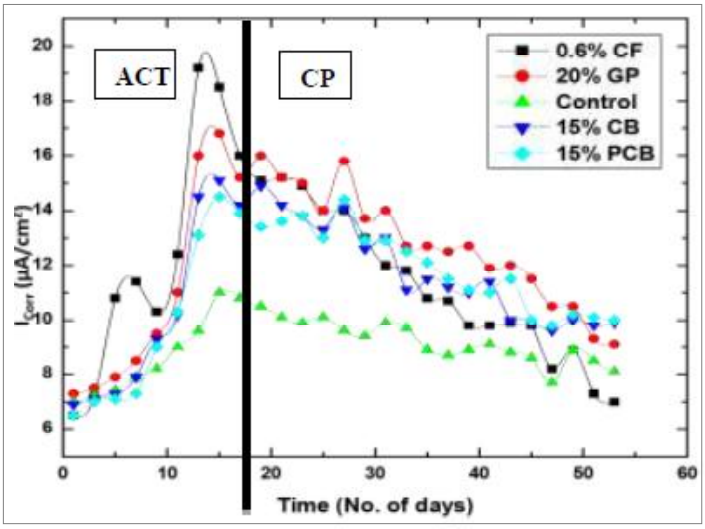


Fig. 4: Current density measurements with LPR technique

Developed composites are evaluated for their performance in laboratory scale specimens as per the NACE criteria for cathodic protection (Fig. 5).

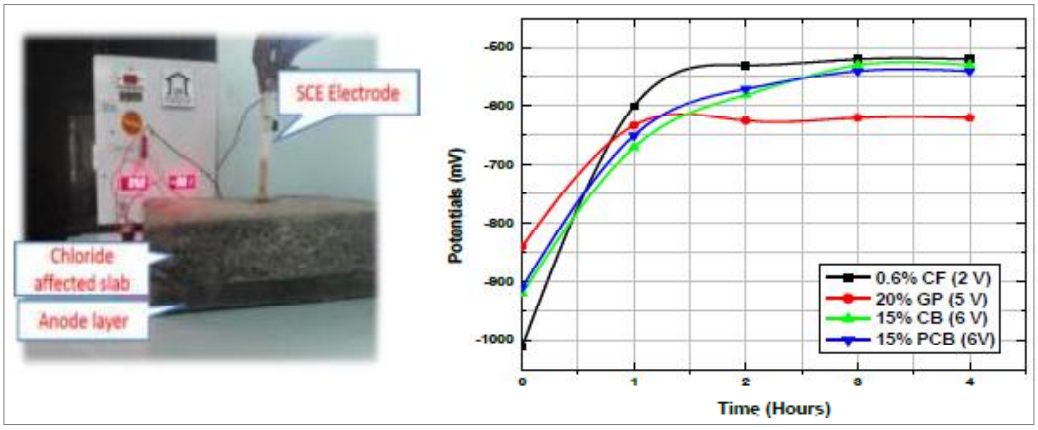
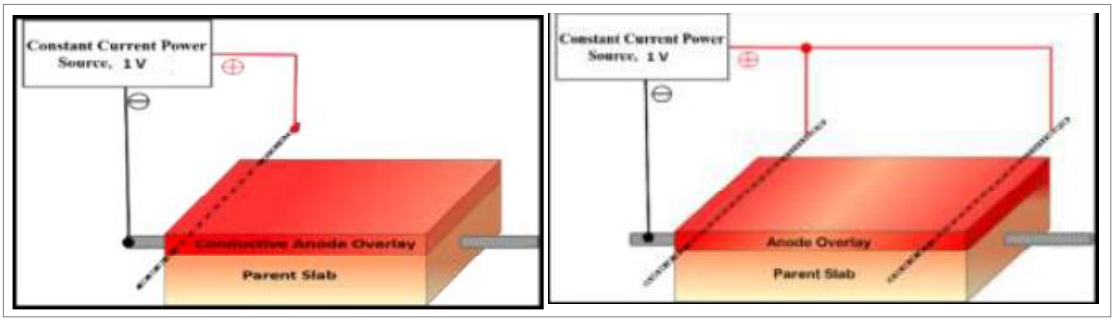


Fig. 5: Driving voltage requirement by different cementitious composite anode

In addition, comparative study of current distribution for control cementitious overlay and 0.6% carbon fibre cementitious overlay, on chloride contaminated slabs (300 × 300 × 50 mm) with 8 mm dia. steel bar was also carried out. Titanium wire used as primary anode and placed at a distance of 2 cm from one the edge of CF overlay and control overlay. Whereas two titanium wires were used for another control cementitious overlay. The rebar of slab connected to the negative pole and titanium wire connected to positive pole of DC power supply (Fig. 6) and constant voltage (1 V) was applied. A saturated copper – copper sulphate electrode as reference electrode was used to study the variations of the rebar potential with the distance along with rebar in the axial direction at every 1 cm distance. The half-cell potential(HCP) of the steel bar measured before application of cathodic protection was found in range of -380 to -390 mV along the steel bar. After constant voltage (1 V) supply to each specimen, the potential of steel bar become more negative. However for control specimen with one Ti wire, the potential increases while moving away from Ti wire along the steel bar (Fig 7). For control mortar overlay with two Ti wires, the potential of steel bar was found to be almost constant along the distance. However, the degree of polarization was less for control overlay as compared to carbon fibre reinforced mortar overlay. In case of carbon fibre cementitious anode only one primary anode found to be sufficient for better current distribution on the rebar for the same distance. The results obtained so far are very encouraging and further experiments on current distribution with anodes using GP, PCB and CB as conductive fillers are in progress.



(a) Conductive overlay with CF **(b) Control overlay**

Fig. 6: Current distribution for carbon fibre overlay and control overlay

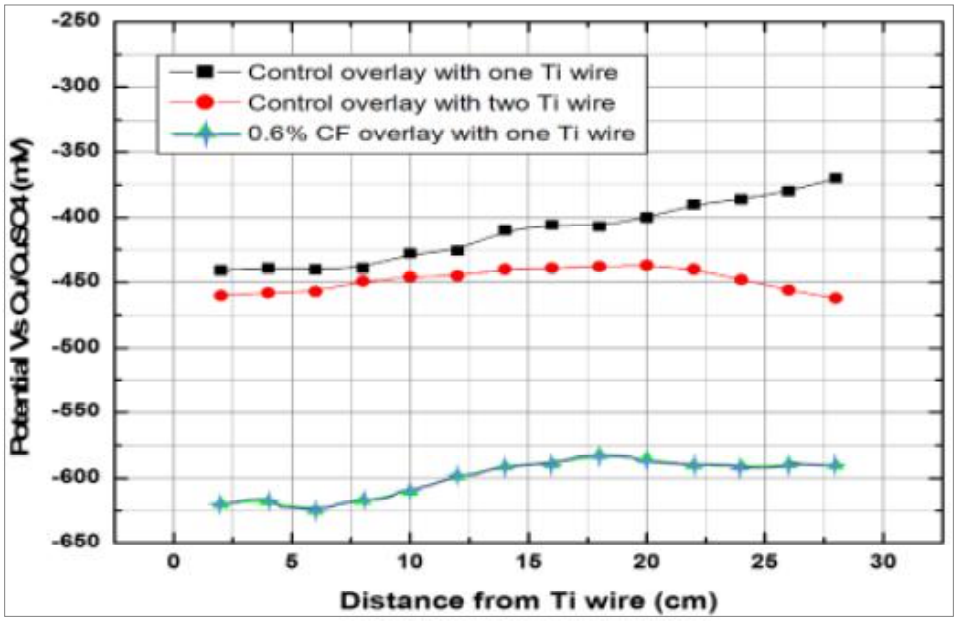


Fig. 7: Potential variation across steel bar in specimens with one and two Ti wires

Development of Fire Safe Polymeric Composite Panels

Harpal Singh

Objective:

To develop fire retardant composite panels with reduced smoke and toxicity

A composite panel consists of two thin and stiff outer and inner face sheets bonded to a thick low density core, forming a lightweight efficient structure. The final properties of a composite panel depend on the core type, outer and inner face sheets type and face-to-core bonding. Rigid polyurethane foam is the first choice as core material in a composite panel due to its predominately low-density cellular structure, low thermal conductivity, low water absorption and good mechanical properties such as compressive strength, dimensional stability etc. The properties of this core material need to be improved are its flammability and toxicity of smoke. The applications of such composite panels are in the building construction and industries as lining material and industrial buildings. The other important applications are in telecommunication shelters, defense shelters and cold storage industry etc. Some significant achievements on some of the important properties of core material such as water absorption, thermal conductivity, compressive strength and thermal analysis at elevated temperature are presented. Core material was prepared in the dimension of 300x300x300 mm in a specially designed wooden mould in the free rising direction. Fire retardant additives such ME and TP individually and in combination were added at the formulation stage and some physical, mechanical and thermal properties etc. of prepared core material were measured.

Water absorption

Water absorption test of CM-C and CM-ME-TP samples was measured as per ASTM D2842 at the ambient temperature. The size of the specimen was 150 x 150 x 75 mm. Specimens were immersed horizontally 50 mm below the water surface for 96 hours. The water absorption of three specimens per sample was measured and their average values are reported. The amount of water absorption of a cellular material mainly depends on the cell size and cell structure, whether it is closed cell or open cell. It is well known that rigid cellular polymers contain 95-98% closed cell content. Figure 1 shows the effect of ME-TP on the water absorption behavior of core material. The results showed that water absorption behavior of CM-ME-TP follow the regular trend with the addition of fire retardant additives and as a result CM-ME-TP showed more water absorption than the control. This was mainly because of the larger cell formation and interconnection of various cells due to the tearing and collapse of the cells. There is an increase in the water absorption of CM-C and CM-ME-TP from 1.38 to 1.92%, an increase by 0.54% which is not a significant increase. This little increase in water absorption is due to the formation of H bonding by residual OH groups with water molecules.

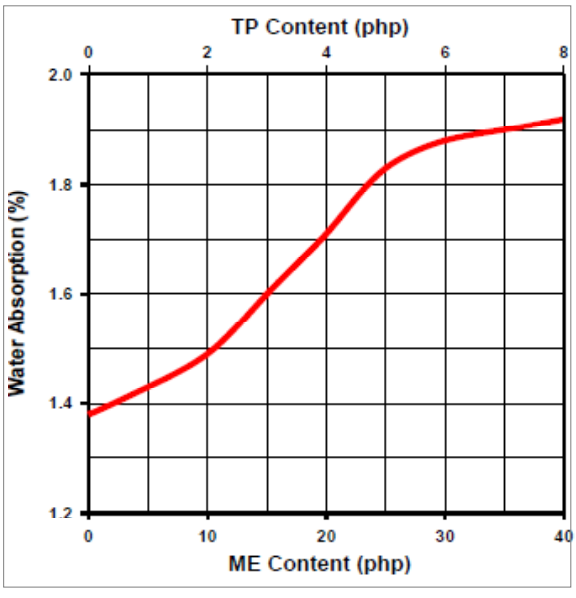


Fig. 1: Effect of fire retardant additives (ME-TP) on the water absorption of core material

Thermal conductivity

Thermal conductivity of CM-C and CM-ME-TP was measured with two slab guarded hot plate with a density of 40 and 52 kg/m^3 respectively at 30^{0}C as per IS: 3346. The size of the samples was 300 x 300 x 50 mm in the free rising direction. Thermal conductivity depends on the density, average cell size, cell orientation, ratio closed to open cell content, thermal conductivity of blowing gases and thermal conductivity of additives. Figure 2 shows the effect of ME-TP on the thermal conductivity of core material. The result showed that there is a decrease in the thermal conductivity of CM-C and CM-ME-TP from 0.030 to 0.027 W/m-k, a decrease by 0.003 W/m-k with increase ME-TP loading. ME-TP itself has a low thermal conductivity because the main constituent of ME-TP is a low conducting atom. The thermal conductivity behaviour had the same analogy with the electrical conductivity. It is well known that, when a non-conductive additive is added to an insulating matrix, the conductivity of the matrix decreases slightly. This signifies that a non-conductive network is found in the insulating matrix through the aggregation of the non-conductive additive. Applying the same analogy here, we found that the incorporation of ME-TP had a lower thermal conductivity compared to control core material. It is well known that the cell size of polyurethane foam depends on the viscosity and surface tension of the mixture. In this study, a decrease in viscosity with the addition of TP additive led to a reduction in the cell size. Thus, the presence of TP additive decreases the average cell size and cell walls become more strong and compact and as a result the thermal conductivity of CM-ME-TP was decreased.

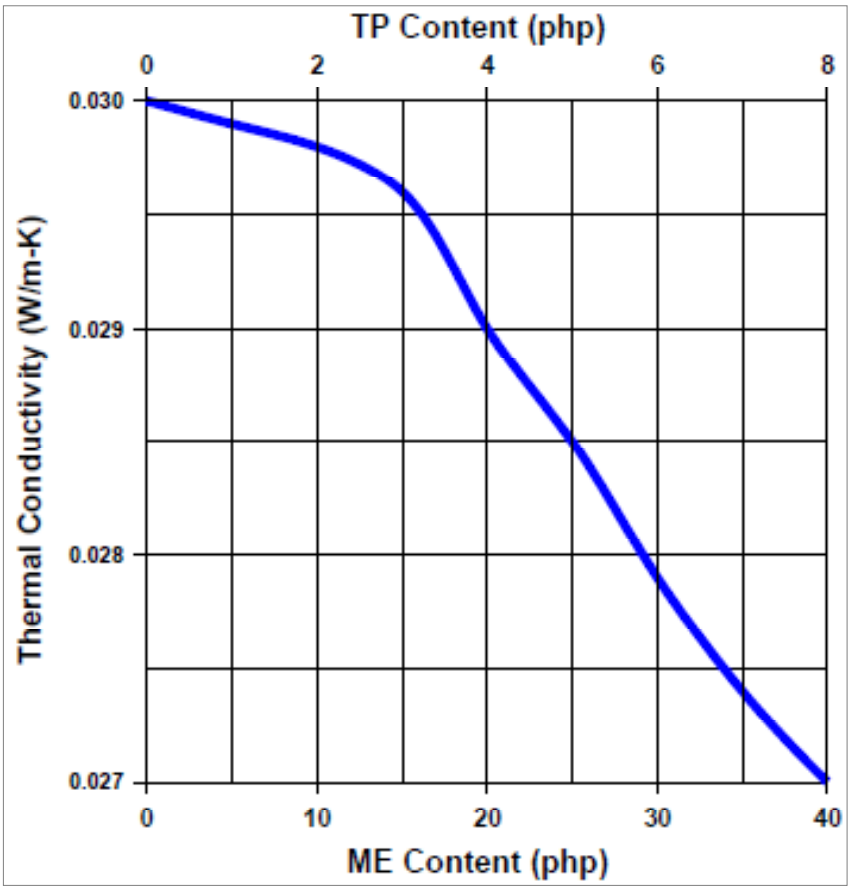


Fig. 2: Effect of fire retardant additives (ME-TP) on the thermal conductivity of core material

Mechanical properties

Compressive strength of CM-C and CM-ME-TP was measured under ambient conditions with a UTM. The 13% deflection of original thickness of the sample in the free-rise foam direction was performed according to ASTM D1621. The dimension of the specimen was 50x50x50 mm^3. The rate of crosshead movement was fixed at 1 mm/min and load cell used was 20kN. The strength of five specimens per sample was measured and averaged. The mechanical properties of core material are very important parameters that determine their applications, such as in load bearing and packaging materials. The achievement of good mechanical properties in filled polymer composite depends on the distribution and dispersion of the additives in the polymer matrix. Figure 3 shows the effect of ME-TP additives on the compressive strength of core material. The compressive strength of CM-C and CM-ME-TP decreases from 0.26 to 0.21 MPa, a decrease by 0.05 MPa. The result confirms that there is no significant decrease in compressive strength of CM-ME-TP compared with CM-C samples. This decrease may be due to the plasticizing effect of TP with ME and higher viscosity of the formulation which leads to bigger average cell size and reduced cell wall thickness of core material. ME particles may locate between the cell walls instead of in the cell strut which also led to the slight decrease in the compressive strength. Thus, result showed that ME-TP had favourable compatibility and miscibility with core material formulation and did not deteriorate the mechanical property of fire retardant core material.

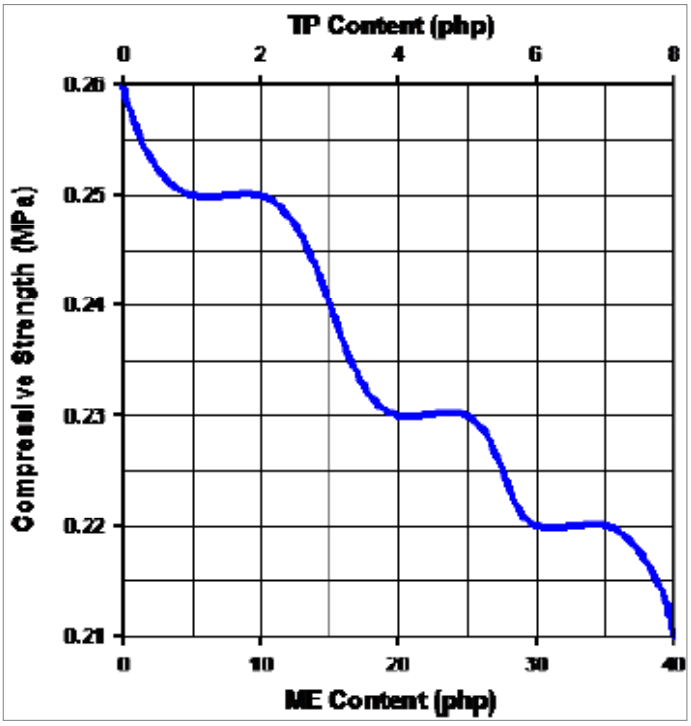


Fig. 3: Effect of fire retardant additives (ME-TP) on the compressive strength of core material

Thermal analysis

The suitability and efficiency of ME-TP as fire retardant additives were investigated through thermal analysis using TGA and DTG thermo grams at elevated temperature. The decomposition temperature and char residue of the core material were analyzed on a TG/DTG analyzer under a nitrogen environment at a heating rate of 10^0C/min over the temperature range up to 600^0C. TGA and DTG

curves of control core material, core material incorporated with fire retardant additives and fire retardant additives can offer much information on their thermal stability and thermal degradation behaviour. The TGA and DTG thermo grams of control core material, core material incorporated with fire retardant additives and fire retardant additives under nitrogen atmosphere are shown in Figure 4 and 5 respectively. The detailed TGA and DTG data are summarized in Table 1. TGA traces showed that the decomposition of ME-TP begins at 207^{0}C and produces 35.4% char residue at 600^{0}C under nitrogen atmosphere. The high quantity of char residue indicates that ME-TP is an efficient char forming agent. DTG curve indicates that ME-TP has a major weight loss stage at 327^{0}C, which can be assigned to intumescent char formation. Compare with control core material, the degradation of ME-TP starts earlier and forms intumescent char before control core material decomposes quickly, which indicates that ME-TP is a suitable fire retardant additive for control core material matrix. The 10% weight loss temperature is lower for CM-ME-TP than for the control core material (CM), which is related to the thermal stability of ME-TP in this temperature range. At high temperature, CM-ME-TP produces high char yield, 20.8% under nitrogen atmosphere at 600^{0}C, in comparison with the control core material, and 9.10% under nitrogen atmosphere at 600^{0}C. As we know, the protective char can be resistant to even high temperatures and shield the underlying polymers from attack of oxygen and radiant heat. Therefore, the addition of ME-TP to the matrix of core material can enhance effectively the fire retardancy of the core material. Overall, it can be concluded that the addition of ME-TP additive does not affect the physical (water absorption and thermal conductivity) and mechanical (compressive strength) properties significantly. However, the thermal analysis results showed that ME-TP is a suitable and efficient fire retardant additive for the core material matrix and the addition of ME-TP enhances the fire retardancy of core material significantly.

Table 1: Data of TGA and DTG Thermo Grams of Fire Retardant Additives & Core Material with & without Fire Retardant Additives

samples	$T_{10\%}$ (^{0}C)	Tmax (^{0}C)	Char residue at 600^{0}C, (%)
CM	241.3	364	9.1
ME-TP	207.1	327	35.4
CM-ME-TP	208.4	343	20.8

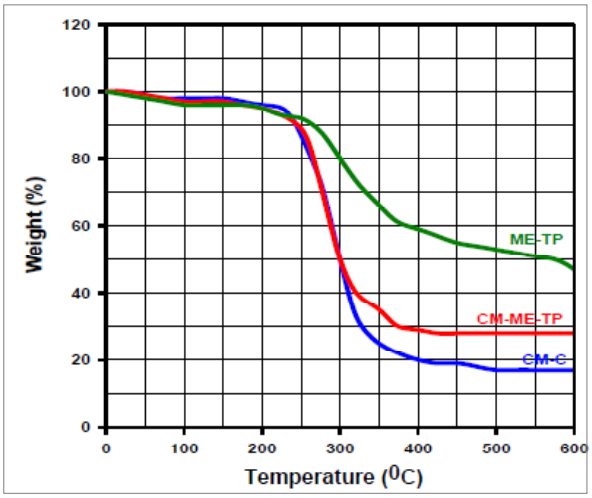


Fig. 4: TGA curves for fire retardant additive and core material with and without fire retardant additive

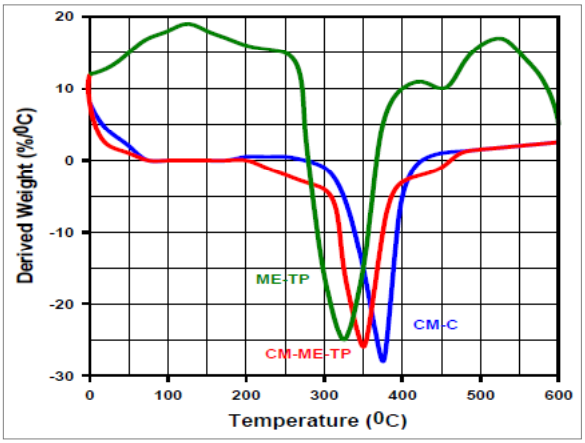


Fig. 5: DTG curves for fire retardant additive and core material with and without fire retardant additive

Study of Impact Behaviour of Reinforced Concrete Elements

Achal Kumar Mittal & Team

Reinforced concrete (RC) structures in its design service life may be subjected to various types of impact loading. In this regard some of the typical cases where structural members of a building system can be subjected to impact loading are falling of rocks in mountain areas, flying debris in case of tall buildings, pounding of building at the time of earthquakes, debris impact at the time of tsunami etc. In continuation to the ongoing study on the behaviour of reinforced concrete structural elements subjected to low velocity impact loading, a systematic study has been initiated to study the behaviour of RC beams under multiple impacts loading. The impact response of RC beams subjected to multiple impacts has been studied experimentally using instrumented drop weight impact testing facility. RC beams of size 150x250x2500 mm made with M-40 grade concrete using three type of reinforcement percentages have been studied. The beams tested for the drop weight of 200 kg from 1.0 m height are designated as A1, A2, A3 series and the beams tested for drop height of 1.5m are designated as B1, B2, B3 series. Table 1 describes the various reinforcement configurations of different beams of series A and B.

Table 1: Reinforcement details in RC Beams

Designation of Beams	Compression reinforcement (A_{cr})			Tension reinforcement (A_{st})		
	No. of Rebars	Size (mm)	Area (mm^2)	No. of Rebars	Size (mm)	Area (mm^2)
A1 /B1*	3	16 Ø	602.88	3	20 Ø	942.0
A2/B2*	2	16 Ø	401.92	2	20 Ø	628.0
A3/B3*	2 1	16 Ø 8 Ø	401.92 50.24	2	20 Ø	628.0

[A_{cr} = 2% & A_{st} = 3.14% (Type A1/B1), A_{cr} = 1.4% & A_{st} = 2.1% (Type A2/B2), A_{cr} = 1.5% & A_{st} = 2.1% (Type A3/B3)]

* A1, A2, A3 for 1.0 m drop and B1, B2, B3 for 1.5 m drop

The response parameters such as deflection, strain in steel reinforcement, and reaction force during the impact event have been recorded using dynamic data logger. Energy absorbed by each beam is computed and presented below.

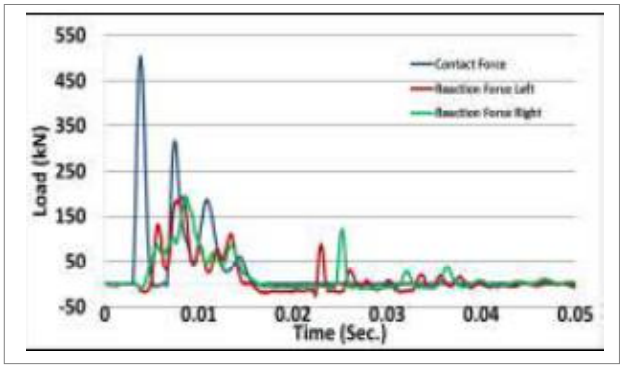


Fig.1: (a) Typical Impact Load and Reaction Force for beam under 1m fall of impact or mass of 200kg (1st Impact).

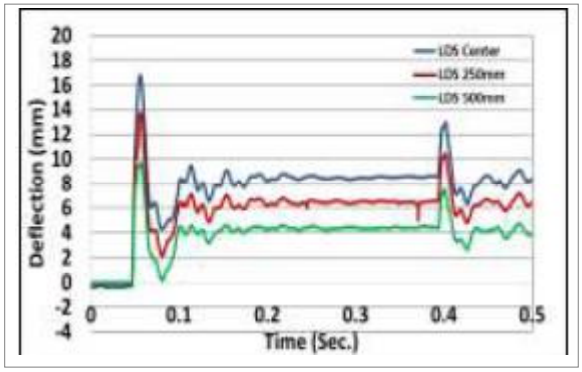


Fig. 1: (b) Typical Deflection-time curve of Beam for 1m fall of impact or mass of 200 kg. (1st Impact)

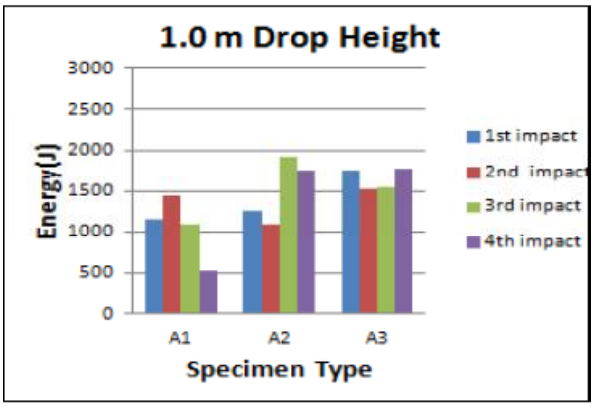


Fig. 2: (a) Variation of Energy Absorption f or series A

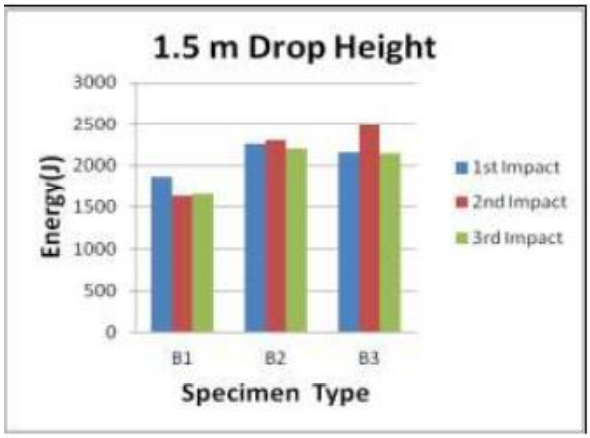


Fig. 2: (b) Variation of Energy Absorption for series B

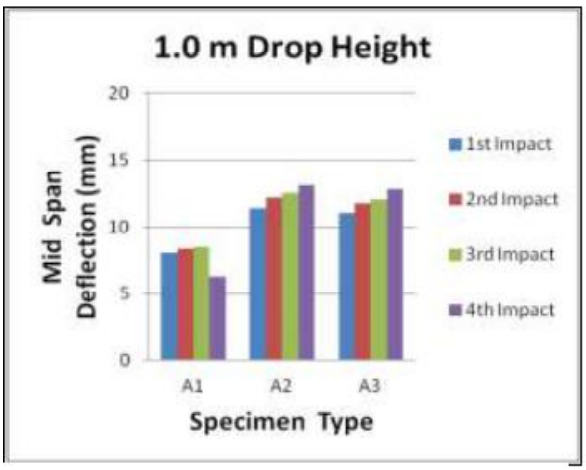


Fig. 2: (c) Variation of Mid Span deflection of Beam for series A

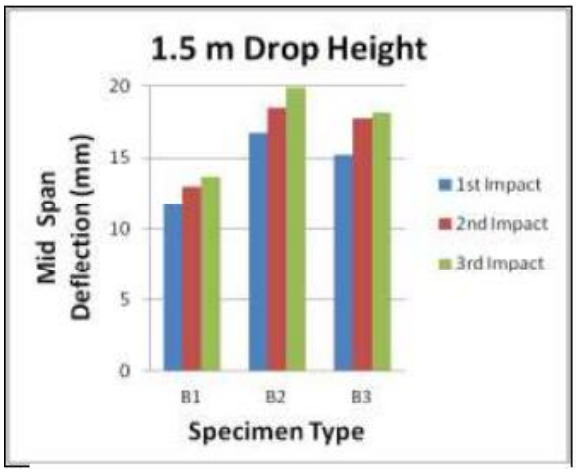


Fig. 2: (d) Variation of Mid Span deflection of Beam for series B

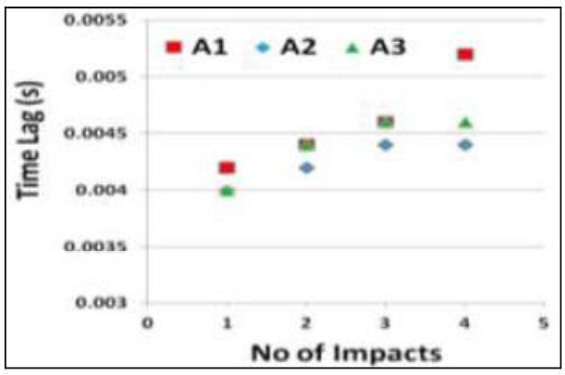


Fig. 3: (a) Variation of time lag for series A

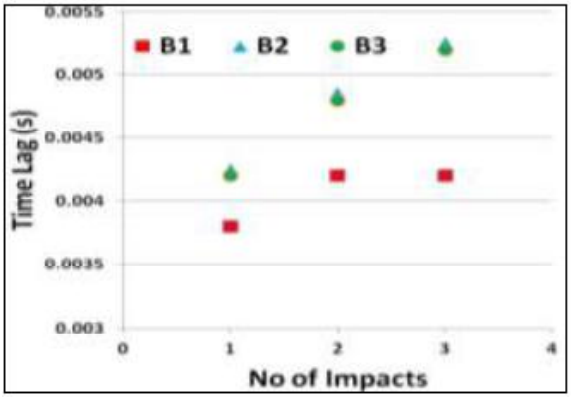


Fig. 3: (b) Variation of time lag for series B

Observations & Discussions

1. The reaction forces for beams are plotted with respect to time (Fig.1 (a)). When hammer strikes the beam, immediately for an instant the reaction is negative showing downward direction, although the negative value is a fraction of positive peak.
2. The negative value of the reaction force is possibly because there is tendency to uplift at the support in the beginning as the weight is dropped, which is resisted by the clamping device.
3. From the Fig.1 (a), it can also be seen that, there is a time lag (~ 0.0038 seconds) between maximum impact load (contact force) and maximum reaction force. The time lag may be defined as the time interval, between the contact force and the reaction force, after the impact is done on the concrete beam. This may be attributed of the fact that stress wave take some time after the impact to reach the end support.
4. The deflection at the middle of the span (impact location) at soffit of the beam has been obtained during the impact event using the LDS. Then the Deflection vs. time is plotted for each type of beams. As can be seem from Fig.1(b), due to the presence of vibration in the beam after the impact, multiple no of peaks in the graph can be seen.
5. It has been observed (Fig.2 (a) & Fig.2 (b)) that when the reinforcement is high i.e. case of A1, with the multiple impacts from 1 m height the energy absorption capacity of the beam decreases over subsequent impacts. Similar trend is observed (in case of B1) when the beam is subjected to impact from the height of 1.5 m. When the reinforcement area was kept at (A_{cr} = 1.5% & A_{st} = 2.1%) i.e. specimen type A3 it is observed with subsequent impact the energy absorption capacity of the beam increased. The trend that is just the opposite of the first case. Although the increase in the energy absorption may be nominal from the 1st impact. Similar trend was observed in the 1.5 m fall.
6. When the deflection criteria is looked into it is observed that at all the three reinforcement areas, with multiple impacts the beam undergoes an increase in deflection, both for 1 m and 1.5 m case. It is also clear from Fig.2 (c), specimen A2 showed the maximum deflection of 13.1 mm followed by 12.84 mm and 8.48 mm for A3 and A1 respectively. Similar trend was observed for the series B beams (Fig.2 (d)).
7. From the above discussions it can be seen that A3 absorbs more energy i.e. (6602 Joules and 6811 Joules) in case of 1m and 1.5 m height drop weight, compared A1 and A3. A2 although absorb about 10 % less energy from the A3, case but it is allowing the beam to deflect more before failure. A2 gives optimum energy abortion capacity and allows a more ductile failure when subjected to impact of 200kg mass from a height of 1 m and 1.5 m.
8. To discuss how the time lag varies for different beams, a plot between time lag and number of impact is plotted (Fig.3 (a) & Fig.3 (b)). In case of A1 beam in 4th impact, the beam absorbs 536 J of energy (lowest) and has the maximum time lag of i.e. 0.0052 s. Similarly in case of A2 in the third impact the energy absorbed by the beam is maximum i.e. 1914 J compared to A1 and A3, and has got the lowest time lag of 0.0044 s.
9. Data of time lag vs. number of impacts (Fig.3 (a) and Fig.3 (b)) is compared with the values of energy absorbed by the beam (Fig.2 (a) and Fig.2 (b)). It is observed that, as the energy absorbed of the beam increases the time lag decreases and vice- a- versa.
10. It may be worth to mention that energy absorbed in series A beams is between 536 J to 1914 J, whereas the energy is between 1638 J to 2495 J for series B beam. In case of series B, it is observed that with the increase in the energy absorbed, the time lag is also increasing. This is opposite to the pattern obtained for series A.
11. The reason for this reversal can be attributed to the fact that there may be development of micro cracks and as a result stress waves take more time to reach the end supports. This observation may be useful in determining safe load for structural elements subjected to low velocity impact loading. More studies on this aspect need to be done to validate the observation.

Future Plan

i. Repairing of cracked beam specimens and then testing them under low velocity impact.
ii. Modification of test setup for testing of plate specimens.
iii. Nonlinear FEM analysis for generation of impact response behavior of RC elements subjected to low velocity impact.

Improved Ventilation System

Syed Ibrahim Sohel & Jaswinder Singh

Objective:

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

Introduction

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.

Exposure Modelling

This is a crucial step in understanding the exposure to levels of pollutants on inhabitants. As personal monitors were unavailable and require long term monitoring, the vertical profiling of particulate levels was carried out to assess the potential hazard at various levels indoors. To profile the pollution levels outdoor, CALINE 4 model, a line source model to predict pollution levels from line source, was used so as to estimate levels at various floor levels of building. For indoor profiling, a methodology of Kinetic Sequential Sampling System was adopted.

The results of CALINE 4 Model (outdoor particle levels) and monitored levels at particular floor height are presented in Table 1.

Table 1: Results of CALINE 4 and Monitored Values at Different Floor Heights

Pollutant	Outdoor			Indoor		
	GI	FI	SL	GL	FL	SL
$PM_{2.5}$	12.9± 10.1	18.1 ± 7.2	11.5 ± 9.3	15.1± 9.3	20.6± 9.3	17.2 ± 7.6

The traffic source was combined with the background PM data and meteorological data was taken from NIH to run this model. It can be seen that the pollution levels are higher inside the building at the same floor heights, just before and after the walls.

The results of KSS system are presented in the Fig. 1. It is clear that the levels of pollution were higher right after cleaning around 10 AM. However, the true picture is seen around 12 AM when there was activity inside the room and two peaks appeared at 0.8 m and 1.75 m height. The second peak is more critical as average height of human lie around this level.

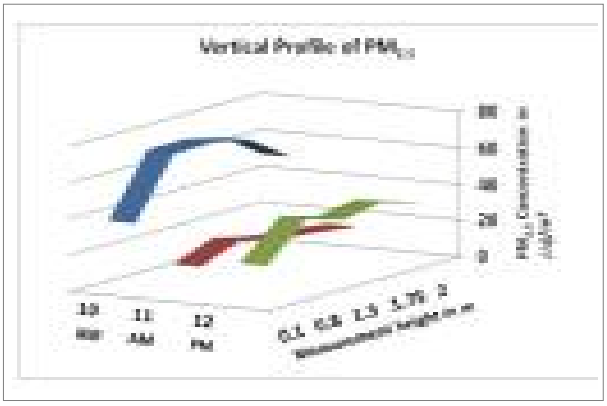


Fig 1: Indoor Vertical Profiling of PM 2.5 by Kinetic Sequential Sampling System

Experiment Description

The vertical profiling of air velocity and particle concentration was carried out in Room No: 226 of EST-CP Division. The layout of the room is presented below (Fig. 2). The room has two ACS and one door with the working desk in the middle. A multi-channel hotwire anemometer was utilized for measuring air velocity and a particle counter was utilized for measuring particle mass concentration by applying Kinetic sequential sampling system. The measurements were taking with both ACs on and off conditions.

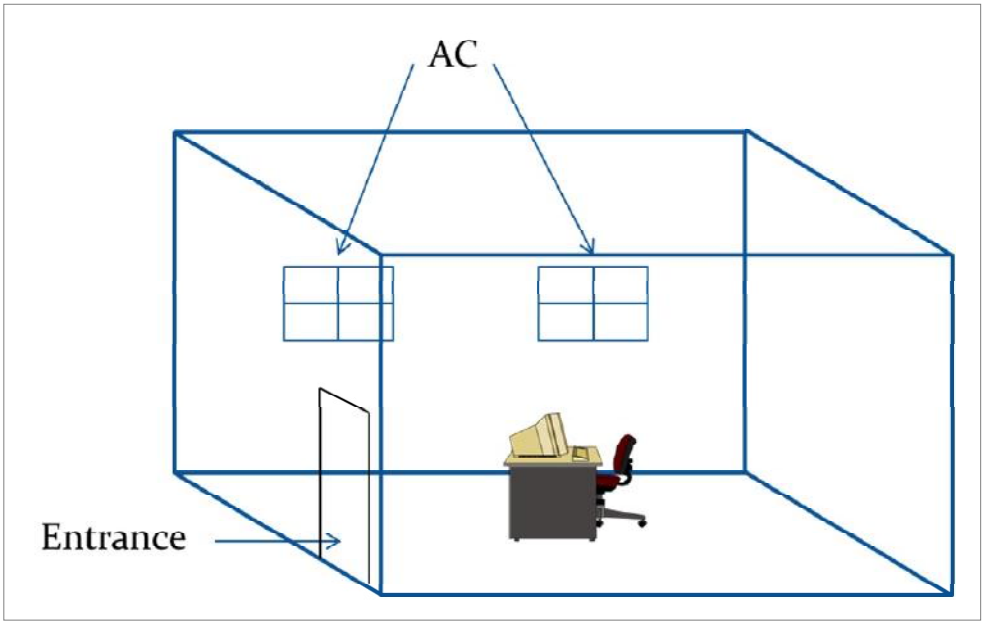


Fig 2: Experimental Site layout

Vertical profiling of air velocity

1. Both ACs off

Higher levels of air velocity were found near the door, spatially reducing towards the center of the room near desk, with a sudden surge right after the desk probably due to downward drag force (Fig 3).

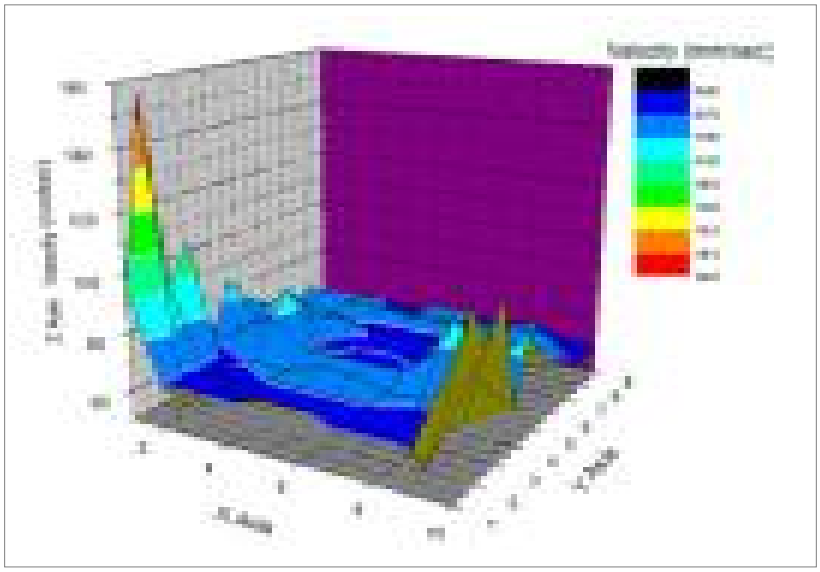


Fig 3: Air Velocity Profiling with Both ACs off

2. Both ACs on

Higher levels of air velocities were found near the ACs creating similar surge of levels beyond the desk location, while the velocities near door remained at same level (Fig. 4).

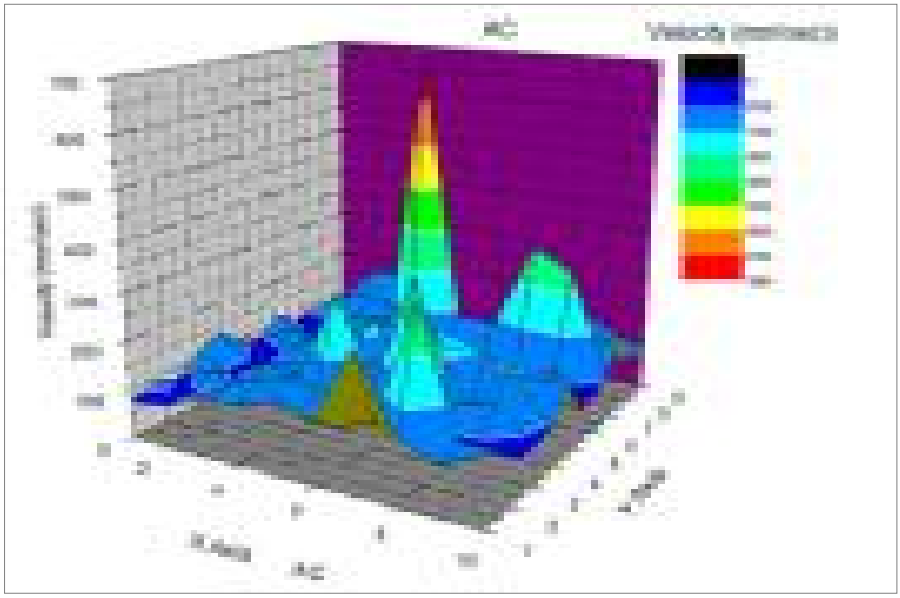


Fig 4: Air Velocity Profiling with Both ACs on

$PM_{2.5}$ Concentration Profile

The vertical profiling of $PM_{2.5}$ mass concentration was done at the computer desk under both ACs on and off conditions and the higher levels of concentration were observed when the ACs were off causing pollutant to build up due to less dispersion. The two peaks were observed at 0.8 meters and 1.7 meters height, with maximum at 1.7 meters, which is an average human breathing level when the person is standing.

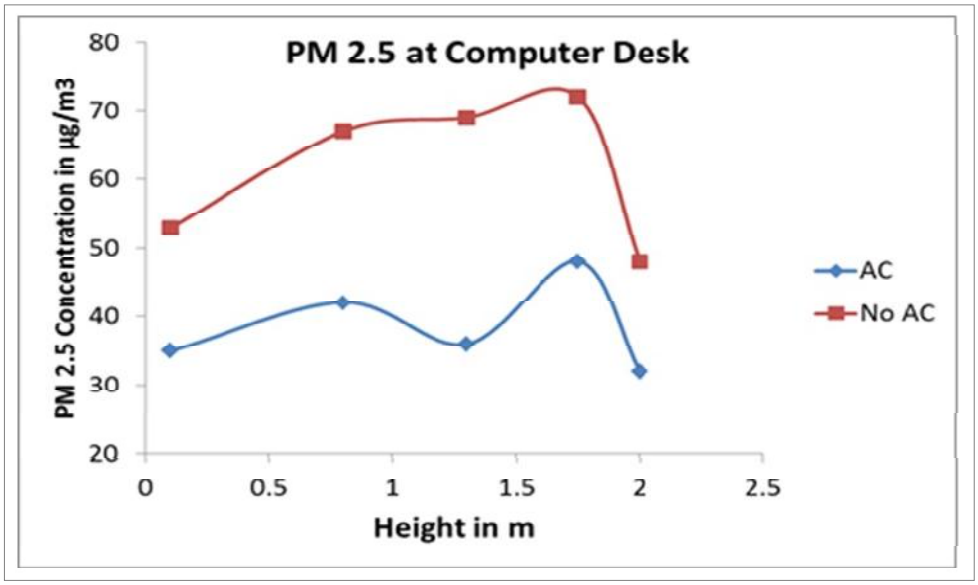


Fig 5: Vertical Profiling of $PM_{2.5}$ with Both ACs on and off

Network Projects (ESC 0102)

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: S. Sarkar & D.P. Kanungo

- Landslide Hazard and Risk Assessment of Chamoli-Joshimath Region, Garhwal Himalaya (CSIR-CBRI),PI: D.P.Kanungo
- Early Warning Instrumentation & Decision Package for a Landslide in Chamoli-Joshimath Region, Garhwal Himalaya (CSIR-CBRI), PI: D.P.Kanungo
- Comprehensive Geo-Investigation and Control Measures of Landslide in Chamoli-Joshimath Region, Garhwal Himalaya (CSIR-CBRI), PI: S. Sarkar

WP-2: Engineering of Earthquake Disaster Mitigation.

PI: Ajay Chourasia & P.K.S. Chauhan

- Sesmic Microzonation of Srinagar, Uttarakhand (CSIR-CBRI), PI: P.K.S. Chahuhan
- Sesmic Behaviour of Piles under Dynamic Lateral Loading (CSIR-CBRI), PI: Parvathi G.
- Sesmic Resistance of Confined Masonary Construction under Different Axial Stress (CSIR-CBRI), PI: Ajay Chourasaia

WP-3: Engineering of Fire Disaster Mitigation.

PI: R.S.Chimote & Suvir Singh

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

WP-4: Post Disaster Shelter Planning.

PI: S.K. Negi

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

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

PI: Ajay Chourasia & Soju Alexander

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

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

PI: R.S. Bisht & A.K. Mittal

- Architectural Planning and Design of a Residential Unit for Integrating Intelligent Building Features (CSIR-CBRI), PI: Ashok Kumar.
- Glass Façade Cleaning Robotics System (CSIR-CBRI), PI: R. S .Bisht.

WP-1 Engineering of Landslide Disaster Mitigation

S. Sarkar & D.P. Kanungo

The occurrence of landslides is a common phenomenon in the Himalayas which presents rock types, tectonic zones, topographic reliefs and slopes of diverse nature. The structurally deformed rocks have been subjected to severe erosion by toe cutting action of rivers and streams. All these adverse characteristics contribute in making the terrain susceptible to landslide occurrence. In recent years implementation of a number of hydro-electric schemes, large scale construction activities as well as indiscriminate mining and quarrying have further aggravated the problem manifold.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 12thFive 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 landslide control measures

Landslide Hazard & Risk Assessment

D.P. Kanungo & Team

The objective of the study is to prepare large scale landslide hazard and risk maps in Chamoli-Joshimath region of Garhwal Himalaya. The landslide hazard maps depicting the existing and potential landslides of different types will be prepared by integrating all the causative parameters. The information pertaining to the travel/flow path and zone of influence of all the landslide hazard zones will also be an integral part of the hazard map. Further, the risk elements in the region such as habitations and infrastructural facilities etc. will be mapped using available information and remote sensing image analysis and interpretation. Risk information will be finally integrated with the hazard maps to produce the landslide risk map for the region.

A number of thematic data layers for the Chamoli-Joshimath road corridor of NH-58 along the Alaknanda valley of Garhwal Himalayas have been prepared based on field investigation, Survey of India toposheets, and remote sensing data and GIS tools. The thematic data layers such as slope and slope aspect are derived from the contour maps on 1:50000 scale. The drainage layer is generated from the GeoEye remote sensing data with 0.5m spatial resolution. The landslide areas are mapped from the GeoEye image and also verified from the field. The lithology layer has been extracted from the published literature of the study area.

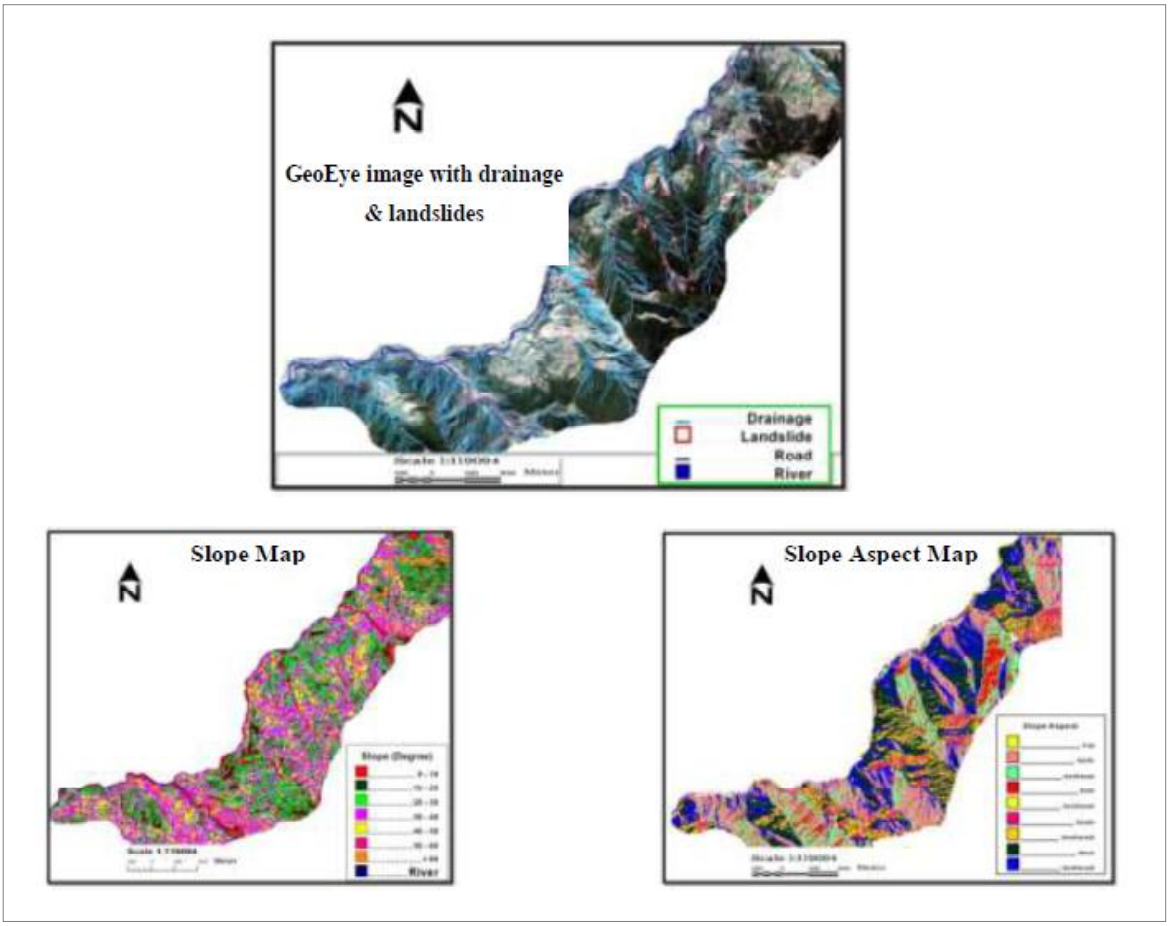


Fig. 1: GIS based Thematic Maps

Development of Landslide Early Warning System for a Landslide in Chamoli-Joshimath Region of Garhwal Himalaya

D.P. Kanungo & Team

The objective of this study is to develop a region specific operational Landslide Early Warning System based on multi parameter trigger thresholds. The system includes sensing instruments, real time data transfer system, decision making mechanism & the multi level alarm signal dissemination. Real Time Monitoring can provide immediate information on the landslide activity that may be critical to protect lives and property.

In this attempt, a Landslide Observatory has been established at Pakhi Landslide, 9km from Pipalkoti towards Joshimath on NH-58. The observatory includes installation of 16 In-place Inclinometer (IPI) sensors in 4 boreholes, 4 vibrating wire piezometric (VWP) sensors in another 4 boreholes, 3 wire-line extensometer (WLE) sensors on surface and an Automatic Weather Station (AWS) including rain gauge, temperature sensor, relative humidity sensor and wind velocity & direction measurement sensors. The Data Acquisition System (DAS) and Gateway are acquiring real time data wirelessly from all these sensors at the Observatory. These data are getting communicated also on real time to CSIR-CBRI, Roorkee through web server and are being visualized and monitored using ARGUS monitoring software.

Fig. 1: Landslide Observatory & Data Acquisition Software

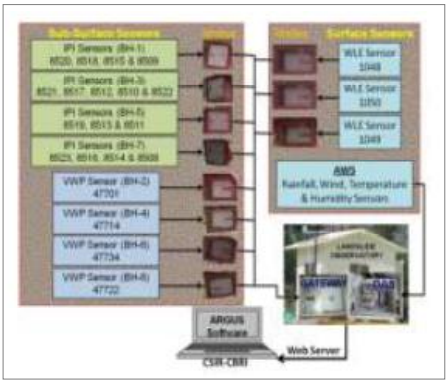


Fig. 2: Wireless Landslide Instrumentation & Real Time Monitoring System

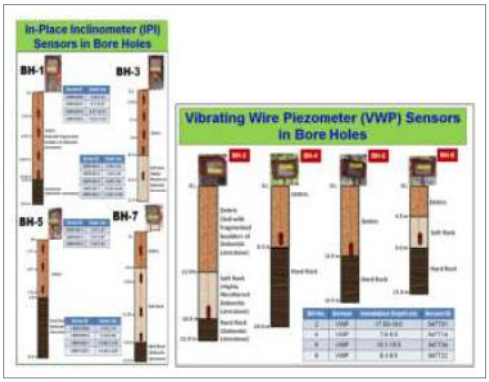


Fig. 3: Details of Instrumentation at Pakhi Landslide

Monsoon period data will be analyzed to develop multi-parameter trigger threshold model. Landslide Early Warning System once developed will help in alerting people in advance to save property & loss of lives and to manage traffic before occurrence of a major event particularly during the monsoon season.

Comprehensive Geo-Investigation & Control Measures for a Landslide in Chamoli-Joshimath Region of Garhwal Himalaya

S. Sarkar & Team

The objective of this project is to carry out a comprehensive study of geological & geotechnical investigations of an active landslide of Chamoli-Joshimath region of Garhwal Himalaya to arrive at design and implementation of suitable control measures

Geotechnical investigation and slope stability analysis of the Pakhi landslide near Pipalkoti in Garhwal Himalaya have been carried out. The control measures selected for the landslide include soil nailing to protect the debris slide in the uphill portion and gabion/reinforced earth retaining wall to protect the road. Soil nailing is an in situ soil reinforcing technique adopted for stabilizing unstable slopes. The soil nail acts as a passive bearing element, which relies on soil movement and subsequent active earth pressure to mobilize the shear strength along the nail whereas a tieback anchor is pre-stressed to mobilize shear strength.

Soil Nail Pullout Test Set-up

A new laboratory pull-out testing arrangement has been developed to investigate the influence of overburden pressure, degree of saturation, and surface roughness of soil nail on the interface shear strength. Laboratory or field pullout tests have been the most convenient and popular means to obtain the design resistance of a nail.

The pullout arrangement permits the pullout loads to be applied in a displacement controlled manner with minimum linear speed of 0.7 mm/min. The maximum pullout capacity is 45 kN, which is adequate for carrying out pullout tests of grouted nails in sandy fills. The required inclination angle up to 25° with horizontal can also be achieved by arrangement for pulling the nail along its longitudinal direction during the test.

The pullout arrangement is shown in the Fig. 1. It consists of three major components: a pullout unit to pull the nails at a predefined displacement rate; a tank to

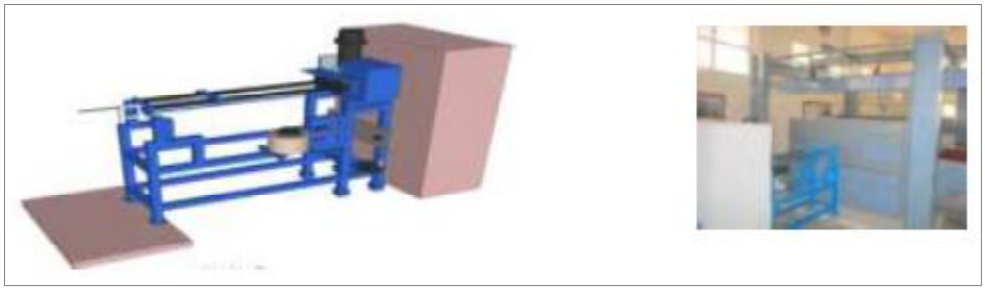


Fig. 1: Soil Nail Pullout Capacity Set-up

Soil Nail

To examine the efficacy of different types of nails, a few nails were designed and fabricated from mild steel. The following four types of nail surface were considered:

- Untreated smooth surface nail (SN)
- Nail surface glued by coarse sand (600 mm retaining) (RN-C)
- Nail surface glued by fine sand (300 mm retaining) (RN-F)
- Nail ribbed surface (RN)

Fig. 2: Nails of Different Roughness

accommodate the soil and nails; and a portal frame for the application of vertical pressure.

Experiments & Results

A number of experiments were carried out with different nails under different conditions. The effective nail length that was kept in contact with soil was 0.90m. Five strain gauges were installed along the nail length, each at spacing of 250 mm. The pullout capacity obtained from the tests is shown in the Fig. 3.

The experiments with more nails under different conditions are being carried out to finalize the suitable design of the nail applicable for landslide control.

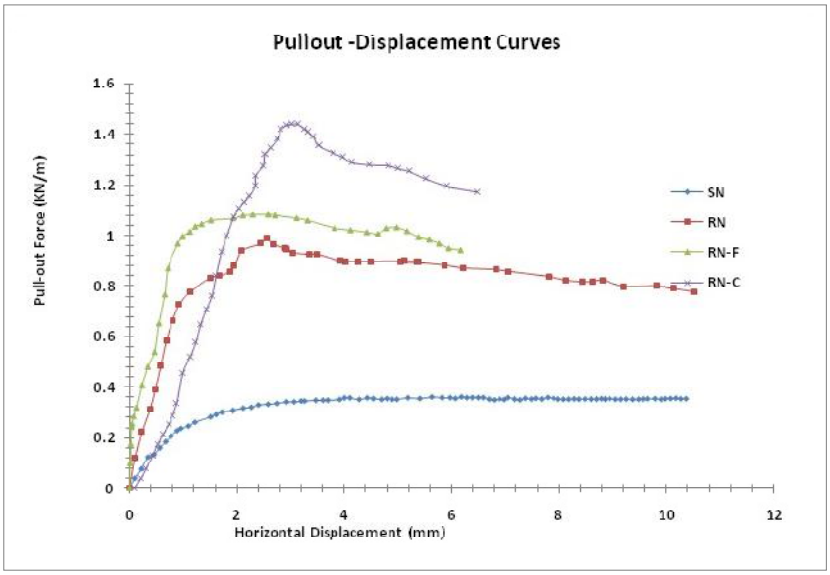


Fig. 3: Pullout & Displacement Curve

WP-2 Engineering of Earthquake Disaster Mitigation

Ajay Chourasia & P. K. S. Chauhan

Seismic Microzonation of Srinagar, Uttarakhand

P. K. S. Chauhan & Team

Seismic Microzonation of Srinagar (Uttarakhand) has been initiated in March 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 the year 2014-2015, the following works were completed;

- Geophysical investigation at five sites using Seismic methods
- Geophysical investigation at five sites using Electrical methods
- Collection of strong motion data from installed SMA's Network in Srinagar

Geophysical investigation using Seismic and Electrical methods were carried out at the both banks of the river to delineate the subsurface structure. In total of 5 Seismic Refraction Surveys, 4 Resistivity Imaging profiles and 3 MASW profiles were taken. The depth of investigation in these methods depends upon the length of the profile used and the impact of source in the case of Seismic method. The data processing and interpretation has provided the sub-surface information up to the depth of 20m. The sites covered are:

- SSB Ground Srinagar
- ITI Ground Srinagar
- Horticulture Ground Srinagar
- Chauras Inter College Srinagar
- Court Compound Kirti Nagar

The results for all type of surveys are shown in Fig. 1 (a, b, c).

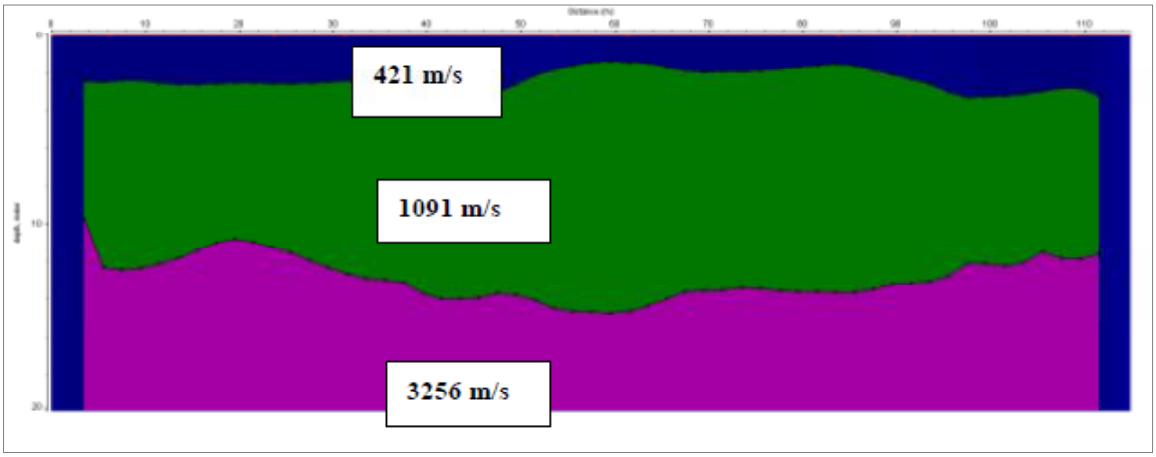


Fig. 1: (a) P-Wave Velocity Variation at IIT Ground, Srinagar using Refraction Method

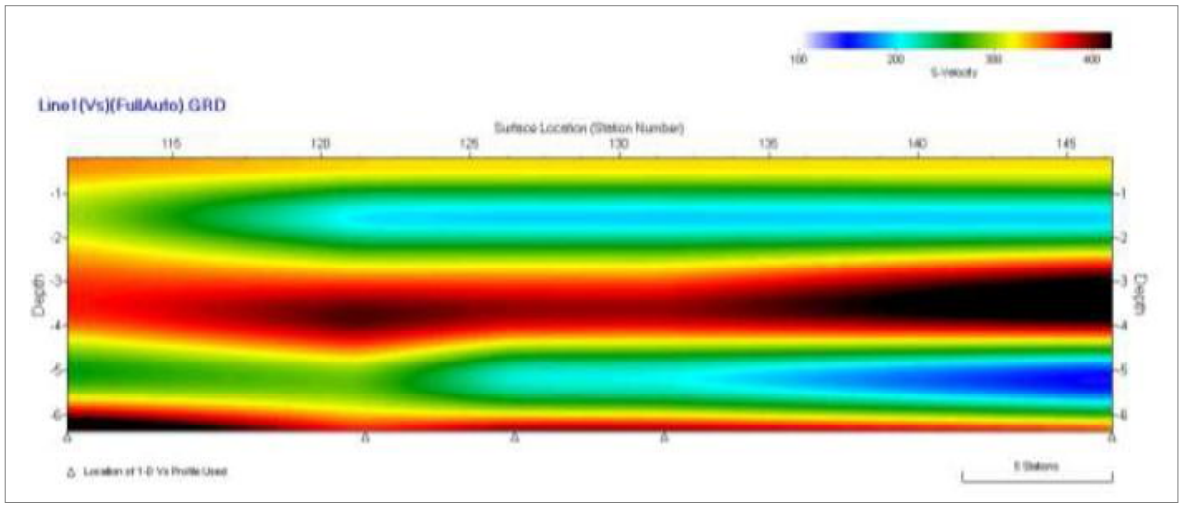


Fig. 1: (b) Shear Wave Velocity Variation at Chauras Inter College, Srinagar using MASW

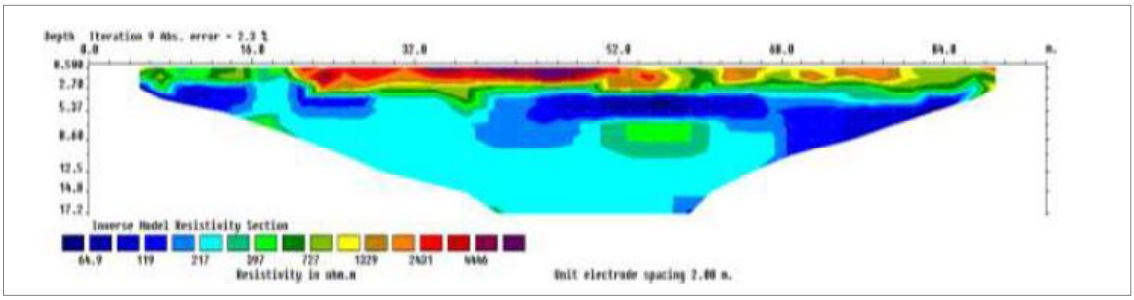


Fig. 1: (c) Resistivity Variation at SSB Ground, Srinagar using Resistivity Imaging System

Strong motion data have been retrieved from the installed SMA,s network at the following locations through data retrieving system using WinSCP software.

- Tehsil Srinagar
- SSB Srinagar
- GGIC Srinagar
- SDM office Kirtinagar

Fig. 2

The official permission from civil authorities at Srinagar for Geotechnical Investigation is under progress and for which the sites have been tentatively identified. The process of getting geo-technical reports for other engineering projects from different organizations like GVK Hydro Project, University Civil Department and PWD Srinagar is in progress.

Seismic Behaviour of Piles Under Dynamic Lateral Loading

Parvathi G.

Objectives of the project:

I. To investigate the seismic behavior of piles subjected to dynamic lateral loading through numerical analysis and experimental model testing.

II. To investigate the influence of various soil and pile parameters on the seismic behavior of piles under dynamic lateral loading. The influence of liquefiable soil layer on the behavior of piles will also be studied.

III. Development of a methodology for seismic design features of piles in layered sandy soils.

Progress made so far:

1. Experimental model test design is completed. This includes the design of the test tank and the test piles. The sand from Solani River will be used to carry out the model tests.
2. The Uniaxial Shake Table has been procured and a dynamic soil test facility with adequately designed strong floor has been created to carry out tests to simulate earthquake conditions in the soil.
3. Numerical modeling of pile groups in loose and dense sandy soils, subjected to combined axial and lateral loading has been done. A lot of published work has been validated. The parametric studies are also being carried out to study the influence of lateral loading on pile foundation in a seismic condition
4. Literature review of the preset work is carried out continuously to up keep knowledge base of the project.

Fig. 1: Uniaxial Shake Table and its accessories

Results and Discussions:

1. The pile group carrying lateral load was numerically modeled in PLAXIS 3D. The validation of the 3x3pile group numerical model was carried out with the published results of Comodromos et al. (2009). Further, parametric study was carried out for 3x3 groups of piles. The pile cap is properly designed according to BS 8110 Part 1:3.11.4.1(5). The pile cap dimension was chosen as 2300x2300x900 mm and the pile diameter and the length were taken as 0.5m and 10m respectively.

From the analysis of results, it was observed that due to the shadowing effect, the leading pile row carries 80% of the load as compared to the load it would have carried as a single pile. Middle row carries 30% of the load and the trailing pile row carries the 50% of the load. So, the pile group behavior can be explained through p-multiplier approach.

Seismic Resistance of Confined Masonary Construction under Different Axial Stress

Ajay Chourasia

Many literatures are available which mainly outlines the prescriptive design procedure for confined masonry for a few parameters. These provisions includes – wall layout and density, minimum size of confining elements i.e. tie-column, bond-beam, reinforcement size and detailing. Although, these provisions are adequate for confined masonry buildings, up to two storeys, medium-rise buildings (up to four to five storey) call for validated design procedure and guidelines. Interestingly, this is more relevant to India, as no design rules or standards are yet available on confined masonry. The reason may be due to lack of masonry design practice, and limited or no experimental evidences of Indian confined masonry, there are no codal provision in India. As a result, there are reservations in using the CM technology in the field by the practicing engineers and owners.

To bridge the above gap, the outcome of the present study i.e. material characterization and experimental results on full-scale CM model were utilized to formulate a compressive design procedure for CM buildings. To do so, the recommendations given in Argentinean code (INPRES-CIRSOC 103), European code (EC6), Peruvian codes, literature - Rihai et al., and other reported data were referred. In addition, the material strength and seismic resistant building design guidelines applicable in India (IS-1905:2002, IS-456:2000, IS-1893:2002, IS-13920:1993, IS-4326:2013) were also referred.

The design procedure developed for confined masonry broadly comprises assessment of material properties, geometrical configuration, seismicity of the area, checks for wall density, calculation of loads, checks for walls stability, lateral load resistance and stress verification for in-plane and out-of-plane walls, and design of confining elements. The generalized flow-sheet for design of CM is shown in Fig. 1. The design steps, considers the combined effect of masonry and confining elements in lateral load resistance, in the principle direction. Similarly, the design of tie-column is based on the stiffness approach incorporated by masonry and tie-column.

The above design steps were implemented in design of tested a full-scale CM building. For single storey CM building, the above results were in agreement with experimental values. Further, the above procedure was implemented for design of 2, 3 and 4 storied CM buildings in seismic zone iv & v, to establish the accuracy of the design steps, which indicates that at a given material scenario, the Indian CM buildings having material characteristics as adopted in the present study, can be constructed up to 4 storey, in 220mm thick brick masonry. It was observed that the higher than 4 storey construction of Indian CM was restrained due to exceedance of shear stress at ground floor than that of permissible limits.

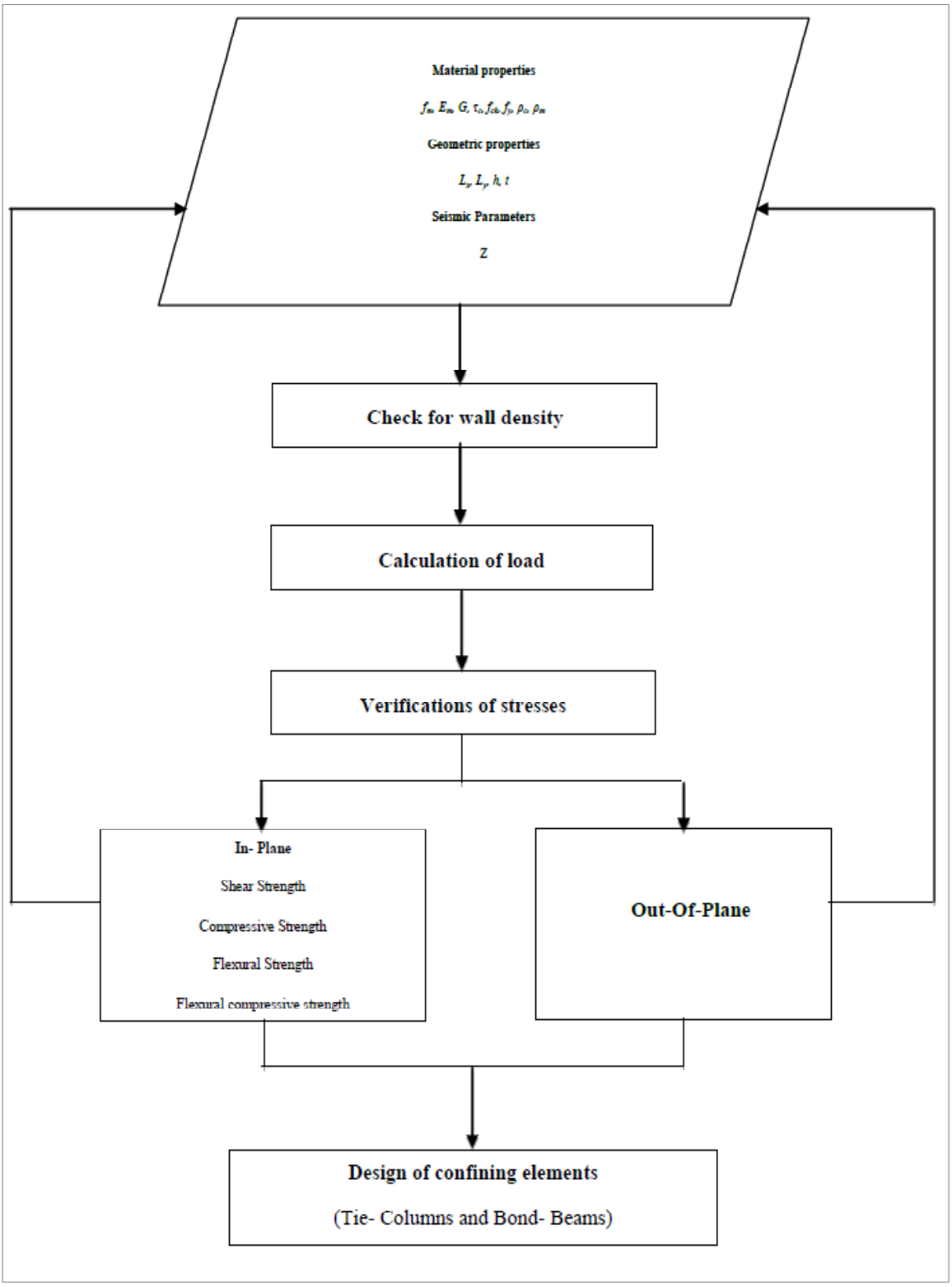


Fig. 1: Generalized Flow-Sheet for Design of Confined Masonry Building

WP-3

Engineering of Fire Disaster Mitigation

R.S. Chimote & Suvir Singh

Development of Low Ozone Depletion Potential (ODP) (0.01-0.5) Innovative Fire Suppression System

R. S. Chimote

Objectives:

- Development of water-mist based fire extinguisher
- Development of evaluation facilities for fire extinguishing system

Yearly Objectives and deliverables of the project during April 2014 to Mar 2015:

- Comparative evaluation of on micro-size particles in discharge cluster
- Optimization of compositions based on fire suppression efficacy for water mist system
- CFD Modeling of interaction of water mist fire suppression system under "NO" Fire condition.
- Design details for Fire Suppression System in respect of Water mist system
- Preparation of innovative material composition and system design based on validated results for Class A/Class B fires

Significant Contribution during April 2013 to Mar 2014:

- New facility developed and added for optimization of compositions based on fire suppression efficacy for water mist system and comparative evaluation of on micro-size particles in discharge cluster as per IS: 15683-2006 on Class A wooden-crib fires to experimentally simulate the realistic fires in various building occupancies, as: 1) Class 1A fires; 2) Class 2A fires; 3) Class 3A fires; and 4) Class 4A fires.

Fig. 1: New facility developed for optimization of compositions based on fire suppression efficacy for water mist system and comparative evaluation of on micro-size particles in discharge cluster as per IS: 15683-2006 on Class A wooden-crib fires.

- CFD Modelling of interaction of water mist fire suppression system under "NO" Fire condition:

Under "NO" fire condition, the experiments were conducted in the experimental domain size of 2m*3m*2.75 m. Water mist nozzle is located at 1.7 m above fire source. The water mist data generated and measured at 20 cm below the nozzle with a spray angle of 45 deg and a particle number rate of 21,00,000/s. With this experimental data, simulation studies were performed as water mist Simulation under no fire condition. Results of water mist modelling and simulation under no fire condition are as below in Fig. 2.

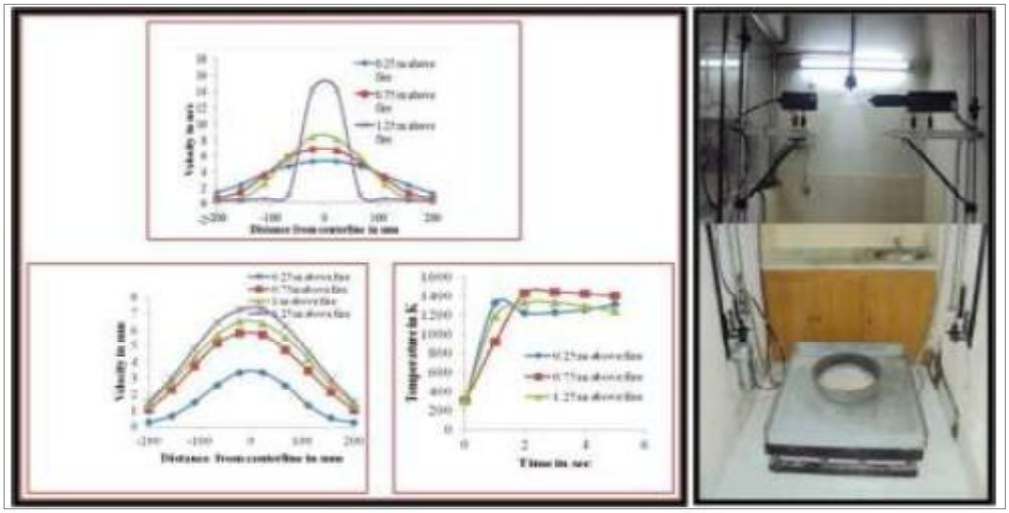


Fig. 2: CFD Modelling of interaction of water mist fire suppression system under "NO" Fire condition

- Development of Innovative 50-Litre Capacity Water–Mist fire Extinguisher
- An innovative 50-Litre Capacity Water–Mist fire Extinguisher has been developed for combating the large-scale fires, as depicted below in Fig. 3.
- Design details for the development of Novel Water-Mist and/or Low ODP Extinguishant Fire Suppression System based on water-mist technology to be installed and commissioned for a working space of 25-30M^2 have been finalized as depicted in the following fig. 4.

Fig. 3: An Innovative 50-Litre Capacity Water–Mist Fire Extinguisher

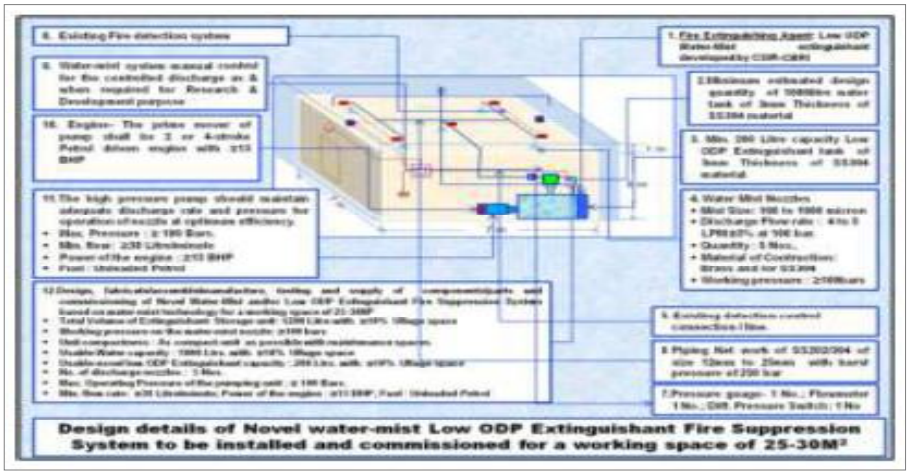


Fig. 4: Design Details for the development of Novel Water-Mist and/or Low ODP Extinguishant Fire Suppression System based on water-mist technology to be installed and commissioned for a working space of 25-30M^2

- Design details for the development of Novel Design details of Mini Water-Mist Fire Tender based on water-mist technology to be fabricated, installed and commissioned at CSIR-CBRI Premise have been finalized as depicted in the following fig. 5.

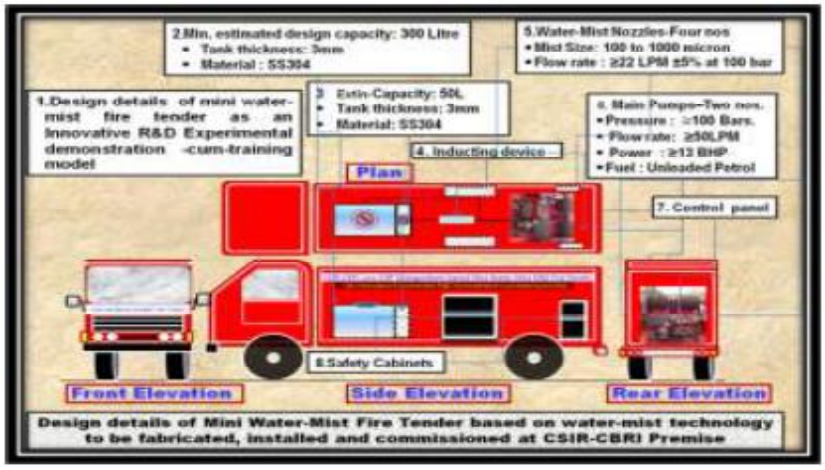


Fig. 5: Design details for the development of Novel Design details of Mini Water-Mist Fire Tender based on water-mist technology to be fabricated installed and commissioned at CSIR-CBRI Premise

- Preparation of innovative material composition and system design based on validated results for Class A/Class B fires: Innovative Zero ("0") ODP Fire Extinguishant material composition and system design based on validated results for Class A/Class B fires has been developed with 95-100% fire suppression efficiency in 10 to 15 s on 1000cm^2 fires, as shown in Fig. 6.

Fig. 6: Experimental validation of fire extinguishing performance of an Innovative Zero ("0") ODP Fire Extinguishant material composition with 100% fire suppression efficiency in 10 to 15 s on 1000cm^2 fires.

- CFD Modelling of interaction of water mist fire suppression system under Fire condition: The CFD Modelling of interaction of water mist fire suppression system with 2.45m, 2.50m and 2.55m ceiling heights has been carried out which validates the experimental fire suppression time of 10 to 15 seconds with 100% fire suppression efficiency by bringing down the fire temperature in the range of 90 to 100deg. C with fire control time from 5s to 10s as shown in the following figures 7, 8 and 9, respectively.

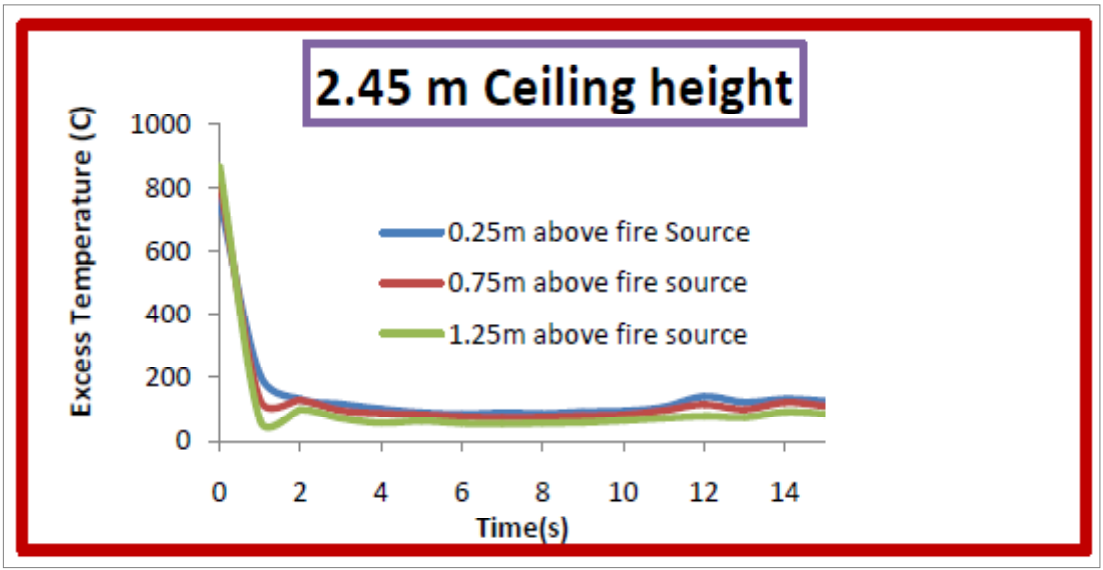


Fig. 7: CFD modelling for validation of fire extinguishing performance of an Innovative Zero ("0") ODP Fire Extinguishant material composition with 100% fire suppression efficiency in 10 to 15s on 1000 cm² fires for a water-mist nozzle discharge at a ceiling height of 2.45m.

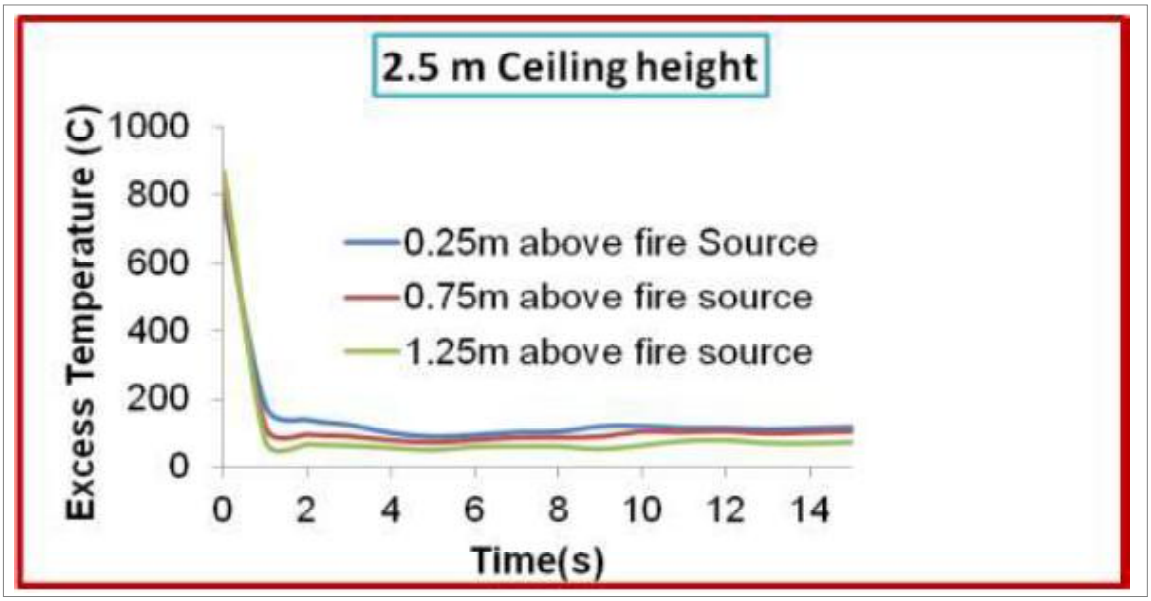


Fig. 8: CFD modelling for validation of fire extinguishing performance of an Innovative Zero ("0") ODP Fire Extinguishant material composition with 100% fire suppression efficiency in 10 to 15 s on 1000cm² fires for a water-mist nozzle discharge at a ceiling height of 2. 5m.

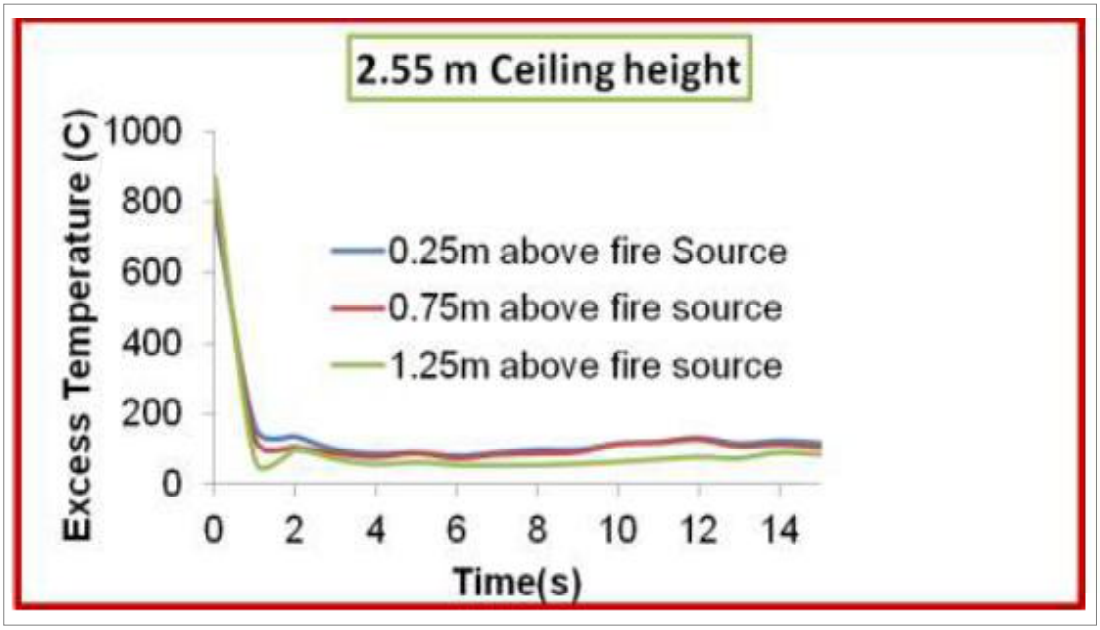


Fig. 9: CFD modelling for validation of fire extinguishing performance of an Innovative Zero ("0") ODP Fire Extinguishant material composition with 100% fire suppression efficiency in 10 to 15 s on 1000cm² fires for a water-mist nozzle discharge at a ceiling height of 2. 55m.

WP-4 Post Disaster Shelter Planning

S.K. Negi & Team

Design & Development of Disaster Resistant Intermediate Shelters for Western Himalayan Region

S. K. Negi & Team

Objective

To develop a technology package for Disaster Resistant Transit Shelters for Western Himalayan Region.

Envisaged Deliverables

1. Case Studies and Gaps Identification & Design Alternatives suiting to the climate conditions of the region.
2. Prototype Development and its validation of Transit Shelters.
3. Field Demonstration of Prototype designs of Transit Shelters.
4. Detailed Project Report.

Fig. 1

Design

Two prototype design options of Foldable Portal frame (Aluminum) shelter by varying the size of the portal frame for a family of five to six members is developed. The size of one portal frame is 1800mm and 2100mm and four such frame are joined together to form a portal which can be folded from the joints. Three foldable frames are used in one shelter to form the skeleton of the shelter. The use of aluminum in the frame makes it light weight as well as durable. Pre-coated corrugated aluminum sheet & sandwich panels are used for roofing and walling.

Detail of the prototype Foldable Portal Frame shelter:

- The shape & geometry i.e. detail working drawing of mechanical & architectural as per the fabricators requirement.
- Cladding – Pre-coated corrugated aluminum sheet & sandwich for roofing/walling.
- Weight of structural system = 80 - 100 kg. Approx.
- Weight of one portal frame = 16 - 20 kg. Approx.
- Floor Area = 22 sq. m.

Salient Features

- The shelter has sufficient spaces like living, kitchen and sleeping for a family of 5 persons.
- Ease of transportation and minimum erection time.
- Light weight and durable structure.
- Water, wind and fire resistance.
- Structural stability against hazards.
- Use of minimum skilled man power, tools & equipments for erection and knockdown of the shelter.
- Shelter can be used as emergency as well as transit shelter.
- Simple joinery detail reduces erection time and helps in community participation.

WP-5 Health Monitoring of Buildings Using Wireless Sensor Network

Ajay Chourasia & Soju Alexander

Collection & Validation of Data Using Developed Sensor, Numerical Modelling, Model Updation & Field Implementation for Building System

Ajay Chourasia & Team

To assess the health of building, extensive instrumentation, data acquisition, its analysis was carried out on a scaled six-storied RC building using wired and wireless sensor network (WSN). Two different approaches i.e. by using Modal Curvature and Wavelet Transform were used for data analysis. The dynamic characteristics of building were evaluated along with the development of numerical model for damage identification. The measurement of response of building to ambient and forced vibration was performed using sensors (wired and wireless). Different excitation functions and forced levels were used in the vibration tests to explore the extent of non-linearity in vibration data. Different types of excitation forces sine sweep, sine continuous (at natural frequency) and sine continuous (other than natural frequency) are used to obtain the resonant frequencies and modal information and also to study the influence and efficacy of each signal type in extracting modal characteristics.

The time history was recorded under ambient condition for no external mass case, along the shorter and longer direction of the RC building. The details of experiments conducted on RC building are given in Fig. 1. The mass on the floors was varied in steps, under forced and ambient vibrations. Fig. 2 shows a typical experimental set-up for health monitoring of RC building. To achieve forced vibration condition, long stroke shaker was mounted at 5th floor and set to oscillate along the shorter direction. Consequent upon recording of vibration response, incremental over-loading was performed at third floor. Vibration response from all floors of RC building in ambient and loaded conditions was analyzed for FRS. CDF values were calculated from the curvature mode shapes in loaded and unloaded condition. CDF algorithm could not detect the addition of load when load was less than 25kg due to absence of single peak in CDF plot. For other cases with higher loads, CDF could detect the variation effectively. Thus, CDF approach is not robust in detecting the location of abrupt change in physical properties of the RC building. Also CDF based damage identification algorithm requires the baseline or model which is not always available. Hence applicability of CDF approach is conditional.

Vibration response from wireless accelerometers was further analyzed in MATLAB 2013a. Complex continuous Gaussian wavelet (cgau5) and complex continuous Frequency B- spline wavelet (fbsp 2-1-1) was applied on the acceleration-time history. Complex wavelet coefficients were obtained and their absolute value was determined for each wavelet scale. High frequency component (HFC) is added to acceleration-time history corresponding to any damage (stiffness reduction), mass variation. Though HFC is added to response from all sensors placed on structure, however the effect on the response from sensors nearest to the location of variation is prominent. High frequency component in the response was identified and corresponding wavelet coefficient was recorded.

Wavelet coefficient modulus was observed to be maximum for the floor where sudden mass was varied. Complex Gaussian wavelet was not robust in detecting

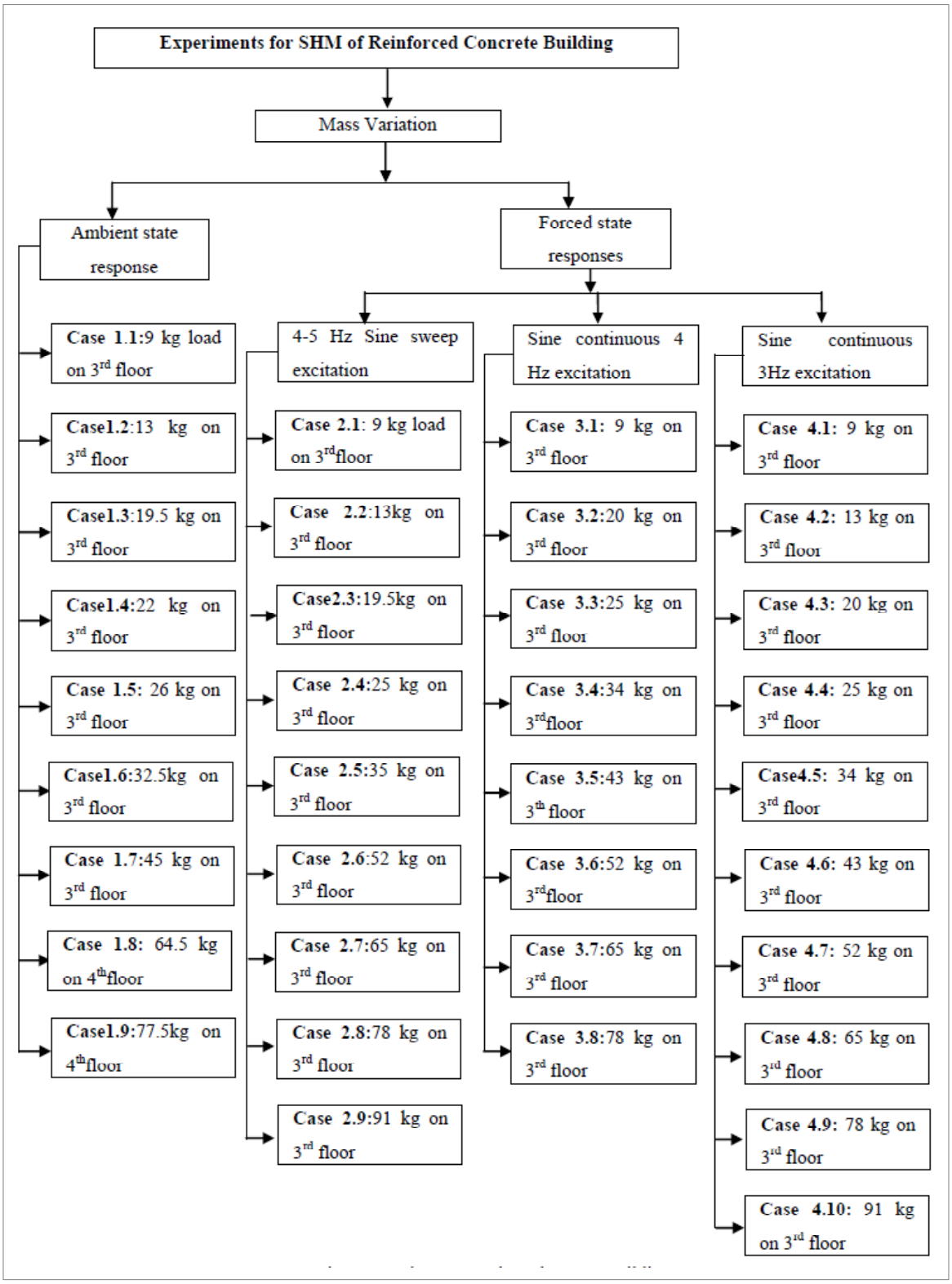


Fig. 1: Various Experiments conducted on RC Building

the location of added load. It could not detect the mass variation in case in maximum cases. Most of the cases were corresponding to ambient state response. Frequency B-splines wavelet was able to locate the change in all the cases considered. Fbsp 2-1-1 wavelet showed better correlation as compared to cgau5 in detecting the higher frequency components in recorded vibration response.

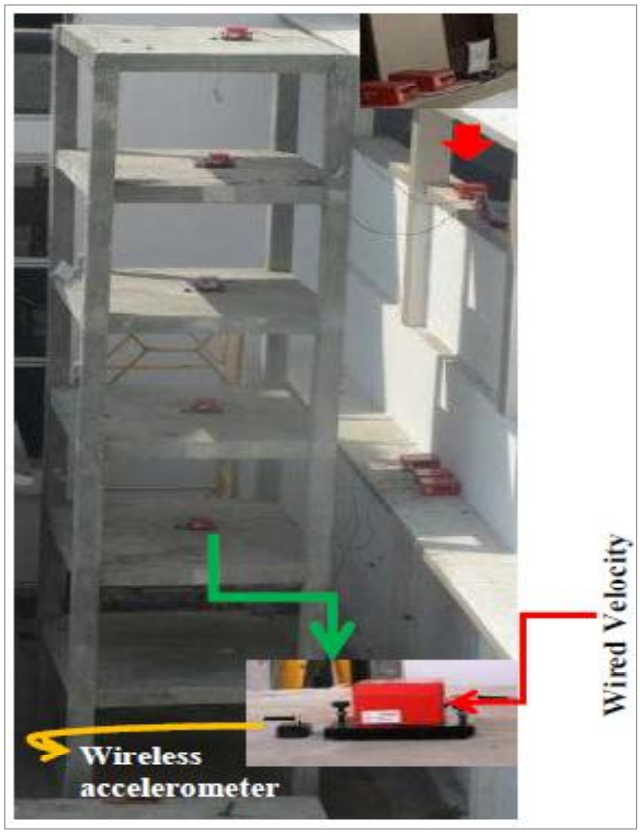


Fig. 2: Health Monitoring of RC Building with Wireless Accelerometers and Wired Velocity Sensors

WP-6 Intelligent Building System for Model Residential Unit.

Architectural Planning & Design of a Residential Unit for Integrating Intelligent Building Features

Ashok Kumar & Team

The aim of the project is to develop cost - effective and energy efficient intelligent residential unit with intelligent features that automatically caters the building security, maintenance, energy efficiency and fire safety along with the functionality of services and amenities provided.

Spaces, Amenities and Salient Features:

The building consists of Ground floor and First floor as shown in Fig. 1(a) & Fig. 1(b). Ground Floor has a Reception –cum- Computer room, Control room with a Store and a Conference room with Pantry and Toilets. First Floor has two VIP suites for guests, each suite consists of a Lounge/Drawing room, one Bedroom and a Toilet attached with Dress area. The salient features in the building are: (i) day light sensors, (ii) occupants presence detector, (iii) vacuum robot cleaner, (iv) fingerprint & password protected door, (v) CCTV camera, (vi) smoke detectors and (vii) face identification, (viii) Building Energy Management System, (ix) Integrate system of IRIS, Face and Finger Print, (x) Energy efficient fixtures and (xi) Energy efficient materials etc.

An artist view of the proposed building is shown in Fig. 1(c).

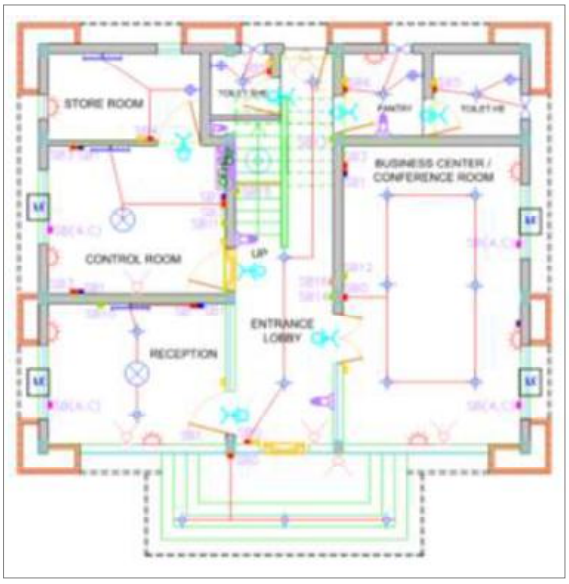


Fig. 1: (a) Ground Floor Plan

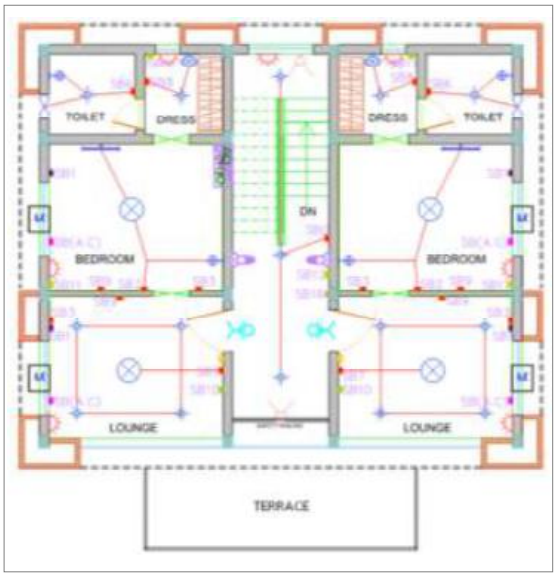


Fig. 1: (b) First Floor Plan

Fig. 1: (c) View of the Proposed Intelligent Building

Glass Facade Cleaning Robotic System

Ravindra Singh Bisht & Team

Objective:

Design and development of a service robotic system for cleaning of glass façade

Progress Highlights/ Significant Achievements:

Research studies on adhesion mechanism and dirt detection sensor to be used in cleaning mechanism were carried out for development of glass facade cleaning robot.

Adhesion mechanism test:

Test samples of electro-adhesive mechanism as shown in Fig. 1 for two different cases have been fabricated for laboratory testing.

Case 01: This involves study of the mechanism with simple electrode pair design for different insulating materials (Silicon rubber, Mylar and Teflon).

Case 02: This involves study of the mechanism with comb shape electrode pair design for different insulating materials (Silicon rubber, Mylar and Teflon).

Experimental work has been performed for the testing of above discussed two cases and results are shown in Fig. 2. As seen from the test results, the comb shape electrode pair design with Maylor insulating material of adhesion mechanism is more suitable for the robot design as compared to design based on other insulating materials.

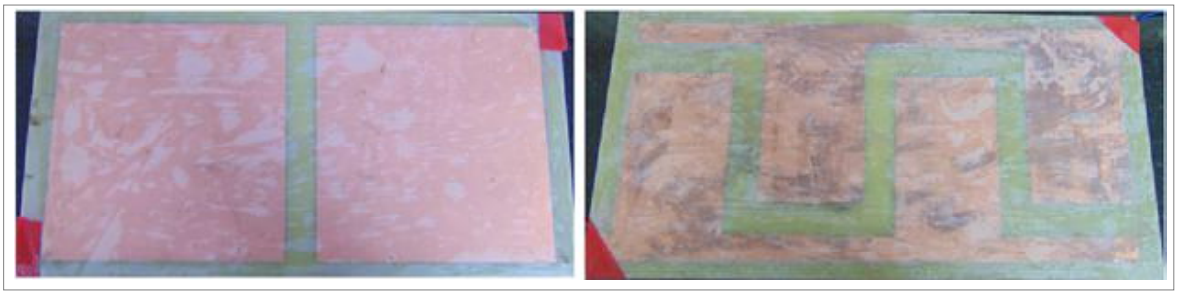


Fig. 1: Simple and Comb Shape Electrode Pair Design of Test Samples

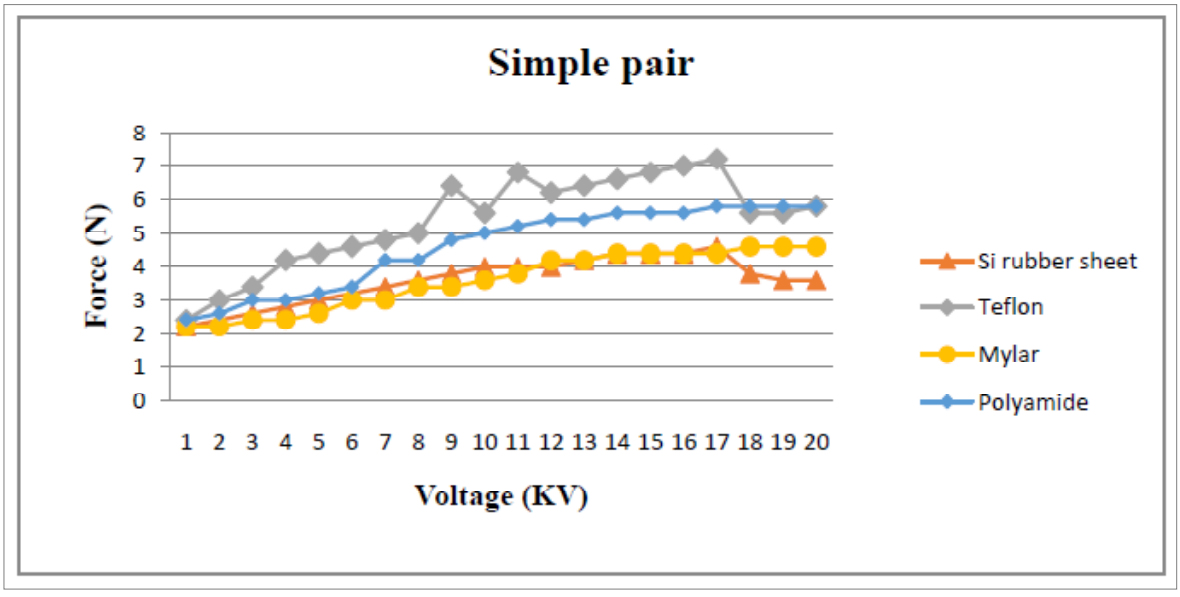


Fig. 2: Test Results for Different Insulating Material for Comb and Simple Electrode Based Design Samples (*Contd*.)

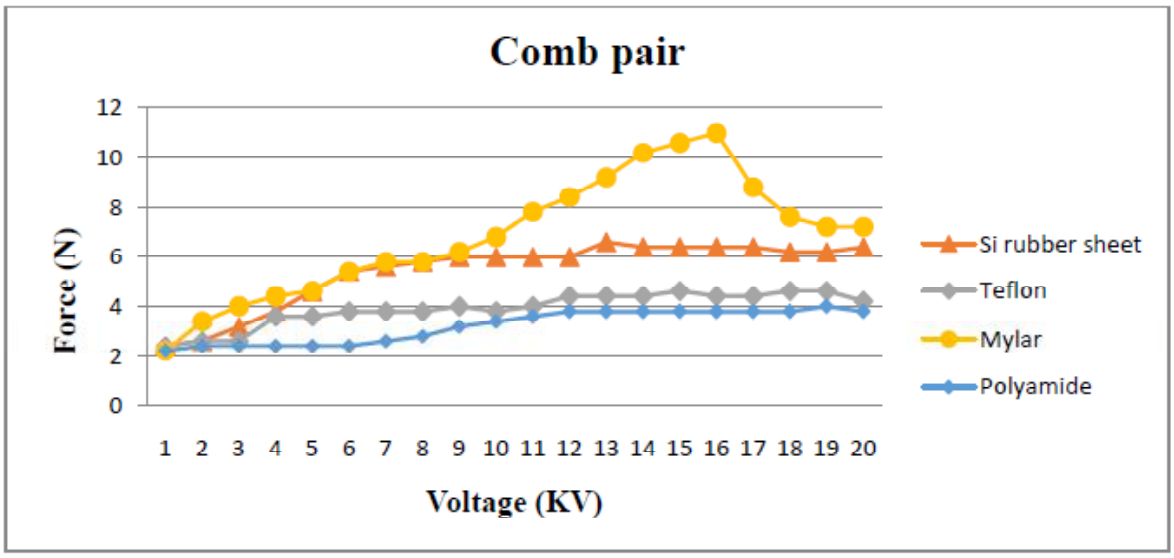


Fig. 2: Test Results for Different Insulating Material for Comb and Simple Electrode Based Design Samples

Uniform Dirt distribution and dirt detection test for sensor development:

Experiments have been carried out to devise a methodology for detecting dirt using Photo diode and LED, to be incorporated within the cleaning mechanism. Experimental set-up using Trapezoidal chamber with fans for dust circulation as shown in Fig. 3 has been developed for the uniform dirt distribution over the glass slabs and Fig. 4 shows uniformly distributed dirt samples (glass) in ascending order for testing.

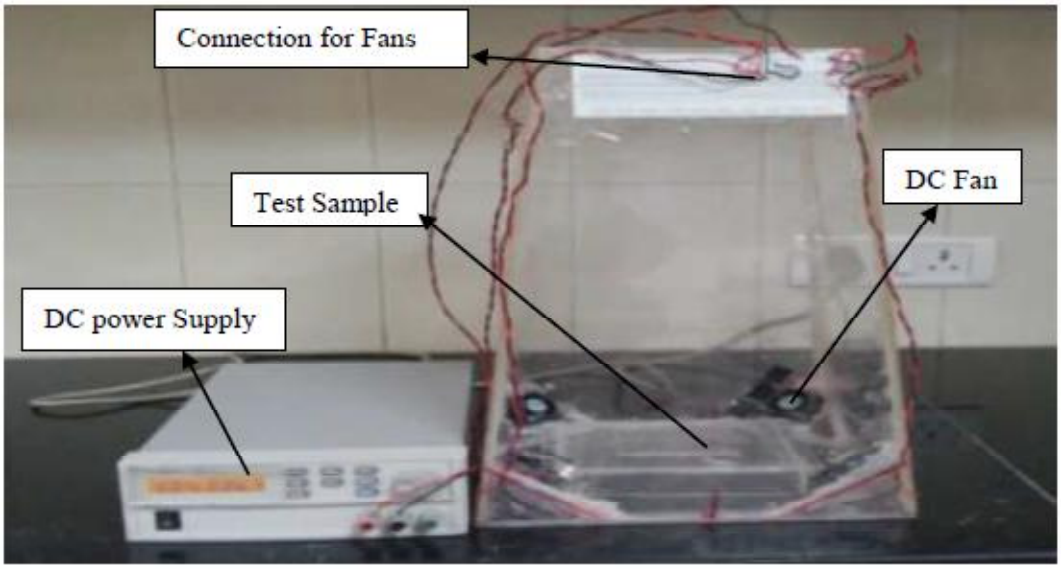


Fig. 3: Experimental Set-up for the Uniform Dirt Distribution

Laboratory testing of dirt detection by IR photo diode sensor was carried out by comparing its output voltage for different glass slabs with varying dirt level. In order to obtain maximum output from the dirt sensor, the optimal position (H, d, θ) of IR photo diode (PD) and IR LED with respect to glass sample has been evaluated from the experiments. As seen from the Fig. 5(a) & Fig. 5(b), H is height for both IR LED and IR PD from the glass sample, d is the gap and θ is the angle between IR LED and

Fig. 4: Uniformly Distributed Dirt Samples (Glass) in Ascending Order for Testing

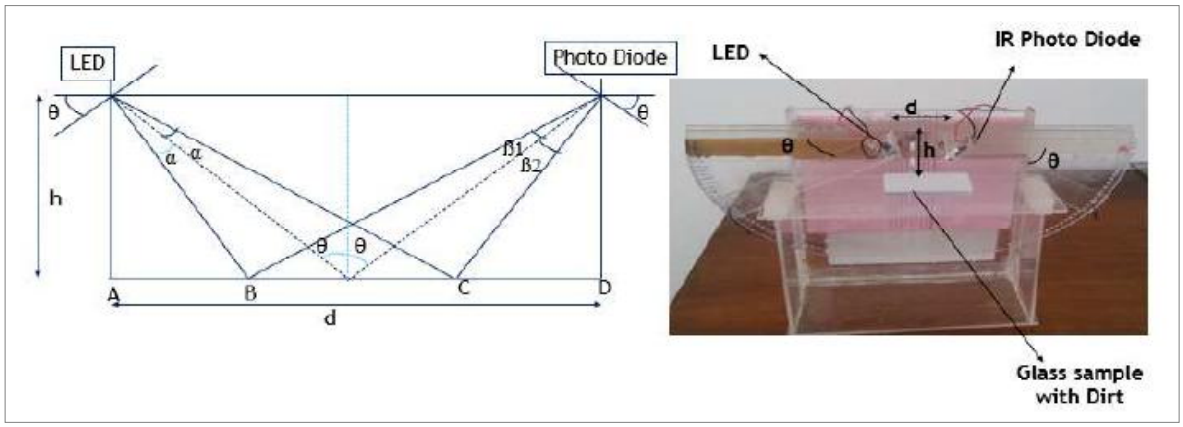


Fig. 5: (a) LED & Photo Diode for Dirt Detection

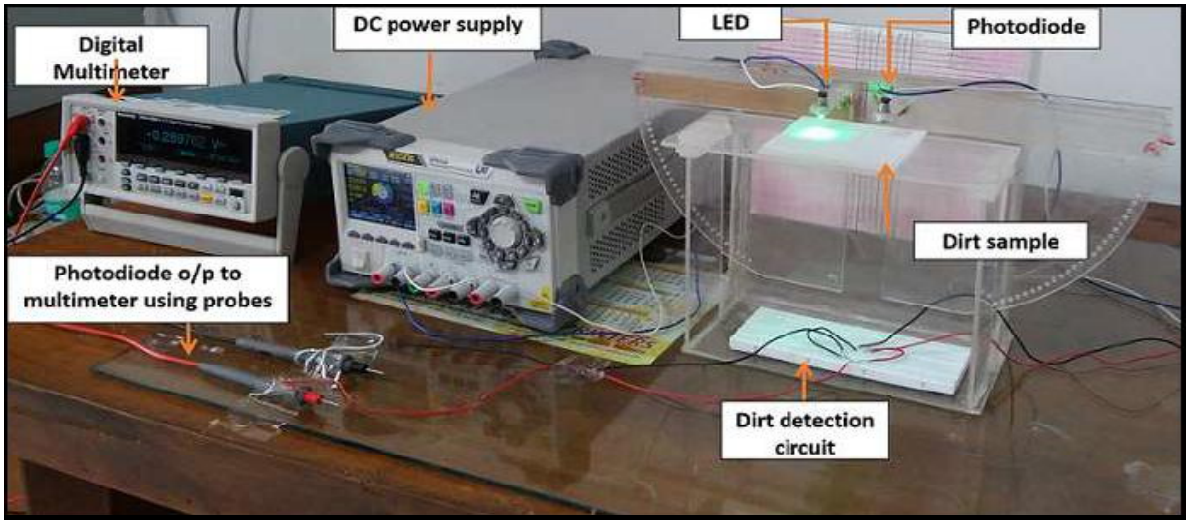


Fig. 5: (b) Experimental Setup for Dirt Detection

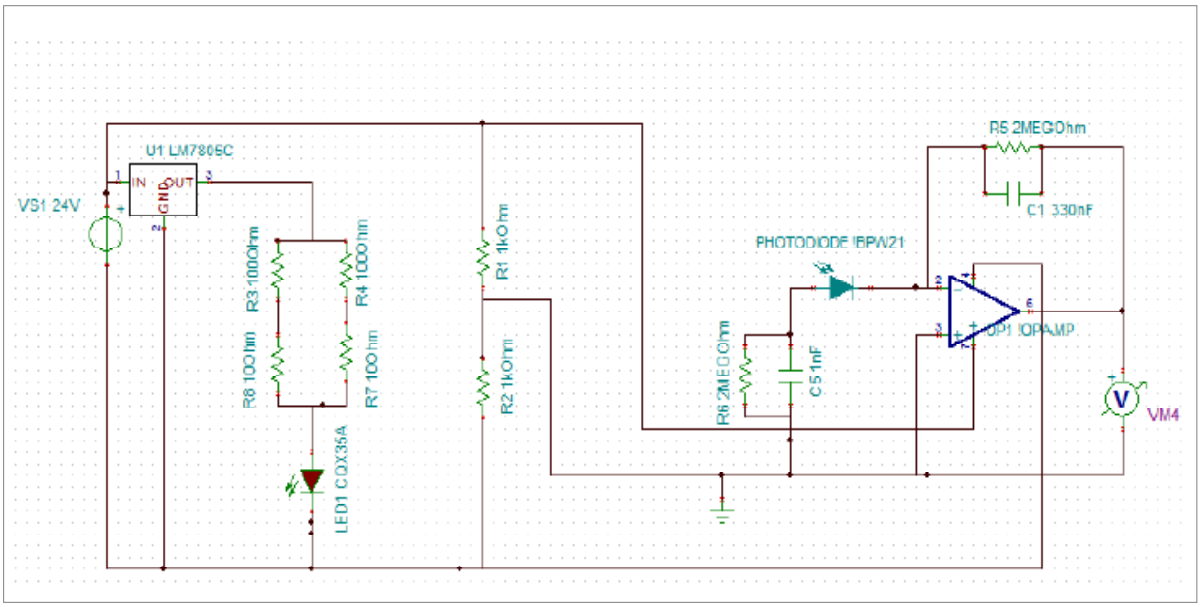


Fig. 6: Circuit Diagram for Dirt Sensor

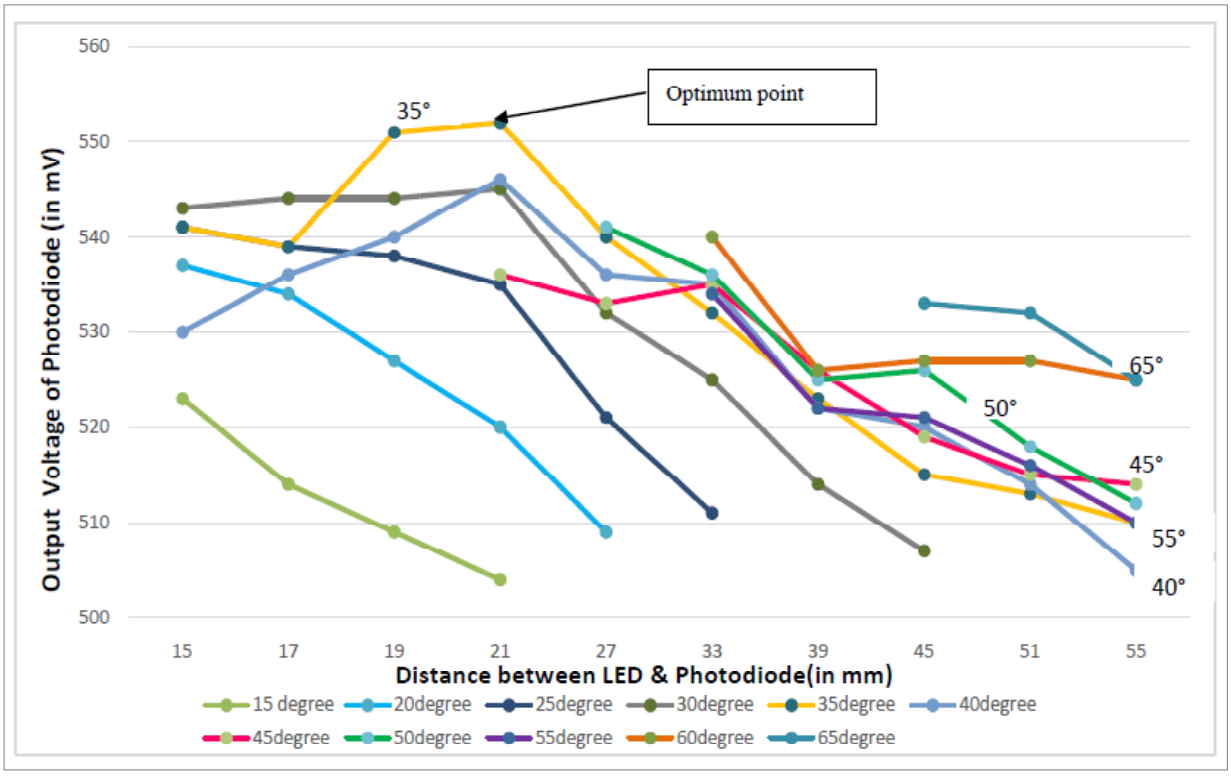


Fig. 7: Experiments for Optimal Position of IR PD and IR LED with respect to Glass Samples

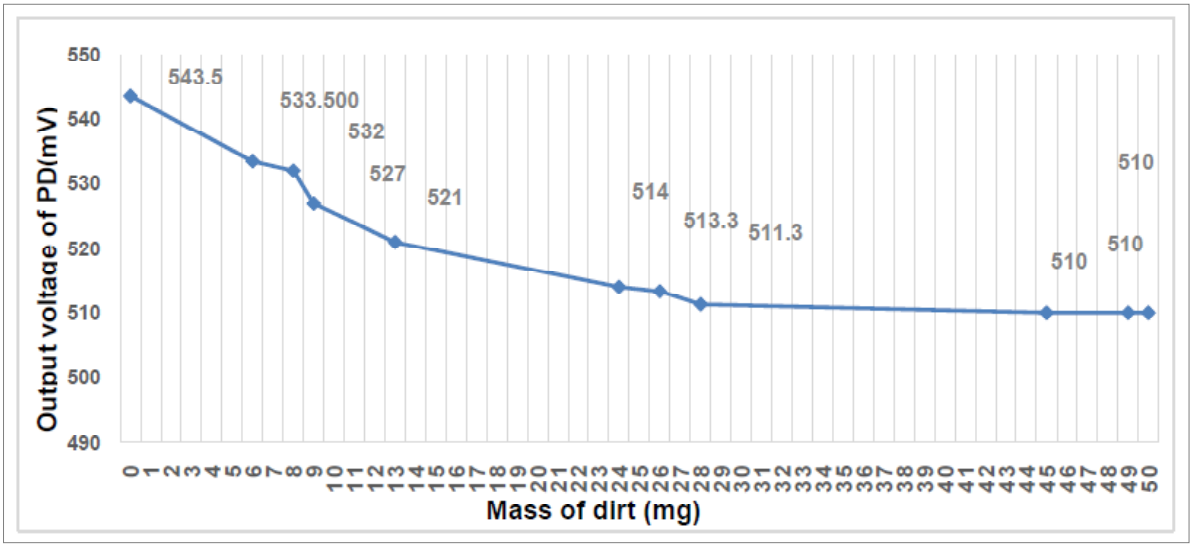


Fig. 8: Test Results for Different Dirt Samples

IR PD, respectively. For IR LED (viewing angle = 20˚) and IR PD(acceptance angle = 40˚) pair, the optimal position is (15 mm, 21 mm, 35˚) evaluated from the experiments as shown in Fig. 7. The circuit diagram for the experiments is shown in Fig. 6.

The test results have been evaluated and the variation of output voltage of IR PD with respect to mass of dirt has been measured. Experimental results are shown in Figure 8 for different dirt distributed glass slabs. As dirt increases, output voltage decreases and stabilizes (510 mV) after a particular amount of dirt (approximately 45mg.).

Network Projects

CSIR-CBRI as a Participating Laboratory

Network Projects

CSIR- CBRI AS A PARTICIPATING LABORATORY

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

PI: S. Maiti
[CSIR-NEERI, "Clean Water: Sustainable Options"]

Estimation of Crustal Deformation of Garhwal Himalaya.

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

Energy Efficient Seed Storage Structures.

PI: 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: Ajay Chourasia
[CSIR- CIMFR, Dhanbad]

Service Robot for Building and other Structures.

PI: Ravindra S. Bisht
[CSIR-CMERI, Micro Machines and Robotics]

CSIR Knowledge Gateway & Open Source Private Cloud Infrastructure.

(KNOWGATE),
PI: S. K. Senapati
[CSIR-NISCAIR, New Delhi]

Removal of Heavy Metals from Waste Water using Fly ash & Secured Disposal of the Sludge (ESC-0306)

S. Maiti & A. K. Minocha

Coordinating Lab: CSIR-NEERI

Participating Lab: CSIR-CBRI

Objective: Main objectives of this project are

- 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.

A packed bed reactor of 7 liter capacity was designed and fabricated. This reactor was used for removal of metal ions from waste water using fly ash as an adsorbent material. The calculated adsorption capacity of fly ash for copper, cadmium, zinc and nickel were 1.9, 3.6, 2.25 and 0.8 mg/g respectively. The adsorption capacity of this fly ash was compared with the adsorption capacity of different fly ash and shown in the table 1. The results indicate that this fly ash could be used as a potential adsorbent for removal of this metal ion.

Table 1: Metal uptake capacity of Renusagar fly ash

Metal uptake (mg/g)	Temp (°C)	Reference
Copper		
0.4-1.9	30	This study
0.63–0.81	25	Lin and Chang (2010)
Zinc		
1.2-2.25	30	This study
0.25-2.8	20	Bayat (2002)
Chromium		
0.66-1.1	30	This study
1.38	30-60	Banerjee S.S. et al., (2004)
Cadmium		
2.8-3.6	30	This study
18.98	25	Papandreou A. et al., (2007)
Nickel		
0.4-0.8	30	This study
3.9	25	Ricou P. et al., (1999)

- An integrated adsorption-solidification/stabilization process was developed for fixing and immobilizing the metal loaded fly ash. To assess the possibility of using the metal-laden fly ash as a construction material, the cement-fixed metal-laden fly ash product was tested for compressive strength and metal leach ability. The addition of metal loaded fly ash increased the initial and final setting times of cement. Figure 1 demonstrates the compressive strength of mortar as a function of percentage of zinc loaded fly ash in cement. Blank sample has maximum compressive strength. It is clear from these figures that compressive strength of the stabilized product decreases slightly with increasing the metal content in the cement. This can be explained by following points:-
- Portlandite formed during cement hydration, reacts with metal ion and produce low solubility

$$C_3S + H_2O \longrightarrow C\text{-}S\text{-}H + Ca(OH)_2$$
$$Zn(OH)_2 + 2OH^- \longrightarrow 2H_2O + ZnO_2^{2-}$$
$$ZnO_2^{2-} + Ca(OH)_2 + H_2O \longrightarrow Ca(Zn(OH)_3)_2.\ 2H_2O$$

complex $Ca(Zn(OH)_3)_2$. Thus, hydration of cement affected and less amount of calcium silicate hydrate gel forms and compressive strength decrease.

- When zinc salt added to the Portland cement and fly ash, zinc ions precipitated as hydroxides and dispersed in the matrix of C-S-H which is responsible for compressive strength. These zinc ions trapped in the C-S-H pores during solidification and retard the hydration process. Thus, compressive strength decreases on increasing the amount of zinc salt in cement mixture.
- But the compressive strength of cement mixture increases with increase in the curing period because of increase in the hydration process.

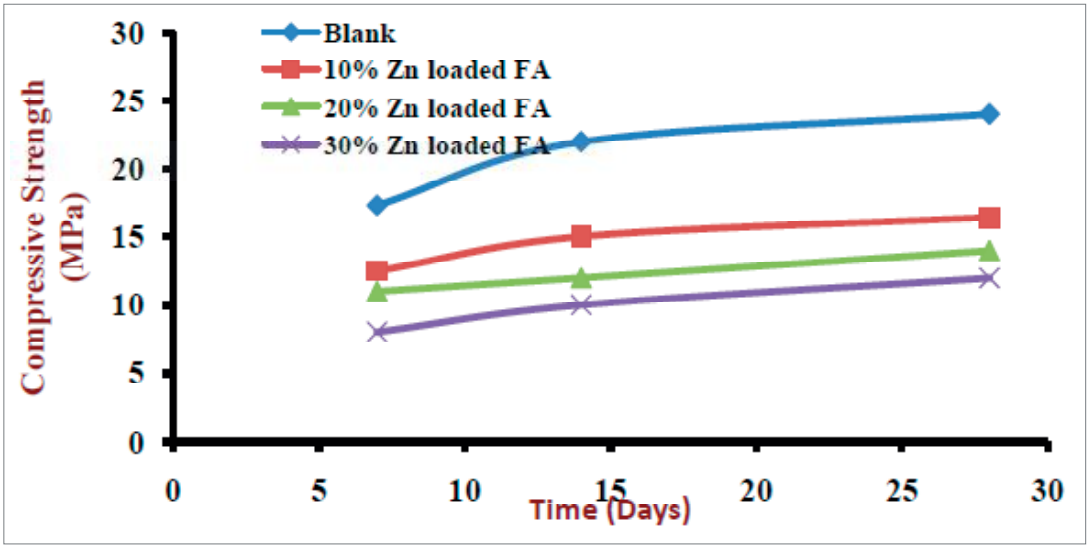


Fig. 1: Permanent GPS Station at CSIR-CBRI

Since the building materials produced in this process contains potentially hazardous heavy metals, it is very much essential to evaluate the effectiveness of cement fixation by leach ability test. The leach ability test was carried out by ASTM extraction D3987-85 method. The particles used in the ASTM extraction were passed through a No. 6 sieve (0.333 cm) and retained on a No. 16 sieve (0.119 cm). The solution pH was kept constant at 5.0 + 0.2 by adding acetic acid (1 N). The samples were vigorously agitated (170 RPM) on a shaker for 24 hr; then, a 10-mL sample was taken and filtered through a 0.45 µm fiber filter paper.

The amount of metal leached was determined by measuring its concentration in the Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES, Model: Prodigy XP) and presented in table 2.

Table 2: Results of Metal Leaching Test by the USEPA Method

	Fly ash mortar		Metal laden fly ash mortar	
Fly ash (%)	Zn leached (ppm)	Cd leached (ppm)	Zn leached (ppm)	Cd leached (ppm)
0	0.01	BDL	0.01	BDL
10	0.04	BDL	0.11	< 0.01
20	0.05	BDL	0.56	< 0.01
30	0.05	BDL	0.71	< 0.01
BDL: Below detectable limit				

The leaching behaviors of these metals in the S/S waste materials were mainly controlled by the alkaline nature and acid buffering capacity of the S/S matrix. During the progressive toxicity characteristic leaching procedure tests, the alkaline conditions and acid buffering capacity of the matrix decreased with the dissolution of calcium hydroxide and C–S–H, therefore, the leaching of heavy metals in the S/S waste materials increased. Compressive strength and leaching test results suggest that metal-laden fly ash can be considered for use in secondary construction materials.

Effect of metal ion concentration on compressive strength as well to setting time can be further explained by XRD study. The graphs obtained by the XRD analysis of the blank & sample containing zinc ions are presented in figure 2 & 3 respectively.

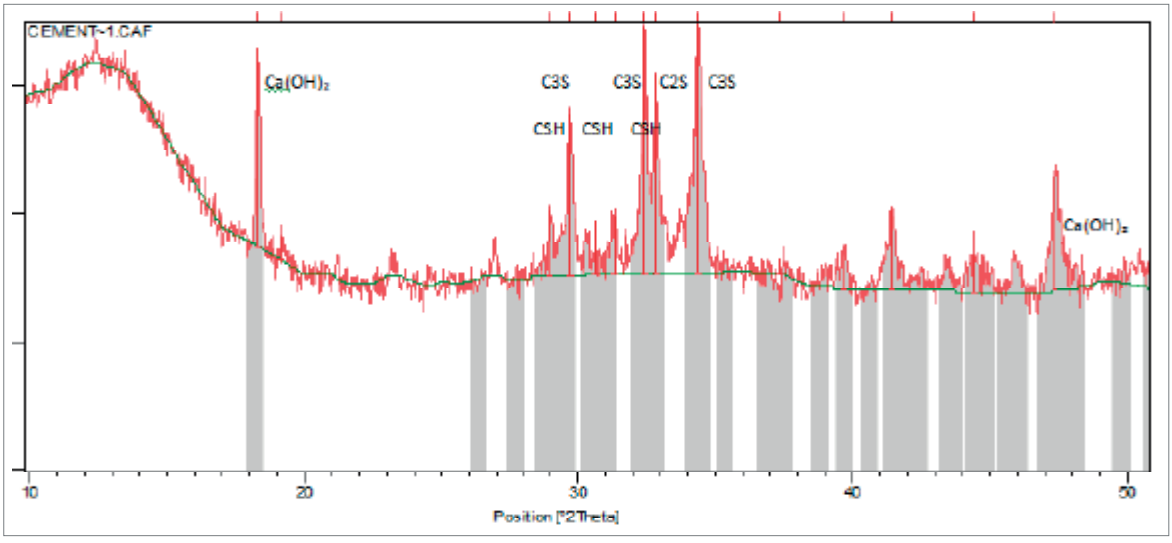


Fig. 2: X-Ray Diffractogram of Pure Cement Sample on 28 Day of Curing

It is observed that peaks of Ca $(OH)_2$ are obtained at 2 theta of 18^0 and 47.3^0 and peaks of C_3S and C_2S are obtained at 2 theta of 29.5^0,$32.6^0$and 34.5^0. Peak of $Ca(OH)_2$ is obtained has high intensity in hydrated cement in comparison to intensity of $Ca(OH)_2$ in mixture of cement and zinc. A peak of Calcium silicate hydrate also obtained at 32.05^0. Peak of C-S-H and $Ca(OH)_2$ are obtained because of the reaction of calcium silicates with water. It is clear from the figure 2 that the intensity of peak of cement hydration product $Ca(OH)_2$ decreased due to formation of the $Ca(Zn(OH)_3)_2$. Compressive strength, leaching test and XRD analysis results suggest that metal-laden fly ash can be considered for use in secondary construction materials.

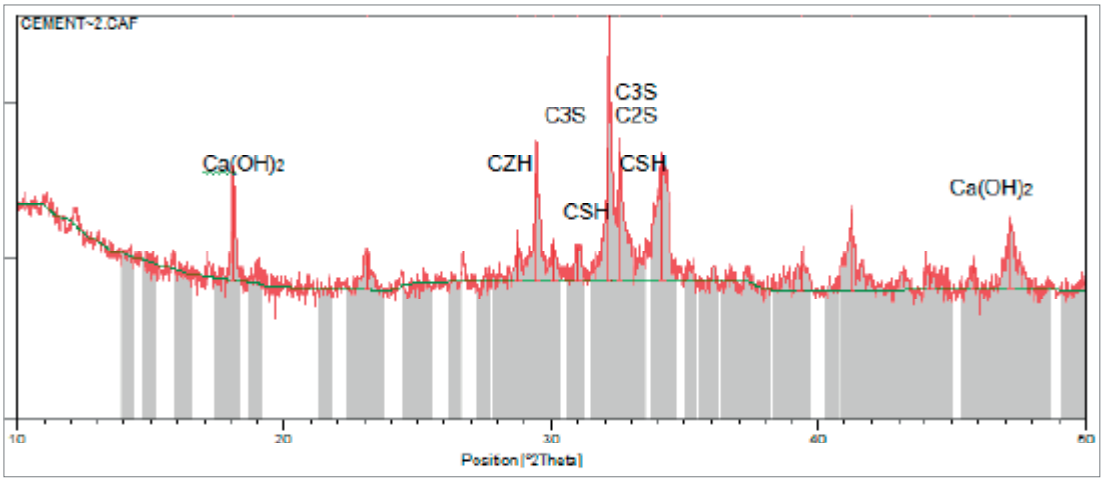


Fig. 3: X-Ray Diffractogram of Cement Sample containing 1000 ppm of zinc at 28 Day of Curing

Estimation of Crustal Deformation of Garhwal Himalaya (ISC-0301)

S. Sarkar & Team

Coordinating Lab: CSIR-4PI

Participating Lab: CSIR-CBRI

This project is one of the Tasks of the Work Package on "Data Intensive Research for Earthquake Hazard Assessment by Modelling the Solid-earth (DREAMS)" under 12th five year plan project, co-ordinated by CSIR-Four Paradigm Institute, Bangalore. The main objective of the project is the estimation of the ongoing tectonic deformation of Garhwal Himalayas by establishing a real time GNSS network.

A permanent GPS station has been installed at CSIR-CBRI. GPS data are being collected in a continuous mode throughout the year & transmitted to 4PI for analysis.

Fig. 1: Permanent GPS Station at CSIR-CBRI

Collection of GPS data in campaign mode at several locations in Garhwal Himalaya has been initiated. These locations are Pipalkoti, Auli, Malari, Tungnath, Sukki, Chamba and Lansdown. The data are being collected from these campaign stations. The newly setup GPS campaign station at Pipalkoti is also being used as a reference station for monitoring a nearby landslide.

Fig. 2: Locations of GPS Campaign Stations of CSIR-CBRI &CSIR-4PI in Garhwal Himalaya

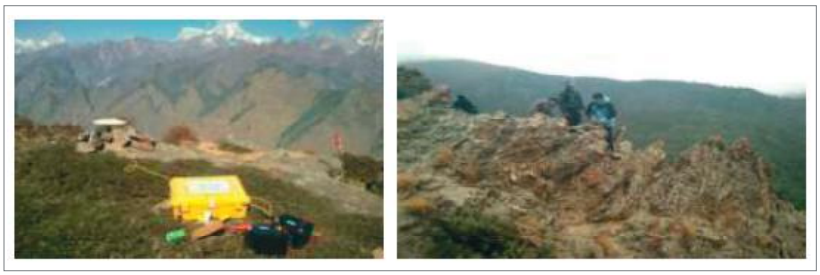


Fig. 3: GPS Data being collected at Auli & Malari Campaign Stations near Joshimath

The Time-Series data of CBRI is being analysed with International GNSS Service Stations which are Bangalore, Hyderabad, Uzbekistan, Lucknow, Lhasa, Port Blair and Kyrgyztan.

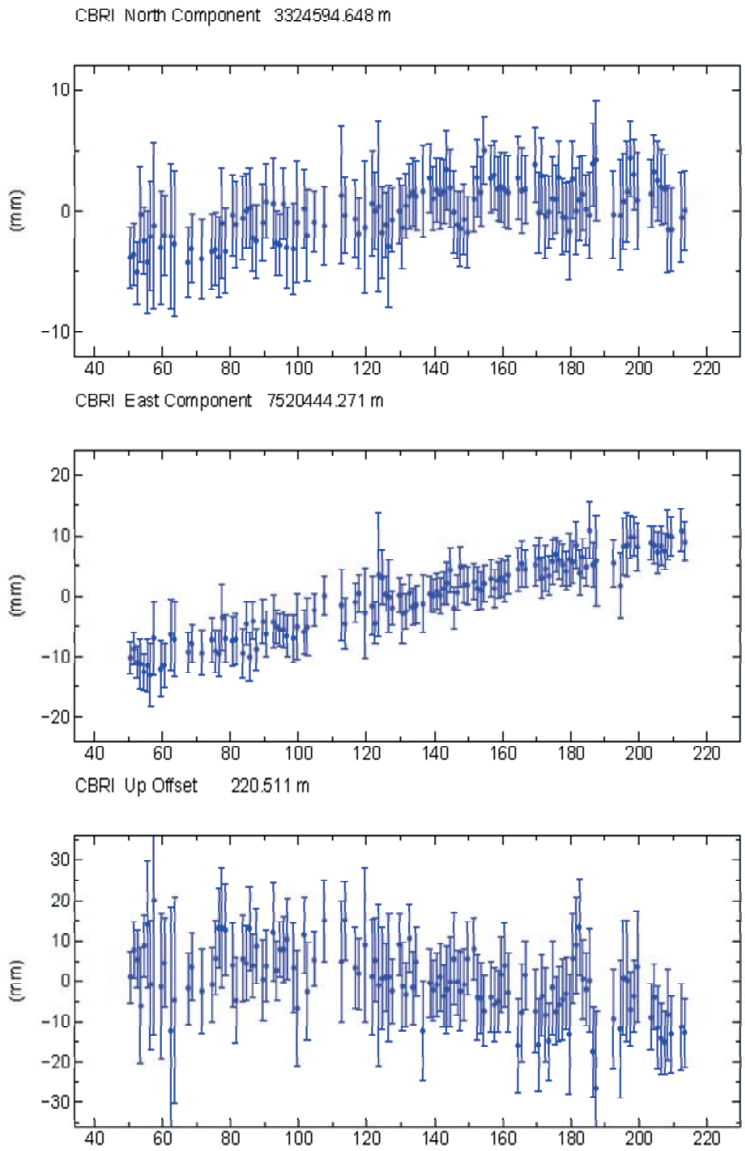


Fig. 4: Time Series Data of CBRI GPS Stations

Energy Efficient Seed Storage Structures (PSC-0103)

Nagesh B. Balam

Coordinating Lab: CSIR-CSIO

Participating Lab: CSIR-CBRI

Objective: To develop energy efficient seed storage structure with controlled environment to avoid spoilage and deterioration of quality of seeds.

Seed Storage Criteria:

- Temperature
- Relative Humidity
- Moisture content of the seed
- Seed Respiration rate
- Illumination
- Effect of Fungi, bacteria and other pests

The lower the temperature and relative humidity the longer the seeds can be safely stored.

Roof Insulation cooling technique to reduce indoor temperature of seed storage structures:

The passive cooling technique provides comfortable conditions in a room through natural means. Generally roof temperature is higher than the other parts of room, hence the heat gain through the roof will be higher, which constitutes 70% of the total heat gain. So, to reduce the indoor temperature of seed storage structure, roof insulation passive cooling strategy is adopted in which a sheet of thermal insulating material (e.g. thermocol sheet, GI sheet etc.) was imposed above the roof with some air gap between them. By varying air gap between roofs and insulating material sheet, variation in indoor temperature was analyzed.

Fig. 1: (a) Experimental Room

Fig. 2: (b) Arrangement of Insulation Sheet above the Roof

Analysis of roof insulation cooling strategy:

1. By using thermocol sheet for insulation, effect on indoor temperature is shown below

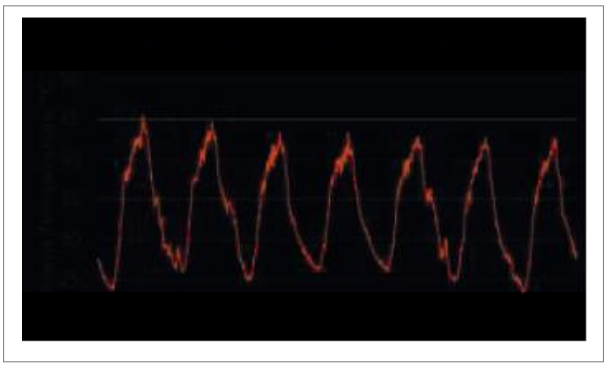


Fig. 2: (a) Ambient Temperature from 6th to 12th June

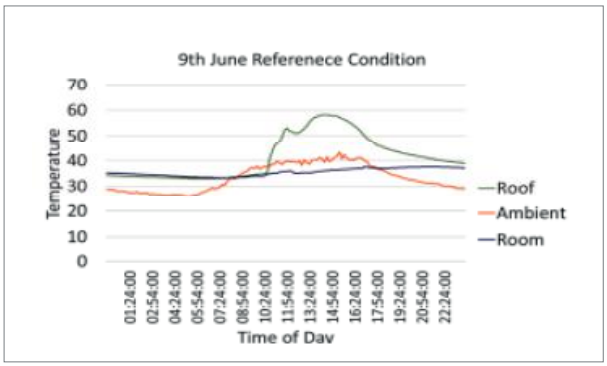


Fig. 2: (b) Hourly Variation in Roof, Room and Ambient Temperatures without Insulation

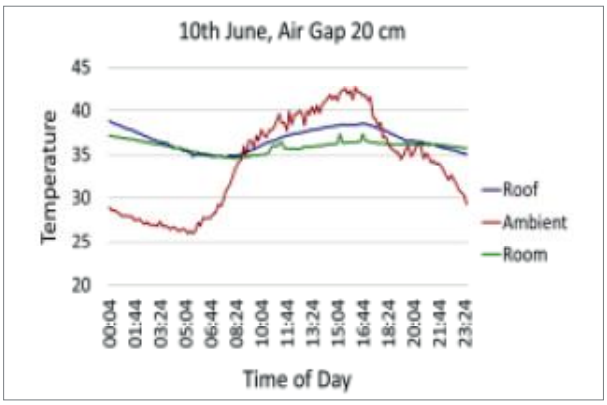


Fig. 3: (a) Temperature Variation with the Air Gap of 20 cm

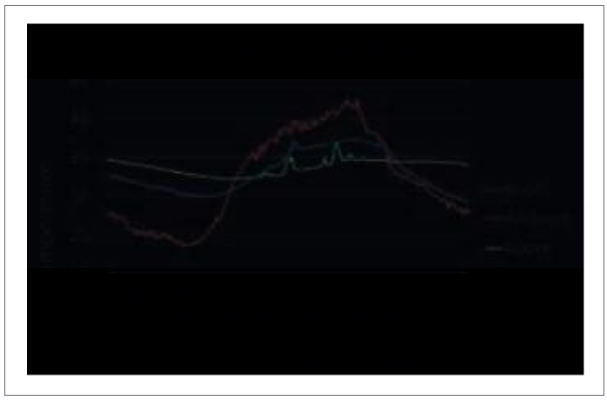


Fig. 3: (b) Temperature Variation with the Air Gap of 36 cm

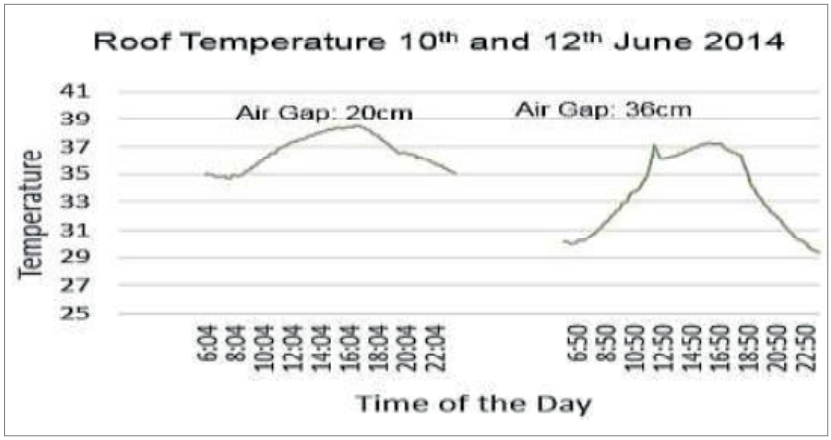


Fig. 4: Comparison of Room Temperatures with the Air Gap of 20cm and 36cm

From the Fig. 4 it is concluded that increasing the air gap increases the cooling rate of roof during nights.

1. By using GI sheet for insulation effect on indoor temperature is shown below

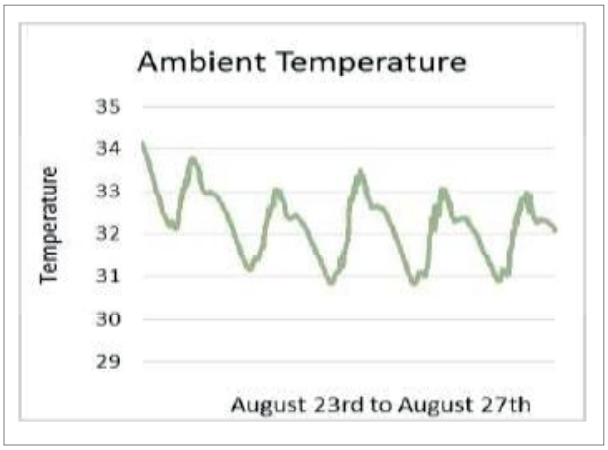


Fig. 5: (a) Ambient Temperature from 23rd to 27th August

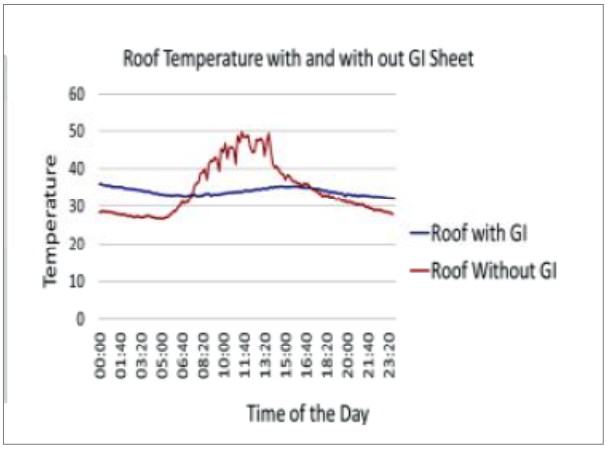


Fig. 5: (b) Hourly Variation in Roof Temperature with and without GI Sheet

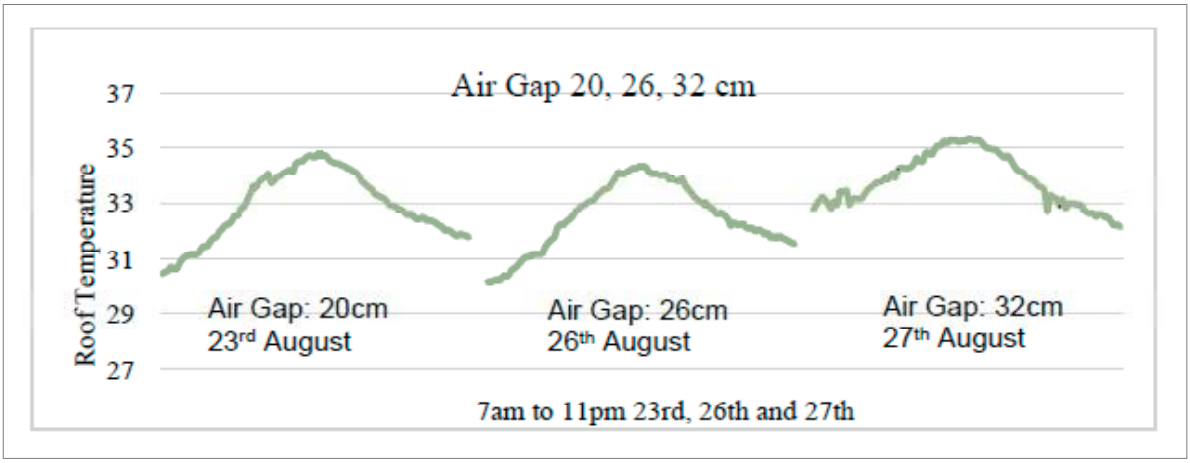


Fig. 6: Comparison of Roof Temperatures with the Air Gap of 20cm, 26cm and 32cm

Inferences:

- Double deck roof can reduce roof temperatures by 15 to 20 °C and room temperatures by 3 to 4 °C
- Heat transfer in Insulated sheets is by convection and in GI sheet it is both by convection and conduction.
- GI sheets are more effective for nocturnal ventilation than EPS insulated sheets.
- Increasing the air gap increases the cooling rate of roof during nights.
- An optimized air gap for metallic sheets is approximately 25cm above which the air gap does not significantly reduce the roof temperature.

Development of Artificial Pillars for Optimal Extraction of Locked-up Coal [ESC-0105]

Ajay Chourasia & Team

Coordinating Lab: CSIR-CIMFR

Participating Lab: CSIR-CBRI

The primary objective of underground coal mining is to extract maximum coal from the developed panels without threatening structural safety of surface features like buildings and roads, and underground structures like coal pillars. A reduced size of the supporting coal pillars increases coal productivity, but in consequence, enhances probability of failure of pillars mainly by crushing due to overburden load of the rock strata. Therefore, it would be appropriate to refill the extracted voids by suitable means/ materials.

Accordingly, Self-compacting geo-polymer (SCG) concrete suitable for pumping is attempted from criterion on strength and rheology. Nine trial batches of concrete mix were proportioned with the adjustment of the ingredients in terms of powder content, sand-coarse aggregate ratio, and rheology modifiers. The mixes comprised of binder content, 395-418 kg/m^3 ; coarse aggregate 764-847 kg/m^3 ; fine aggregate 747-880 kg/m^3; activator 271-299 kg/ m^3; HRWRA 16-25 kg/m^3 ; Modifier 0.39-1.04 kg/ m^3 and hardener 1.9-4.16 kg/m^3 . Activator-binder ratio in the mix was kept between 0.6 and 0.85. The workability of these mixes was evaluated on the basis of filling ability (slump flow test & V-funnel test), passing ability (J-ring test & L-box test) and segregation index (column test). It was observed that the slump flow of mixes varies from 500-743 mm. The difference between J-ring flow and slump was 11 to 68.5mm. The blocking ratio changed between 7 and 11. According to the requirements of specification, the mixes were screened. The finalized mixes exhibited slump flow in the range of 687 to 742 mm and T_{50} from 5-9 sec which satisfied the recommended range (650-800 mm). No segregation was observed. In V-funnel test, the mixes showed flow time of 8-12 sec which meets the acceptable criteria. During J-ring test the blocking ratio was ~8 which are below the permissible limit. The flow ranged of 8.5-23. These values are well below the required value of specification (EFNARC 2002). L-box test was also carried out to assess the passing ability of mixes. It was observed that blocking ratio of mixes was found to be 0.88-0.94. T_{20} and T_{40} value of mixes were in the range of 2.5-4 and 7-14 respectively. Figure 1 show the various tests performed on developed SCG concrete. The column segregation test of mixes was carried out according to ASTM C-1610 by measuring the coarse aggregate content in the top and bottom portions of a cylindrical specimen. The percentage segregation was about 2-3% showing good stability of mixes.

(a) Slump Flow Test (b) V-Funnel Test (a) J-Ring Test (d) L-Box Test

Fig. 1: Various test performed on developed SCG concrete

The concrete was cast by mixing dry and wet ingredients in the pan mixer and then filled into 150mm x 150mm x 150mm cubes, cylinders (150mm x 300mm) and prisms (100mm x 100mm x 500mm). The hardened properties of finalized mixes such as compressive strength, splitting tensile strength, flexural strength, modulus of elasticity and bond strength with reinforcing bars were determined. The compressive strength of mixes was in the range 25-35 MPa. The modulus of rupture was ~3 to 4 MPa. The splitting tensile strength was ~3 to 5 MPa. The bond between concrete and reinforcing bar was 6-8 MPa. Drying shrinkage of mixes was ~3.608 x 10^{-3} micro strain at the end of 3 months. Durability studies and pump ability characteristic are under progress.

Robotic Technology for Periodic Inspections of Civil Infrastructures (ESC-0112)

Ravindra Singh Bisht & Team

Coordinating Lab: CSIR-CMERI

Participating Lab: CSIR-CBRI

Objective:

a. To design and develop a service robot with manipulator for precise inspection of desired surface of the civil structure
b. The precise inspection will be carried out by vision and NDT sensors mounted on the service robot

Progress Highlights/ Significant Achievements:

Vacuum gripper as an adhesion mechanism has been chosen for its performance testing under different vacuum level and actuator speed. Experimental set-up using Motorized test stand with digital force gauge was used to measure the axial force generated along the axis of adhesion mechanism. Further design calculations have been made using numerical simulations and experimental results. The CAD model for proposed robot is given in Figure 6 and tentative specifications are shown in Table 1.

Experimental Testing of Vacuum Gripper:

Laboratory experiments have been performed for axial force generation by the vacuum gripper under different vacuum levels which has a geometrical diameter of 50 mm. Vacuum level inside the gripper is controlled through the flow regulated valve of FRL unit. Air compressor is used for the air supply to the vacuum generator. As seen from the Fig 1, 2, 3 generated force form the test results by the vacuum gripper is increasing as we increasing different vacuum level (100 mbar, 200 mbar, 300 mbar, 400 mbar, 500 mbar, 600 mbar and 700 mbar), and different pulling speed of the motorized test stand actuator (25 mm/min, 50 mm/min, 75 mm/min, 100 mm/min, 75 mm/min, 150 mm/min).

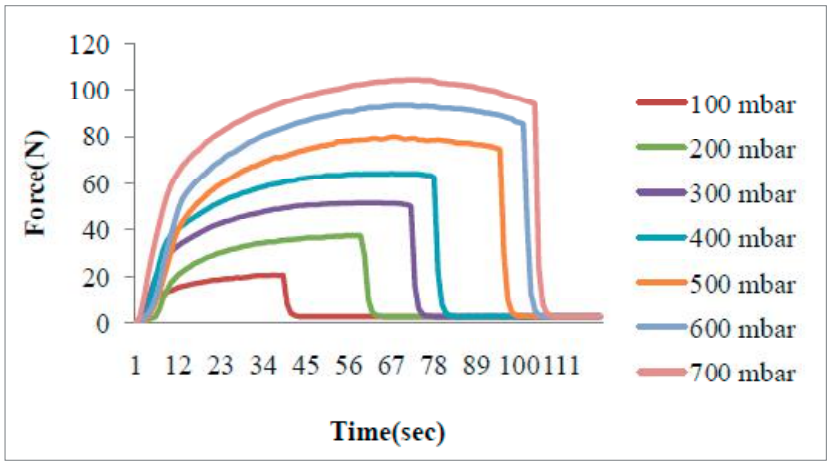


Fig. 1: Pneumatic Force Characteristics under Different Vacuum Level (50 mm/min Pulling Speed, Surface = Smooth Concrete Surface)

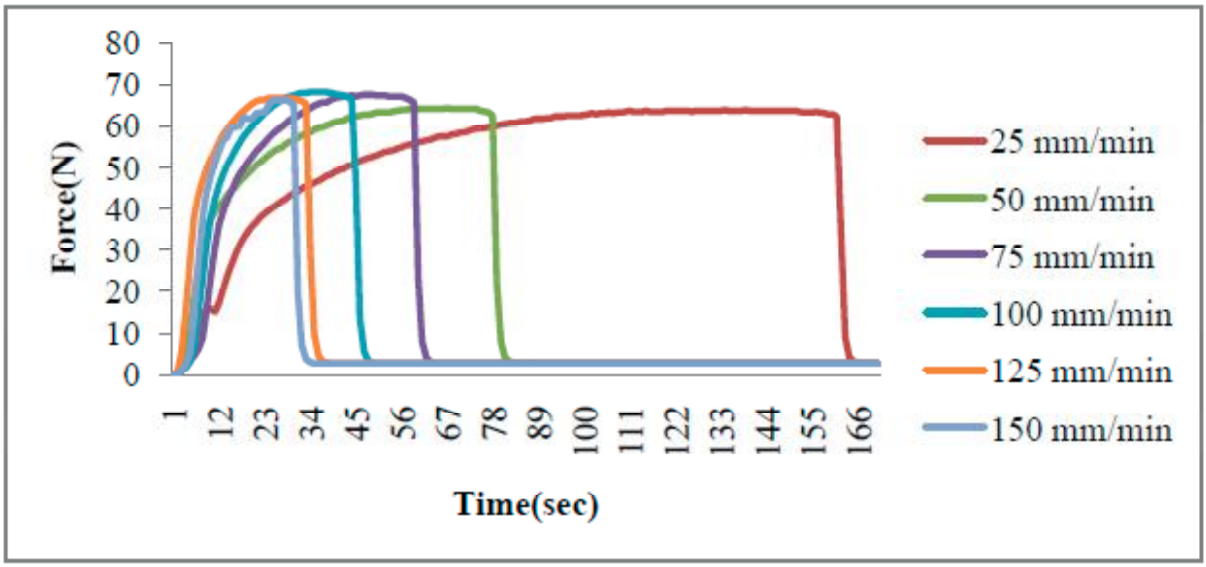


Fig. 2: **Pneumatic Force Characteristics under Different Pulling Speed of Actuator (400 mbar Vacuum Pressure, Surface = Smooth Concrete Surface)**

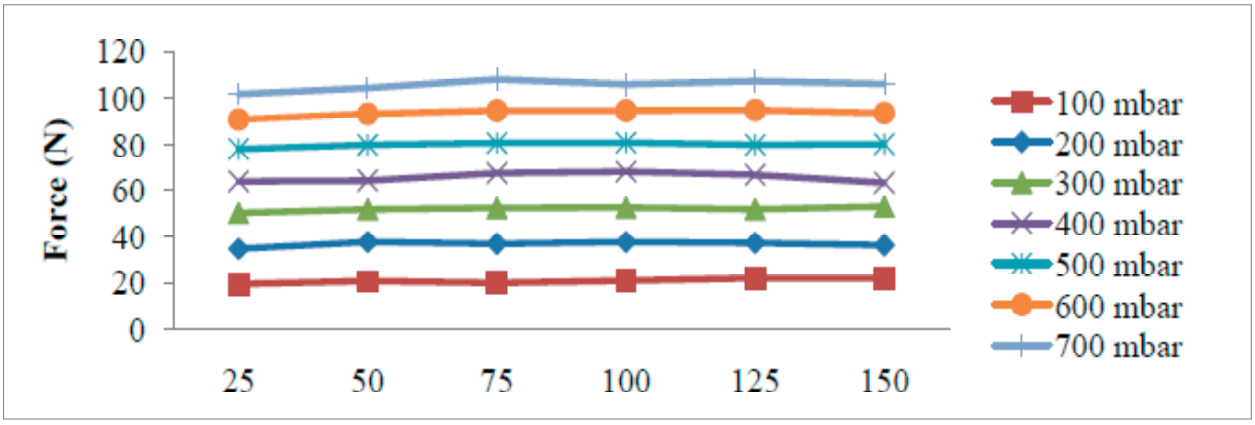


Fig. 3: Pneumatic Force Characteristics under Different Vacuum Level and Actuator Speed (Surface = Smooth Concrete Surface)

Modelling and simulation of vacuum gripper:

The deformation behaviour of gripper under different vacuum levels was analysed using ABAQUS finite element software package. Computer aided design (CAD) of all the mechanical components for numerical simulation have been designed using Solid Works modelling software. Details of the assembly CAD model and axial deformations pattern of rubber vacuum gripper is shown in Fig 4 and Fig 5, respectively.

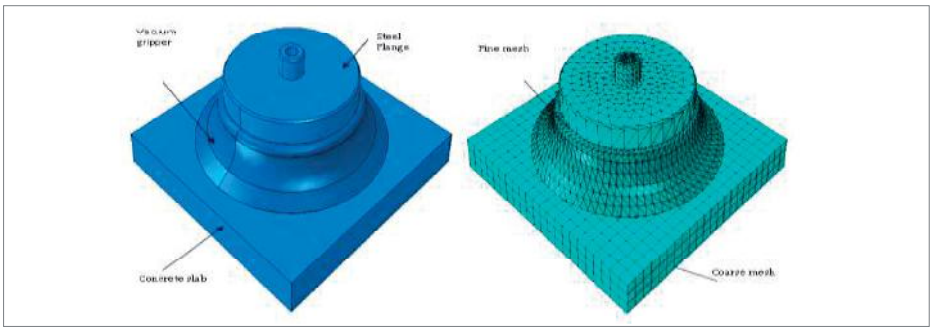


Fig. 4: Assembly CAD Model with Fine Meshed Vacuum Gripper used in Interface Contact Model with the Coarse Meshed Concrete Test Slab

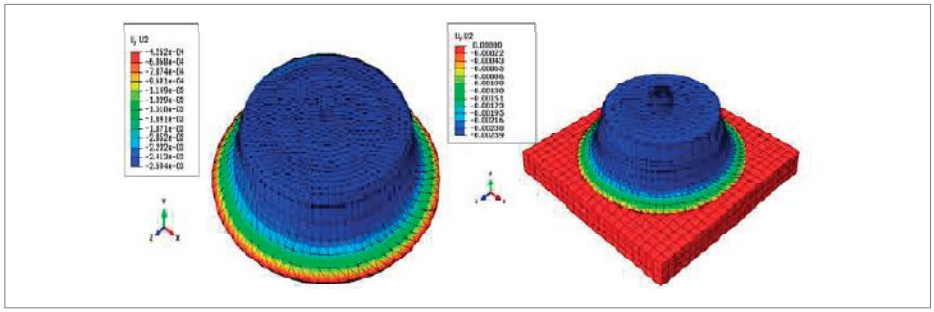


Fig. 5: Deformation of the Vacuum Gripper under Axial Loading for 400 mbar Vacuum Pressure

Table1: Tentative specifications of proposed robot

Fig. 6: Conceptual Design of Inspection Robot

Weight	10 Kg (Approx.)
Approx. Dimension	350 (L) X 300 (W) X 250 (H)
Locomotion unit	Tracked wheel, Driving motors
Adhesion unit	Pneumatic adhesion mechanism
Inspection unit	Acoustic impact sensor/Vision sensor
Control unit	On-board microcontroller, sensors, motor drivers
Communication unit	Wired/wireless communication
Power supply unit	LI-ION polymer battery bank
Purpose	Precise inspection of civil structures

CSIR Knowledge Gateway & Open Source Private Cloud Infrastructure (KNOWGATE) (ISC-0102)

S. K. Senapati & Team

Coordinating Lab: CSIR-NISCAIR

Participating Lab: CSIR-CBRI

CSIR Knowledge Gateway & Open Source Private Cloud Infrastructure (KNOWGATE) is one of the Net working Project (NWP) (ISC0102)of CSIR under 12th Five Year Plan of Information Science cluster as coordinated by the CSIR-NISCAIR, New Delhi (ISC0102). All CSIR labs are the members of the project. By virtue CSIR-CBRI is a member of the project.

This project has three following modules:

	Description
CSIRCloud	Capacity and Capability Building: CSIR Open Source Cloud Computing Infrastructure and Open Source Software Technology Solution Cell (OSSTSC)
CSIRCat	CSIR Distributed Library/Virtualized Union OPAC of CSIR Holdings, using Z39.50 protocol & Open Source Integrated Library Management Software
CSIRTrend	Multi-dimensional Analysis System (MDAS) -Extended information access for enabling excellence

Members of CSIR Laboratories have to be provided existing data of KRC for CSIRCat for centralizing union catalogue with single open sources software and PME data (Patents, research papers and developed technologies) for CSIRTrend for centralized multidimensional analysis. The converted data have to maintain at lab level as well as centralized level for accessing and retrieving data among the CSIR labs through cloud computing.

Completed Task (2014-15):

As per requirement of the project and direction of CSIR-NISCAIR the following task has been completed at CSIR-CBRI.

- Bibliographic data of books of CBRI-KRC has been converted into text form in different segment and sent to CSIR-NISCAIR.
- Operating software i.e. CentOS as well as KOHA (library management software)has been uploaded into server.
- Converted data of books has been verified and uploaded into server.
- Converted data of Bound Volumes has been verified and uploaded into server.
- PME data (paper publication/patents and developed technologies) sent to CSIR-NISCAIR on desired format.

R&D Projects

Development of Technology for Making Flooring and Wall Tiles using Kota Stone Waste

Rajni Lakhani & Team

This project has been sponsored by Department of Science & Technology (DST), New Delhi for utilizing dumped Kota stone waste for the development of value added products such as floor tiles, wall tiles and thermal insulated tiles/blocks.

An attempt has been made utilizing Kota stone slurry waste for the preparation of flooring tiles; as a replacement to sand. Light weight blocks have also been produced using this slurry waste. Different mix designs have been prepared by varying amount of waste, w/c ratio, weight of foam etc.

The trials are in process to get the optimized composition for the use of slurry waste in light weight blocks having density 800 Kg/m^3 & 1000Kg/m^3. The studies conducted for the characterization of mortar is as follows:

(i) XRD Studies

(a) Mortar base mixes after 90 days

XRD profiles of base mix of cement - sand - water (Fig.1) and cement - ksw – water (Fig.2) are shown.

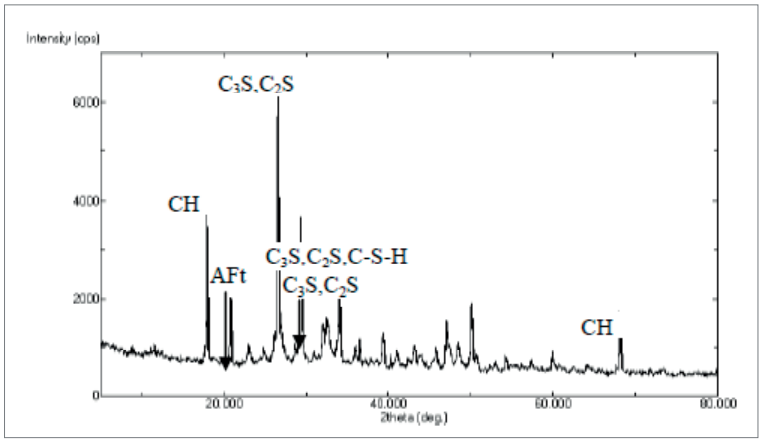


Fig. 1: XRD Profile of Mortar Base Mix (0% ksw).

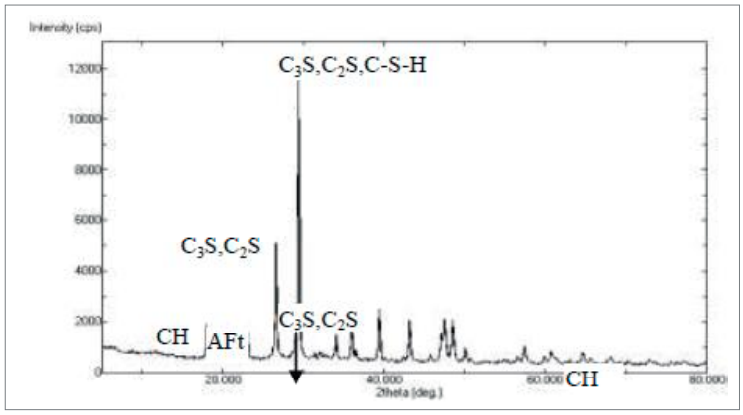


Fig. 2: XRD Profile of Mortar Base Mix having 100% ksw

From Fig. 1 & 2, it is clear that after 90 days:

1. Using ksw as 100% replacement of sand, less CH was remained after 90 days than that of 0% replacement because in long term calcium hydroxide was reacted with the amorphous SiO_2 from ksw to form the main cementing material C-S-H.
2. C-S-H formed in case of 100% replacement is more as compared to 0%.
3. The solution provide nucleation sites for deposition of CH and alumina silica hydrates, thus, hydration was accelerated.

(ii) SEM Studies

(a) ksw-mortar base mixes after 7 and 28 days

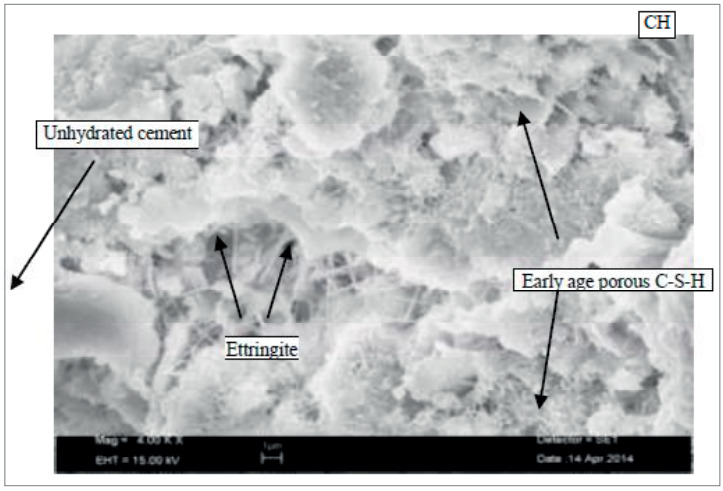


Fig. 3: SEM Micrograph of the hydrated Matrix of the ksw-Mortar Base Mix at 7 days.

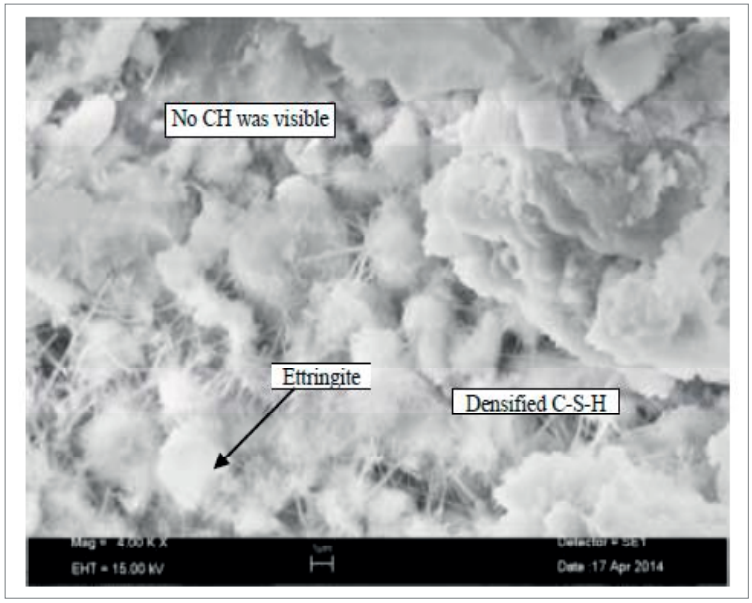


Fig. 4: SEM Micrograph of the hydrated Matrix of the ksw-Mortar Base Mix at 28 days.

1. Early age C-S-H i.e. porous C-S-H was formed at 7 days but, after 28 days it disappears and flattened, densified C-S-H was formed with gain in strength.
2. CH crystal was formed after 7 days but with age it disappears and its reaction by com bining with silica, C-S-H phase was came in feature as shown in Fig. 4
3. AFt phase was formed more with age i.e. the amount of ettringite was more at 28 days than that of 7 days. Because, ***Monosulfate*** tries to convert into ***Calcium monocarboaluminate Hydrate*** and ***Ettringite*** by reacting with ksslw.

THERMAL PROPERTIES

The thermal properties of CFC of block of density 1000 kg/m^3 and 800 kg/m^3 with 50% replacement of sand with ksslw are given below:

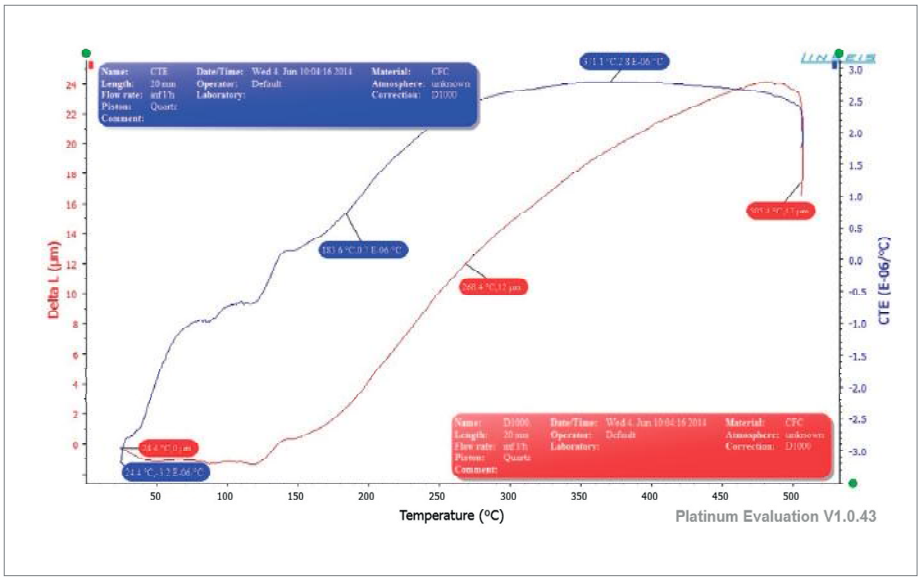


Fig. 5: Change in Length and CTE for CFC Block 1000Kg/m^3

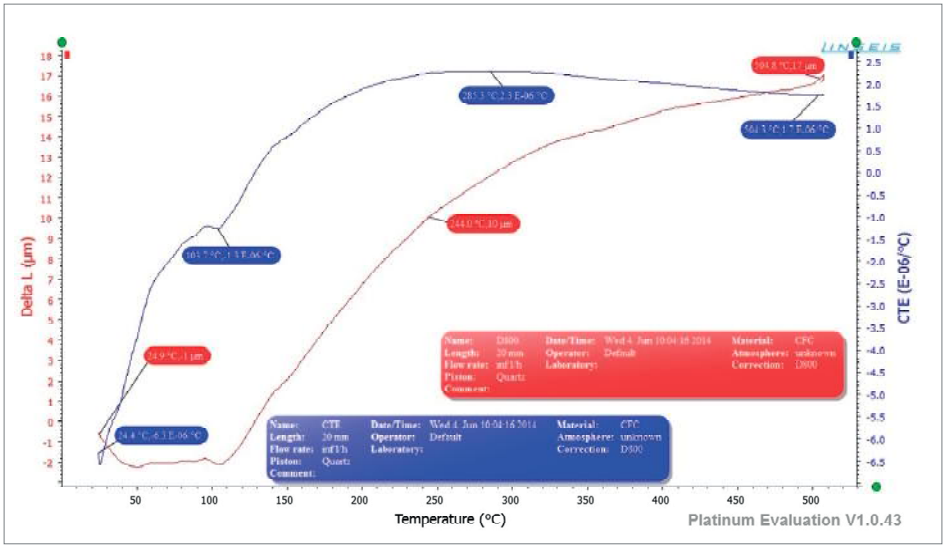


Fig. 6: Change in Length and CTE for 800 kg/m^3

Further work for CFC blocks is in progess.

Evaluation of Durability and Response of FRP Strengthened Reinforced Concrete Beams (OLP-0371)

Harish Chandra Arora

Introduction

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, labour 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 Fibre reinforced polymers (FRP) 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 in designing FRP structures as well as their utilization in repair and rehabilitation projects all over the world.

A large number of field application results where FRP has been used, are still awaited. Research work is continuing to assure the suitability of these materials under different loading and environmental conditions. Durability and long term performance of strengthened structures is a crucial element which governs the life-cycle cost of FRP applied reinforced concrete (RC) structures and 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 prove to be beneficial for construction and repair society. Getting test results through an extensive experimental research program by investigating the effects of different parameters on the long term performance aspects of FRP strengthened reinforced concrete structural elements are done. The project is directed towards characterization of FRP strengthened RC structural members with ongoing damages in terms of their durability, structural integrity and performance. Study is expected to contribute to guidelines for FRP-strengthened concrete members, to ensure better long-term performance under service loads and environmental effects.

Experimental Methodology

Earlier in this research program, concrete mix designs were carried out for two target strengths. Concrete beams were structurally designed for desired failures. For this study a number of RCC beam specimens of size 100mmx150mmx1220mm and 100mm x100mm x500mm and PCC beam specimens of size 100mmx100mmx500mm were cast. A sustained loading system was designed and installed for performing corrosion studies on RC beams. The system is shown in Fig. 1. This system was used in one of the experimental phase of this project.

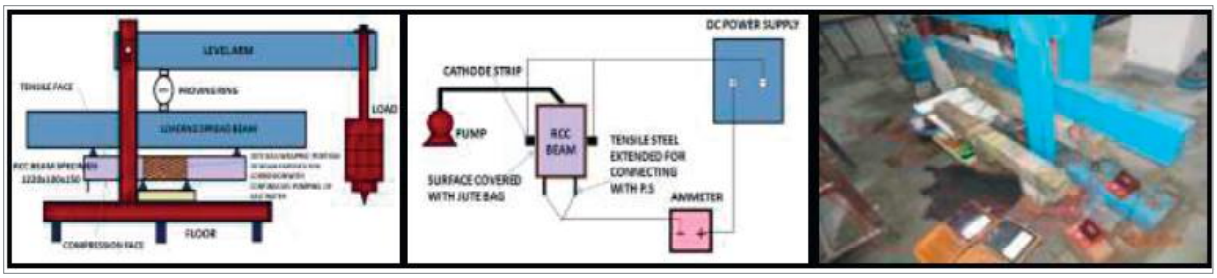


Fig. 1: Schematic View of Sustained loading Test Set-up, Corrosion Scheme and Corrosion Tests during Sustained loading on Beams

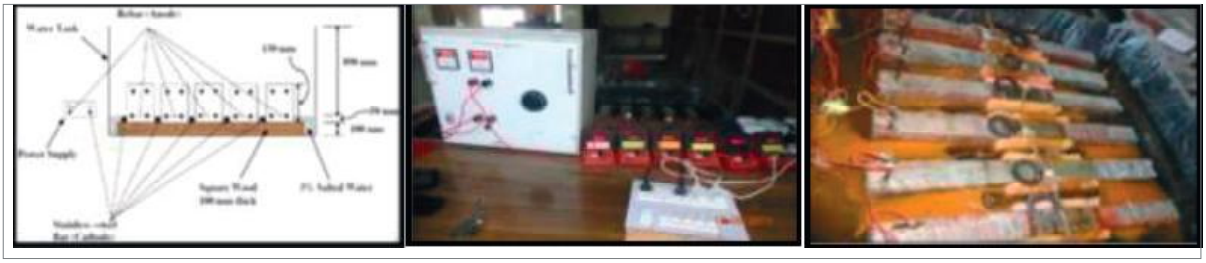


Fig. 2: Scheme for Corrosion Acceleration and Beams Corrosion in Progress

The accelerated corrosion set-up is schematically shown in Fig. 2. The procedure followed for FRP application on beams and different FRP strengthening schemes adopted on beams for up-gradations is shown in Fig. 3 and Fig. 4. The procedure for gravimetric testing adopted was as per ASTM procedure and is clear from Fig. 5.

Fig. 3: Procedure for FRP application

Fig. 4: Strengthening Schemes for Beams

Fig. 5: Gravimetric Testing Procedure (Breaking of Beams for Re-bars Extraction, Cleaning of Re-bars, Weight/ Depth Measurements & Bars Identifications)

These beams were structurally tested particularly for flexural study phase in this project. The structural test set up used for testing of beam specimens is shown in Fig. 6.

Fig. 6: Structural Test Set-up and Beams Testing in Progress

Results and Discussion

Rate of corrosion was specifically noted to be depended upon the area of the structure exposed for corrosion. As un-strengthened beams have more surface area in contact with the electrolyte (saline water), the corrosion was found more in this case as compared to those in strengthened beams. Importantly, in strengthened beams also, the orientation and way of laying the GFRP sheets play a crucial role. More the area covered with GFRP sheets, lesser was the rate of corrosion. Thus, the GFRP sheets act as corrosion inhibiting agent in structures. Also, due to the preloading done, the cracks were introduced in the beams which resulted in higher rate of corrosion. Proper quantification was attempted with respect to the both the strengthening ratio on surface of concrete beams and the cracks (or loading amount) presence. A few of the results are shown in Fig. 7.

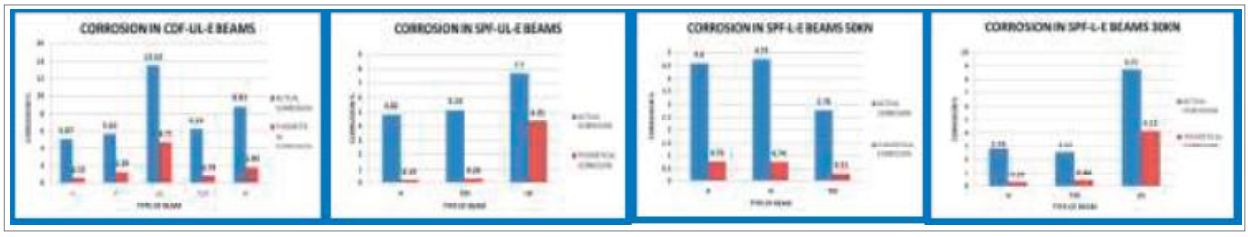


Fig. 7: Corrosion in Strengthened v/s Un-strengthened and Unloaded v/s Loaded Beams

The flexural strengths and the performance of the beams were noticed to vary with different parameters such as grade of concrete used, amount of corrosion, type of strengthening technique and the loading condition (Fig. 8 & Fig. 9).

Fig. 8: Different Failure Types Observed during Structural Testing of Beams

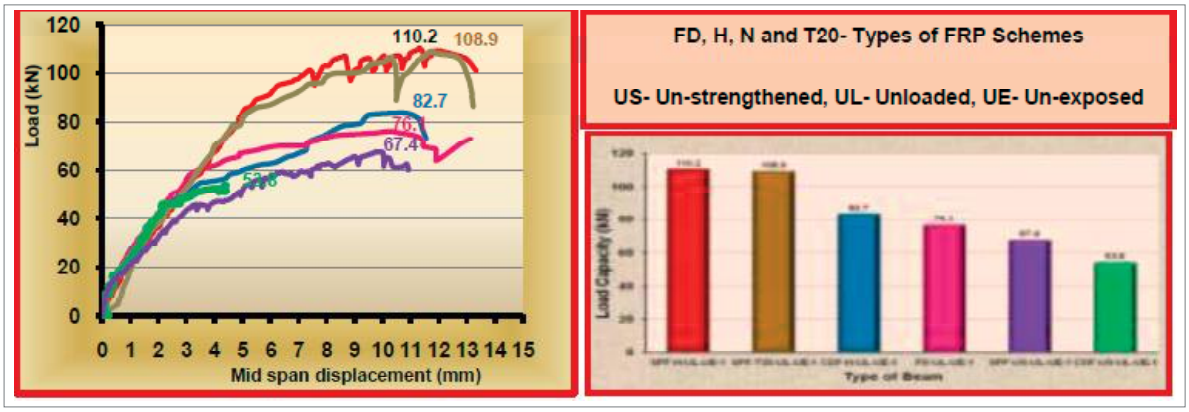


Fig. 9: Comparative Structural Performance of Beams (Un-strengthened and Strengthened Beams)

The results indicate that the unexposed beams have more strength than exposed beams in all cases. FRP strengthened beams could bear from 76.1 kN to 110.2 kN for different FRP patterns for even M30 beams, whereas the un-strengthened beams could take maximum of 53.8 kN for M30 and 67.4 kN for even M50 beams.

The preloading reduces the strength of the beam. Further if the preloaded beam was exposed to corrosion the ultimate capacity further reduces. These results also indicate that the strength of the beam is highly influenced by the pattern of strengthening of the beam, the orientation of fibers of GFRP sheets and the exposed area. Also, in strengthened beams, the same amount of preload was observed to have lesser effect on beams as the crack formations were less in those cases. If both exposure and preloading is taken into consideration, the strength further reduces. The results are more closely applicable for field conditions as comparison to unloaded exposed beams because the structures exposed at site are always susceptible to various loading conditions.

The results obtained during corrosion of both beams i.e. sustained loaded and unloaded are as shown in Fig. 10 below and are self explanatory. The experimental study shows that for beams under sustained loading, the rate of corrosion as well actual corrosion held during equal time period of exposures increases as comparison to beams in unloaded condition. This ultimately leads to decrease in ultimate capacity of the sustained loaded beams.

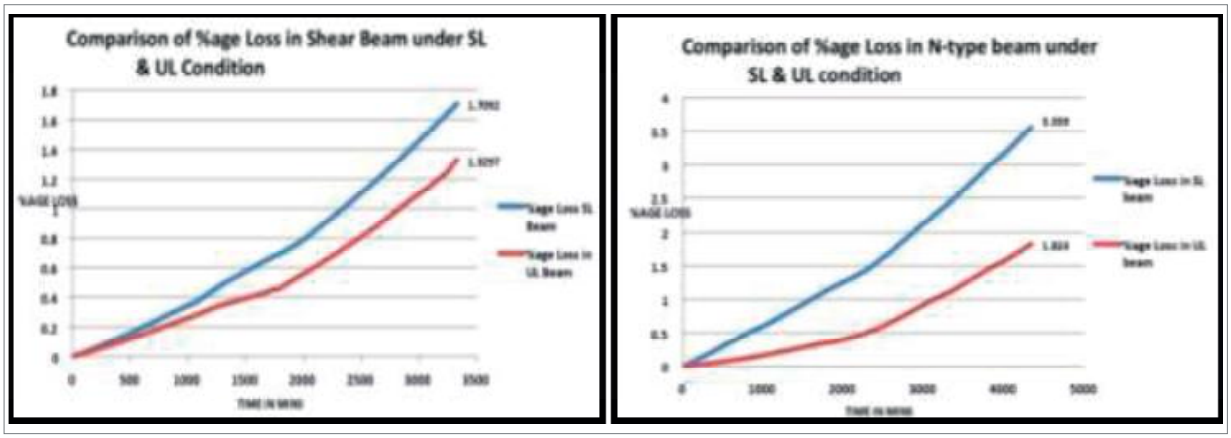


Fig. 10: Beams Behavior during Sustained Loading and during Unloaded Conditions (Flexure and Shear Study Phase)

Detailed analysis from the enormous experimental data collected is being attempted for proper quantification with respect to the effect of individual parameter. The output is expected to arrive at the guidelines and suitable strength reduction factors for the environmental conditions considered. These factors are anticipated to be applicable at the design stage itself.

Design of Retaining Wall under Seismic Condition using a Modified Pseudo-Dynamic Method (OLP-0377)

Anindya Pain

Determination of active thrust developed due to seismic activities on retaining wall is very essential for safe design of retaining wall in the seismically active regions. The objective of the project is to develop a robust technique to determine the bearing capacity of shallow strip foundations under seismic condition. After completing the stated objective, the methodology is applied for the stability analysis of rigid retaining walls under seismic condition. Sliding stability of gravity retaining wall on a rigid foundation is investigated for the active case under seismic conditions. Limit equilibrium approach with simple planar failure surface together with modified pseudo-dynamic seismic forces has been adopted. Stability factor F_W is proposed to determine the safe weight of the retaining wall against sliding failure under seismic conditions. If the safe weight of the retaining wall is known under static condition then by simply multiplying that with F_W can give the safe weight of the retaining wall required to resist sliding for the design seismicity. Present study shows that wall-soil interaction in various seismic conditions may or may not be in-phase for the entire duration of the input motion. It depends on the properties of the backfill soil, properties of the wall material and also on then characteristics of the input motion. The critical seismic acceleration coefficients for sliding are computed. If the ground acceleration exceeds the critical base acceleration, then the wall will slide. And the amount of sliding is computed by using Newmark's sliding block method. The details of the retaining wall, backfill soil and critical direction of seismic inertia forces are shown in the Fig.1.

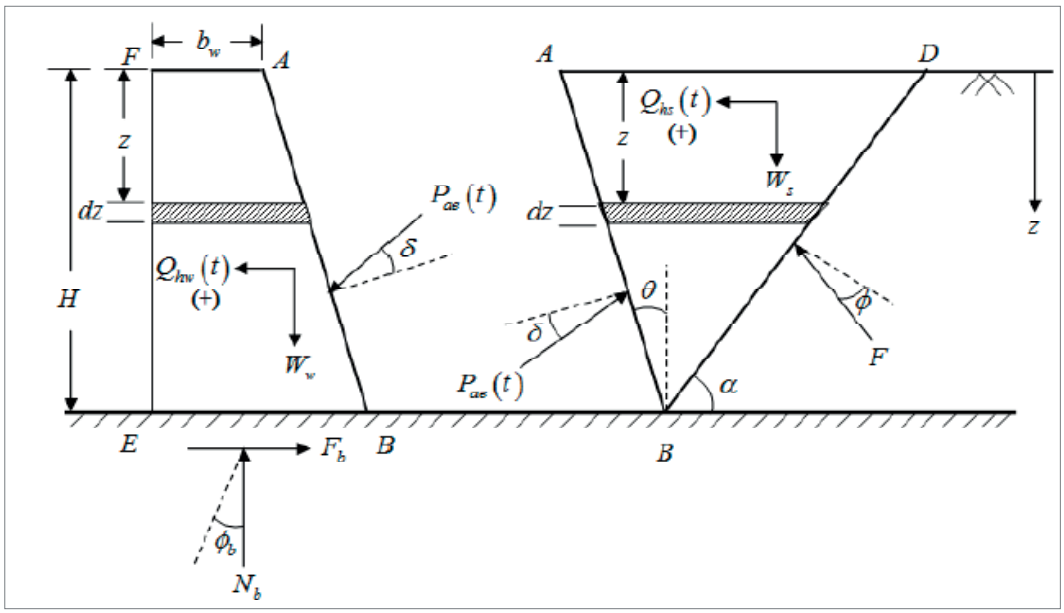


Fig. 1: Details of Forces Acting on the Soil Wedge and the Wall

From the analysis, it is clear that the sliding displacement not only depends on the properties of the backfill, it depends on the characteristics of the input motion and also depends on geometry and the properties of the wall material. Soil friction angle, wall friction angle, wall inclination angle and the top width of the wall have significant influence on the sliding displacement.

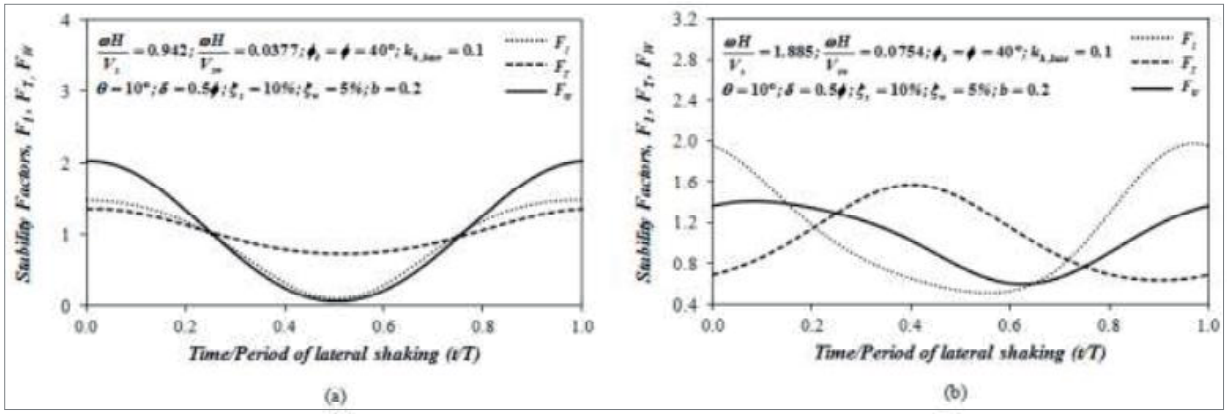


Fig. 2: Variation of Stability Factors F_I, F_T and F_W with time/Period of Lateral Shaking (t/T)

Fig. 2(a, b) shows the variation of the stability factors F_I, F_T and F_W for the input parameters mentioned in the figure. Referring to Fig. 2(b), the maximum value of F_W is 1.41 and occurs at t/T = 0.081, whereas the maximum active thrust occurs at t/T = 0.402 and the value of F_W is 1.02. It is clear that when F_W has its maximum value, the other two partial factors may or may not be at their maximum values. Hence require proper engineering judgment for the design of retaining wall under seismic condition.

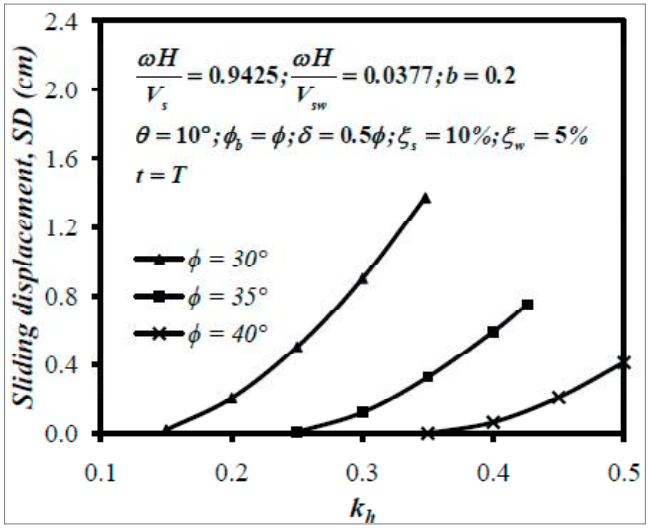


Fig. 3

Sliding displacement of the retaining wall is obtained by numerical integrating the relative acceleration of the wall-soil combined failure wedge with respect to base. Fig.3 gives, sliding displacement against different horizontal seismic acceleration coefficient values at the base. The present method is useful for safe and economic seismic design of retaining wall.

Optimization of Water Sprays & Location of Sprinkler in an Enclosure Fire (OLP-0383)

A. Aravind Kumar & Rajiv Kumar

Objective:

Optimization of water sprays and sprinkler location in enclosure fire

Prediction of hot layer temperature and species concentrations

Progress Highlights/Significant achievements:

In this project compartment fire modelling, suppression and sprinkler spray characteristics optimization studies have been carried out using Computational Fluid Dynamics (CFD) tool of Ansys CFX-5. The predicted results by CFD are compared with the experimental results from literature as well as from CBRI data using two techniques (i) Heat Release Rate (ii) Combustion Kinetics. Numerical simulations are carried out with the help of CFD tool (ANSYS-CFX) using combustion model for data due to Steckler et al generated in steady state fire of different strengths at different locations. CBRI experimental data of benzene fire and its suppression with sprinkler in a room of size 2.5 m * 2.0 m *1.5 m have been used for comparison of predicted hot layer temperature near to the ceiling and door using heat release rate modelling technique. Prediction of fire suppression time using standard sprinkler (P13B) are also carried out in the study. Optimization studies are carried out for water droplets of different volume mean diameter by CFD using data due to Thomas et al. The droplet diameters are of size 439, 696, 744, 814, 850, 1117, 1167, 1197, 1251, 1450, 3393 µm are chosen to predict the fire suppression time for the enclosure fire for CBRI experimental data. The optimum water mean droplet diameter range (696-895 µm) is found suitable based on the sensitivity analysis. The time for fire suppression is predicted using different volumetric flow rates of water viz, 20, 40 and 60 lpm at the sprinkler nozzle, for the optimum volume mean droplet diameter range. Effect of nozzle location on suppression time was also studied at three different locations in the enclosure. The nozzle locations near the ceiling are exactly above the fire source, 0.75 m and 1.5 m from the centre are chosen in the enclosure within 3m diameter range of the sprinkler covered area. Comparison of the predicted results with CBRI experimental data are given in Figure 1 (a-d).

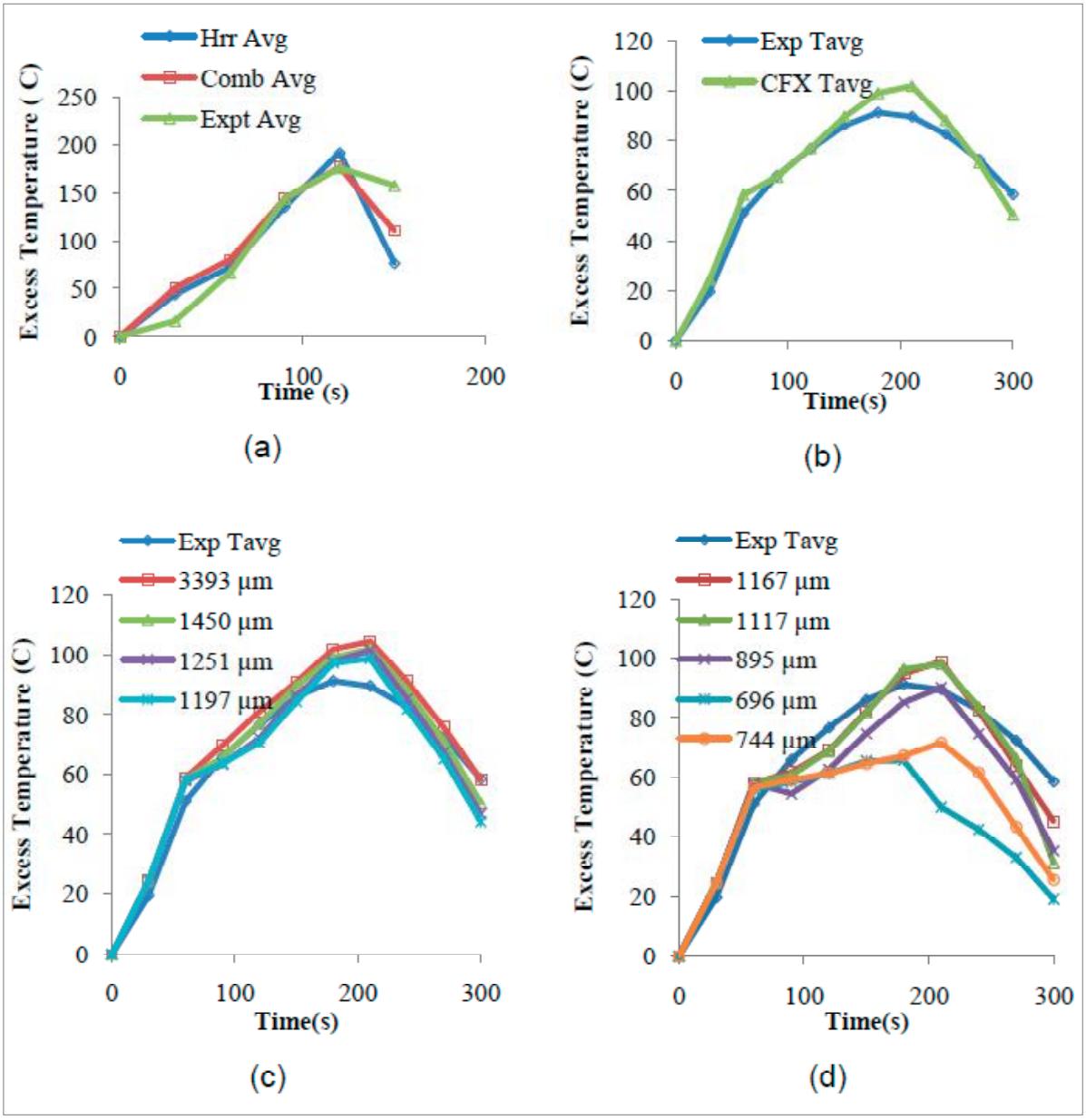


Fig. 1: Comparison of Predictions of Average Ceiling Temperature with CBRI Experimental Data in the Enclosure Fire for (a) Combustion and Heat Release Rate Modelling; (b) Standard Sprinkler (Water Particle Average Volume Mean Diameter of 1450 µm); (c) ,(d) Different Particle Sizes.

Active Structural Acoustic Control of Building Service Equipment at the Source (OLP-0385)

S.K. Panigrahi

Objectives

To apply Active Structural Acoustic Control (ASAC) approach to control the noise by actively reducing the vibration of the enclosure induced due to Acoustic energy.

Scope:

- Selection of best technique for Active Structural Acoustic Control (ASAC) approach to control the noise by actively reducing the vibration of the enclosure induced due to Acoustic energy.
- Optimization of sensor and actuator locations to make it more effective for noise resistant at optimum cost

Milestone Achieved

- Setting up Acoustic Laboratory
- Finalization of Lab Instruments
- Selection and development of an approach for active noise transmission through enclosure

Study of Residential Schools in Composite Climate for Energy Conservation (OLP-0384)

Neeta Mittal

The objective of the study is to evolve strategy for improvement in thermal comfort through passive design techniques in schools complexes situated in composite climate.

Thermal comfort study has been done in school during the winter and summer seasons. Visited the residential schools Jawahar Navodaya Vidyalaya selected for the study located in Baghra dist. Mujaffarnagar, and measured the various climatic parameters such as temperature, humidity, mean radiant temperature, air velocity and also illumination in various buildings of the campus which affect the comfort inside the building and also the learning ability of the children. Study has been done in school class rooms, laboratory, and dormitories and in dining hall. It has been observed that Inside the class room the measured temperature during winter season is 13.5 ^{0}C in the month of January .The evaluation of thermal comfort has been done in April month during summer season also. The maximum ambient temperature recorded was 41 ^{0}C and the temperature inside the class room was 33^{0}C., interacted with the students of various classes to collect their views. The study shows that the roofing material also influences the temperature inside the room significantly.

Fig. 1: Dormitory - JNV Mujaffarnagar

Fig. 2: School - JNV Mujaffarnagar

Experimental Evaluation of Precast Beam-Beam Connection (OLP-0378)

Siddharth Behera & Achal Kumar Mittal

The use of properly designed and detailed beam-column Joint modules for multi-storied buildings necessitates the study of their connections with the cast-in-situ members (beam/columns/slabs). The behaviour of these connections when subjected to earthquake forces needs to be properly understood both experimentally and numerically. The outcome of this research work will help to develop suitable connection detailing for these precast modules which can then be safely incorporated in multi-storied buildings.

Objective

Development of suitable connection detailing at Cast-in-Place beam-beam joint for a precast beam-column joint modules

Project Details

In this particular project, initially casting of full scale control and precast jointed RC beams were carried out with proper instrumentation. Suitable connection detailing was adopted at the beam-beam connection portion between the precast and cast-in-situ intermediate parts. The experimental set-up was designed prior to testing where the specimens were to be subjected to centre point loading with supports fixed. All other instrumentations for recording of deflections and strains were also carried out. The specimens were tested quasi-statically in a state-of-the-art 300T UTM facility present in Heavy Testing Laboratory of Structural Engineering Group. The parameters studied included the load-deflection characteristics, energy absorption capacity, cracking patterns etc. All the loads, deflections and strains recorded by data acquisition system were analysed carefully and the considered parameters of study were calculated and plotted graphically.

In this study it was observed that the load deflection characteristics and energy absorption capacities of the precast jointed specimen were comparable with those of the cast-in-situ control beam. The test results have also been shown in figures given below. The non-linear FEM analysis of the same in ANSYS 15.0 is currently ongoing.

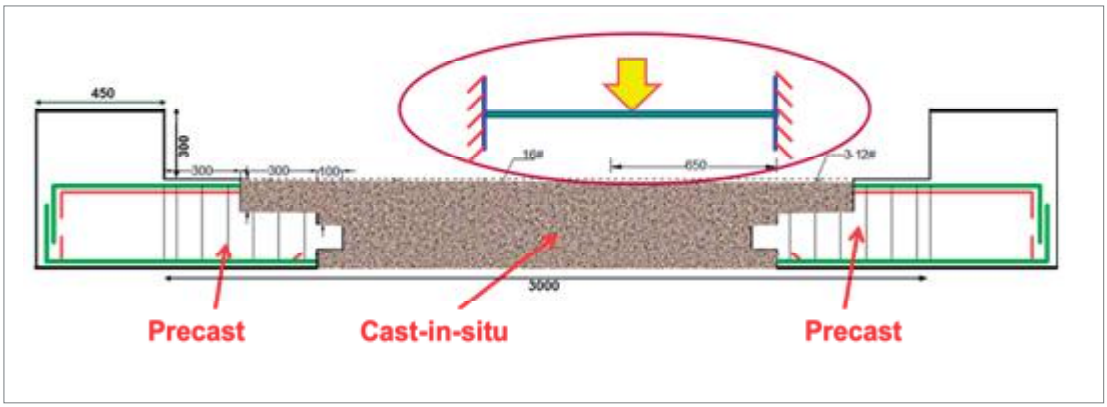


Fig. 1: Details of the Specimen and Loading Scheme

Fig. 2: Reinforcement Detailing & Casting of Precast Joints

Fig. 3: Test Set-up in 300T UTM

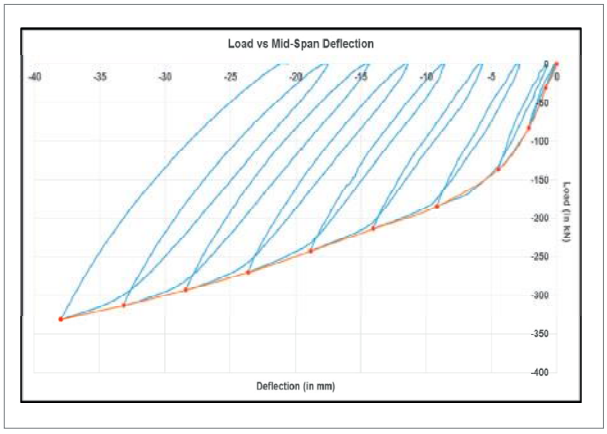


Fig. 4: Load - Deflection Characteristics Obtained during Test

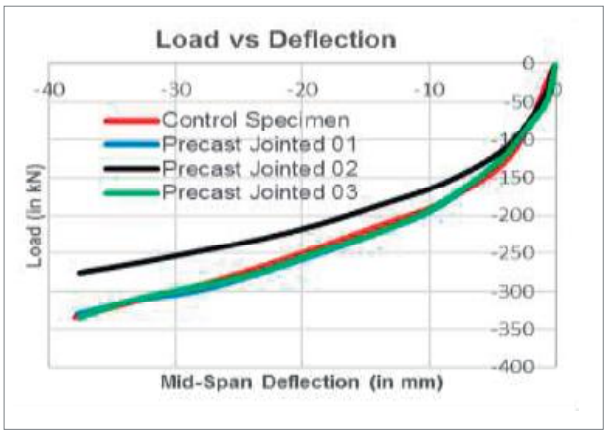


Fig. 5: Comparison of Load-Deflection characteristics for all specimen

Fig. 6: Crack mapping of the Specimen

Energy Simulation of Potato Cold Storage using Different BASF Insulation Products & Recommendation of Measures for reducing Energy Consumption

B. M. Suman

Objective:

Simulation studies for determination of energy consumption of the potato cold storage without insulation, by using rice husk and EPS as thermal insulation and by using BASF insulation products.

Progress Highlights/Significant Achievements

Simulation studies have been carried out for determination of reduction in energy consumption in potato cold storage by using different insulation materials with software TRNSYS, which is capable of carrying thermal simulation of commercial building such as cold storage as well as multi-zone building.

The untreated potato cold storage consists of walls with 0.230m thick brick wall plastered on both side with cement mortar of 0.013m thickness and its U-value is 2.12 W/m^{2}K. The solar absorption coefficients of the walls are 0.6 on the front side and 0.6 on the back side. Ceiling of the cold storage is 0.100 m thick heavy reinforced concrete slab plastered inside with thickness of 0.013m. The total thickness of each of roof is 0.113m and its U-value is 4.54 W/m^{2}K. The floor of the cold storage is made of heavy concrete of 0.100m, and clay-soil of at least 0.100m thickness. The total thickness of the floor is 0.200 m and its U-value is 4.46 W/m^{2}K. The untreated potato cold storage is considered as reference cold storage which is situated at Kannauj near Kanpur which lies in composite climate of India. All weather parameters are put into the software to simulate the cold storage.

Energy consumption of potato cold storage has been determined without insulation, using rice husk and EPS as thermal insulation are determined. Apart from this, energy consumption of potato cold storage by using BASF insulation products has also been undertaken for simulation study. Table 1 consists of hourly power consumption for all the seven cases of energy simulated cold storage. Detail results are given in table 1, fig.1 and fig. 2. Before carrying out experimental work, thermal conductivity of BASF Insulation Product was measured by Guarded hot plate Apparatus which is shown in Fig 3. The volume of this cold storage is 3774.375 m^3 and the average power consumption of non-insulated cold storage is recorded as 72.44 KW/hour when indoor temperature of the cold storage was maintained at 4^{o}C. It can be observed from this Table that hourly power consumption can be reduced by 16% when ceiling and wall of the cold storage is treated by 8.5 cm Rice Husk with untreated cold storage. The reduction in hourly power consumption is increased up to 53.7% when floor of the cold storage is replaced with 8.5 cm Peripor (32 kg/m^3) keeping wall and ceiling insulation same. The power consumption per hour is reduced by 53.1% when ceiling, wall and floor of the cold storage is treated by 8.5 cm EPS with untreated cold storage. It is also observed that maximum power is saved when only 7cm PUF is used in ceiling, wall and floor of the cold storage. On comparison with untreated cold storage the saving in power consumption is recorded as 57.9% when ceiling, wall and floor of the cold storage is treated with 7 cm PUF.

Table 1: Hourly Power Consumption of the Cold Storage

Case	Roof/ Ceiling	Wall	Floor	Power Consumption (KW/hour)
I	0.10 m RCC	0.23m Brick & CPI on both sides	0.10 m Concrete	72.44
II	0.10 m RCC	0.45m Brick+0.45m Rice Husk +0.225m Brick& CPI.both side	0.10 m Concrete	60.80
III	0.085m Neopor +0.10m RCC	0.45m Brick + .085m Neopor +0.225m Brick& CPI.both side	0.1 m Conc.+ 0.085m Peripor **(24kg/m^3)** + 0.025m Marble Stone	33.59
IV	0.085m Neopor + 0.10 m RCC	0.45m Brick +.085m Neopor + 0.225 m Brick & CPI.both sides	0.1 m Conc.+ 0.085m Peripor**(32kg/m^3)** + 0.025mMarble Stone	33.57
V	0.085 m EPS + 0.10 m RCC	0.45m Brick +0.085m EPS + 0.225m Brick& CPI on both sides	0.1mConc.+0.085m EPS + 0.025mMarble Stone	33.96
VI	085m Peripore (24kg/m^3) + 0.1 m RCC	0.45m Brick + 0.085m Peripor (24kg/m^3) + 0.225m Brick & CPI on both sides	0.1m Conc.+ 0.085m Peripor (24kg/m^3) + 0.025m Marble Stone	34.31
VII	0.07 m PUF +0.10m RCC	0.45m Brick+ 0.07m PUF + 225m Brick& CPI on both sides	0.1mConc.+0.07mPUF + 0.025m Marble Stone	30.50

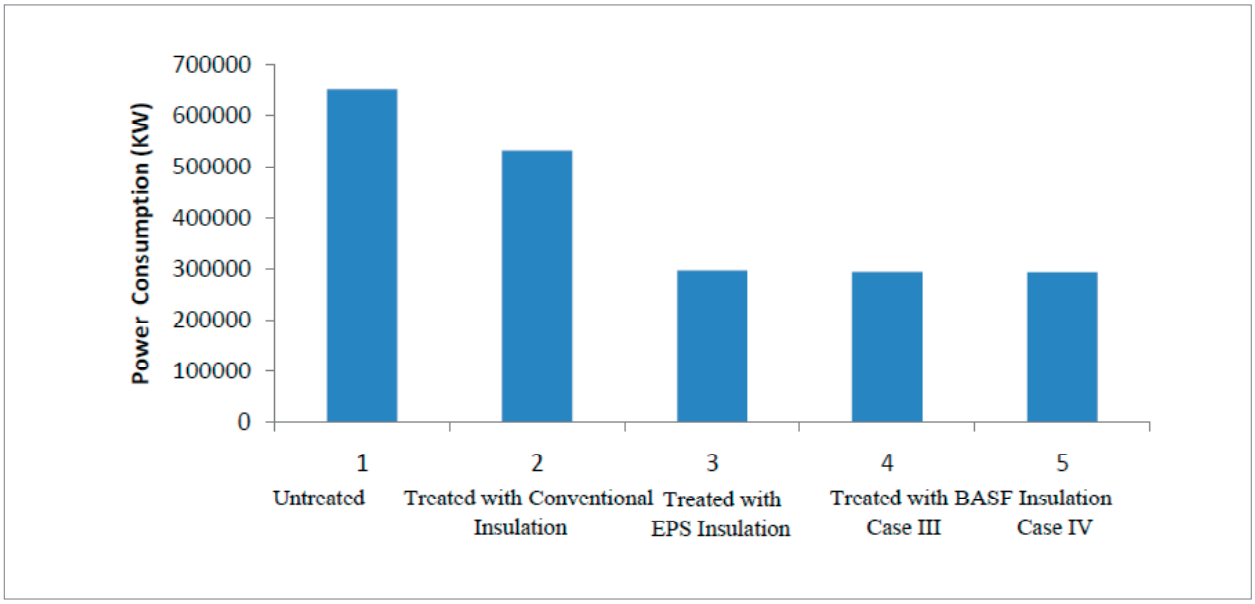


Fig.1: Annual Power Consumption of a Cold Storage with and without Thermal Insulation

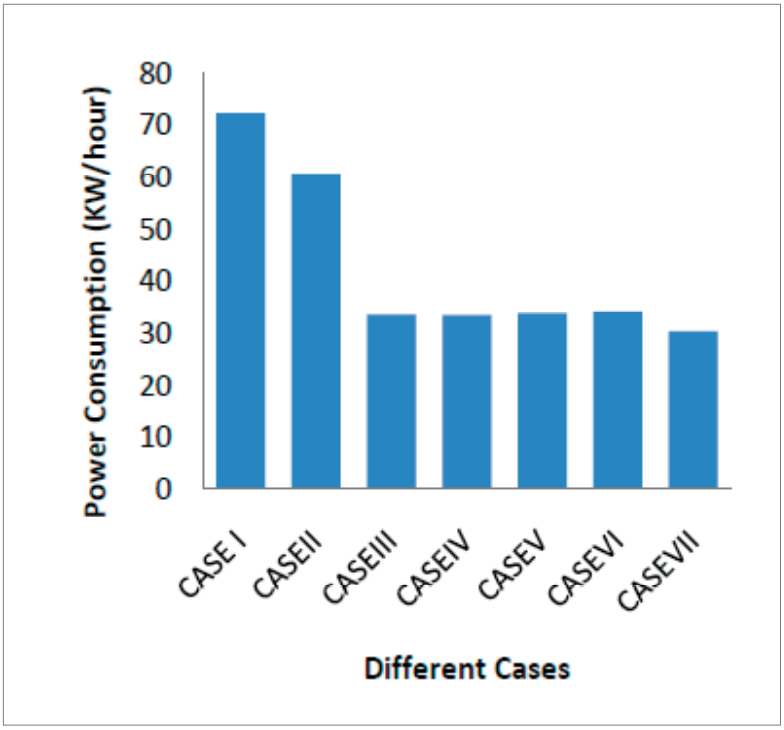


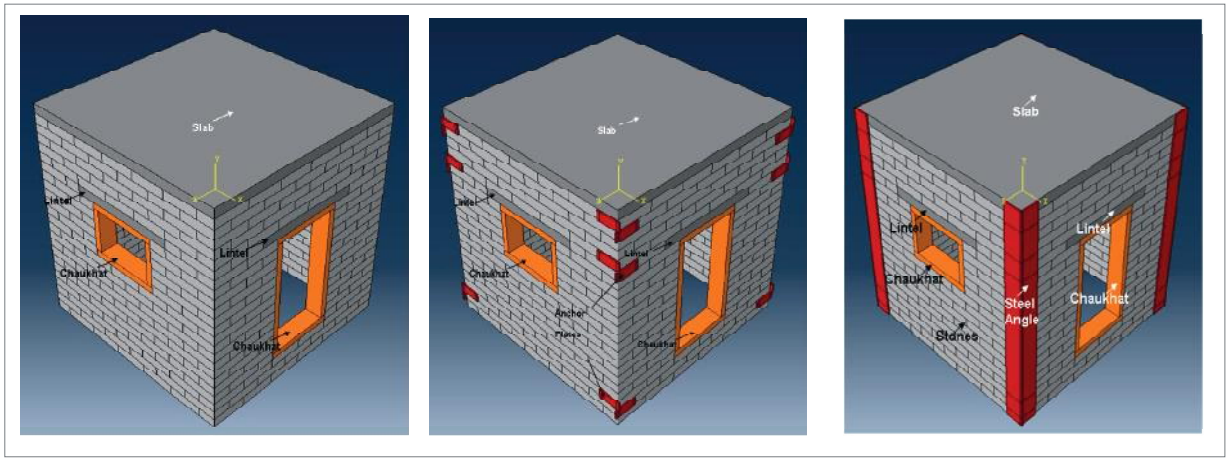
Fig. 2: Hourly Power Consumption of a Cold Storage

Fig. 3: Automatic Guarded Hot Plate Apparatus

Strengthening of Stone Masonry Housing Constructions against Earthquakes (OLP-0372)

Navjeev Saxena

Three finite element models where NS represents masonry structure with No Strengthening (Fig. 1a), ESS represents masonry structure strengthened using existing scheme (Fig. 1b) and DNS-IBA1 represents masonry structure strengthened using innovative scheme (Fig. 1c), were developed using ABAQUS finite element package. All models incorporate modeling of contacts between all its structural elements to allow slip and separation to capture response that is more realistic. The research study numerically evaluates behavior of NS, ESS and DNS-IBA1 under inertial lateral loading (until acceleration of 0.90g that corresponds to Maximum Considered Earthquake loading) with same model parameters except the changed strengthening scheme to emphasize contribution solely of schemes. The results conclude that under bi-directional lateral loading in horizontal plane applied to DNS-IBA1, the peak displacement, tensile stress and compressive stress in the stones reduce by 98%, 92% and 85% respectively compared to ESS (Fig. 2a-c) that is quite significant. The contours of displacements of NS, ESS and DNS-IBA1 at MCE loading conditions are visible in Fig. 3(a-c) respectively. Hence, DNS-IBA1 considerably improves behavior of stone masonry structure owing to significant reduction in the peak tensile & compressive stresses and peak displacements of masonry hence proves to be meaningfully effective in improving IBA, which is much required for improving seismic behavior.



(a) NS (b) ESS (c) DNS-IBA1

Fig. 1: Dry jointed stone masonry structure assemblies

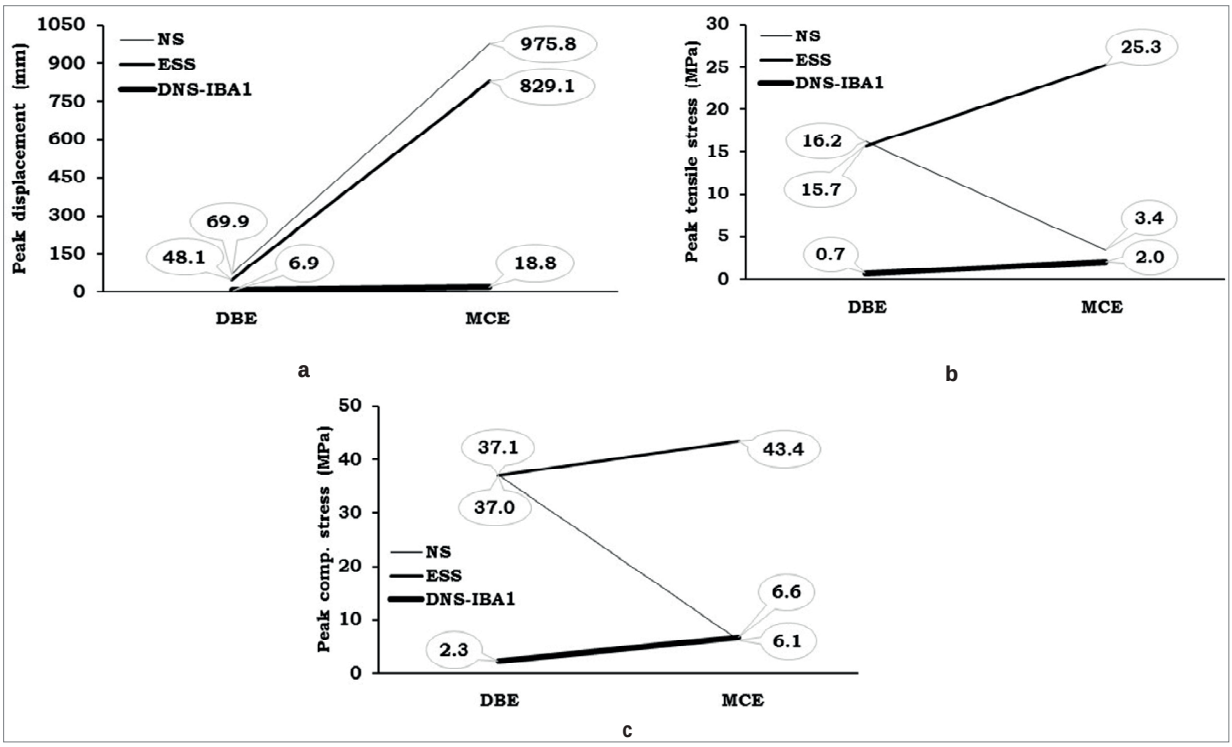


Fig. 2: Comparison of peak responses in stone masonry using NS, ESS and DNS-IBA1(initial load in x & z) (a) displacement (b) tensile stress and (c) compressive stress

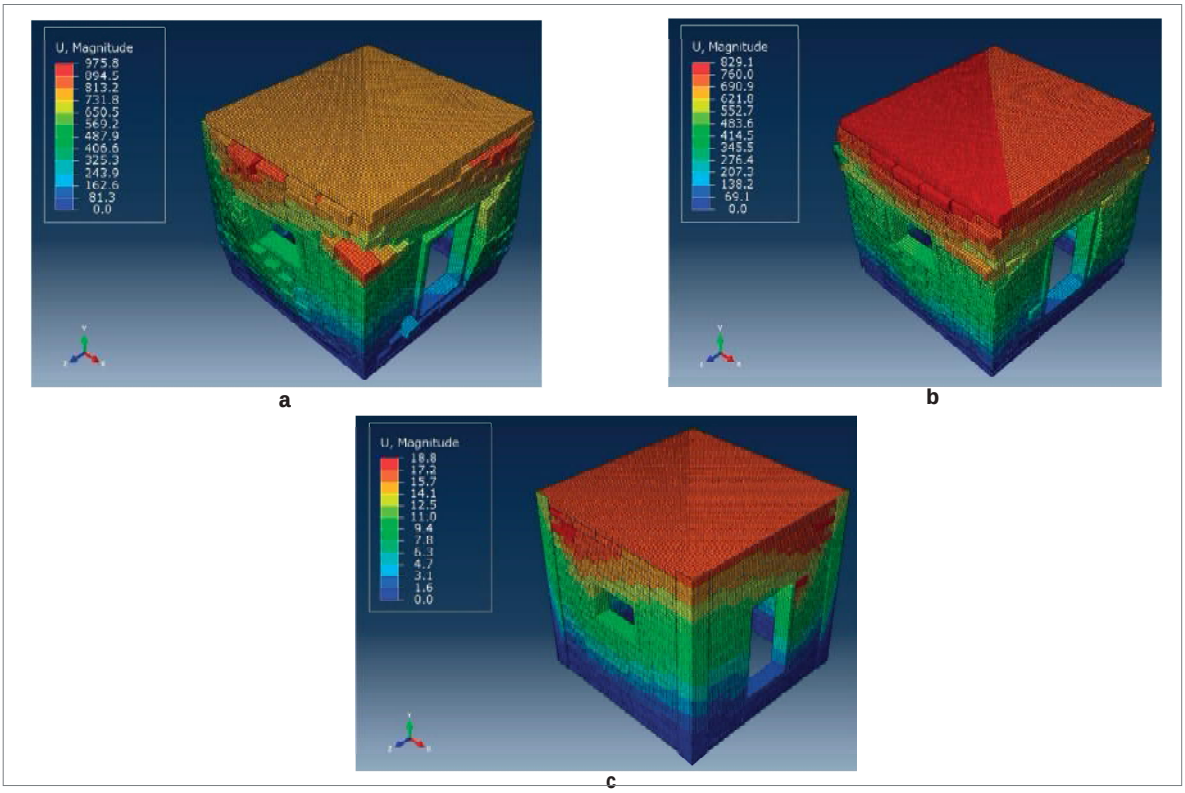


Fig. 3: Displacement contours at MCE (a) NS, (b) ESS and (c) DNS-IBA1

Group Effect of Piles in Loose Sandy Soil in Earthquake Inducted Lateral Spreading (OLP-0386)

Piyush Mohanty

Objectives:

I. Development of a methodology to determine lateral load distribution in a pile group in case of earthquake induced lateral spreading.
II. It can be used to design methods to countermeasure the detrimental effect of liquefaction on central piles by putting surrounding piles.

Progress made so far:

1. The validation of the numerical model for liquefied soil has been carried out through the finite element package OpenseesPL. The previous numerical tool PLAXIS 3D is not used as it is not found suitable to model liquefaction in case of group of piles. The model and its behavior in liquefaction has been compared with the published results of Algie and Pender (2013) and Forcellini and Tarantino (2014). The results of the present numerical model and the experimental results have reasonable agreement.
2. For the experimental work, the shake table has been procured. The foundation for the same has been prepared in the institute premises. The perspex box of 1.4m ×1m ×1m has been fabricated and will be used for the tests.\

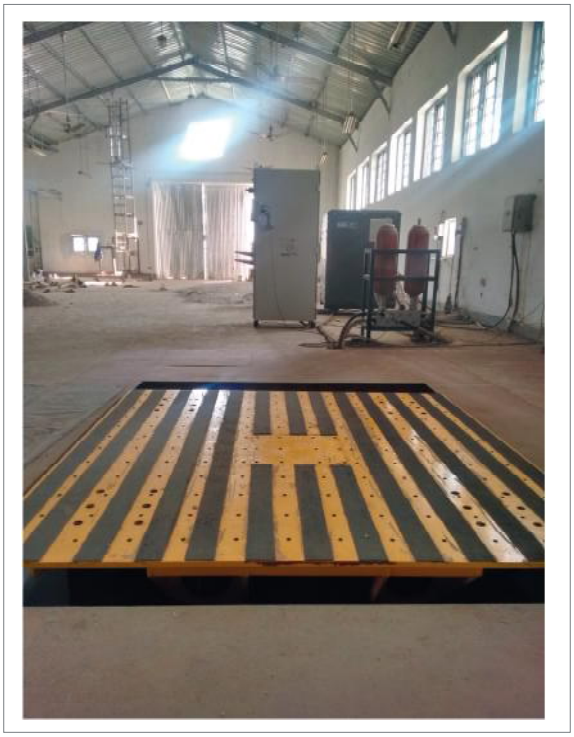


Fig. 1: Newly Installed Uniaxial Shake Table of 2m x 2m

Results and Discussions:

1. Seismically induced increases in excess pore pressure around and beneath end-bearing piles can lead to excessive settlement of the foundation. The use of a rigid superstructure in these tests means the values quoted herein are likely to be a lower bound on those which may occur for foundations supporting flexible structures. Settlement can therefore be as important a design consideration as lateral displacement, particularly for laterally stiff piles with lower static safety factors in level ground where lateral displacements are small.
2. During dissipation of the excess pore pressures, shaft loads in the piles are reduced due to down drag from the reconsolidating sand. Settlements occurring during this phase become small compared to the co-seismic settlements as the excess pore pressure ratio in the bearing layer increases.

Study of Carbonation of RC Structures (OLP-0387)

Mickey M. Dalbehera

Carbonation is a major cause of reinforced concrete structures deterioration leading to expensive maintenance cost. The corrosion of steel bars due to carbonation affects the durability of reinforced concrete, thereby decreasing the long term performance and safety of the structures. The rate at which carbonation in concrete takes place is mainly dependent on the moisture content and relative humidity in the vicinity of the concrete structure. Carbonation is also greatly influenced by the CO_2 concentration in the air, type of cement, w/c ratio of the concrete mix. Even though the results from accelerated carbonation tests have been used in the past to predict long term carbonation depths, there is in general no agreement on how to extrapolate from accelerated testing conditions in laboratory to real conditions in the field. This is because carbonation in itself is a complex phenomenon. Microstructure of the carbonated concrete formed in the accelerated conditions may not be same as under natural conditions. Mass transport properties as well as CO_2 concentrations of accelerated testing and natural conditions differ from that of laboratory specimens and structural elements on filed. Variances in mass transport property of concrete arise from different placing; compacting, curing conditions; relative humidity and dry- wet cycles.

Objective

To study the effect of cyclic humidity on M20, M30, M40 grade of concrete subjected to carbonation.

Progress made so far

1. Moisture movement in structural concrete during the course of service plays a critical role in the initiation and propagation of rebar corrosion in reinforced concrete (RC) elements. The provision of an adequate cover depth is thus essential to restrain the ingress of moisture up to the layer of embedded steel, mitigating thereby the evolution of the corrosion process.
2. It has been observed that Water–cement ratio has an inverse effect on the carbonation resistance of the concrete. An increase in water-cement ratio (w/c) causes higher porosity, which leads to a coarser pore structure of the concrete. Higher values for w/c reduce the carbonation resistance in an exponential manner. This effect is more pronounced for concretes that have low potential resistance due to the binder type (e.g. slag cements).
3. An increase in cement content increases the binding capacity which improves the carbonation resistance. On the other hand, an increase in cement content will also increase the amount of permeable cement paste, leading to a higher effective diffusion coefficient and thus reduced carbonation resistance.
4. A numerical study in MATLAB is made to map the moisture movement inside the concrete when subjected to different moisture content.

AcSIR

AcSIR Activities

CSIR-Central Building Research Institute (CBRI) is offering an integrated M. Tech - Ph.D. (IMP) programme under the aegis of Academy of Scientific & Innovative Research (AcSIR) since 2010 in the area of 'Building Engineering & Disaster Mitigation (BEDM)'. The institute is also taking PhD students in the area of Engineering Sciences, Chemical Sciences and Physical Sciences. The details of different batches are given below:

M. Tech

- 1st Batch (2010-12) - 6 Students completed
- 2nd Batch (2011-13) - 8 Students completed
- 3rd Batch (2012-14) - 8 Students Completed
- 4th Batch (2013-15) – 5 Students in 4th Semester
- 5th Batch (2014-16) – 5 Students Joined

Ph. D.

- 5 Students joined for Ph. D. in Engineering Sciences in August'14
- 1 Student joined for Ph. D. in Chemical Sciences in Jan.'15.
- Presently total 13 Ph. D. students of AcSIR

Some of the highlights of the student activities in the current year are:

1. Fourth Convocation Ceremony at CSIR-SERC, Chennai on 28th August 2014 - 8 Students of CSIR-CBRI were awarded M. Tech. Degree in BEDM

2. Orientation programme of the fresh students:

3. Teachers' Day celebrated on 5th September, 2014

4. A team of AcSIR students Monalisa Behera, Tarannum Yasmin and Kirthika S. won the second prize in the 'Engineering Challenge Competition' on Mix Design & Experimental Verification of Compressive Strength of Concrete Cubes on the occasion of National Science Day Celebration 2015 at CSIR-CBRI.

Information, Extension & Project Management

Publication Group

The Publication Group continued to serve as the nerve centre 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 Bhavanika (Newsletter in Hindi) periodically, publication of Building Research Notes, Project Profile, Technical and Divisional Brochures etc., preparation of other scientific/technical reports and filling up of questionnaires/organizations; providing inputs for CSIR Annual Report as well as for CSIR News and CSIR Samachar; reporting of the scientific and technical work carried out at the Institute in Hindi and English and Publicity of the Institute's R&D capabilities through print Media.

1. CSIR-CBRI Annual Report

- **R&D Highlights**
- **Research Output**
- **R&D Projects**
- **Consultancy Projects**
- **Sponsored Project**
- **Information, Extension & Project Management**
- **Honours & Awards**
- **CBRI Family**
- **Date Line**

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

2. CBRI in CSIR Newsletter

A glimpse of CSIR-CBRI achievements/activities appeared in CSIR Newsletter

1.	CSIR-CBRI Signs MoU with University of Petroleum Studies, Dehradun	Volume 64	81	April, 2014
2.	National Science Day Celebrations at CSIR-CBRI Roorkee	Volume 64	88-89	April, 2014
3.	Development of Pervious Concrete at CSIR-CBRI	Volume 64	103-104	May, 2014
4.	Green Retrofit Strategies for Office Buildings by CSIR-CBRI	Volume 64	105	May, 2014
5.	National Technology Day Celebrations at CSIR-CBRI Roorkee	Volume 64	137-138	June, 2014
6.	World Environment Day Celebrations at CSIR-CBRI Roorkee	Volume 64	163-164	July, 2014
7.	CSIR-CBRI develops Light Weight Blocks using Industrial Wastes based on Fly-ash/Rice husk ash/ Marble dust	Volume 64	174-175	August, 2014
8.	CSIR Foundation Day Celebrations at CSIR-CBRI Roorkee	Volume 64	227-228	October, 2014
9.	Cement-free Plaster Developed from Fluoro-gypsum by CSIR-CBRI	Volume 64	267-268	December, 2014
10.	Study of Impact Behaviour of Reinforced Concrete Elements at CSIR-CBRI	Volume 64	269-271	December, 2014
11.	CSIR-CBRI Working on Anti-termite Barrier for New Buildings	Volume 65	04-05	January , 2015
12.	Engineering of Landslide Disaster Mitigation at CSIR-CBRI	Volume 65	08-09	January, 2015
13.	CSIR-CBRI develops Bio-concrete as Self Healing Material	Volume 65	31-33	February, 2015
14.	CSIR-CBRI Technology Demonstration-cum-Classroom	Volume 65	41-43	February, 2015
15.	CSIR-CBRI working on Green Retrofit Strategies for Office Buildings	Volume 65	50-51	March, 2015
16.	CSIR-CBRI working on Solar Thermal Air Conditioner	Volume 65	51-52	March, 2015
17.	CSIR-CBRI Serving the Nation	Volume 65	70-71	March, 2015

3. CBRI in CSIR Samachar

A glimpse of CSIR-CBRI achievements/activities appeared in CSIR Samachar

1.	lh,lvkbvkj&lhchvkjvkb e bLikr icfyr ddhV ljpukvk d fy, Lon'kh dFkkfMd ljf{k.k i.kkyh dk fodkl	o"k 2	vd 4] 52&53	viy 2014
2.	lh,lvkbvkj&lhchvkjvkb u ;fuofl Vh vkQ iVkfy;e LVMht] ngjknu d lkFk le>krk Kkiu ij gLrk{kj fd,	o"k 2	vd 4] 53	viy 2014
3.	lh,lvkbvkj&lhchvkjvkb] :Mdh e jk"Vh; foKku fnol	o"k 2	vd 4] 55	viy 2014
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6.	lh,lvkbvkj&lhchvkjvkb e i"lk in'kuh dk vk;ktu	o"k 2	vd 5] 74	eb 2014
7.	lh,lvkbvkj&lhchvkjvkb] :Mdh e uuk ik|kfxdh d mi;kx }kjk cgdk;kRed foy;k dk fodkl	o"k 2	vd 6] 89	tu 2014
8.	lh,lvkbvkj&lhchvkjvkb] :Mdh dh efgyk oKkfudk dk lEeku	o"k 2	vd 6] 89	tu 2014
9.	lh,lvkbvkj&lhchvkjvkb] :Mdh e jk"Vh; ik|kfxdh fnol lekjkg	o"k 2	vd 6] 95&96	tu 2014
10.	lh,lvkbvkj&dUnh; Hkou vul/kku lLFkku] :Mdh e fo'o lk;koj.k fnol lekjkg	o"k 2	vd 8] 124&125	vxLr 2014
11.	lh,lvkbvkj&lhchvkjvkb e jk"Vh; ik|kfxdh fnol lekjkg lEiUu	o"k 2	vd 9] 145&146	flrEcj 2014
12.	lh,lvkbvkj&lhchvkjvkb e jh&buQklM ddhV@ihLVLM ddhV rUok d bEiDV fcgfo;j dk v/;;u	o"k 2	vd 9] 151&152	flrEcj 2014
13.	lh,lvkbvkj&lhchvkjvkb e fo'o i;koj.k fnol dk vk;ktu	o"k 2	vd 10] 158&159	vDVcj 2014

14.	lh,lvkbvkj&lhchvkjvkb e LFkkiuk fnol lekjkg dk vk;kstu	o"k 2	vd 10] 167&168	vDVcj 2014
15.	lh,lvkbvkj&lhchvkjvkb e LFkkiuk fnol lekjkg dk vk;kstu	o"k 2	vd 11] 172&173	uoEcj 2014
16.	lh,lvkbvkj&lhchvkjvkb }kjk ft;kifyej ddhV e icyu NMk dk vkcU/k 0;ogkj v?;;u	o"k 2	vd 12] 201&204	fnLkEckj 2014
17.	lh,lvkbvkj&lhchvkjvkb }kjk fufer LVhy icfyr ddhV ljpuk gr Lon'kh dFkkfMd lj{kk i.kkyh	o"k 3	vd 1] 12&13	Tkuojh 2015
18.	lh,lvkbvkj&lhchvkjvkb }kjk fufer Bkl vk|kfxd vif'k"V&flfoy fuek.k d fy, ft;k&eVfj;y ,d lLkk/ku	o"k 3	vd 1] 14&16	Tkuojh 2015
19.	lh,lvkbvkj&lhchvkjvkb ik|kfxdh fun'ku&lg&Dykl :e	o"k 3	vd 03] 43&45	ekp 2015
20.	lh,lvkbvkj&lhchvkjvkb e Hkfexr [knkuk e Ql dk;y d vf/kdre mR[kuu gr df=e fiYyjk d fy, lefpr lgk;d i.kkyh dk fodkl	o"k 3	vd 03] 45&46	ekp 2015

4. News-items/R&D Stories in Media covering functions, events, Conferences, Workshops etc. (Approx. 100)
About 100 news items have been published in Media

5. Bilingual CSIR-CBRI Newsletters/ Hkofudk - Quarterly Issues

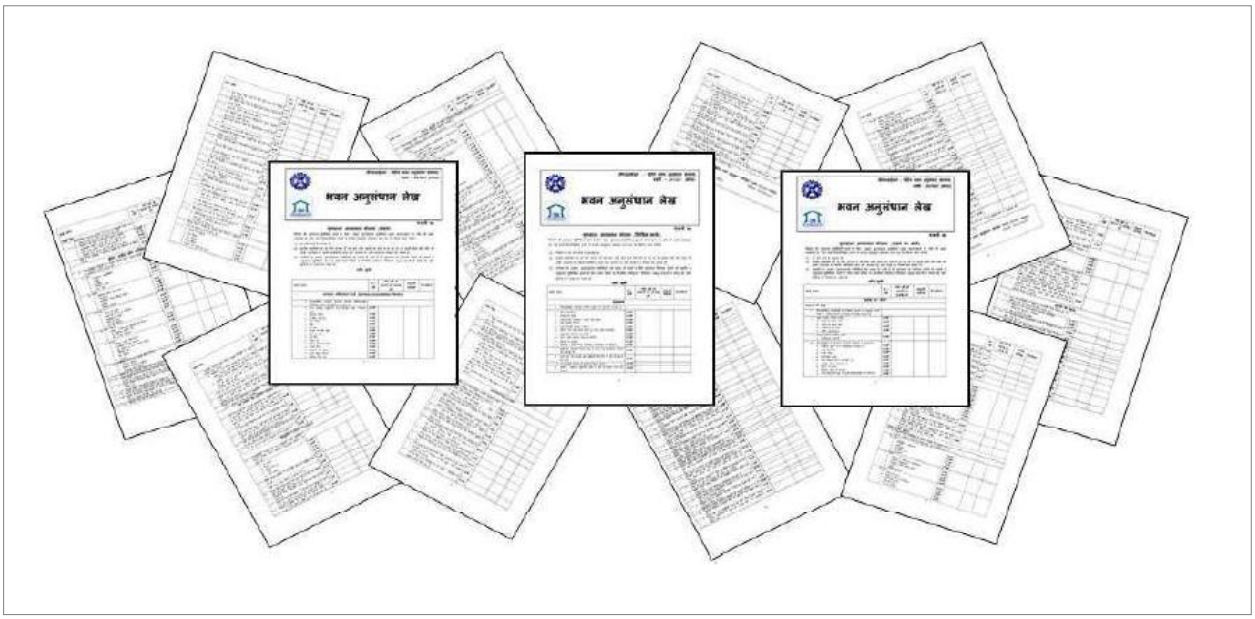
(April-June, July-September, October-December, January- March)

Four Issues

6. Technology Brochure: Brochure on CSIR-CBRI Technology Demonstration-cum-class room.

7. Calender/ Diary/ Greeting Cards

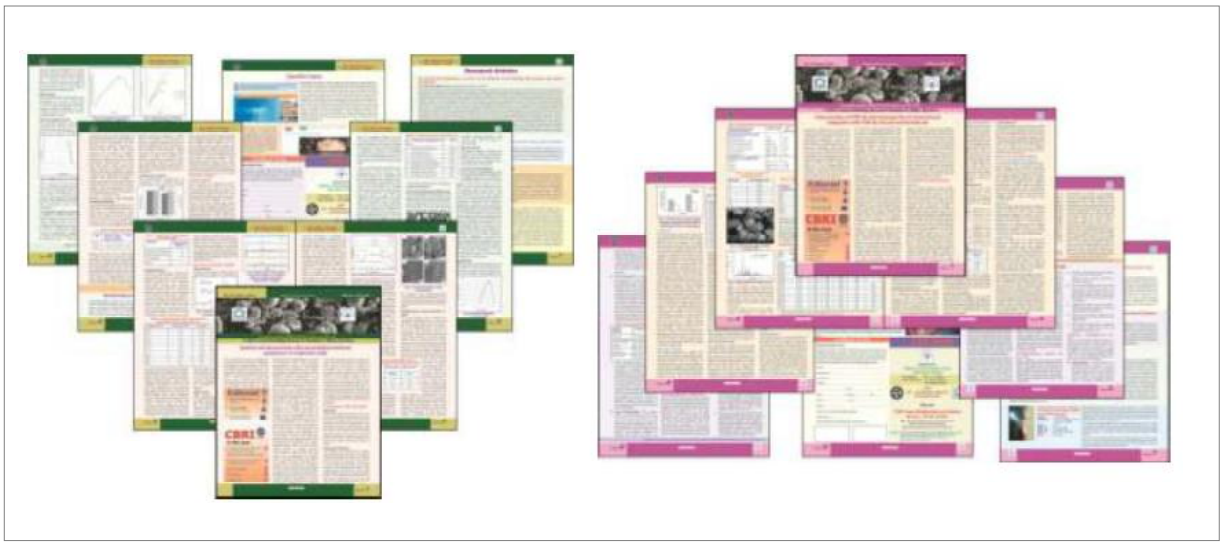
8. Building Research Notes: Print Production of Technical notes



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

10. Publicity through Advt in Conference/ Souvenir/Symposium Proceedings etc.

11. ENVIS Newsletters- 2 issues (Jan. - June & July - Dec)



12. Proceedings of INDIA-UK Scientific Seminar on GCMSB-2015

Development, Construction & Extension Group

The Development, Construction and Extension Group at the Institute is involved in various activities with the objective to disseminate R&D outcomes of the Institute among the user agencies for field implementation. The Group organizes or participates in training programmes related to disaster resistant cost-effective housing, rural housing and creating awareness through exhibitions, visits of students, professionals and related authorities. The Group also keeps generating display material and technical videos. The Group also takes up developmental activities to develop user friendly systems and their dissemination under the Documentation and S & T Intervention in the Traditional Architecture of Rural Areas of the Western Himalayan Region**.** Some of the activities have been highlighted below;

Extension Activities

1. Organized training programme in Village Saddal, in the flood affected areas of Jammu.

2. Participated in an Extension activity organized by CSIR-CGCRI on Rural Development at Malda, WB.

3. Participated in Industry and Technology Expo 2015 held at Dehradun, Uttarakhand, Organized by MSME

Technical and Educational visits of professionals and students

1. A group of 40 second year Civil Engineering students, from Meharchand Polytechnic along with two lectures, visited CSIR – CBRI on Feb 05, 2015.
2. A group of 50 B. tech civil engineering (III Year) along with 2 Professor from Quantum Global Campus Roorkee, visited in the Institute on November 5, 2014.
3. Shri. Ravindra Shrivastava, Asst. Professor along with a group of 30 students from UP & ES, Dehradun along with 2 faculty member visited this Institute on November 12, 2014 and learnt about new materials, building components and work done by CSIR-CBRI on anthropometrics, Fero-Cement Technique, day lighting, ventilation, fenestration design and passive systems of cooling developed for its use in buildings.
4. A group of 55 first class engineers from Water Resources Department of Maharashtra visited CSIR – CBRI laboratories on June 13, 2014.

Extension and Technical Guidance to User agencies

- As a part of dissemination of newly developed technologies among the user agencies the DC&E Group produced a technical video titled 'Confined

Masonry'. Confined masonry has been studied in details by full size experimentation to validate theoretical benefits for the first time in India. Copies of the video have been provided to about 300 different user agencies in public interest.

Dissemination, Promotion & Extension Activities:

- A Training Programme on Improved Mud and Thatch Construction, rural sanitation and safe drinking water was organized for Tharu tribal of Dudhwa Forest, UP.

Knowledge Resource Centre (Library)

'Knowledge Resource Centre' (KRC) of CSIR-CBRI is actively engaged in acquisition, technical processing, updating the collection and providing the platform for e-access of information sources to expand the horizon of information base to the scientific community. Now it is fully automated and RFID enabled systems and services.

Acquisition: **Books:** KRC added 295 numbers of books.

Journals: The library has subscribed 83 (40 foreign +43 Indian) journals. 144 volumes of journals were got bound.

Library Statistics: The present position of library Collection: Books including reports; standards; conference proceedings; theses & maps: 44087; Bound Periodicals: 20448

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 Indian Science Congress Association (ISCA), Kolkata and Life Member of the Institution of Engineers (India).

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: CBRI KRC is maintaining continuously good relationship with the libraries 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 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:** Now, access to over 2000 full text of e-journals of leading S&T publisher's viz., ASCE, full text of ASTM Standards, Elsevier(selected), Emerald, ICE (UK), IEEE, OUP, RSC, , 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. 1071 records has already uploaded 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 proceedings volumes, organized by CBRI. This database can be accessed at http://krc.cbri.res.in/dspace.

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, sponsored, grant–in-aid projects etc. Documents like annual plan, manpower deployment, 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 were organized for selection of new R&D projects. The ongoing projects were monitored for progress and/ or mid-course corrections. Comments of experts were conveyed and it was ensured that the same were incorporated before the projects are placed before

Research Council. R&D projects were processed under the four R&D areas of the institute, namely, new construction material, health monitoring rehabilitation and strengthening, disaster mitigation and energy efficient system.

Project Evaluations & Peer Reviews

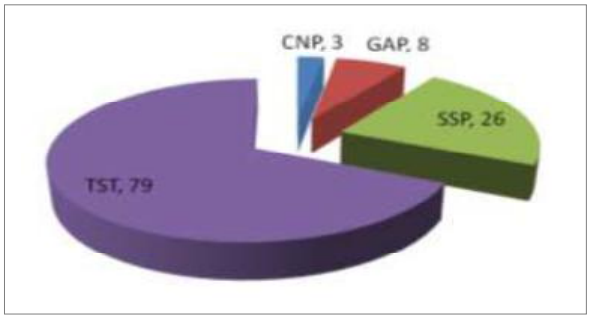
Internal and external peer review meetings and project evaluation meetings were organized for new and on-going In-house R&D projects as well as for the 12th Five Year Plan Projects during the year. PME group coordinated the scheduling of presentations & interacted with the project leaders for putting 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 a year to monitor the progress of R&D projects of the Institute. The R&D agenda of 50th & 51st 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.

External Funded Projects

The Institute has undertaken the externally funded projects on basis of the expertise in different areas in the form of Consultancy, Sponsored, Grant-in aid and Testing. During the period following projects were taken.



A Database of all the externally funded projects is maintained. This helps in effective monitoring of these projects. Necessary record and receipts of Service Tax & TDS collection are maintained. Service tax is deposited with the authorities and Form-16 sent to CSIR for recoupment of tax deducted at source by the sponsors of various projects.

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 manpower planning and deployment.

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

CSIR Resource Input		External Cash Flow	
Revenue	1391.402 Lakh	Private	31.720 Lakh
Capital	459.511 Lakh	Government	312.241Lakh
Special Projects	628.165 Lakh	Testing	236.314Lakh
Total	**2479.078 Lakh**	**Total**	**580.275 Lakh**

Special Events

National Technology Day

CSIR-Central Building Research Institute, Roorkee celebrated National Technology Day on May 12, 2014. Prof. Tushar Kanti Datta, FNAE & Emeritus Professor IIT Delhi, graced the occasion as Chief Guest and delivered a special lecture on National Technology Day. He highlighted various scientific achievements and motivated the S&T staff 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.

He explained on the study of productivity of Scientists and Engineers in R&D Laboratories in six European Countries conducted by UNESCO, revealed a number of interesting findings which are helpful in fostering productivity of Scientists (including Engineers engaged in research) in the laboratories. Some of the findings show that (i) Restricted freedom with visibility of consequence is conducive to productivity; (ii) Intrinsic motivation stands the erosion of age in productivity, while extrinsic motivation largely depends on the reward system to maintain productivity; (iii) Diversity is helpful for creativity; (iv) Informal communication with colleagues leads to better productivity and (v) Job satisfaction is key to higher productivity. Similar study was conducted in Indian academic settings with no difference in results.

The Technology Day celebration started with a lighting of lamp by the Chief Guest Prof. Tushar Kanti Datta, FNAE & Emeritus Professor IIT Delhi and Prof. S.K. Bhattacharyya, Director, CSIR-CBRI.

Earlier, in his Presidential address, Prof. S.K. Bhattacharyya, Director, CSIR-CBRI, Roorkee, briefed on the importance of National Technology Day to the gathering. He remarked that May 11th 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. The day, which proved the technical prowess of Indian scientists, is marked as the National Technology Day to inspire young minds to achieve high goals and excel at innovations.

On this occasion, various CBRI publications viz. CSIR-CBRI Annual Report 2012-13, Bilingual Newsletter / Bhavanika (Jan-March 2014), and Hindi version of Proceedings of National Workshop on Engineering Geophysics for Civil Engineering and Geo-hazards were released . Dr. A. K. Mittal, Scientist, introduced the Chief Guest and Dr. Shorab Jain, Scientist proposed a vote of thanks.

World Environment Day

The CSIR-Central Building Research Institute (CBRI) Roorkee celebrated the World Environment Day 2014 on June 5, 2014 to promote awareness on the importance of preserving our biodiversity, the need to identify problems related to the environment and ways to take corrective action. It was on this day in the year 1972 that the United Nations Conference on the Human Environment was formed. First celebrated in 1973, World Environment Day, also popularly known as Environment Day, is a means to tackle environmental challenges that include climate change, global warming, disasters and conflicts, harmful substances, environmental governance, ecosystem management and resource efficiency. The theme for this year of World Environment Day

celebrations was **Raise your voice, not the sea level** which encourages us to become more aware of the environmental impact of the sea levels raise. We make and empower us to make informed decisions.

Mr. Jai Raj, IFS, Addl. Principal Chief Conservator of Forest (Environment), Dehradun, Prof. S.K. Bhattacharyya, Director CSIR-CBRI and Prof. Prem Krishna, Chairman, Research Council, CSIR-CBRI Roorkee planted trees in CSIR-CBRI Campus as a gesture of harmonious living with nature.

Mr. Jai Raj IFS, Addl. Principal Chief Conservator of Forest (Environment), Dehradun, delivering his speech as Guest of Honour 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 and also proposed that both CBRI and Forest Department of Uttarakhand can have joint projects on environmental problems of the Uttarakhand.

Earlier, Prof. S.K. Bhattacharyya, Director CSIR-CBRI in his Presidential Address apprised that unlike the previous years, the different trees were chosen for plantation. Prof. Bhattacharyya 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.

Prof. Prem Krishna, Chairman, Research Council while addressing the gathering that in recent times, the need to promote more earth friendly practices in order to maintain the health of our planet has come to the forefront, as world nations struggle to reverse the present

trend of climate change. The World Environment Day is a reminder to show our gratefulness to Mother Nature, which sustains all forms of life. This is the day to focus our thoughts and our energies to make collective efforts towards protecting the environment. This is an urgent appeal to each one of us to recognize the significance of "Elixir of Life" and the role each one of us can play to conserve it. India has rich traditional knowledge and wisdom in the conservation of nature and natural resources. Religious beliefs, culture and folklore have together treated nature and environment with sanctity. Conservation and protection of environment and love for nature have always been part and parcel of Indian ethos and culture. Poster Competition was also organized for CBRI wards and winners were awarded. Dr. A.K. Minocha, Chief 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 globle day for positive environmental action. Vote of thanks was presented by Dr. V. C. Srivastava Member, Exec. Commitee IE(I), Roorkee Local centre , Roorkee. The Programme ended with National Anthem.

Independence Day

The Independence Day was celebrated with a deep sense of patriotism combined with gaiety on August 15, 2014 in CSIR-CBRI Main lawns of the Institute. Prof. S.K. Bhattacharyya, Director, CSIR-CBRI 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 and CBRI Junior High School presented various cultural programmes on patriotic themes.

Sadbhavna Diwas

The Institute observed Sadbhavna Diwas on August 20, 2014 with a view to promote harmony amongst people of all religion, languages and states and goodwill towards everyone. Mr. A. Ghosh, Chief Scientist, CSIR-CBRI administered Sadbhavna pledge to all the staff members of the Institute.

Hindi Pakhwara

Hindi Pakhwara was observed at the Institute during September 12-25, 2014 with great zeal and enthusiasm. Dr. Budhinath Misra, Ex-DGM, ONGC, Dehradun graced the inauguration function as Chief Guest and the function was chaired by Prof. S.K. Bhattacharyya, Director, CSIR-CBRI. Dr. Budhinath Misra stressed on the need of paying more attention on the use of Hindi in day to day work as it is easy to work in Hindi. Moreover, working in Hindi language is everyone's constitutional duty, which should be followed religiously. Prof. Bhattacharyya appealed to all officials to carry out their maximum official work in Hindi language and urged them to continue with this effort. Mr. Y. Pandey conducted the programme and stated that he is overjoyed to find out that large number of officials are participating in the event.

During this period several lectures were organized including "Behaviour of Elephants in Rajaji National Park" by Dr. B. D. Joshi, Gurukul Kangri University, Haridwar, "Around the Books" by Mr. Yadvendra Pandey, Chief Scientist, "Termite Control in Green Buildings" by Dr. B. S. Rawat, Principal Scientist, "Traditional Water Conservation Techniques in India" by Mr. Anupam Mishra, Gandhi Peace Foundation, New Delhi, "Awakening Public Awareness by Mass Communication" by Dr. Atul Kumar Agarwal, Sr. Principal Scientist, "General Information on LTC Rules" by Mr. Alok Sharma, Section Officer, "Rare Pictures of the Himalayas" by Mr. A. K. Jethi, Retired Technical Officer, CSIR-CBRI, Roorkee.

Various Competitions including Hindi Noting and Drafting, poetry recitation, speech competition were also organized. An exhibition on Hindi books was also organized in which the viewers appreciated the Hindi books available in the Library.

Mr. Leela Dhar Mandloi, Director, Bhartiya Gyanpeeth New Delhi graced the valedictory function as Chief Guest of the Hindi Pakhwara. Winners of various competitions were felicitated in the end. The Hindi Pakhwara concluded with a vote of thanks with the special contribution of Mr. Mehar Singh, Mr. Suba Singh and Mr. Naresh Yadav.

CSIR Foundation Day

72nd anniversary of CSIR was celebrated with great enthusiasm at CSIR-Central Building Research Institute, Roorkee on September 26, 2014. Dr. S.P.S. Bakshi, Chairman cum Managing Director, Engineers Projects India Ltd. (EPIL) and President, Indian Building Congress, New Delhi graced the occasion as Chief Guest and 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.

The programme was started with 'Swachh Bharat Abhiyan (A Cleanliness Drive)' in which everyone participated including the chief guest Dr. S. P. S. Bakhi and Prof. S. K. Bhattacharyya, Director, CSIR-CBRI. Students from various colleges presented their working models under 'CSIR Faculty Training Program and motivation to Science Students' mentored by institute scientists and technical officers. The chief guest took keen interest and appreciated the projects.

Prof. S. K. Bhattacharyya, Director, CSIR-CBRI highlighted the glorious past of CSIR, establishment of five labs in the year 1942 and CBRI in 1947. Since then CSIR has been contributing in the development of the country covering all the important areas of science and technology through thirty seven laboratories all across the country. He highlighted the role of scientists in the development of the country with the example of the successful mission of 'Mangal Expedition'.

He informed that CSIR–CBRI has taken initiatives for promoting electronically green culture in the institute through different modules. He also talked about the major focus areas of R&D activities of the institute and the activities of AcSIR in the institute; M. Tech. programme on 'Building Engineering and Disaster Mitigation' (BEDM); Ph.D. programme and dedicated power line installation by UPCL for the uninterrupted power supply in the institute.

Dr. S.P.S. Bakshi, suggested that CSIR-CBRI may join hands with EPIL for the forthcoming 100 smart city project by the Ministry of Urban Development. He highlighted the need of optimum utilization of resources i.e. fly ash and role of R&D institutions in construction by EPIL. He highlighted the need of fire safety in buildings and suggested that fireproof materials need to be developed. He ended his address by recalling the successful mission on Mars and need of 'Swachhta Abhiyan' for country's glory.

On this occasion bilingual edition of 'CBRI News Letter' and 'Bhavanika' was released by the chief guest. CSIR prize for meritorious staff children, who have secured more than ninety percent marks in three science subjects in class XII and getting admission in IITs, were honoured. The superannuated scientists/ staff of CSIR-CBRI were honoured by presentation of a shawl, samman patra and a wrist watch. Also, CBRI staff members who have completed twenty five years' service in CSIR were felicitated by the chief guest by presenting them a wrist watch. Mr. R. K. Garg, chief scientist proposed a vote of thanks.

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. On this occasion, school children from seven local schools along with faculty members visited the institute. A cultural program was organized in the evening which was enjoyed and appreciated by one and all. Mrs. Kajal Bhattacharya, Patron ladies club, CSIR- CBRI and chief guest of this function gave away the prizes.

CBRI Celebrates Swachh Bharat Abhiyan

Swachh Bharat Abhiyan (Clean India Mission) is a national level campaign by the Government of India, covering 4041 statutory towns to clean the streets, roads and infrastructure of the country.

Swachh Bharat Abhiyan was announced by Prime Minister of India, Mr. Narendra Modi on Indian Independence Day and on Gandhi Jayanti. Prime Minister Mr. Narendra Modi himself wielded broom and cleaned a road. The campaign is India's biggest ever cleanliness drive and 3 million government employees and schools and colleges students of India participated in this event. The mission was started by Mr. Narendra Modi, the Prime Minister of India, nominating nine famous personalities for this campaign, and they take up the challenge and nominate nine more people and so on (like the branching of a tree). It has been carried forward since then with famous people from all walks of life joining it.

Swachh Bharat Abhiyan, with the help of the Government of India, political parties, NGOs, corporations and with active people's participation, is slated to be completed in 2019. It was Mahatma Gandhi who laid great emphasis on cleanliness. He himself said "Sanitation is more important than Independence". He wanted India to be a clean India. He very well had a clear understanding of the pathetic condition of the rural people. It's been 67 years of Independence, and even today, more than half of India's population does not have proper toilets. Considering this fact in mind, the present Government of India wants to fulfil the dream of Mahatma Gandhi and usher a clean India by 2019, which will mark the 150th birth anniversary of Mahatma Gandhi.

This campaign aims to accomplish the vision of 'Clean India' by October 2, 2019, 150th birthday of Mahatma Gandhi and is expected to cost over ₹62000 crore (US$9.7 billion). The fund sharing between the Central Government and the State Government/ Urban Local Bodies (ULBs) is 75%:25% (90%: 10% for North Eastern and special category states) the campaign was described as "beyond politics" and "inspired by patriotism". The aims were:

1. To eliminate open defecation
2. Conversion of insanitary toilets to pour flush toilets
3. To eradicate manual scavenging
4. 100% collection and scientific processing/disposal reuse/recycle of Municipal Solid Waste
5. To bring about a behavioural change in people regarding healthy sanitation practices
6. To generate awareness among the citizens about sanitation and its linkages with public health
7. To strengthen urban local bodies to design, execute and operate systems
8. To create enabling environment for private sector participation in Capital Expenditure and Operation & Maintenance (O&M) costs

Government would be launching a Nationwide Real Time Monitoring system for toilets constructed under the Swachh Bharat Abhiyan. With this system government aims to attain 100% Open Defecation Free India by 2019.

Major Issues of Swachh Bharat Abhiyan:

According to Central Pollution Control Board (CPCB), Urban India generates about 47 million tonnes of solid waste every year. It is also reported that more than 75 percent of sewage or wastewater disposal is not treated in India. Recycling solid waste is a big problem. These issues need to be addressed now, so that a major crisis can be prevented in the future.

- In rural India, lack of adequate sanitation is a huge challenge.
- Another major challenge is to change the mindsets of the people. When will our countrymen learn not to spit or throw garbage on the roads? Or when will our people learn to keep themselves and their localities clean?

A cleanliness campaign was launched with an oath ceremony. Mr. A. Ghosh inspired to spend at least 100 hours annually & 2 hours in a week in this drive. Mr. Ghosh accented & emphasized on the necessity of cleaning in our life.The cleaning campaign in the Institute was initiated in all the sections & groups including Fire Research, Rural Park, Structural Engineering, Badminton Court, Bal Vidya Mandir, Dispensary, Security, Publication, Finance, Library etc.

All employees participated in this campaign with enthusiasm. On this occasion Dr. A K. Minocha, Mr. R. K. Garg Dr. Atul Kumar Agarwal, Mr. Anil Kumar, Mr. R. K. Manjhiwal, Dr. M. K. Sinha, Mr. Rajiv etc. were present.

Diwali Mela

The Diwali Mela was organized jointly by CSIR-CBRI Staff club and Shanti Nagar Ladies Club Roorkee on October 17, 2014 at Shanti Nagar Colony ground. Prof. S.K.Bhattacharyya, Director, CSIR-CBRI inaugurated the Mela. This annual festival has fun for the entire CBRI family. In this Mela, entertainment programmes viz. traditional singing and dancing performance by artists of different age group of childern's from CBRI staff were organized. Prof. S.K.Bhattacharyya, Director visited all the stalls organized by member of CBRI Ladies Club.

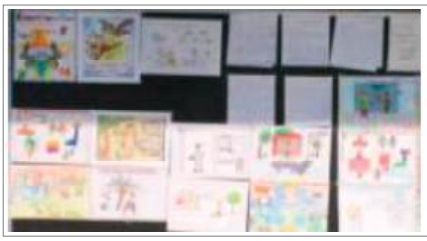
Stalls offering wide variety of delicious traditional food were well appreciated. A beautiful group dance "Dandia" was presented by children of the CBRI staff. A huge rush attached for the viewing Fashion show of different age groups. Baby show was also programmed for 1-2 Years babies. In addition to that many other activities like "Hawaii Guitar", Dance Competition, Tombala, Lucky Dip etc. were also appreciated by audience, viewers and judges. Prizes were distributed to the winners of all the competitions including Lucky Dip. The fun and revelry was accompanied by everyone who was present there. Viewers appreciated the whole programme and perceived the importance of "Festival of Light" in life . In the end "Atishbazi" session was also prevailed and it makes to all people stunned for an instance.

Vigilance Awareness Week

The Vigilance Awareness Week was observed in the Institute from October 27 to November 01, 2014 with fervour and exultation. The week started with the Inaugural Ceremony in which the Pledge was administered by Prof. S. K. Bhattacharyya, Director CSIR- CBRI to all the employees of the Institute including project assistants, temporary staff and students etc.

Mr. Ashok Kumar, Senior Principal Scientist & Chairman Vigilance Awareness Week -2014 Committee gave an overview of the week long activities to be organized. Various programs were organized during the week to sensitize the employees, students, public and society at large about how technology can be used in Combating Corruption - the theme of the awareness week.

An Internal Lecture was delivered by Mr. Ashok Kumar, Senior Principal Scientist, CSIR- CBRI & Chairman Vigilance Awareness Week - 2014 on October 29, 2014 on "Combating Corruption – Technology as an Enabler", at DCE Hall which was attended by scientific, technical, administrative, accounts & purchase staff and also by temporary staff such as project assistants & fellows, Ph. D. scholars as well as the students.



Other activities such as Debate Competition, Essay Competition, and Poster Competition were also organized for the CBRI staff and their children and other school children during the Vigilance Awareness Week.

An Invited Lecture was delivered by Mr. N. K. Mishra, AGM (Vigilance) BHEL Haridwar on October 31, 2014 and he stressed on Combating Corruption through best use of technology. He also mentioned the initiatives taken by BHEL, Haridwar in this direction.

Prizes were given to all the Prize Winners by Prof. S. K. Bhattacharyya, Director CSIR- CBRI and Mr. N. K. Mishra, AGM (Vigilance) BHEL Haridwar.

Prof. S. K. Bhattacharyya, Director CSIR- CBRI gave his Presidential Address and stressed on how technology should be used efficiently to get positive effects of it in combating corruption.

Mr. Ashok Kumar, Chairman, Vigilance Awareness Week Committee, gave a Vote of Thanks and acknowledged everyone for directly or indirectly helping in organizing the week long activities, especially to Prof. S. K. Bhattacharyya, Director CSIR- CBRI for his guidance throughout the week and thanked Mr. N. K. Mishra for delivering an Invited Lecture.

Republic Day

The Republic Day of the Nation was celebrated with a deep sense of patriotism combined with gaiety on January 26, 2015 at CSIR- Central Building Research Institute main lawns. 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 and CBRI Junior High School Shanti Nagar presented various cultural programmes on patriotic themes. A Cricket Match was also arranged.

CSIR-CBRI Foundation Day

69th CSIR-CBRI Foundation Day was celebrated with great enthusiasm at CSIR-Central Building Research Institute, Roorkee on Tuesday, February 10, 2015. Dr. Rajendra Dobhal, Director General, Uttarakhand State Council for Science & Technology graced as the chief guest and Prof. S.K. Bhattacharyya, Director, CSIR-CBRI presided over the function.

Prof. S.K. Bhattacharyya, Director, CSIR-CBRI addressed the gathering, highlighting the glorious past of CSIR-CBRI, which was established on February 10, 1947. Since then it has been contributing in the development of the country and carrying out R&D on all aspects of housing and assisting the building industry in solving problems of planning, designing, foundations, materials and construction including disaster mitigation in all kinds of buildings, environment preservation and energy conservation. He informed that the institute has taken up projects related to conservation of nationally important heritage structures such as Taj Mahal, Chittaurgarh Fort and Sun Temple, Konark. He spoke about the CSIR-800 project and role of the institute aiming at the upliftment of the life of poor people in the country. Integrated M. Tech – Ph. D Programme on "Building Engineering & Disaster Mitigation (BEDM)" which CSIR-CBRI has started under the Academy of Scientific and Innovative Research (AcSIR) was also highlighted. Recently Institute has started MS by Research programme for achieving excellence to train existing young manpower. He talked about the major focus areas of R&D, newer areas of research such as sustainability, nanotechnology, bio-concrete and waste utilization in the production of construction materials and products. Recent technology transfers, collaborations and MoU signed were also highlighted.

Dr. Rajendra Dobhal, Chief Guest, appreciated the work done by CSIR-CBRI. He stressed the need of sustainable development and highlighted the role of construction industry in the growth of the smart cities & country. He also emphasised the work done by some prominent scientists in R&D like Dr. A.P.J Kalam, Albert Einstein, and Louis Pasteur & Jayant Vishnu Narlikar etc. He called "Scientists are the pride of Nation" & they play a vital role in the development process of Nation. He discussed about the quality of higher education and research in today's India. He called CBRI is an ultimate institute of nation for ultimate peoples which has its special vision and purpose in reference of Nation Development.

Diamond Jubilee Directors' Award for the best research paper was awarded for the paper entitled " Rainfall Thresholds for Prediction of Shallow Landslide around Chamoli-Joshimath Region, Garhwal Himalayas, India" authored by Dr. D. P. Kanungo & Ms. Shaifaly Sharma. Diamond Jubilee Director's Award for development of best Technology/Innovation/Know-how which has maximum impact on the society was awarded to Dr. Suvir Singh, Dr. N. K. Saxena, Mr. Rajeev Bansal, Mr. Narendra Kumar & Mr. Sushil Kumar on "Development of Fire Resistant Door".

On this occasion, a number of CSIR-CBRI publications were released including a special edition of book named 'Nirmanika' , Bilingual 'CSIR-CBRI News Letter'/ 'Bhavanika' and CSIR-CBRI Annual Report 2013-2014, a special brochure on "CSIR-CBRI Technology Demonstration-cum-Class Room". Dr. A. K. Minocha, Chief Scientist proposed a vote of thanks. The superannuated staff of CBRI and all the staff members of the institute also witnessed the occasion besides other dignitaries.

There have been a number of activities, organized to celebrate CSIR-CBRI Foundation Day including games. A cultural programme was organized in the evening by the staff club and ladies club of the institute which was enjoyed and appreciated by one and all. Mrs. Kajal Bhattacharya, patron, CBRI Ladies Club, distributed the prizes to the participants.

Inauguration of Landslide Observatory

A Landslide Observatory for real time monitoring of a potential landslide at Pakhi near Pipalkoti along the Alaknanda Valley of Garhwal Himalayas using wireless sensors network has been put in place by the initiative of CSIR-CBRI, Roorkee under 12th Five Year Plan activity to develop an early warning system for landslides in Garhwal Himalayas. The measurement sensors include in-place inclinometers and piezometers installed in bore holes, surface wire-line extensometers placed across the developed tension cracks and an automatic weather station (AWS) with rain gauge, temperature, humidity, wind velocity and direction measurement sensors. These sensors are wirelessly communicating through nodes to the gateway for real time data acquisition at the landslide observatory.

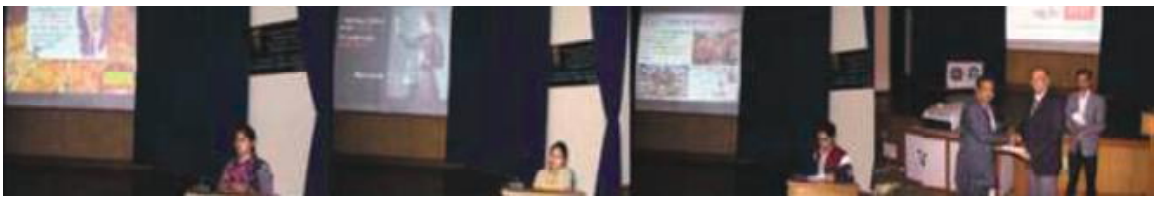
The data is being transferred from the observatory to the central station at CSIR-CBRI campus through web server using ARGUS monitoring software. The real time data during coming monsoon seasons will be monitored and analysed to establish multi-parameter based landslide warning thresholds based on which an early warning system for landslide will be developed. Such type of real time landslide monitoring can provide immediate information on the landslide activity and also insight into the dynamics of landslide movement that may be critical to protect lives and property and for improved geotechnical designs or emergency actions aimed at mitigating landslide hazards.

Prof. Sriman K. Bhattacharyya, Director, CSIR-CBRI, Roorkee inaugurated the Landslide Observatory at Pakhi Landslide on February 21, 2015. On this occasion, Dr. S. Sarkar, Senior Principal Scientist & and Dr. D.P. Kanungo, Principal Scientist & Project Leader were also present. The project fellows involved in this project namely Mr. Anil Maletha, Mohd. Atif, Ms Neelu Sharma and Ms Manali Singh were also present at site on this occasion.

With this effort, Landslide Early Warning System (LEWS) once developed will help in alerting people in advance to save property and loss of lives and to manage traffic before occurrence of a major event particularly during the monsoon season.

National Science Day

CSIR-CBRI celebrated the National Science Day on February 27th, 2015. On this occasion "CSIR-CBRI Engineering Challenge Competition" was organized among the Students/Project Fellows/Project Assistants/ Trainees / CBRI S&T Staff. The objective of this competition was to design concrete mix and test the compressive strength of the cubes so that the characteristic compressive strength of 25MPa is achieved on the 7th day. Ten teams comprising of students, project fellows and young scientists of CSIR-CBRI participated in the competition and 1st, 2nd & 3rd prizes were given to the winners. All the team presented the methods of preparing the concrete cubes through posters.



A program was also organized on "Legends in Science" in which the AcSIR students of CSIR-CBRI presented brief life sketches of a few legendary scientists such as Madam Qurie, Wilhelm Rontgen, Satyendra Nath Bose and Michael Faraday.

Prof. S.K. Bhattacharyya, Director, CSIR-CBRI expressed his views about the National Science Day and the significance of "Science for Nation Building" which was the theme of the year 2015. This was followed by the National Science Day lecture on "A Framework for Development of Technology - Inspired by Nature" by Prof. Bikas Mohanty, Indian Institute of Technology, Roorkee.

International Women's Day

CSIR-CBRI celebrated International Women's Day on March 8, 2015. A Panel discussion on "Role of Women in Nation Building" was organised. The women working in different profession such as Dr. Varija, Practicing Doctor, Dr. Rama Bhargava, Professor, IIT Roorkee, Ms. Shashi Kir, Teacher, APS -2, Dr. Nisha, Medical Officer, Civil Hospital, Dr. Shalini Pant, Principal, S.D. Degree College, Mrs. Kajal Bhattacharya, Patron, CBRI Ladies Club participated in the discussion and shared their valuable views on the subject. Prof. S. K. Bhattacharyya Director graced the function as Chief Guest and emphasized the importance of women in the progress of the country. The women scientists, CBRI ladies club members and scientists of the institute attended the programme and actively participated. Mrs. Neeta Mittal, Senior Principal Scientist, convened the event.

Exchange Meet

CSIR-CBRI in association with Indo-US Science and Technology Foundation and Michigan State University, USA organised an Exchange Meet on Structural and Passive Fire Safety in Buildings: Issues & Challenges during March 9-10, 2015.

During the inaugural function Dr. Rejeev Sharma, Executive Director, Indo-US Science and Technology Foundation spoke about IUSSTF programme Prof. S. K. Bhattacharyya, Director CSIR–CBRI, Roorkee and Prof. Venkatesh Kodur, Professor and Director SAFE-D Center, Dept. of Civil and Environmental Engineering, Michigan State University, USA also addressed the audience.

The researchers working in the area of Fire Engineering from different Institutes of India experts involved in the fire safety issues from Industries, individuals such as entrepreneurs, consultants, engineers and other professionals were present during the two days exchange meet. Main focus areas were:

- Fire safety in buildings
- Passive fire protection: Trends, Issues and Challenges
- Structural Fire Engineering
- Case studies and lessons from post fire investigations
- Fire protection of structural elements
- Compartmentation and fire resistance of building elements

An exhibition was also organised to provide guidance and practical advice on the latest technologies and range of products available in the market, directly by the promoting agencies/ companies. Several companies participated in the exhibition.

More than fifteen speakers presented the papers during this two days exchange meet. On the second day two panel discussions were also organised. Panel Discussion - 1 was on Structural fire engineering: Research trends & needs. Panel Discussions–2 was on Enhancing fire safety in buildings: Strengthening of passive fire protection systems

Annual Flower & Vegetables Show

CSIR–CBRI Staff Club organised 48th Annual Flower and Vegetable Show on March 15, 2015. Most of the institutions such as IIT Roorkee, Bengal Engineering Group & Centre, Roorkee and National Institute of Hydrology, Roorkee have participated in the show. There were several categories for the competition which include flower garden, pot plants, cut flowers for institutions and individuals, Vegetables, Flower Rangoli and Salad Arrangements for individuals. The show was inaugurated by Prof. S.K. Bhattacharyya, Director, CSIR-CBRI and

Brig. Sunil Takiar, Commandant, Military Hospital, BEG & Centre as Chief Guest and gave away the prizes to the winners. Dr. P.K.S. Chauhan, Scientist was the convener of the flower Show. The show was organized under the Chairmanship of Ar. S. K. Negi, Scientist.

INDO-UK Scientific Seminar

CSIR-Central Building Research Institute, Roorkee organized a two days Seminar at India Habitat Centre, New Delhi during March 28-29, 2015. The seminar was jointly sponsored by Department of Science and Technology, New Delhi and Royal Society, London, UK. Dr. M.O. Garg, Director General, Council of Scientific & Industrial Research, New Delhi was the Chief Guest at the Inaugural Function and Prof. S.K. Bhattacharyya, Director, CSIR–Central Building Research Institute, Roorkee presided over the Inaugural Function. Dr. L. P. Singh (India Side) and Dr. Wenzhong Zhu (UK side) coordinated the seminar and briefly highlighted the relevance of theme.

The seminar was aimed to cover the recent advancements and trends in the area of green construction materials vis-à-vis sustainable built environment to share and networking on the emerging and futuristic challenges. Objective of the seminar was to explore and highlight how sustainable building material can contribute to lessen the impact of environmental degradation and create healthy buildings which will be comfortable to the occupant as well as sustainable. The two days seminar was attended by 15 Indian delegates from industry/academics/research institutes and 4 UK delegates. The seminar was divided into five technical sessions: Greener Concrete, Composite Materials, Energy Efficiency, Next Generation Materials and Recycling of Construction & Demolition Waste. It was arrived upon during the seminar that adopting green building materials is an excellent approach to meet the target of sustainable built environment.

Building related contributions to environmental issues are large and therefore, essential to be addressed by the scientists, engineers and technologists. While there is obviously need for new technologies to optimize the applications of low-impact building materials, it is also true that

there are several technologies or systems, currently in use. Selection of construction materials which have minimum environmental burdens is useful in the sustainable development of a country. The seminar concluded with a list of research priorities to work in collaborative mode and develop a roadmap for Green Construction Materials for Sustainable Built Environment.

Projects

In-house R&D Projects (2014-15)

Sl. No.	Project No.	Title of the Project	Principal Investigator Co-Investigator	Duration
Health Monitoring, Rehabilitation & Strengthen				
1.	OLP 0371	Critical evaluation of durability and response of FRP upgraded and rehabilitated reinforced concrete beams.	Mr. H.C. Arora	1012-0914 - 1214
2.	OLP 0374	Investigations of foundation system through borehole radar.	Mr. Ajay D.	1212-0514
3.	OLP 0376	Development of sandwich soil technology for Geo synthetic reinforced earth walls.	Ms. Parvathi G.S.	0413-0315
4.	OLP 0377	Seismic bearing capacity for shallow foundation by pseudo-dynamic method.	Mr. Anindya Pain	0413-0315
5.	OLP 0378	Experimental evaluation of precast beam-beam connection.	Mr. Siddharth Behera Dr. A.K. Mittal	0413-0315-0615
6.	OLP 0386	Group effect of piles in loose sandy soil in earthquake inducted lateral spreading.	Mr. Piyush Mohanty	0414-0316
7.	OLP 0387	Study of carbonation of RC structures.	Mr. Mickey M. Dalbehera	0414-0316
Disaster Mitigation				
8.	OLP 0372	Strengthening of stone masonry housing constructions against earthquakes.	Dr. Navjeev Saxena	1012-0914-0315
9.	OLP 0383	Optimization of water sprays and location of sprinkler in an enclosed fire.	Dr. A. Arviind Kumar Dr. Rajiv Kumar	0413-0315
10.	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 up-to-date worldwide searched work.	Dr. Manju Mittal	1012-0915
Energy Efficient System & Other Projects				
11.	OLP – 0375	Development of a process of improving indoor thermal comfort by exchanging head with underground water.	Mr. H.K. Jain Dr. P.K. Bhargava Mr. Nagesh B. Balam	0113-0614
12.	OLP 0384	Study of residential schools in composite climate for energy conservation.	Mrs. Neeta Mittal	0413-0315
13.	OLP 0385	Active structural acoustic control of building service equipment at the source.	Dr. S.K. Panigrahi	0413-0315
14.	OLP 0388	Design, development and dissemination of appropriate rural housing systems for northern India	Prof. S.K. Bhattacharyya	0914-0315

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** WP-2: Next Generation Concrete for Sustainable Construction. **PI: Mr. S. K. Singh** WP-3: Green Building Technologies. **PI: Mr. Ashok Kumar** WP-4: Materials & Technologies for Hazard Reduction. **PI: Dr. S.R. Karade**
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** WP-2 : Engineering of Earthquake Disaster Mitigation **PI: Dr. P.K.S. Chauhan & Mr. Ajay Chourasia** WP-3 : Engineering of Fire Disaster Mitigation **PI: Mr. R.S. Chimote & Dr. Suvir Singh** WP-4 : Post Disaster Shelter Planning **PI: Mr. S.K. Negi** WP-5: Health Monitoring of Buildings Using Wireless Sensor Network. **PI: Mr. Ajay Chourasia & Mr. Soju Alexander** WP-6: Intelligent Building System For Model Residential Unit. **PI: Dr. A.K. Mittal & Mr. R.S. Bisht**
03	06- Network Projects CSIR- CBRI Participating Laboratory	"Removal of Heavy Metals from Waste Water using Fly ash & secured Disposal of the Sludge" **PI: Mr. S. Maiti [CSIR-NEERI]** ESC 0306 Estimation of Crustal Deformation of Garhwal Himalaya. **PI : Dr. S. Sarkar**, ISC 0301 **[CSIR-4PI, Advance Research in Engineering & Earth Sciences (ARiEES) : Data Intensive Modelling & Crowd Sourcing Approach]** Energy Efficient Seed Storage Structures. **PI: Mr. Nagesh B. Balam,** PSC0103 [**CSIR-CSIO, Advanced Instrumentation Solutions for Health Care and Agro – based Applications - ASHA]** Development of Appropriate Support System for Artificial Pillars for Optimal Extraction of Locked-up Coal from Underground Mines. [**CSIR- CIMFR, Dhanbad]** **PI. : Mr. Ajay Chourasia,** ESC0105 Service Robot for Building and other Structures, **PI: Mr. Ravindra S. Bisht** **[CSIR-CMERI, Micro Machines and Robotics]** ESC 0112 CSIR Knowledge Gateway & Open Source Private Cloud Infrastructure-KNOWGATE. [**CSIR- NISCAIR] PI: Dr. S.K. Senapati,** ISC0102

R&D SUPPORT ACTIVITIES

(Decision Unit 06)

S.N.	Activity No.	Activity	Coordinator
1	STS 0001	**Knowledge Resource Centre (KRC)** Library Services, Documentation, Books, Publication and Institutional Depository	Dr. B. Singh Dr. 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 & MC Agenda (Externally Funded Projects)	Dr. Sunil K. Sharma (Up to Oct., 2015) Mr. Y Pandey (From Nov., 2015) Mr. 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	Dr. Sunil K. Sharma (Up to Oct., 2015) Mr. Y Pandey (From Nov., 2015) Dr. P.K. Yadav
4	STS 004	**Development Construction & Extension (DC&E)** Inland Liaison Including Exhibitions, Displays, Training, Special Functions & Visitors, Development, Technical Guidance/Aid, & Films, Demonstration, Constructions, Feedback, Overseas Collaboration & Deputation and Liaison with BIS & others and Photography Services	GL(DC&E) Mr. H.K. Jain
5	STS 0005	**Extension Centre, Delhi**	Dr. Rajesh Deoliya
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)**	Mr. H.K. Jain Mr. Soju Alexander Mr. Nagesh B. Balam

SUPPORT ACTIVITIES

Administrative Support Activities (Decision Unit 08)		**Coordinator**
General Administration & House Keeping		**Director**
1.	**Director's Secretariat (DTS)**	Director
2.	**Administration**	AO
3.	**Finance & Accounts**	F&AO
4.	**Store & Purchase**	S&PO
5.	**Security**	Security Officer
6.	**Hindi Unit**	Mr. Y. Pandey
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**	Secretary Staff Club
10.	**Estate (Civil Works)** Civil Works, New Construction, Maintenance & Cleaning & Sanitation Institute Cleaning Services Horticulture Services & Flower Show Water Supply related Services	Dr. S.R. Karade Mr. S.K. Negi Dr. P K S Chauhan Dr. Pradeep Kumar-I
11.	**Technical Services Group (TSG)** Air Conditioning Electrical Services, Maintenance of Vehicles PABX System	Mr. D.K. Sehgal Mr. D.K. Sehgal Dr. A.K. Mittal Mr. Soju J. Alexander Mr. Nagesh B. Balam Dr. Rajiv Kumar Dr. A.K. Mittal

Externally Funded Projects

S.No.	Project No	PI	Sponsor Agencies	Title
1.	CNP0030	S. R. Karade	General Manager (PE- Civil), National Thermal Power Corporation, Engg office complex, A- 8A, Sector- 24, Noida-201301	Health Assessment and Remedial Measures for the repair of Cooling Towers of NTPC Simhadri
2.	CNP0203	A. Ghosh	i) M/s Pandya & Poonawala, Advocates & Solicitor, 102-104, Bhagyoday, 1st Floor, 79, Nagindas Master Road, Fort, Mumbai ii) M/s Federal & Rashmikant (Rgd), Seksaria Chambers, 1st Floor, Office No. 101-104, 139, Nagindas Master Road, Opp. Commerce House, Fort, Mumbai	Evaluation of Geotechnical, Geological, Structural and Environmental Aspects of proposed Slum Rehabiliation Project at Malabat Hills, Mumbai
3.	CNP0273	Y. Pandey	Birla Cement Works, Madhavnagar, Chanderia, Chittorgarh-312021	Evaluation of Cumulative Effect of Mine Blasting on Chittorgarh Fort Structures & its Environment
4.	GAP0024	L.P.Singh	Ministry of Environment & Forests (EI Division), Paryavaran Bhawan, CGO Complex, Lodhi Road., New Delhi-3	Transferred from GAP3522
5.	GAP0032	L. P. Singh	Uttrakhand Council of Science & Technology, 6, Vasant Vihar, Phase I, Dehradun	Performance Enhancement of Cementitious and Polymetric Materials through Nanotechnology
6.	GAP0062	Ajay Chourasia	Department of Science & Technology, Technology Bhawan, New Mehrauli Road, New Delhi	Health Monitoring of Buildings using Wireless Sensor Network
7.	GAP0072	A. K. Minocha	Department of Science & Technology, Technology Bhawan, New Mehrauli Road, New Delhi	Demolition Wastes as Raw Materials for Low Cost Construction Products
8.	GAP0132	Rajni Lakhani	Department of Science & Technology, Technology Bhawan, New Mehrauli Road, New Delhi	Development of Technology for making Flooring and Wall Tiles using Kota Stone waste
9.	GAP0213	S. K. Bhattacharyya	Indo-US Science & Technology Forum, Fulbright House, 12 Hailey Road, New Delhi	Fire Center for Advancing Research and Education in Structural Fire Engineering
10.	GAP0251	Shefali Sharma	Department of Science & Technology, Technology Bhawan, New Mehrauli Road, New Delhi	Development of Landslide Prediction Models using Numerical and Statistical Approaches

S.No.	Project No	PI	Sponsor Agencies	Title
11.	GAP0433	L. P. Singh	Department of Science & Technology, Technology Bhawan, New Mehrauli Road, New Delhi	Studies of Nano-Engineered Cementitious and Polymeric Binders in Developing High-Performance Building Materials
12.	SSP0044	Ajay Chourasia	Executive Engr., CP Division No. 5, Chandigarh	Restoration and Preservation of Reinforced Concrete Heritage Buildings of Chandigarh - Stage 1: Secretariate Building
13.	SSP0094	Suvir Singh	Superintending Engr., Shimla Central Circle, CPWD, Kennedy Cottage, Shimla	Post Fire Investigations of Fire Damage Gorton Castle Building and Remedial Measures
14.	SSP0103	Suvir Singh	M/s Stanvac Chemicals (I) Ltd., 15-16 Old Sewa Nagar Market, P.O. Lodhi Road, New Delhi-49	Toxilogical and Flame Spread Studies on Coated Cables
15.	SSP0133	A. Ghosh	AGM (CS-III), NTPC Ltd., 6th Floor, Engg. Office Complex, Plot No. A-8A, Sector 24, NOIDA-201301	Foundation Design of Oil Exploration Well Sites, Cambay Basin, NTPC sites
16.	SSP0152	Suvir Singh	M/s Addl Gen. Manager (Civil) Ircon International Ltd. JKRL Project Banihal 146182 Distt. Ramban, J & K	Spalling Behaviour of Tunnel Lining Concrete under High Temperature Loading
17.	SSP0162	A. K. Mittal	Superintending Archaeologist, Archaeological Survey of India, Bhubaneshwar Circle, Bhabaneshwar	Investigation at Sun Temple Konark
18.	SSP0164	A. K. Mittal	Director (planning), Army Welfare Housing Orgn (AWHO), South Hutment, Kashmir House, Rajaji Marg, New Delhi	Structural Checking of AWHO Group Housing Project at Pachkula
19.	SSP0173	Y. Pandey	Superintending Archaeologist, Archaeological Survey of India, Dehradun Circle, Dharohar, Tyagi Road, Dehradun-248001	Studies & Advice on Safety of Patal Bhubaneshwar cave, Pithoragarh (Uttrakhand)
20.	SSP0174	Suvir Singh	M/s Jaslonite Konard Hi-Tek Pvt. Ltd, Dharam Industrial Complex, Chhokra Nala, G.E. Road, Raipur	Fire Performance Assessment of Protected Steel Column under High Temperature Loading
21.	SSP0181	A. K. Mittal	State Project Office Sarva Shiksha Abhiyan, Dehradun, Uttarakhand	Design And Construction Monitoring Of School Buildings Under Sarva Shiksha Abhiyan
22.	SSP0242	B. M. Suman	Mr. Udipt Agarwal, M/s BASF India Ltd., Plot No. 37, Chandivali Farm Rd., Andheri (E), Mumbai-72	Energy Simulation of Potato Cold Storage using Different BASF Insulation Products and Recommendation of Measures for reducing Energy Consumption

S.No.	Project No	PI	Sponsor Agencies	Title
23.	SSP0254	S. Sarkar	Airport Authority of India, Rajiv Gandhi Bhawan, Safdarjung Road, New Delhi	Instrumentation and Monitoring of Buildings and Reinforced Soil Structure at Greenfield Airport at Pakyong, Sikkim
24.	SSP0290	Y. Pandey	Superintending Archaeologist Archaeological Survey Of India Delhi Circle Safdarjang Tomb New Delhi	Physical Structural And Material Study Of Qutub Minar
25.	SSP0302	A. K. Sharma	The Suprintending Archaeologist, Archaeological Survey of India, Agra Circle, 22, The Mall, Agra - 282 001	Comprehensive Geotechnical and Structural Investigation of Taj Mahal
26.	SSP0324	Rajesh Deoliya	Executive Engr., Civil Buildings Maintenance Division, M-431, Near Gate No. 6, J. L. Nehru Stadium, New Delhi	Third Party Quality Assurance for the Civil Construction Work of Redevelopment of 'C' Block at High Court, New Delhi
27.	SSP0333	Ashok Kumar	Director, Central Statistics Office (National Accounts Division-4), Ministry of Statistics & Programme Implementation, Sardar Patel Bhavan, Sansad Marg, New Delhi-1	Study of Improvement in Rates and Ratios used in the Estimates of Gross Value added in Construction Sector and Capital Information
28.	SSP0362	B. M. Suman	Asstt. Manager Marketing, M/s UP Twiga Fiberglass Ltd., Twiga House 3, Community Centre, East of Kailash, New Delhi - 65	Study on Thermal Behavious of Twiga RB Fiberglass with increasing Temperature at six Densitites taking as Fix Parameter
29.	SSP0382	B. S. Rawat	M/s Bayer CropScience, BG Environmental Science, Bayer House, Central Avenue Hiranandani Gardens, Powai, Mumbai	Studies on Premise Foam (Inidacloprid 0.05%) for Termite Management in Building
30.	SSP0384	S. K. Singh	Addl. General Manager, Bharat Electronics Limited, PO-Bharat Nagar, Ghaziabad	Assessment of Fire Damaged SRE Tower Building at AFS, Hindon & Suggesting Strengthening Measures
31.	SSP0401	S. K. Panigrahi	Sr. Manager (CS), NTPC Ltd., Rihand Super Power Thermal Station, P.O. Rihand Nagar, Dist. Sonebhadra, UP	Health Assessment of Stage-I Steel and Concrete Structures
32.	SSP0424	A. K. Mittal	Mr. Ajay Kr. Awasthi, Chief Executive Officer, Mr. Kashi Vishwanath Mandir, Varanasi	Investigation of Kashi Vishwanath Mandir, Varanasi
33.	SSP0434	Manojit Samanta	Punjab State Transmission Corporation Ltd., Mall Road, Patiala	Assessment and Strengthening of Existing Pile Foundation of 220 KV Transmission Line Tower, Punjab

S.No.	Project No	PI	Sponsor Agencies	Title
34.	SSP0472	B. S. Rawat	Dr. Lakshmipathi Srigiriraju, DOW Agro Sciences India Pvt. Ltd., Vikroli (W), Mumbai - 79	Bio-Efficacy Studies of Sentricon System for Termite Management in Buildings
35.	SSP0491	S. K. Singh	Executive Engineer, (Project-II), Municipal corporation of India, WZ Under Zakhira flyover New Delhi	Technical Advice on ongoing Rehabilitation and Strengthening work of Janak Setu Flyover New Delhi
36.	SSP0614	Suvir Singh	State Bank of India, Premises & Estate Dept., Local Head Office, 4th Floor, Circle top House, 16, College Lane, Chennai	Post Fire Investigations and Remedial Measures of Fire Damaged SBI Chennai Main Branch Building and Remedial Measures
37.	SSP0634	B. M. Suman	Manager - Marketing & Business Development, UP Twiga Fiberglass Ltd., Twiga House, 3 Community Centre, East of Kailash, New Delhi	Study the Effect of Density on Thermal Behaviour of Twiga Fiberglass at Mean Temperature remains Constant for five mean temperatures
38.	TST0014	Suvir Singh	M/s OTIS Elevator Company (I) Ltd., No. 92, KIADB Indl. Estate, Phase-II, Jigani Indl. Area, Anekal Taluk, Bangalore-562105	Fire Performance Assessment of Elevator Doors
39.	TST0023	Suvir Singh	M/s Vijay system engineers pvt. ltd. 35, Chandivali village, Off Sakivihar ROad, Andheri(E), Mumbai - 400072	Fire Performance Assessment of Fire door
40.	TST0033	Suvir Singh	M/s Hilti India Pvt Ltd. F-90/4, Okhla Industrial Aria, Phase-I New Delhi -110020	Fire Performance Assessment of Cable Fire Barrier
41.	TST0034	Suvir Singh	M/s Ahlada Engineers Pvt. Ltd., SY#66-68, Bahadurpally (V), Qutbullapur Mandal, R. R. Dist., Hyderabad	Fire Performance Assessment of Fire Rated Door
42.	TST0054	Suvir Singh	M/s Shakti Hormann Ltd., Regd. Office Plot No. 20, Sripuri Colony, Karkhana, Secunderabad	Fire Performance Assessment of Fire Rated Door
43.	TST0064	Suvir Singh	M/s Everest Industries Ltd., Genesis A-32, Mohan Co-operative Industrial Estate, Mathura Road, New Delhi	Fire Performance Assessment of Fiber Cement Board Partition
44.	TST0074	Suvir Singh	M/s Engineers India Ltd., Engineers India bhawan, 1 Bhikaji Cama Place, New Delhi 66	Fire Performance Assessment of Protected Steel I-Beam

S.No.	Project No	PI	Sponsor Agencies	Title
45.	TST0083	B. M. Suman	General Manager (Prod. & Technical), Keltech Energies Ltd., Vishwasnagar, Karkala Taluk, Udupi District, Karnataka-574108	Thermal Behaviour of Expanded Perlite Powder with varying Density at Freezing Point
46.	TST0084	Suvir Singh	M/s Saint Gobain Glass India Ltd., Plot No. A-1, SIPCOT Industrial Park, Sriperumbudur, Tamil Nadu	Fire Performance Assessment of Fire Rated Glazed Door
47.	TST0093	Suvir Singh	M/s GreenPly Industries Ltd., 5th Floor, Narain Manzil, 23, Barakhamba Road (C.P), New Delhi - 1	Fire Performance Assessment of Fire Door
48.	TST0104	Suvir Singh	M/s Siporex India Pvt. Ltd., 72-76, Industrial Estate, Mundhwa, Pune-411 036	Fire Resistance Evaluation of Siporex Reinforced Slab under Uniform Loading
49.	TST0113	Suvir Singh	M/s Kutty Flush Doors & Furnitures Co. Pvt. Ltd., 1167, (old No. 37) Poonamalle High Road, Koyambedu, Chennai	Fire Performance Assessment of Fire Rated Door
50.	TST0114	Suvir Singh	M/s Ozone Overseas Ltd., Trilokpur Road, Kala Amb, Nahan	Fire Performance Evaluation of Fire Door
51.	TST0123	Suvir Singh	M/s Vishnu Door Industries Ltd., B-7, Jain Nagar Ext., Near Rohni Sctor-22, Karala, New Delhi-81	Fire Performance Assessment of Fire Door
52.	TST0124	Suvir Singh	M/s Ahlada Engineers Pvt. Ltd., SY#66-68, Bahadurpally (V), Qutbullapur Mandal, R. R. Dist., Hyderabad	Fire Performance Evaluation of Fire Rated Door
53.	TST0134	Suvir Singh	M/s Ahlada Engineers Pvt. Ltd., SY#66-68, Bahadurpally (V), Qutbullapur Mandal, R. R. Dist., Hyderabad	Fire Performance Evaluation of Fire Rated Door
54.	TST0143	Suvir Singh	M/s Ekta Power & Insulation Services, 25/7 (3rd Floor), East Patel Nagar, New Delhi - 8	Fire Performance Assessment of FSC Fire Retardant Coating for Cables
55.	TST0144	A. A. Ansari	M/s Alstrong Enterprises India (Pvt) Ltd., E-40/3, Okhla Industrial Area, Phase-II, New Delhi	Reaction to Fire Characteristic Studies on Cement Fiber Board with UV (Zinnia) Coating
56.	TST0153	Suvir Singh	M/s Shakti Met-Dor Ltd., Plot No. 20, Sripuri Colony, Karkhana, Secunderabad-500015	Fire Performance Assessment of Fire Door
57.	TST0163	Suvir Singh	M/s Airport Authority of India, Coimbatore Airport, Coimbatore	Fire Performance Assessment of Fire Door
58.	TST0183	Suvir Singh	M/s Air Master Equipment India (P) Ltd., #11, C.K. Palya Road, Ommadevanahalli, Gottigere Post, Bannerghatta Road, Bangalore-560083	Fire Performance Assessment of Fire Damper

S.No.	Project No	PI	Sponsor Agencies	Title
59.	TST0184	A. A. Ansari	M/s Kool Pack & Allied Industries, Subathu Road, Dharmapur, Dist. Solan, Himachal Pradesh	Reaction to Fire Characteristic Studies on Wood Fibre Cement Board
60.	TST0193	Suvir Singh	M/s Shreeji Wood Craft Pvt. Ltd., B/5, Gurukul Bldg. No. 2, Jaywant Sawant Road, Dahisar (W), Mumbai-400068	Fire Performance Assessment of Shreeji Fire Retardant Door
61.	TST0194	Suvir Singh	M/s HILTI India Pvt. Ltd., F-90/4, Okhla Industrial Area, Phase-1, New Delhi	Fire Resistance Evaluation of Firestops
62.	TST0204	Suvir Singh	M/s Johnson Lifts Pvt. Ltd., #17, Poonamallee Bye Pass Road, Poonamallee, Chennai	Fire Resistance Evaluation of Lift Landing Door
63.	TST0214	A. A. Ansari	M/s Divine Thermal Wrap Pvt. Ltd., 180-C, Jeevan Nagar, New Delhi	Reaction to Fire Characteristic Studies on Air Bubble Reflective Insulation
64.	TST0224	P. C. Thapliyal	Dy. Chief Engineer, Southern Railway, Office of Dy. Chief Engr., Gauge Conversion/II, Tiruchirapalli, Tamilnadu	Performance Evaluation of IPNet paints to be used to coat PSC 'I' Girder Bridges for KMU-TRM stations at Tiruchirapalli
65.	TST0234	Suvir Singh	M/s ECE Industries Ltd., A-20, Industrial Area, Meerut Road, Ghaziabad	Fire Resistance Evaluation of Elevator Door
66.	TST0243	Suvir Singh	Office of the Asstt. Engr-I, CPWD, IIT Mandi Project Div-I, Kamand Mandi (HP) - 175005	Fire Performance Assessment of Fire Door and Partition
67.	TST0244	Suvir Singh	Airport Authority of India, Chandigarh Division, Civil Air Terminal, Chandigarh	Fire Resistance Assessment of Steel Fire Door
68.	TST0253	Suvir Singh	M/s Navair International Ltd., 59/17, 2nd Floor, Kalka ji Extension, Guru Ravi Dass Marg, New Delhi-19	Fire Performance Assessment of Steel Glazed Fire Door
69.	TST0264	A. A. Ansari	M/s Ramco Industries Ltd., Post Box. No. 17, Arakkonam, Dist. Vellore, Tamilnadu	Reaction to Fire Characteristic Studies of Calcium Silicate Board
70.	TST0274	Suvir Singh	M/s Shakti Hormann Ltd., Regd. Office Plot No. 20, Sripuri Colony, Karkhana, Secunderabad	Fire Performance Assessment of Wooden Fire Rated Door
71.	TST0283	Suvir Singh	M/s Navair International Ltd., 59/17, 2nd Floor, Kalka ji Extension, Guru Ravi Dass Marg, New Delhi-19	Fire Performance Assessment of Steel Fire Rated Doors

S.No.	Project No	PI	Sponsor Agencies	Title
72.	TST0284	B. M. Suman	GM (Quality Control), Mahagun Mezzaria Pvt. Ltd., Sector-78, Noida	Determination of Overall Thermal Transmittance & Measurement of K-value of M35 Concrete of Various Thicknesses
73.	TST0293	Suvir Singh	M/s R K Inovattive Doors, Gat No. 114, Opp Mother Care Packers, Near Om Logistics, Pune-Nashik Highway, Chimbli, Tal-Khed, Pune-410501	Fire Performance Assessment of Wooden Fire Door
74.	TST0294	Suvir Singh	Asst. Engr., IMS Sub Division, Under Varanasi Central Division, CPWD, Kendranchal Bada Lalour Lamhi, Varanasi	Fire Resistance Assessment of Fire Door
75.	TST0303	Suvir Singh	M/s GWS Engineers & Fabricators Pvt. Ltd., A-512, TTC Industrial Area Mahape, Navi Mumbai-400710	Fire Performance Assessment of Fire Door
76.	TST0304	Suvir Singh	M/s Ramco Industries Ltd., Aurus Corporate Centre, VI Floor, 98-A, Dr. Radhakrishan Road, Mylapore, Chennai	Fire Performance Assessment of Partition and False Ceiling
77.	TST0313	Suvir Singh	M/s Mitsubishi Elevator ETA india Pvt. Ltd., 5th Floor, Chennai City Center, No. 10 & 11, Dr. R. K. Salai Mylapore, Chennai-4	Fire Performance Assessment of Fire Door
78.	TST0314	Suvir Singh	M/s HILTI India Pvt. Ltd., F-90/4, Okhla Industrial Area, Phase-1, New Delhi	Fire Resistance Assessment of Firestop
79.	TST0323	A. A. Ansari	M/s Agni Fiber Board Pvt. Ltd., 990/3/4, GIDC, Makarpura, Vadodara-390010	Determination of Fire Propogation Index of FRP Pulterded Panel
80.	TST0334	A. A. Ansari	M/s Formica Laminates (I) Pvt. Ltd., Block No. 591 & 592, 6th Km Stone, Kalol-Vamaj Road, Village Piyaj, Taluka Kalol, Gandhinagar	Reaction to Fire Characteristic Studies on Formica Decorative Laminates
81.	TST0344	A. A. Ansari	M/s Raj Builtcon, A-205, Nishat Complex, Opp. Theosophical Society, Slatwada Road, Baroda	Reaction to Fire Characteristic Studies on FRP Pultrded Section
82.	TST0353	A. A. Ansari	M/s Berger Paints (I) Ltd., Berger House, 129 Park Street, Kolkata-700017	Reaction to Fire Characteristic Studies on Flameshield
83.	TST0354	Suvir Singh	M/s GMP Technical Solutions Pvt. Ltd., Gunai Road, Mandhala, Via Barotiwala, Dist. Solan, HP	Fire Resistance Evaluation of Metal Partition

S.No.	Project No	PI	Sponsor Agencies	Title
84.	TST0363	Suvir Singh	M/s Super Steel Industries, 7th Mile Stone, Rohtak Road, Multan Nagar, New Delhi-110056	Fire Performance Assessment of Filing Cabinet
85.	TST0364	Suvir Singh	M/s Jotun India Pvt. Ltd., 101, Ist Floor SNS Energy, Near Valentine Theatre, Athwa-Dumas Road, Surat	Fire Resistance Assessment of Protected Steel Sections
86.	TST0373	Suvir Singh	M/s Omega Elevators, 5/C, Archana Industrial Estate, Opp. Ajit Mills, Rakhial, Ahmedabad-380023	Fire Performance Assessment of Elevator Door
87.	TST0374	Suvir Singh	M/s Wallmax India Enterprises Pvt. Ltd., 12/4, Banga Complex, Main Mathura Road, Faridabad	Fire Resistance Assessment of Cable Firestop
88.	TST0383	Suvir Singh	M/s CTR Manufacturing Industries Ltd., B-23, Chlktthana, Aurangabad-431006	Fire Performance Assessment of Fire Retardant Cable Coating
89.	TST0393	Suvir Singh	M/s Galaxy Fire Protection Co., D-251, Saurabh Vihar, Jaitpur Road, badarpur, New Delhi - 44	Fire Performance Assessment of Fire Door
90.	TST0394	Suvir Singh	M/s Saint Gobain Glass India Ltd., Sigapi Aachi Bilding, Floor No. 7, 18/3, Rukmani Lakshmipathy Road, Egmore, Chennai	Fire Resistance Evaluation of Uninsulated Fire Door
91.	TST0403	Suvir Singh	IIT Hyderabad, Ordanance Factory Estate, Yeddumailaram-502205 (AP)	Fire Performance Assessment of Fire Door
92.	TST0404	A. A. Ansari	M/s Jotun India Pvt. Ltd., Plot No. D-280, Ranjangaon MIDC, Village Karegaon, Taluka - Shirur, Dist. Pune	Determination of Surface Spread FOF Flame Classification of Jotamastic 80
93.	TST0413	Suvir Singh	M/s Oil and Natural Gas Corporation Ltd., 10th Floor, Jeevan Bharti Bldg, Tower-II, 124, Indira Chowk, Connaught Place, New Delhi-1	Fire Performance Assessment of Fire Rated Steel Door
94.	TST0414	Suvir Singh	M/s Tecno Doors Pvt. Ltd., Plot No. LI, SIPCOT Industrial Park, Mambakkam & Pondur A Village, Sriperumbudur Taluk, Dist. Kancheepuram	Fire Resistance Assessment of Fermator Premium Landing Door
95.	TST0423	Suvir Singh	M/s Oil and Natural Gas Corporation Ltd., 10th Floor, Jeevan Bharti Bldg, Tower-II, 124, Indira Chowk, Connaught Place, New Delhi-2	Fire Performance Assessment of Fire Rated Glass Door

S.No.	Project No	PI	Sponsor Agencies	Title
96.	TST0443	Suvir Singh	Fujitec India Pvt. Ltd., Plot No. P-52, 1st Cross Rd, 8th Avenue, Mahindra World City, Chengalpattu, Kancheepuram Dist., PIN - 603002	Fire Performance Assessment of Landing Door
97.	TST0444	A. A. Ansari	M/s Sumip Composites Pvt. Ltd., Panchratna Industrial Estate, Changodar, Sarkhej - Bavla Road, TA. Sanand, Dist. Ahmedabad	Reaction to Fire Characteristic Studies on FRP Channels
98.	TST0453	Suvir Singh	M/s Kone Elevator India Pvt. Ltd., India Land Tech Park Tower-B, 3rd Floor No. 14, 3rd Main Road, Ambattur Industrial Estate, Chennai-600058	Fire Performance Assessment of Elevator Landing Door
99.	TST0454	Suvir Singh	M/s Signatures Interiors Pvt. Ltd., 64, RPTS Road, Near Jerry Lawns, Surendra Nagar, Nagpur	Fire Resistance Evaluation of Fire Door
100.	TST0464	Suvir Singh	M/s OTIS Elevator Company (I) Ltd., No. 92, KIADB Indl. Estate, Phase-II, Jigani Indl. Area, Anekal Taluk, Bangalore-562105	Fire Resistance Evaluation of Elevator Door
101.	TST0474	A. A. Ansari	M/s GMP Technical Solutions Pvt. Ltd., Gunai Road, Mandhala, Via Barotiwala, Dist. Solan, HP	Reaction to Fire Characteristic Studies on PUF Panels
102.	TST0484	Suvir Singh	M/s Mitsubishi Elevator ETA India Pvt. Ltd., 5th Floor, Chennai City Center, No. 10 & 11, Dr. R. K. Salai Mylapore, Chennai	Fire Performance Assessment of Lift Doors
103.	TST0494	Suvir Singh	M/s OTIS Elevator Company (I) Ltd., No. 92, KIADB Indl. Estate, Phase-II, Jigani Indl. Area, Anekal Taluk, Bangalore-562106	Fire Performance Assessment of Elevator Doors
104.	TST0504	Suvir Singh	M/s Valency Compunds Services Pvt. Ltd., A-62, MIDC Area, Ahmednagar	Fire Performance Assessment of 'Valency Fire Stop-401' Cable Coating
105.	TST0514	Suvir Singh	M/s Shreeji Wood Craft Pvt. Ltd., B-803, Western Edge II, Western Express Highway, Borivali (E), Mumbai	Fire Performance Assessment of Shreeji Fire Retardant Door
106.	TST0524	Suvir Singh	M/s Kone Elevator India Pvt. Ltd., India Land Tech Park Tower-B, 3rd Floor No. 14, 3rd Main Road, Ambattur Industrial Estate, Chennai	Fire Performance Assessment of Elevator Landing Door

S.No.	Project No	PI	Sponsor Agencies	Title
107.	TST0534	Suvir Singh	M/s Johnson Lifts Pvt. Ltd., No. 1, East Main Road, Annanagar West Extension, Chennai	Fire Performance Assessment of Lift Doors
108.	TST0544	Suvir Singh	M/s MP Swastik Doors, 207, Shreyas Ind. Estate, Near Western Express Highway, Goregaon (E), Mumbai	Fire Performance Assessment of Fire Door
109.	TST0554	Suvir Singh	M/s Shree Engineers, Plot No. 252, Sector No. 7, PCNTDA, MIDC Bhosari, Pune	Fire Performance Assessment of Fire Safe Encloser
110.	TST0564	Suvir Singh	M/s Sehgal Doors, B-133, Phase-I, Industrial Area, Mayapuri, New Delhi	Fire Performance Assessment of Fire Door
111.	TST0574	Suvir Singh	M/s Sukri Paints & Chemicals Pvt. Ltd., 380, Chirag Delhi, New Delhi	Fire Performance Assessment of Glazed Door Assembly
112.	TST0584	Suvir Singh	M/s Pragati Enterprise, Plot No. B-15/24, Road No. 13, Sachin Udhyognagar, Dist Surat, Gujarat	Fire Performance Assessment of Fire Door
113.	TST0594	Suvir Singh	M/s PVKS Corporation Pvt. Ltd., Plot No. 28, Sector 14, Faridabad	Fire Performance Assessment of Fire Door
114.	TST0604	Suvir Singh	Executive Engg, Building Project Division B-132, PWD, DGFR Complex, Sector 3, Dwarka, New Delhi	Fire Performance Assessment of Fully Glazed Fire Door
115.	TST0624	A. A. Ansari	M/s Akzonobel India Ltd., M&PC Technical Dpt., Plot No. 62, A&B, Hoskote Industrial Area, Bangalore	Surface Spread of Flame Studies of Alkyd Paints
116.	TST0644	Suvir Singh	M/s Stanvac Chemicals (I) Ltd., 552, Sector 37, Pace City-II, Gurgaon, Haryana	Fire Performance Assessment of Cable Fire Barrier System FIREX FB-250

Colloquium

Colloquium

12th May 2014, Productivity of Scientists and Engineers in Research and Academic Laboratories	Prof. Tushar Kanti Datta (IIT, Delhi)
21st May 2014, Information Security Awareness	Dr. Abha Mittal
28th May 2014, Research Ethics	Mr. A. Ghosh
04th June 2014, Implementation of our Official Language 'Hindi' in a Better Way	Mr. Shrinivas Joshi (Manager, Rajbhasa (HR), BHEL, Haridwar)
18th June 2014, GPR - Sub Surface Profiling Technique	Mr. Ajay Dwivedi
9th July 2014, Implementation of Official Language 'Hindi'	Dr. Nagendra Kumar (Associate Professor, Department of Humanities & Social Sciences, Head, Hindi Cell, IIT Roorkee)
23rd July 2014, Experiences from Full Scale Fire Tests on R.C. Building Frames	Dr. Umesh Kumar Sharma (Associate Professor, Department of Civil Engineering, IIT, Roorkee)
20th August 2014, Fire Hazard Index of Building Materials	Mr. A A Ansari
27th August 2014, Official Language Sensitization	Mr. Suba Singh
3rd September 2014, CSIR-CBRI Vision 2035	Dr. A K Minocha
10th September 2014, Enterprise Resource Planning (ERP) - Let us do it	Mr. H K Jain
15th September 2104, Behaviour of Elephants in Rajaji National Park	Dr. BD Joshi (Gurukul Kangri University, Haridwar)
16th September 2014, Around Books	Mr. Yadvendra Pandey
17th September 2014, Termite Control in Green Buildings	Dr. B. S. Rawat
18th September 2014, Traditional Water Conservation Techniques in India	Mr. Anupam Mishra (Gandhi Peace Foundation, New Delhi)
19th September 2014, Awakening Public Awareness by Mass Communication	Dr. Atul Kumar Agarwal
22nd September 2014, General Information on LTC Rules	Mr. Alok Sharma
23rd September 2014, Rare Pictures of the Himalayas	Mr. A. K. Jethi (Ex-Technical Officer, CBRI)
5th November 2014, Debris Flow Behaviour – An Experimental Perspective	Dr. D. P. Kanungo
12th November 2014, Research in Cementitious Materials using Nano technology	Dr. L. P. Singh
19th November 2014, Critical Review of Automatic Sprinkler System Design: National vs. International Standards	Dr. Shorab Jain

03rd December 2014, Framework, Concepts, Case studies and Cutting Edge Technologies in Developing Sustainable and Smart Cities – Key Learning's from the Japan Visit.	Mr. Ashok Kumar
10th December 2014, Ancient Indian Science and Invention	Dr. P. K. S Chauhan
07th January 2015, Nano Twinned Metals: Achieving High Strength and High Ductility	Dr. Yashashree Kulkarni & Bill D. Cook (Department of Mechanical Engineering, University of Houston, USA)
14th January 2015, Managerial Effectiveness in R&D Laboratory	Dr. B. M. Suman
21st January 2015, Fire Retardant Fabrics: Past Research and Future Challenges	Dr. Harpal Singh
28th January 2015, The Sun Temple, Konark: Rehabilitation Challenges	Prof. S.K. Bhattacharyya
04th February 2015, Personal Branding	Mr. Sudhir Sharma
18th February 2015, Ground Engineering Through Stone Columns	Mr. Manojit Samanta
25th February 2015, Integrity Studies on FRP Strengthened Concrete Structural Elements	Mr. H.C. Arora
04th March 2015, Low Velocity Impact Studies on Reinforce Concrete – Scope & Challenges	Mr. Mickey Mecon Dalbehera

CBRI Family

CBRI FAMILY

Group-IV-Scientific Staff

S. No.	Name	Designation
1.	Prof. S.K. Bhattacharyya	Director
2.	Mr. Y. Pandey	Chief Scientist
3.	Dr. A.K. Minocha	Chief Scientist
4.	Dr. Brijeshwar Singh	Chief Scientist
5.	Mr. R.S. Chimote	Chief Scientist
6.	Dr. Manju Mittal	Sr. Principal Scientist
7.	Dr. (Mrs.) Abha Mittal	Sr. Principal Scientist
8.	Dr. Suvir Singh	Sr. Principal Scientist
9.	Mrs. Neeta S. Mittal	Sr. Principal Scientist
10.	Mr. Ashok Kumar	Sr. Principal Scientist
11.	Mr. S.K. Negi	Sr. Principal Scientist
12.	Dr. Shantanu Sarkar	Sr. Principal Scientist
13.	Dr. Harpal Singh	Sr. Principal Scientist
14.	Dr. Atul Kumar Agarwal	Sr. Principal Scientist
15.	Dr. Pardeep Kumar	Sr. Principal Scientist
16.	Mr. A. A. Ansari	Sr. Principal Scientist
17.	Dr. R. Dharma Raju	Principal Scientist
18.	Mr. A.K. Sharma	Principal Scientist
19.	Dr. Rajni Lakhani	Principal Scientist
20.	Dr. D.P. Kanungo	Principal Scientist
21.	Dr. Achal Kumar Mittal	Principal Scientist
22.	Dr. S.R. Karade	Principal Scientist
23.	Mr. Nadeem Ahmed	Principal Scientist
24.	Dr. Sujit Kumar Saran	Principal Scientist
25.	Dr. Rajesh Deoliya	Principal Scientist
26.	Dr. Navjeev Saxena	Principal Scientist

S. No.	Name	Designation
27.	Mr. A.P. Chourasia	Principal Scientist
28.	Mr. S.K. Singh	Principal Scientist
29.	Dr. P.C. Thapliyal	Principal Scientist
30.	Dr. B.S. Rawat	Principal Scientist
31.	Dr. Shorab Jain	Principal Scientist
32.	Dr. S.K. Panigrahi	Principal Scientist
33.	Dr. Pradeep Kumar II	Sr. Scientist
34.	Dr. Rajesh K. Verma	Sr. Scientist
35.	Mr. H.C. Arora	Sr. Scientist
36.	Dr. P.K.S. Chauhan	Sr. Scientist
37.	Dr. Leena Chaurasia	Sr. Scientist
38.	Dr. L.P. Singh	Sr. Scientist
39.	Dr. Neeraj Jain	Sr. Scientist
40.	Dr. Vineet Kumar Saini	Scientist
41.	Mr. Syed Ibrahim Sohel	Scientist
42.	Mr. Ravindra Singh Bisht	Scientist
43.	Mr. Nagesh Babu Balam	Scientist
44.	Mr. Manojit Samanta	Scientist
45.	Mr. Soju Joseph Alexander	Scientist
46.	Mr. Somitra Maiti	Scientist
47.	Mr. Srinivasa Rao Naik B.	Scientist
48.	Mr. Subash Chandra Bose Gurram	Scientist
49.	Dr. A. Aravind Kumar	Scientist
50.	Mr. Anindya Pain	Scientist
51.	Mr. Mickey Mecon Dalbehera	Scientist
52.	Mr. Piyush Mohanty	Scientist
53.	Mr. Siddharth Behera	Scientist
Group III Technical Staff		
54.	Dr. Rajiv Kumar	Principal T.O.
55.	Mr. H.K. Jain	Principal T.O.

S. No.	Name	Designation
56.	Mr. D.K. Sehgal	Principal T.O.
57.	Mr. Sudhir Sharma	Principal T.O.
58.	Mr. Narendra Kumar	Principal T.O.
59.	Dr. B.M. Suman	Principal T.O.
60.	Mr. Rajesh Kumar	Principal T.O.
61.	Mr. Prakash Chand	Principal T.O.
62.	Mr. Rajeev	Principal T.O.
63.	Mr. Jaswinder Singh	Principal T.O.
64.	Dr. P.K. Yadav	Principal T.O.
65.	Mr. Bhupal Singh	Sr. T.O. (3)
66.	Dr. S.K. Senapati	Sr. T.O. (3)
67.	Mr. Dalip Kumar	Sr. T.O. (3)
68.	Mr. Rajeev Kumar Sharma	Sr. T.O. (3)
69.	Mr. Sushil Kumar	Sr. T.O. (3)
70.	Dr. M.K. Sinha	Sr. T.O. (2)
71.	Mr. Zamir Ahmad	Sr. T.O. (2)
72.	Mr. Rakesh Kumar –II	Sr. T.O. (2)
73.	Mr. Vivek Sood	Sr. T.O. (2)
74.	Mr. Jalaj Prashar	Sr. T.O. (2)
75.	Mr. Ram Ashray Rai	Sr. T.O. (2)
76.	Mr. Bharat Bhushan	Sr. T.O. (2)
77.	Mr. A.K. Jain	Sr. T.O. (1)
78.	Mr. Naresh Kumar	Sr. T.O. (1)
79.	Mr. Rajesh R. Ghadse	Sr. T.O. (1)
80.	Mr. B.K. Kalra	Sr. T.O. (1)
81.	Mr. Itrat Amin Siddiqui	T.O.
82.	Mr. Amit Kush	T.O.
83.	Mrs. Deepti Karmakar	T.O.
84.	Mr. Ajay Dwivedi	T.O.

S. No.	Name	Designation
85.	Mrs. Gayatri Devi	T.O.
86.	Mr. Sameer	T.O.
87.	Mr. D.S. Dharamshaktu	T.O.
Group II		
88.	Mr. Rizwanul Hasan	Sr. Tech. (2)
89.	Mr. Rajinder Kumar	Sr. Tech. (2)
90.	Mr. Govind Singh	Sr. Tech. (2)
91.	Mr. Gopal Chand	Sr. Tech. (2)
92.	Mr. P.K. Yadav	Sr. Tech. (2)
93.	Mrs. Neelam Gupta	Sr. Tech. (2)
94.	Mrs. Sangeeta Sharma	Sr. Tech. (2)
95.	Mr. Sheeraj Ahmad	Sr. Tech. (2)
96.	Mrs. Saroj Rani	Sr. Tech. (1)
97.	Mr. Anil Kumar Sharma	Sr. Tech. (1)
98.	Mr. Manmeet Singh	Sr. Tech. (1)
99.	Mrs. Urmila Kotnala	Sr. Tech. (1)
100.	Mr. Rishi Pal Singh	Sr. Tech. (1)
101.	Mr. Sushil Kumar	Sr. Tech. (1)
102.	Mr. Himanshu Sharma	Sr. Tech. (1)
103.	Mr. Amar Singh	Sr. Tech. (1)
104.	Mr. Shiv Prakash Tyagi	Sr. Tech. (1)
105.	Mr. B.S. Bisht	Sr. Tech. (1)
106.	Mr. Rajeev Bansal	Sr. Tech. (1)
107.	Mr. Pradeep Kr. Kapooria	Sr. Tech. (1)
108.	Mr. Arvind Saini	Sr. Tech. (1)
109.	Mr. Shorab Khan	Sr. Tech. (1)
110.	Mr. Ashwani Kumar Mishra	Sr. Tech. (1)
111.	Mr. Harish Kumar	Sr. Tech. (1)
112.	Mr. Sukhbir Sharma	Sr. Tech. (1)

S. No.	Name	Designation
113.	Mr. Arvind Kumar	Sr. Tech. (1)
114.	Mr. Kedar Nath	Sr. Tech. (1)
115.	Mr. Santosh Kumar Mishra	Sr. Tech. (1)
116.	Mr. Sharad Kumar	Sr. Tech. (1)
117.	Mr. Mam Chand Agarwal	Sr. Tech. (1)
118.	Mr. Arvind Kumar Sharma	Sr. Tech. (1)
119.	Mr. Tahir Husain	Sr. Tech. (1)
120.	Mr. Ghanshyam Mittal	Sr. Tech. (1)
121.	Mr. Francis Charles	Sr. Tech. (1)
122.	Mr. Iqubal Ahmed	Sr. Tech. (1)
123.	Mr. Manoj Kumar Tyagi	Sr. Tech. (1)
124.	Mr. Jai Pal	Sr. Tech. (1)
125.	Shorab Khan	Sr. Tech. (1)
126.	Mr. Jameel Hasan	Tech. (2)
127.	Mr. U.C. Bhatnagar	Tech. (2)
Group I Supporting Staff		
128.	Mr. Harpal Singh	Lab. Asstt.
129.	Mr. D.P. Yadav	Lab. Asstt.
130.	Mr. Yakub Ali	Lab. Asstt.
131.	Mr. Amar Singh	Lab. Asstt.
132.	Mr. Deepak Singh	Lab. Asstt.
133.	Mr. Gurucharan Singh	Lab. Asstt.
134.	Mr. Rajeshwar	Lab. Asstt.
135.	Mr. Rishi Pal	Lab. Asstt.
136.	Mr. Vijay Kumar	Lab. Asstt.
137.	Mr. Vishwas Kumar	Lab. Asstt.
138.	Mr. Jagdish Pal	Lab. Asstt.
139.	Mr. Deepak Kumar	Lab. Asstt.
140.	Mr. Hira Lal	Lab. Asstt.

S. No.	Name	Designation
141.	Mr. Subhash Chand	Lab. Asstt.
142.	Mr. Shiv Kumar	Lab. Asstt.
143.	Mr. Rajesh Kumar	Lab. Attd. (2)
Administrative Staff /House-Keeping		
144.	Mr. Anil Kumar	A.O.
145 .	Mr. Parag Saxena	A.O.
146.	Mr. S.P. Singh	S&PO
147.	Mr. R. K. Manjhiwal	F&AO
148.	Mr. R.C. Saxena	Sr. H.O.
149.	Mr. Sukhvir Singh	S.O. (S&P)
150.	Mr. Babu Ram	S.O. (F&A)
151.	Mr. Dheeraj	S.O. (F&A)
152.	Mr. Alok Sharma	S.O. (G)
153.	Mr. S.K. Jakhwal	S.O. (G)
154.	Ms. Rashmi Devi	S.O. (G)
155.	Mr. V.K. Sharma	S.O. (G)
156.	Mr. S.P. Kapil	P.S.
157.	Mr. K. Arora	P.S.
158.	Mr. V.P.S. Rawat	Security Officer
159.	Mr. Mehar Singh	Hindi Officer
160.	Mr. Suba Singh	Hindi Officer
161.	Mr. Satya Pal	Sr. Seno
162.	Mr. Naresh Yadav	Sr. Steno
163.	Mrs. Archana	Sr. Steno
164.	Mr. Arvind Kumar	Sr. Steno
165.	Mr. Dalpat Singh	Sr. Steno
166.	Mr. Dharam Singh Negi	Sr. Steno
167.	Mr. Constan Kujur	Asstt. (G) Gr. I
168.	Mrs. Nisha Tyagi	Asstt. (G) Gr. I

S. No.	Name	Designation
169.	Mrs. Sarita Khanna	Asstt. (G) Gr. I
170.	Mrs. Sheema Farhat	Asstt. (G) Gr. I
171.	Mr. R.K. Johar	Asstt. (G) Gr. I
172.	Mr. Sudhir Kumar	Asstt. (G) Gr. I
173.	Mr. Yogesh Kumar	Asstt. (G) Gr. I
174.	Mr. Shiv Kumar	Asstt. (G) Gr. I
175.	Mrs. Sunita	Asstt. (G) Gr. I
176.	Mr. Pawan Kumar	Asstt. (G) Gr. I
177.	Mrs. Mamta Sharma	Asstt. (G) Gr. I
178.	Mr. Dharam Pal Singh	Asstt. (G) Gr. I
179.	Mr. Virendra Singh	Asstt. (F&A) Gr. I
180.	Mr. Aman Kumar	Asstt. (F&A) Gr. I
181.	Mr. Vipin Kumar Sharma	Asstt. (F&A) Gr. I
182.	Mr. Suraj Pal Singh	Asstt. (F&A) Gr. I
183.	Mr. Satyarth Prakash	Asstt. (F&A) Gr. I
184.	Mrs. Rubina Zaidi	Asstt. (F&A) Gr. I
185.	Mr. Sanjeev Bansal	Asstt. (S&P) Gr. I
186.	Mrs. Anju Rani Simon	Asstt. (S&P) Gr. I
187.	Mr. Arpan Maheshwari	Asstt. (S&P) Gr. I
188.	Mr. Kalam Singh Chauhan ‘	Asstt. (S&P) Gr. I
189.	Mr. Vishwash Tyagi	Asstt. (S&P) Gr. I
Group C		
190.	Mrs. Arun Lata	Asstt. (G) Gr. II
191.	Mr. Sushil Kumar	Asstt. (G) Gr. II
192.	Mr. Sanjay Kr. Tyagi	Asstt. (G) Gr. II
193.	Mrs. Seema Ahuja	Asstt. (G) Gr. II
194	Mr. Ravinder Kumar	Asstt. (G) Gr. II
195.	Mr. Vijay Kumar-II	Driver (NT)
196.	Mr. Rajendra Singh	Sr. Tech. (1)

S. No.	Name	Designation
197.	Mr. Radhey Shyam	Sr. Tech. (1)
198.	Mr. Sushil Kumar	Sr. Tech. (1)
199.	Mr. M. Ramakrishna	Driver (NT)
200	Mr. Satya Pal	MTS
201.	Mr. Sant Ram	MTS
202	Mr. Ram Samajh	MTS
203.	Mr. Raj Kumar	MTS
204.	Mr. Kailash Chand	MTS
205.	Mrs. Usha	MTS
206.	Mr. Mukesh Kumar	MTS
207.	Mrs. Kusum Lata	MTS
208.	Mrs. Bala	MTS
209.	Mr. Subhash Chand	MTS
210.	Mr. Inder Pal (ACP)	MTS
211.	Mr. Desh Raj	MTS
212.	Mr. Rakesh Kumar	MTS
213.	Mr. Ramesh Kumar	MTS
214.	Mr. Santosh Kumar	MTS
215.	Mr. Rakesh Kumar	MTS
216.	Mr. Krishna Gopal Thakur	MTS
217.	Mr. Mani Ram	MTS
218.	Mr. Rohitash Kumar	MTS
219.	Mr. Radhey Shyam	MTS
220.	Mr. Ranbeer Singh	MTS
221.	Mr. Devendra Kumar	MTS
222.	Mrs. Prakash Kaur	MTS
223.	Mrs. Anju	MTS
224.	Mr. Khalil Ahmad	MTS
225.	Mr. Subhan Singh	MTS

S. No.	Name	Designation
226.	Mr. Anit Kumar Pal	MTS
227.	Mr. Pritam Giri	MTS
228.	Mr. Pooran Vassi	MTS
229.	Mr. Kirat Pal	MTS
230.	Mr. Kiran Pal	MTS
231.	Mr. Rajesh Kr. Yadav	MTS
232.	Mr. Jai Prakash	MTS
233.	Mr. Ranjeet Singh	MTS
234.	Mr. Satya Pal	MTS
235.	Mr. Satya Pal Singh	MTS
236.	Mr. Mehraj Deen Khan	MTS
237.	Mr. Dharam Pal	MTS
238.	Mr. Sunil Kumar	MTS
239.	Mr. Dharam Singh	MTS
240.	Mr. Rakesh	Tea Maker (ACP-I)
241.	Mr. Arun Kumar	Bearer ACP-II
242.	Mr. Ravinder Kumar	Bearer-ACP
243.	Mr. Dil Bahadur	Bearer-ACP
244.	Mr. Rajinder Pal	Bearer-ACP
245.	Mr. Malkhan Singh	Wash Boy / Bearer
246.	Mr. Dheer Singh	Wash Boy-ACP

Superannuation

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

Mr. Naresh	Safaiwala	30.06.2014
Mr. Ramesh Chand	Principal Technical Officer	31.08.2014
Dr. Mridul Garg	Sr. Principal Scientist	30.09.2014
Dr. Sunil K. Sharma	Chief Scientist	31.10.2014
Mr. Vijay Kumar	Technician	31.10.2014
Mr. Lakshmi Chand	Chowkidar	30.11.2014

Mr. R.K. Garg	Chief Scientist	31.12.2014
Mr. A. Ghosh	Chief Scientist	31.12.2014
Dr. N.K. Saxena	Sr. Principal Scientist	31.12.2014
Mr. Shiv Dass	Sr. Tech. (2)	31.01.2015
Mr. Prem Singh	Technician	31.01.2015
Mr. Shyam Lal	Technician	31.01.2015

Transfer on Promotion

Mr. J.K. Chaurasia	S.O. (F&A)	10.09.2014

(From CSIR-CBRI Roorkee to CSIR-CSMCRI Bhavnagar to join as F&AO)

Promotion

Mr. V.P.S. Rawat	Security Officer	24.10.2013
Mr. B.K. Kalra	Sr. T.O. (1) Gr.III (4)	17.09.2012
Mr.Ram Ashray Rai	Sr. T.O. (2) Gr.III (5)	20.04.2012
Mr. Bharat Bhushan	Sr. T.O. (2) Gr.III (5)	31.03.2013
Mr. Rajeev Kumar Sharma	Sr. T.O. (3) Gr.III (6)	02.07.2012
Mr. Sushil Kumar	Sr. T.O. (3) Gr.III (6)	01.09.2012
Mr. Prakash Chand	Principal T.O. Gr.III (7)	06.11.2012
Mr. Rajeev	Principal T.O. Gr.III (7)	06.12.2012
Mr. Jaswinder Singh	Principal T.O.Gr.III (7)	01.02.2013
Dr. P.K. Yadav	Principal T.O. Gr.III (7)	13.06.2012
Mr. D.S. Dharamshaktu	T.O. Gr.III (3)	13.06.2012
Mr. Kedar Nath	Sr. Tech. (1) Gr.III (3)	24.09.2012
Mr. Santosh Kumar Mishra	Sr. Tech. (1) Gr.III (3)	24.09.2012
Mr. Arvind Kumar	Sr. Tech. (1) Gr.III (3)	15.04.2012
Mr. Sharad Kumar	Sr. Tech. (1) Gr.III (3)	01.06.2012
Mr. Mam Chand Agarwal	Sr. Tech. (1) Gr.III (3)	01.06.2012
Mr. Arvind Kumar Sharma	Sr. Tech. (1) Gr.III (3)	01.06.2012
Mr.Tahir Husain	Sr. Tech. (1) Gr.III (3)	01.06.2012
Mr. Ghanshyam Mittal	Sr. Tech. (1) Gr.III (3)	02.06.2012

Mr. Francis Charles	Sr. Tech. (1) Gr.III (3)	01.06.2012
Mr. Manoj Kumar Tyagi	Sr. Tech. (1) Gr.III (3)	28.01.2013
Mr. Jai Pal	Sr. Tech. (1) Gr.III (3)	28.01.2013
Mr. Iqubal Ahmed	Sr. Tech. (1) Gr.III (3)	28.01.2013
Mr. Shorab Khan	Sr. Tech. (1) Gr.III (3)	28.01.2013
Mr. Naresh Yadav	Sr.Steno (3rd MACP)	30.06.2013
Mrs. Sarita Khanna	Asstt. (G) GR.I (3rd MACP)	11.11.2013
Mr. R.K. Johar	Asstt. (G) GR.I (3rd MACP)	11.11.2013
Mr. Yogesh Kumar	Asstt. (G) GR.I (3rd MACP)	05.06.2014
Mrs. Archana	Sr.Steno (2nd MACP)	30.09.2014
Mr. Arvind Kumar	Sr.Steno (2nd MACP)	30.09.2014
Mr. Dalpat Singh	Sr.Steno (2nd MACP)	30.09.2014
Mr. Sushil Kumar	Asstt.(G) GR.II (2nd MACP)	02.12.2013
Mr. Satya Pal	MTS (2nd MACP)	01.09.2010
Mr.Anit Kumar Pal	MTS (1st MACP)	28.05.2014
Mr.Mehraj Deen Khan	MTS (1st MACP)	28.05.2014

Obituary

Mr. Har Sagar Sharma	Sr. Tech. (2)	22.10.2014

Research Papers

Research Papers

International Journal

1. Aravind A. Kumar, Rajiv Kumar and Shorab Jain, "Application of Computational Fluid Dynamics for Different Fire Strengths in a Compartment using Combustion Modeling", International Journal of Fire Science and Technology, Vol. 33(2014) No.2 35-46, DOI:http://dx.doi.org/10.3210/fst.33.35.
2. Ashok Kumar, R. Deoliya, and P.S Chani, "Insulating Materials for Energy Saving in Buildings", published in Special topic volume with Invited Peer Reviewed Papers on Materials and Technologies for Green Construction, Key Engineering Materials, Vol. 632 (2015), 1-14.
3. A. Pain, D. Choudhury and S. K. Bhattacharyya, "Seismic Stability of Retaining Wall-Soil Sliding Interaction using Modified Pseudo-dynamic Method", Geo-technique Letters (ICE), 2015, 5(1), 56-61 [(DOI): 10.1680/geolett.14.00116].
4. D.P. Kanungo, Shaifaly Sharma and Anindya Pain, "Artificial Neural Network (ANN) and Regression Tree (CART) Applications for the Indirect Estimation of Unsaturated Soil Shear Strength Parameters", Frontiers of Earth Sciences, September 2014, Volume 8, Issue 3, pp 439-456 DOI:10.1007/s11707-013-0146-5, 2014
5. Jayant Joshi, Harish Chandra Arora and Umesh Kumar Sharma, "Structural Performance of Differently Confined and Strengthened Corroding Reinforced Concrete Columns", Construction and Building Materials (Elsevier, UK), Vol. 82, February 2015, 287-295.
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Papers in Conference/Seminar/Workshop

1. Aravind A Kumar, Shorab Jain, R.S. Chimote, and Rajiv Kumar, "Numerical Simulation of Fire Behavior in a Compartment with Fire Source at Different Locations using Computational Fluid Dynamics", 4th Fire & Disaster Management Conference and Exhibition, organized by Institution of Fire Engineers, Lucknow, November, 2014, 12-21.
2. Abha Mittal, "Delineating the Near Subsurface Geology using Seismic Refraction Method", 51th Annual Convention on Earth Science and Society, Kurukshetra University, November 19-21, 2014
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4. Ashok Kumar & Ajay Chaurasia, "Guidelines for Construction of Buildings in Seismic and Landslide Prone Hilly Regions" Status of Natural Hazards in Himachal Pradesh on November 08, 2014 organized by Central University of Himachal Pradesh, 51-55.
5. Ashok Kumar, "Green Building Retrofitting – Concepts & Strategies: CSIR – CBRI's Initiatives", National Conference on "Retrofitting of Renewable Energy and Energy Efficiency Systems for Sustainable Habitat", jointly organized by MNRE (GoI), HUDCO (HSMI) and Sharp Developments (SD), New Delhi, during December 18, available online: http://icfild.org/green-retrofit/presentations.html

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7. AK. Mittal, S. Behera, D. Ghosh and S.K. Bhattacharyya, "Issues of Tall Building due to Wind Forces-A Case Study" 7th National conference of Wind Engineering, November 21-22, 2014, 53-60
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12. P.C. Thapliyal & Kirti, "Effect of Nano Particles on Bonding of Coatings with Concrete", 9th USSTC, 326, 2015.
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14. Rajesh Kumar, Rajni Lakhani, Priyanka Tomar and Shahnawaz Khan, "Potential Use of Kota Stone Waste in the Production of Value Added Products" MRSI- AGM held in Jaipur during February 9-11, 2015.
15. Ravindra S. Bisht, Soju J. Alexander and Akshay Kumar, "Numerical Simulation of Vacuum Gripper for Robotic Applications," International conference on Advances in Computing, Communications & Informatics, COER Roorkee, November 28-30, 2014 (**ISBN:** 978-93-84935-14-6), 98-105.
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Article in Magazine

1. Ashok Kumar, "Smart Avam Deerghkaleen Shehroon ki Sankalpana aur Pramukh Visheshtayien : ek Adhhyann (Concept and Key Features of Smart & Sustainable Cities : A Study)", Nirmanika, CSIR- Central Building Research Institute Roorkee, 2015, 41- 42.

2. Bal Mukund Suman, " Jalvayu Parivartan ke Niyantran mein Paryavaran Samarthak Ushmarodhi Bhavan Samagri ki Upyogita (Utility of Environmental Pro Insulating Building Materials in the Control of Climate Change)" Nirmanika, CSIR- Central Building Research Institute Roorkee, 2015, 01- 05.
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8. P.C. Thapliyal, "Nano Coatings and Paints for Green Future", Nanodigest, 5, 42, 2014
9. P.C. Thapliyal, "Laep aur uske upyog (Coating and its use)", Nirmanika, CSIR- Central Building Research Institute Roorkee, 2015, 43-44.
10. P.C. Thapliyal and Kirti Singh, "Nano based Aerogels as Insulation Building Materials'', Nanodigest, 1, 30-33, 2015.
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12. Sushant Kumar Senapati, "Library Materials Development, Conservation & Use: From Brick to Click", Nirmanika, CSIR-Central Building Research Institute, Roorkee, 2015, 58-61.

Book Chapters

1. Ashok Kumar, and S.K. Bhattacharyya, "Blue Sky Research, Habitat Vision -2035", TIFAC, DST, Government of India, New Delhi, 77-80, March 2015.
2. Ashok Kumar and S.K.Bhattacharyya, "Transitioning to a Low Carbon Energy Economy in Building Sector," International Council of Academics of Engineering and Technological Sciences (CAETS) & INAE, New Delhi.
3. Ashok Kumar, Rajesh Deoliya and P.S. Chani, "Insulating Materials for Energy Savings in Building", Materials for Energy Conservation, Trans Tech Publications Ltd., Kreuzstrasse, Switzerland, doi: 10.4028, Vol. 632, Jan. 2015, 1-14.
4. Shorab Jain, A. Aravind Kumar and R. S. Chimote, "Numerical Simulation of Water Mist Velocity Distribution using Computational Fluid Dynamics", Fire Research and Engineering, Narosa Publishing House, New Delhi, India 2015, ISBN: 978-81-8487-395-5,154-165.
5. P.C. Thapliyal, "Performance Enhancement of Polymeric Materials through Nanotechnology" in 'Micro and Nanostructured Polymer Systems: From Synthesis to Applications', Apple Academic Press Inc., NJ, USA, 2015.

Visits, Lectures, Meetings etc.

VISITS, LECTURES, METTINGS etc.

Visits Abroad

- Dr. P.C. Thapliyal visited School of Engineering, University of the West of Scotland, Paisley, UK; May 31 to June 15, 2014.
- Prof. S.K. Bhattacharyya and Dr Ajay Chaurasia, visited University of Minho, Guimaraes, Portugal during July 5-13, 2014 with a view to establish bilateral programme between CSIR-CBRI and Institute for Sustainability & Innovation in Structural Engineering (ISISE) during July 10-11, 2014 and also to present the R&D work of CBRI on "Seismic Performance of full-scale brick masonry buildings" at 9th International Masonry Conference, jointly organised by International Masonry Society (UK) and University of Minho, Guimaraes, Portugal during July 7-9, 2014.

Lecture Delivered

- Dr. Ajay Chaurasia delivered a lecture on "Advances in Structural Engineering, Rehabilitation and Maintenance of Buildings" in Workshop to Senior Officials of Ordnance Factories of India, organised by National Academy of Defence Protection (NADP), Nagpur, during July 30-31, 2014.
- Dr. P.C. Thapliyal delivered a lecture on "Protective Coatings for Concrete Structures", at School of Engineering, University of the West of Scotland, Paisley, UK; on June 11, 2014.

Meetings attended

- Dr. Ajay Chaurasia attended:
  A meeting on Construction aspects of earthquake resilient buildings in India; NDMA, New Delhi, on March 4, 2015.
  Governing Council meeting of ICI at Nagpur on March 12, 2015.
- Dr. S. R. Karade attended Task Force Meeting to review progress of SINP was held on 13th Feb.'2015
  An interactive meet of Scientists with M/s 2D Energy LLP, New Delhi held on 1st March'15 regarding energy retrofit of existing buildings.

Honours & Awards

- Dr. Ajay Chaurasia was honoured as:
  Personal Member of International Masonry Society (UK)
  Secretary, Indian Society of Earthquake Technology (ISET), Deptt. of Earthquake Engineering, IIT Roorkee.
  Member – Expert Group, Seismic Retrofit Policy of India – Policy, Strategy and Guidelines, NDMA, GOI, New Delhi.
  Member – Expert Group, Seismic Vulnerability Assessment of Building Types in India, NDMA, GOI, New Delhi.
- Dr. S. R. Karade was awarded "Outstanding Reviewer" by the Editorial Board of the Journal 'Construction & Building Materials' (Elsevier, UK) in Oct.'14.

Workshop/Seminar Attended

- Dr. S. R. Karade attended a Workshop on "Concrete Research in India" at IIT, Madras in Chennai on May 10, 2014
- Dr. Ajay Chaurasia attended an All India seminar on New Developments in Use of Alternative Materials for Concrete during March 13-14, 2015.

Training received

Dr. B. M. Suman attended a training program on Managerial Effectiveness for Technical Officers at CSIR-HRDC, Ghaziabad during Nov. 10-10, 2014.

Patent Filed

Mr. Ajay Chaurasia filed a patent, 3-Dimensional Deformometer for measuring displacement response of masonry prism along three axes (App.No. 444/DEL/2015, dt. 17.02.2015).

MoU Signed

Mr. Ajay Chaurasia signed MoU between CSIR-CBRI and Airport Authority of India, New Delhi on project Instrumentation & Monitoring of Buildings and Reinforced Soil structure at Greenfield Airport, Pakyong, Sikkim, on July 15, 2014 at Roorkee.

Thesis Submitted

Mr. Ajay Chaurasia has submitted Ph.D. Thesis on the topic "Performance Evaluation of Confined Masonry Buildings under Cyclic Lateral Loads" to IIT Roorkee, under the guidance of Prof S.K. Bhattacharyya, Prof. Pradeep Bhargava, and Prof. N.M. Bhandari.

Date Line

DATE LINE

S.No.	Date	Salient Details
1.	May 12, 2014	National Technology Day
2.	June 5, 2014	World Environment Day
3.	August 15, 2014	Independence Day
4.	August 20, 2014	Sadbhavna Diwas
5.	September 12-25, 2014	Hindi Pakhwara
6.	September 26, 2014	C .S.I.R. Foundation Day
7.	October 2, 2014	Swachh Bharat Abhiyan
8.	October 17, 2014	Diwali Mela Celebration at CBRI Campus
9.	October 27-01 Nov. 2014	Vigilance Awareness Week
10.	January 26, 2015	Republic Day
11.	February 10, 2015	C.S.I.R.- C.B.R.I. Foundation Day
12.	February 21,2015	Inauguration of Landslide Observatory at Pakhi Landslide near Pipalkoti
13.	February 27, 2015	National Science Day
14.	March 8, 2015	International Women Day
15.	March 9-10, 2015	Exchange Meet on Structural and Passive Fire Safety in Buildings: Issues & Challenges
16.	March 15,2015	Annual Flower and Vegetables Show
17.	March 28-29, 2015	INDO-UK Scientific Seminar on Green Construction Materials for Sustainable Build