NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS
NCB
न हि ज्ञानेन सदृशं

आज़ादी का अमृत महोत्सव

G20 भारत 2023 INDIA
वसुधैव कुटुम्बकम्
ONE EARTH • ONE FAMILY • ONE FUTURE

स्वच्छ भारत
एक कदम स्वच्छता की ओर

ANNUAL REPORT 2022-23

National Council for Cement and Building Materials

Annual Report 2022-23

1st April 2022 to 31th March 2023

National Council for Cement and Building Materials

(Under the Administrative Control of Ministry of Commerce & Industry, Govt of India)

34 KM Stone, Delhi-Mathura Road (NH-2), Ballabgarh-121004, Haryana

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Message from desk of Chairman

Dear Stakeholders,

I hope that this message finds you in good health and high spirits. It gives me great pleasure to present the annual report of National Council for Cement and Building Materials (NCB), a premier body for research, technology development & transfer and capacity building in areas of cement, concrete and building materials. Innovation, an essence for success of our industry is at the heart of NCB. The year gone by has been no different from mission at NCB, pushing the boundaries of cement and concrete technology. In industry, sustainability and customer satisfaction are the two areas where substantial work is achieved but great strides are yet to be taken. The commitment of NCB's scientists and engineers to innovation and keeping up with latest developments in areas that benefit the country and industry, such as preservation of natural resources, energy & environment, increasing productivity and quality assurance & control, is an encouraging sign of things to come ahead in near future. The focus this year once again has been to develop cement solutions acceptable to the environment and I'm glad to note that NCB have been working tirelessly to develop cement formulations that reduce CO_2 emissions without sacrificing quality.

NCB is making a significant contribution to the advancement of emerging technologies and materials, such as composite cements, high volume fly ash cements, portland blended cement and geo-polymeric cements to name a few. It is actively engaged in providing valuable services to various industries through the execution of sponsored projects and conducting extensive material testing in its laboratories accredited by the NABL and recognized by BIS. In addition, calibration services, manufacture of Certified Reference Materials (CRMs) and Bharatiya Nirdeshak Dravya (BNDs) are also on offer. NCB is also providing training and assistance in problem-solving whenever required. It is gratifying to know that NCB has successfully completed not only ten important Research Projects but also 167 Sponsored Projects during the previous financial year, in addition to conducting 31 Training Programs that have effectively disseminated knowledge and expertise to professionals within the industry.

Keeping the industry and stakeholders in mind, NCB undertook programmed projects specifically focussing on effective utilization of waste materials such as FGD gypsum, phosphogypsum, and lime sludge used in cement manufacturing process. Additionally, significant strides were made in development of belite calcium sulpho-aluminate cement, utilizing low grade limestone and industrial waste. NCB took the initiative to explore potential application of cementitious raw materials in development of zeolite, specifically for oxygen concentrators. In order to ensure the feasibility and practicality, NCB conducted experimental trail runs in a downdraft gasifier at BITS Pilani and successfully developed a MAT lab model for RDF gasification, enabling to accurately predict the quality of Syn gas produced. Moreover, transfer chutes that can effectively handle a wide range of solid alternative fuels without encountering any issues related to jamming were designed. NCB has also entered into an agreement to develop predictive models which can enhance TSR through liquid AF in cement plant. In the realm of concrete, notable advancements were made in development of Ultra

High-Performance Concrete (UHPC), exhibiting compressive strength exceeding 150 MPa. Current research efforts are focused on investigating the mechanical and durability properties of High Strength Geopolymer Concrete, furthering knowledge and understanding of this innovative material.

In recent times, NCB has rendered invaluable assistance to the cement industry by undertaking studies on aspects like L-C-F, performance assessment of existing air pollution control equipment, energy audits, feasibility assessments and similar reports. Notable progress has also been made in the domain of serving as a Project Management Consultant (PMC) to international cement plants. This achievement has established NCB's position as a dependable consultancy service provider in this part of the world, catering to the global cement industry.

NCB has been innovating for the construction and concrete industries by evaluating a variety of concrete-making materials and concrete mix designs for unique uses. NCB is skilled in assessing aggregates for the performance of integral crystalline water proofing compounds as well as possible alkali aggregate reactions. It has carried out a wide range of activities related to the assessment of new and existing concrete structures, including studies on Normal and High Strength Concrete (HSC) using various indigenous aggregates for concrete grades ranging from M35 to M100.

In addition to offering the industry excellent calibration services, NCB has developed 18 Bhartiya Nirdeshak Dravyas (BNDs) and 79 different types of CRMs in quality management to meet the diverse needs of the sector. Presently, CRMs are provided in accordance with ISO 17034:2016 and the BND trademark in the cement and cementitious materials sector.

With participation from the global cement and construction sectors, NCB International Seminars have grown to be a distinctive biennial event in this part of the world. I'm looking forward to 18th edition with much excitement as it is expected that like its predecessors, this event will attract the government, academic institutions, machinery manufacturers and consultants from India and around the world as well as professionals, engineers and industry leaders to talk about future action plans aiming to achieve sustainability and net zero carbon emissions in near future for the industry.

I would like to express my admiration to all at NCB. Also, I would like to thank my fellow members of the Board of Governors and its Committees for their insightful counsel and direction on a variety of topics brought before us. Much of NCB's success may be attributed to the government, industry and organizations' providing support and collaboration. My heartfelt gratitude also goes out to Department for Promotion of Industry and Internal Trade for their guidance and support. I hope that NCB will continue to receive unwavering support from DPIIT and patronage from cement and concrete industry to excellence in its various fields of endeavour.

K C Jhanwar
Chairman

20 November 2023

Message from desk of Director General

With a country having economic might, large workforce, dynamism in demography, vibrant democracy and unity in diversity, India's rise as a superpower in current global geopolitics is unquestionable. India's G20 presidency and the times post it will truly turn out to be the defining moments in its history. Its growth will inturn lead to growth in infrastructure fueled by increased budgetary allocations and government spending on affordable housing and mega infrastructure projects, thereby benefitting the cement industry. To reduce its carbon footprint, the industry needs to move away from polluting, volatile and expensive fossil fuels and towards cleaner, more modern technologies. But this doesn't mean that the industry is not looking for options or spoilt for choices. Inspite of what I would term as "*teething troubles*", notable investments can be seen in green energy, circular economy and sustainable materials based on a "*sangam*" of morality and sound financial judgment. I proudly present to the cement and concrete fraternity, government, academia, scientific institutions, civil society and all our stakeholders, the Annual Report for the year 2022-2023. This report celebrates the honest toils of our engineers, scientists and support staff working in this great institution which rightfully stands on pillars of knowledge, ethics, infrastructure, energy and drive of its people.

NCB has provided to both new and its existing clients, reliable technical solutions over the past year by successfully completing 167 sponsored projects for the industry with an enterprising customer-centric approach. NCB is presently pursuing several programmed projects like utilizing industrial wastes, LCF & process optimization studies, energy conservation, environmental improvement, feasibility studies, diagnostic studies on distressed structures and quality audits just to name a few.

Centre for Cement Research and Independent Testing (CRT) completed 17 LCF studies, carried out investigations on lumps in cement bags and development of Portland Dolomite Cement. It developed plant specific secondary standards of cement raw materials and finished products for 16 plants, cements using industrial waste and investigated mineral carbonation mechanism of industrial wastes and raw materials. Specific attention was given to research carried out to utilize waste materials in manufacturing of cement and clinker. Also, more than 7,890 samples were tested by cutting-edge Independent Testing Laboratories in accordance with National and International Standards.

Centre for Mining, Environment, Plant Engineering and Operation (CME) successfully accomplished Project Management Consultancy services for our clients outside India and carried out sponsored studies like assessment of air pollution control equipment, energy audits, plant capacity assessments and enhancement, heat & gas balance studies, feasibility & detailed project reports as well as marketing reports for the utilization of FGD gypsum. Furthermore, the Centre undertook R&D projects like RDF gasification, designing a chute capable of accommodating 19 different types of solid alternative fuels without experiencing any jamming issues and increase in Thermal Subsititution Rate (*TSR*) by application of Artificial Intelligence (*AI*).

Centre for Construction Development and Research (CDR) under various programs is carrying out activities like material evaluation of wide range of concrete mix designs for special applications, alkali aggregate reaction studies, evaluation of integral crystalline waterproofing compound, carbonation induced corrosion for composite cement, utilization of coarser fly ash in concrete, use of EAF slag as fine and coarse aggregate, testing of coarse and fine aggregate materials, evaluation of activated GGBFS as an alternative to hydraulic binder, use of ferrochrome slag as a coarse aggregate in concrete and studies on Ultra High-Performance Concrete. Further, research on cathodic protection to enhance service life of concrete structures, use of 3D printer are taken up. Condition of existing concrete structures, is assessed as part of the structural assessment and rehabilitation process for concrete structures. The Centre aids to build durable infrastructure in India for prestigious projects of national importance by offering specialized services in quality assurance and control and durable repair strategies for distressed RCC structures.

Centre for Quality Management, Standards and Calibration Services (CQC) developed 18 Bhartiya Nirdeshak Dravyas (*BNDs*) in collaboration with CSIR-National Physical Laboratory (*NPL*), envisioned to boost "***Make in India***" program and fulfill the mission of "***Atmanirbhar Bharat***". Supply of 2564 CRMs and 1,274 sets of standard lime was continued. Calibration services were also provided where figure of 96% clients rating NCB's services as excellent, was retained in the past year.

Centre for Continuing Education Services (CCE) imparted training on cement, concrete and construction technologies through its various special, short-term and refresher courses. During the year 2022-23, 31 training programmes were successfully organized with multidisciplinary participants attending the programmes. CIS also organized webinars & workshops, disseminating information on technologies and services through various modes.

I assure that NCB's research and innovation initiatives, including decarbonization, adoption of a circular economy, enhanced sustainability are well aligned with the objectives of the government, industry and society. I thank all my colleagues for their exceptional effort, passion and dedication during the past year and look forward to the same in coming year as well. I thank DPIIT, MoC&I, Govt. of India, the Board and its Committees for their vision, direction and constant inspiration. I express gratitude to the industry for reinstating confidence in NCB and for its continued patronage, revitalizing our long-standing partnership, thereby enabling us to nurture our shared goal of advancing efforts towards societal betterment.

We reaffirm our dedication to upholding the highest standards of integrity, quality and innovation. I hope that through our report, which is a testimony of the above-mentioned commitments, we will be able to showcase the evidence of our promise. Jai Hind!

Dr. L P Singh
Director General

20 November 2023

National Council for Cement and Building Materials (A Premier R&D Organisation under the Administrative Control of Ministry of Commerce & Industry, Govt. of India)

Our Vision

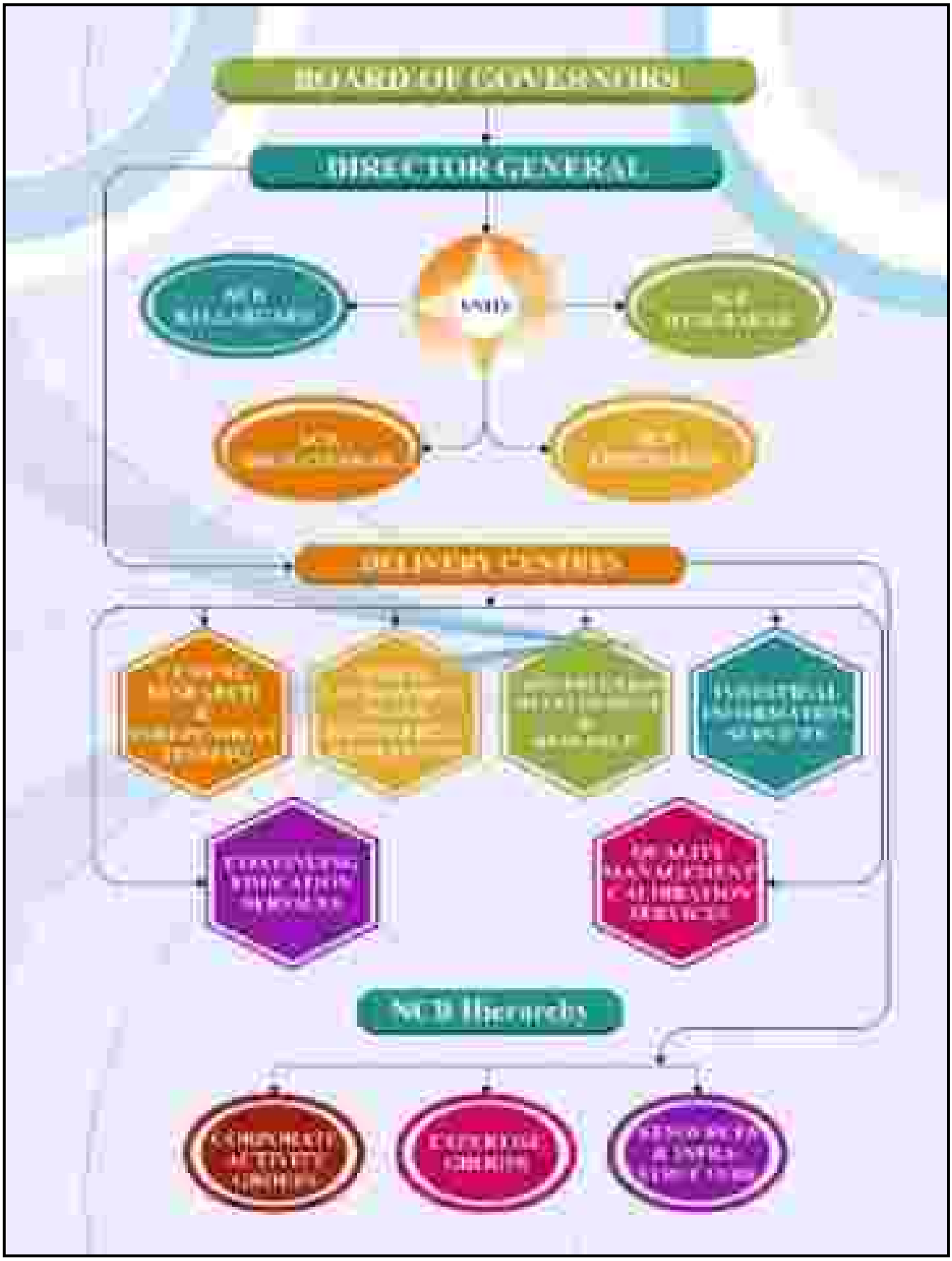
Be a preferred technology partner to cement and construction sectors in the sustainable development of a better infrastructure and housing.

Our Mission

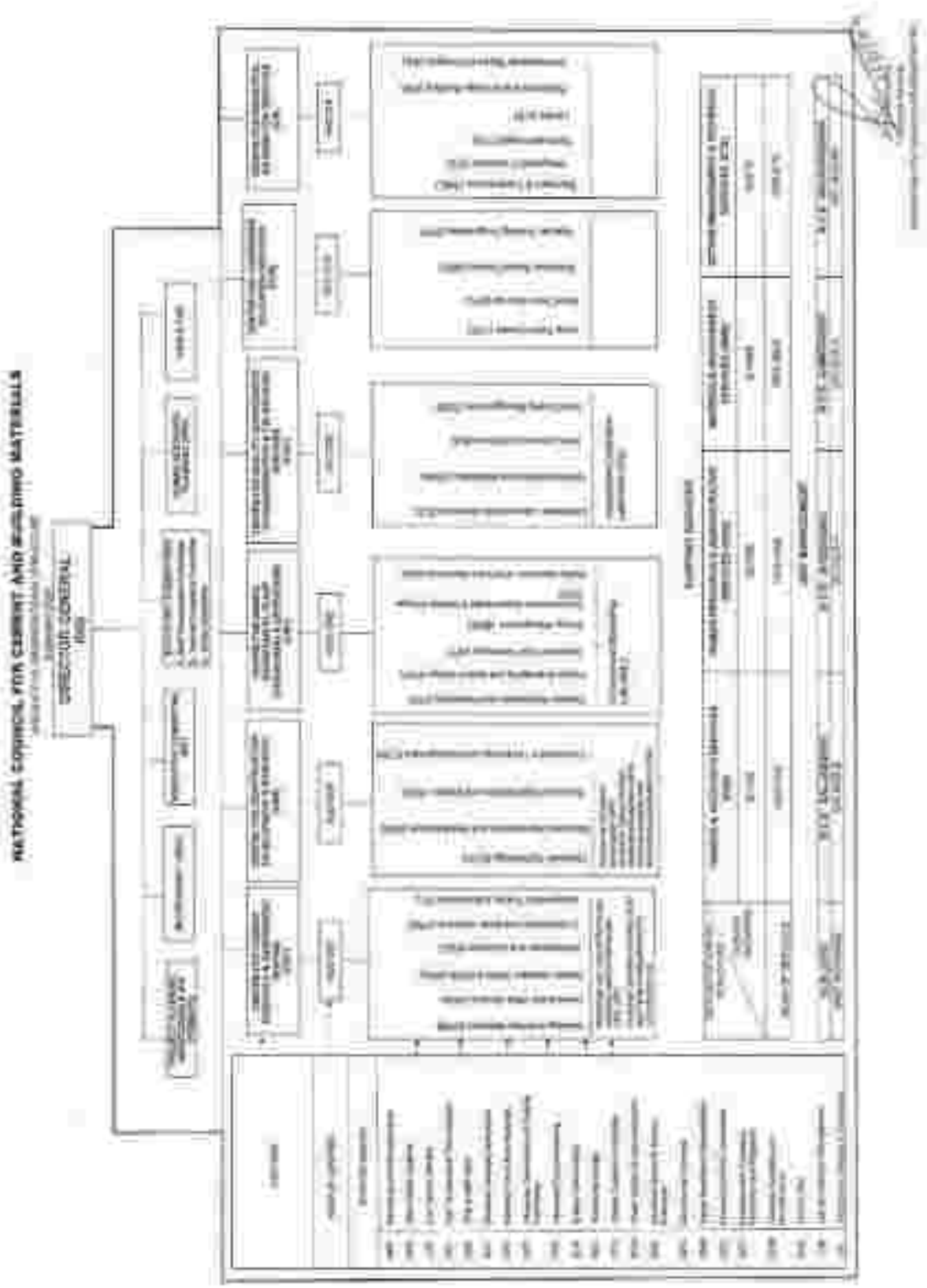
Research and Development of innovative technologies, their transfer and implementation in partnership with cement and construction industries.

- To enhance quality, productivity and cost-effectiveness
- To improve the management of materials, energy and environmental resources
- To develop competency and productivity in human resources
- To develop technologies for durable infrastructure and affordable housing

NCB Hierarchy



NCB Organization Structure



Introduction of NCB

National Council for Cement and Building Materials (NCB), the then Cement Research Institute of India (CRI) was founded on 24th December 1962 with the objective to promote research and scientific work, connected with cement and building materials trade and industry.

NCB is premier autonomous R&D organisation under the administrative control of Ministry of Commerce and Industry, Govt. of India, devoted to technology development &, transfer, continuing education and industrial services for cement and construction industries. It is registered as a society under the Societies Registration Act, 1860. NCB serves as the nodal agency for providing the Government the necessary support for formulation of its policy and planning activities related to growth and development of cement industry.

It is devoted to protect the interests of consumers of cement and concrete in the country. NCB's stakeholders are Government, Industry and Society, who perceive NCB's role as discharging national responsibility, providing adequate technology support and improving the quality of life respectively. Geographically, NCB has its corporate unit and main laboratories located at Ballabgarh (near New Delhi) and regional units at Hyderabad (Telangana), Ahmedabad (Gujarat) and Bhubaneshwar (Odisha). The units of NCB-Ballabgarh, Hyderabad and Ahmedabad are ISO 9001:2015 certified.

NCB's areas of work span over the entire spectrum of cement manufacturing and usage starting with geological exploration of raw materials through the processes, the machinery, the manufacturing aspects, energy and environmental considerations to the final utilization of materials in actual construction, condition monitoring & rehabilitation of buildings and structures.

NCB provides ISO 17025:2017 accredited testing and calibration services and ISO 17043:2010 accredited proficiency testing (PT) services. It also develops and supplies certified reference materials (CRMs) to cement and construction sector as per ISO 17034:2016. For human resource development, NCB imparts training to professionals of cement, concrete and building materials sectors through short term and long-term courses. NCB's Post Graduate diploma in cement technology of one year duration is approved by AICTE. In the area of industrial information services, NCB organizes international seminars/conferences on cement, concrete and building materials. It has organised 17 editions of this seminar/conference, so far.

All these activities of NCB are channelized through six corporate centres:

- **Centre for Cement Research & Independent Testing (CRT):** Centre is responsible for research activity in the areas of cement and other binders, waste utilization, refractory and ceramics, fundamental and basic research. It also looks after testing activities of cement and cementitious materials and other building materials.

- **Centre for Mining, Environment, Plant Engineering & Operation (CME):** Centre carries out its activity in the area of environmental management, process utilization and productivity, energy management, plant maintenance and project engineering and system designing, advanced fuel technology and quality assurance (electrical & mechanical).

- **Centre for Construction Development & Research (CDR):** Centre is responsible for research activities in the area of structural assessment and rehabilitation, concrete technology, construction technology and management and structural optimization and design.

- **Centre for Quality Management, Standards & Calibration Services (CQC):** Centre provides services to the industry in the area of proficiency testing, standards reference materials, calibration services and total quality management.

- **Centre for Industrial Information Services (CIS):** Centre provides the IT infrastructure. Centre also looks after the publications, seminar and conferences, international and national linkage and image building of NCB.

- **Centre for Continuing Education Services (CCE):** Centre organizes need based, industry-oriented training programmes in the area of cement, concrete and constructions.

NCB has following four service groups to support the technical activities of above six corporate centres.

- **Finance and Account Services (FAS):** FAS is responsible for managing all day-to-day financial activities

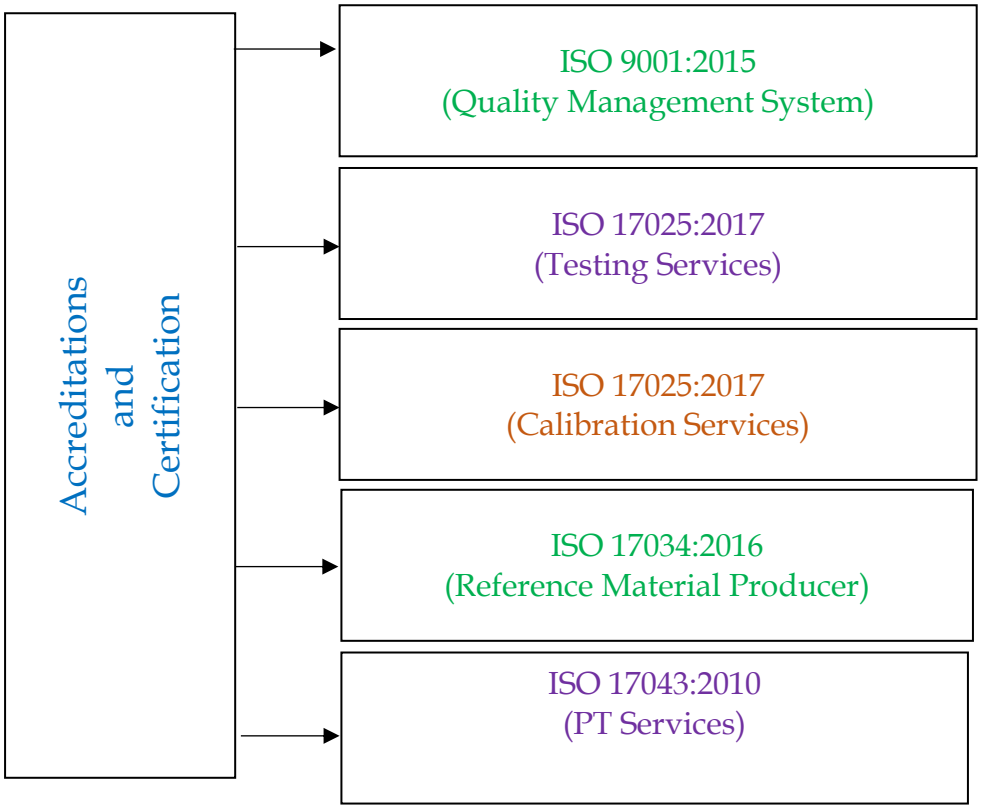
- **Human Resource and Administrative Services (HRS):** HRS-GEN provides the transportation resources and HRS-PER is responsible for human resources activity such as recruitment, promotion, appraisal etc.

- **Estate Management and Technical Services (ETS):** The infrastructure including resources such as workspace, utilities, equipment and communication technology infrastructure are maintained by ETS.

- **Materials Management Services (MMS):** MMS is responsible for purchase of materials including raw material as well as equipment as per the requirements of different departments of organization.

NCB's Commitment to International Quality Standards

NCB in its commitment to achieve excellence has adopted world class practices and implemented international standards for Quality Management System. NCB's quality management system is certified as per ISO 9001:2015. NCB provides world class Testing, Calibration, Proficiency Testing and Reference Material Producer. Activities which are accredited as per International Standards.



Quality Management System Certification as per ISO 9001:2015

ISO 9001 is international standard published by International Organization for Standardization which specifies requirements for quality management system with the aim to enhance customer satisfaction, ability to provide reliable products and services meeting customer's requirements and expectations. NCB implemented ISO 9001 since 2002. NCB-Ballabgarh, NCB-Hyderabad and NCB-Ahmedabad units are ISO 9001:2015 certified.

QUALITY OBJECTIVES

We commit ourselves to:

1. **Pursue global standards of excellence in all our endeavours, covering: Research, Design and Development, Technology Transfer, Continuing Education, Calibration and Testing Services in the areas of Cement, Construction and Building Materials.**

2. **Satisfy all our stakeholders- Government, Industry and Society.**

3. **Continually improve the Quality Management System.**

4. **Comply with the requirements of ISO 9001:2015 Quality Management System and other applicable requirements.**

ISO 17025:2017- Testing Services

ISO/IEC 17025:2017 is international standard published by International Organization for Standardization and International Electro Technical Commission. ISO/IEC 17025:2017 specifies the general requirements for the competence, impartiality and consistent operation of laboratories involved in testing, calibration and sampling. NCB implemented ISO/IEC 17025 for its testing services since 1998. NCB provides complete physical, chemical, mineralogical and micro-structural analysis of various types of raw materials, cement, clinker, pozzolana, aggregate, concrete, admixtures, water, refractory, bricks, coal, lignite, Environment parameters etc. & Non-Destructive Testing as per National and International standards.

QUALITY POLICY

Testing laboratories of National Council for Cement and Building Materials, Ballabgarh are committed to provide reliable and accurate test results to the total satisfaction of customers in accordance with the stated methods and customer's requirement.

ISO 17025:2017 – Calibration Services

ISO/IEC 17025:2017 is international standard published by International Organization for Standardization and International Electro Technical Commission. This standard specifies the general requirements for the competence to carry out tests and/or calibrations, including sampling. NCB implemented ISO/IEC 17025 for its calibration services since 1998. NCB provides quality calibration services in the field of force, mass, pressure, volume, rpm and dimension fields.

Quality Policy

Independent Calibration Laboratories of National Council for Cement and Building Materials, Ballabgarh, are committed to provide reliable, accurate, calibration results to the total satisfaction of customers in accordance with the stated methods and customers' requirements. The laboratories are committed for ensuring impartiality, integrity and confidentiality of customer data, with efforts for continual improvement of management system and consistent operations.

Quality Objectives

1. **Providing reliable calibration services, accurately and timely, to the satisfaction and requirements of customers;**
2. **Laboratory personnel are committed to carry out laboratory activities in an consistent and competent manner with utmost integrity, impartiality and ensuring confidentiality of customer data;**
3. **Continual improvement of effectiveness of management system, continual training of laboratory personnel and up gradation of services and facilities in accordance with changing customer requirements and relevant specifications;**
4. **Continual improvement of customer satisfaction; To meet the above objectives, the laboratories follow the management system appropriate to scope of their activities and meet the requirements of NABL criteria of accreditation and IS/ISO/IEC 17025:2017 – "General requirements for the competence of testing and calibration laboratories" and are provided with necessary resources.**

ISO 17034: 2016 – Reference Material Producer

ISO 17034:2016 is international standard published by International Organization for Standardization. This standard specifies "General Requirements for the Competence of Reference Material Producers" for the Development of Certified Reference Material. NCB implemented ISO 17034:2016 since March 2021. NCB provides Certified Reference Materials in the area of cement and cementitious materials including solid fuel (Coal).

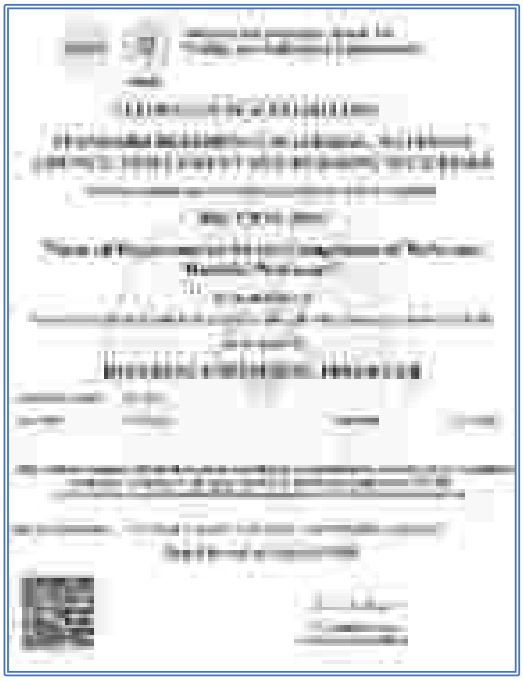
QUALITY POLICY

Standard Reference Material of National Council for Cement and Building Materials, Ballabgarh, are committed to provide highest quality of Certified Reference Materials to customers, to produce RMs which conform to the requirements as per International Standard, to conduct all testing and calibration in support of the production of RMs in compliance with ISO/IEC 17025.

SRM programme are also committed to follow good professional practices and continually improve the effectiveness of the management system. All personnel concerned with SRM programme activities shall familiarize themselves with quality documentation and implement the policies and procedures in their work.

QUALITY OBJECTIVE

1. **To increase resource generation**
2. **To provide efficient and reliable services, to the satisfaction and requirements of customers;**
3. **To continually improve and upgrade SRM programme services;**
4. **To improve feedback of participants and customers.**
5. **To analyze and improve the management system, CRM development and customer service.**



ISO 17043:2010 – Proficiency Testing Services

ISO/IEC 17043:2010 is international standard published by International Organization for Standardization and International Electro Technical Commission. This standard specifies general requirements for the competence of providers of proficiency testing schemes and for the development and operation of proficiency testing schemes. NCB implemented ISO/IEC 17043:2010 since 2013. NCB provided proficiency testing services in testing of various building materials like cement, clinker, fly ash, limestone, coal/coke, granulated slag, water, steel, aggregate etc.

QUALITY POLICY

Interlaboratory Services of National Council for Cement and Building Materials, Ballabgarh, are committed to provide highest quality of proficiency testing services to participants and other customers.

QUALITY OBJECTIVES

1. **To provide efficient and reliable proficiency testing services, to the satisfaction and requirements of proficiency testing participants and other customers.**
2. **To continually improve and upgrade proficiency testing services.**
3. **To improve feedback of participants and customers.**
4. **To analyze and improve the management system, proficiency testing schemes. And customer service.**

Board of Governors (BOG) 2021 & 2022

Composition of BOG

Chairman

Shri K C Jhanwar

President – CMA &
Managing Director
UltraTech Cement Limited

Members

Shri Shashank Priya*
Special Secretary and Financial Advisor, Department for Promotion of Industry & Internal Trade, Ministry of Commerce & Industry, Govt. of India

Shri Anil Agrawal*
Additional Secretary (Cement)
Department for Promotion of Industry & Internal Trade, Ministry of Commerce & Industry, Govt. of India

Ms Arti Bhatnagar**
Additional Secretary and Financial Advisor, Department for Promotion of Industry & Internal Trade, Ministry of Commerce & Industry, Govt. of India

Shri Sanjiv**
Joint Secretary (Cement)
Department for Promotion of Industry & Internal Trade, Ministry of Commerce & Industry, Govt. of India

Shri Abhay Bakre
Director General
Bureau of Energy Efficiency

Chairman
National Highways Authority of India

Shri Neeraj Akhoury#
Vice Chairman-NCB
Managing Director & CEO
Ambuja Cements Ltd.

Shri P N Chhangani#
Wholetime Director
Shree Cements Ltd.

Shri Jamshed N Cooper
CEO & Managing Director
Heidelberg Cement India Ltd.

Shri Rakesh Singh
Executive President
The India Cements Ltd.

Shri Rajendra Chamaria
Vice Chairman & Managing Director
Star Cement Ltd.

Shri Jayakumar Krishnaswamy
Managing Director
Nuvoco Vistas Corp Ltd.

Shri Deepak Khetrapal
Managing Director & CEO
Orient Cement Ltd.

Managing Director
Tamil Nadu Cements Corporation Ltd.

Shri Satish Magar
Chairman, Confederation of Real Estate Developer`s Associations of India (CREDAI)

Dr B N Mohapatra
Director General, NCB

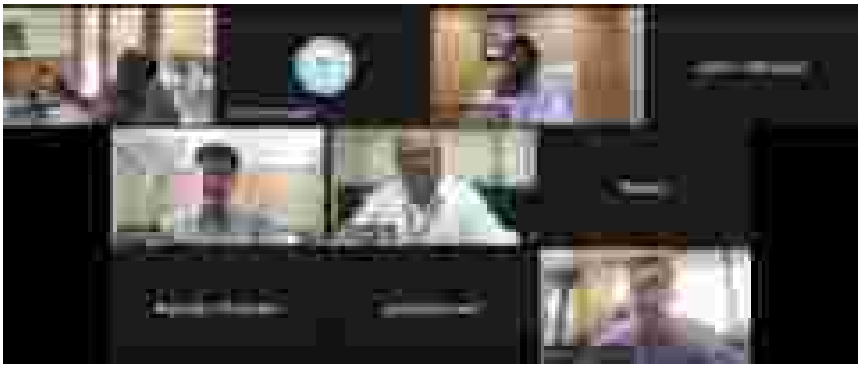
***Member of 123rd BOG, held on 1st November 2022, **Member of 124th BOG, held on 15 March 2023, #Left the organization/resigned**

Meetings of Board of Governors (BOG)

BOG is the highest decision-making body of NCB and is aided by various Committees like Administrative and Finance Committee (AFC), Infrastructural Development Committee (IDC), Research Advisory Committee (RAC) and Advisory Committee for Hyderabad & Bhubaneswar (ACH) of NCB to make informed decisions on multiple issues relating to finance, manpower, service matters and rules.

The 123rd and 124th meetings of Board of Governors (BOG) were held on 1st November 2022 & 15th March 2023 respectively under the Chairmanship of Shri K C Jhanwar, Chairman-NCB & Managing Director, UltraTech Cement Ltd. Many important discussions were held which led to key decisions during the meetings.

123rd BOG Meeting on 1st November 2022



124th BOG Meeting on 15th March 2023

Corporate Advisory Committees

Research Advisory Committee (RAC)

RAC advises on all aspects pertaining to Programmed R&D and industrial support services in NCB, with particular reference to technology forecasting, technology planning, programmes, strategies and methodologies and the overall project programme of NCB. RAC comprises eminent and learned technocrats representing Indian cement and concrete industry, technology suppliers, officials from Ministry of Commerce and Industry, Government of India, academia, Bureau of Indian Standards (BIS), and Director General-NCB etc. The RAC members meet twice in a year. The detailed composition is given below:

Chairman

Shri J N Cooper

CEO & Managing Director
Heidelberg Cement India Limited

Members

Ms. Aparna Dutt Sharma
Secretary General
Cement Manufacturers' Association

Dr Awadhesh Singh
Sr VP and Head (PA and Services)
UltraTech Cement Ltd.

Prof. G. C. Mishra
Ex-Additional Director, NCB,
Director (Cement Technology)
AKS University

Dr K Mohan
Ex Director General-NCB

Dr. Manish V. Karandikar
Vice President-Raw Mix & Product Development
ACC Ltd

Dr. N. Gopalkrishnan
Director
Central Building Research Institute
Roorkee

Sh Ashwani Pahuja
Executive Director & CSO
Dalmia Bharat Group

Controller General (I/c)
Indian Bureau of Mines
Ministry of Mines

Shri Jai Prakash Vrati
GM & Head Quality Assurance
Ambuja Cements Ltd.
Unit-Marwar Mundwa

Ms. Lopamudra Sengupta
Vice President – Technical Services
JSW Cement Limited

Dr Manu Santhanam
Professor and Head (Civil Engg)
Dept. of Civil Engineering
Indian Institute of Technology, Madras

Dr. Nahar Singh
Sr. Principal Scientist
CSIR-National Physical Laboratory

Shri Pankaj Kejriwal
Director
Star Cement

Dr. R. Chitra
The Director
Central Soil & Materials Research Station (CSMRS)

Dr. S.S. Gupta*
Senior Development Officer (Cement)
DPIIT, Ministry of Commerce & Industry, Govt. of India

Shri Ashish Bhargava#
Deputy Secretary (Cement)
DPIIT, Ministry of Commerce & Industry, Govt. of India

Shri Sanjay Pant
Head (Civil Engineering)
Bureau of Indian Standards

Shri Satish Upadhyay
Executive Director
Rammam Hydro Power Project
NTPC Limited

Prof. Shashank Bishnoi
Dept. of Civil Engineering
Indian Institute of Technology, Delhi

Dr. S K Saxena
Sr. Vice President, Jhajjar Unit & QA
J K Lakshmi Cement Ltd.

Sh. Sunil Kumar
Chairman & Managing Director
National Research Development Corp

Director General,
Head of Centres and
Joint Directors of NCB

Dr. Prashant Gargava
Member Secretary
Central Pollution Control Board

Dr. Ravindra Kumar
Deputy Director General
NCEGR, Geological Survey of India

Shri Sanjay Kumar*
Director General of Forest
Ministry of Environment, Forest & Climate Change

Dr R B Lal#
Director (Impact Assessment)
Ministry of Environment, Forest & Climate Change, Govt. of India

Prof. Satish Chandra
Director
Central Road Research Institute

Shri Shalabh Mundra
Sr. Vice President
UltraTech Cement Ltd.

Shri S K Rathore
President & Unit Head
J K Cement Works, Nimbahera, Raj.

Dr. SSV Ramakumar
Director (R&D)
Indian Oil Corporation Limited

Sh. Yatendra Shah
Sr. VP (Manufacturing.)
The India Cements Limited

An NCB Official nominated by DG will be the Member-Secretary

***74th RAC meeting, #75th RAC meeting**

Advisory Committee for NCB–Hyderabad & Bhubaneswar

In an endeavor to reach out to the cement and construction sectors in South India and for sharing NCB's Research and Innovative initiatives, Advisory Committee for NCB-Hyderabad & Bhubaneswar has been constituted. The committee deliberates on various aspects of development of NCB–Hyderabad & Bhubaneswar and its activities. It focusses in particular on the development & utilization of infrastructural facilities of the Units and industrial & training services rendered by it.

The Composition of NCB-Hyderabad & Bhubaneswar has officials from Central/State Government Departments: Cement & Construction Industry, Research Institutes (IIT/NIT/BITS). The detailed composition is given below:

Chairman

Shri Rakesh Singh

Executive President
The India Cements Ltd.

Members

Dr B K Das
Chief General Manager
The Industrial Development Corporation of Odisha Limited
(A Govt. of Odisha Undertaking)

Shri GNB Rao
Plant Head
M/s Zuari Cement Limited

Shri M. Mohamed Ali
Managing Director
M/s Malabar Cements Ltd

Shri M Sai Ramesh
Senior Vice President – Works
M/s Bharathi Cement Corp Pvt Ltd

Shri N Srinivasa Rao
Plant Head
M/s My Home Industries Pvt. Ltd

Er Pradeep Kumar Samal
Engineer In-Chief

Dr. Dinakar Pasla
Associate Professor
School of Infrastructure,
Indian Institute of Technology-Bhubaneswar

Prof. KVL Subramanian
Indian Institute of Technology
Hyderabad

Shri M Achi Reddy
Chief General Manager & Plant Head
M/s Rain Cement Industries Ltd

Shri Madhusudhan Rao
Vice President
M/s KCP Limited

Dr. N V Ramana Rao
Director
National Institute of Technology
Telangana

Shri Rajesh Garg
Plant Head

Odisha Works Dept.

Shri RVR Murthy
Plant Head
M/s. Orient Cement Limited

Shri SV Murali Prasad Reddy
Plant Head
M/s. Penna Cement Industries ltd

Shri S.V.R.K Murthy Rao
Vice President – Process
M/s The Ramco Cements Limited

Director General
National Council for Cement and Building Materials

M/s Kesoram Cement Ltd

Shri S Sreekanth Reddy
Joint Managing Director
M/s. Sagar Cements Limited

Er. Suresh Mishra
Engineer-in-chief
Rural Works Department
Govt. of Odisha

Shri V Ganesan
Chief Operating officer
Chettinad Cement Corpn. Pvt. Ltd

Unit-in-Charge of NCB–Hyderabad & NCB-Bhubaneswar

INFRASTRUCTURAL DEVELOPMENT COMMITTEE

(IDC)

Infrastructural Development Committee (IDC) advises the Board of Governors on various aspects of land, building services, equipment and facilities at the various NCB Units and to cause these infrastructural developments to be carried out at the various NCB Units and to assist in conducting the affairs of the unit in such a manner as to fulfill the set objectives with the programmes, policies and guidelines laid down by the board. The composition of the committee is given below:

Chairman

Shri P N Chhangani

Wholetime Director
Shree Cements Limited

Members

Shri Sathia Raj
CPC Head
UltraTech Cement Ltd.

Dr. Sujit Ghosh
Executive Director (New Building Solutions)
Dalmia Cement (Bharat) Ltd.

Dr. Nahar Singh
Sr. Principal Scientist
CSIR-National Physical Laboratory

Dr. Rakesh Kumar
Head of Deptt. (Rigid Pavements)
Central Road Research Institute

Shri S Khadanga
General Manager-PE-Civil
NTPC Ltd.

Dr Manish Karandikar
Vice President
ACC Ltd.

DG-NCB
Joint Directors and Head of Concerned Services Group in NCB

An NCB Official nominated by DG-NCB : Member-Secretary

ADMINISTRATION AND FINANCE COMMITTEE

(AFC)

Administration and Finance Committee (AFC) advises the Board of Governors on issues relating to financial planning, budgets, accounts, manpower growth plan and service matters including various rules of NCB. To take decisions on behalf of the Board of Governors on individual personnel cases and on issues of administrative nature as may be referred to it by the Board or by the Director General-NCB. All such decisions are reported to the Board at its immediate next meeting through the relevant status report. The composition of the committee is given below:

Chairman

Shri Rajendra Chamaria

Vice Chairman & Managing Director
Star Cement Limited

Members

Shri C K Bagga
Vice President (Fin. & A/Cs)
JK Lakshmi Cement Ltd.

Shri Dharmender Tuteja
Executive Director
F&A & Commercial
Dalmia Cement (Bharat) Ltd.

The Director
Integrated Finance Wing
Department for Promotion of Industry and Internal Trade, Ministry of Commerce & Industry, Govt. of India

Shri Mukesh Kumar Agarwal
Executive President
UltraTech Cement Limited

The Senior Development Officer (Cement)
Department for Promotion of Industry and Internal Trade, Ministry of Commerce & Industry, Govt. of India

DG-NCB
Joint Directors and Heads of concerned Service Groups

An NCB Official nominated by
DG-NCB : Member-Secretary

ANNUAL GENERAL MEETING (AGM)

Chairman

Shri K C Jhanwar

Managing Director
UltraTech Cement Ltd.

Members

Dr A K Singh
Sr. Vice President, Head-Product Assurance & Services,
UltraTech Cements Ltd

Shri Pankaj Kejriwal
Director, Star Cement

Shri Vivek Agnihotri
CEO
Prism Johnson Ltd.

Dr S K Handoo
Advisor
My Home Industries Ltd.

Shri Manish Singh
President – Head Technical
Prism Johnson Ltd.

Shri Dinesh Randad
Director (Works)
Gujarat Sidhee Cement Ltd.

Shri Pranav Desai
Nuvoco Vistas Corp Ltd.

Shri Pravesh Kumar Sharma
Sr. General Manager (QC)
Prism Johnson Ltd.

Shri Narendra Singh
Unit Head
Saurashtra Cement Ltd

Shri Sunil Khandare
Director
Bureau of Energy Efficiency

Shri S.K. Rathore
President
J K Cement Ltd.

Shri Raju Goyal
Chief Technical Officer
UltraTech Cement Ltd.

Shri Rajesh Kakkar
President
Birla Corp. Ltd.

Shri G V Ramakrishna
CMO
Dalmia Cement (B) Ltd

Shri Umashankar Choudhary
Unit Head, JK Cement Works,
Muddapur, Bagalkot, Karnataka

Shri K Vinayagamurthi
Executive Director
Dalmia Cement (B) Ltd.

Shri Prakhar Srivastava
Head (QA & QC)
JK Cement Ltd.

Dr P K Panigrahy
Amrit Cement Ltd.

Shri Prabhat Kumar Singh
Dalmia Cement (B) Ltd

Shri Arun Das
Amrit Cement Ltd.

Dr Mukesh Kumar
J K Lakshmi Cement Ltd.

Shri Amit Kanojia
Adani Cement Ltd.

Dr B N Mohapatra
Director General, NCB

Shri P N Ojha
Joint Director, NCB

Dr Sanjay Mundra
General Manager - NCB

Shri Jamil Siddiqi
Nuvoco Vistas Corp Ltd.

Dr Arunachal Sadangi
Asst. General Manager (Cement)
Nuvoco Vistas Corp. Ltd.

Shri Pankaj Kumar
My Home Industries Ltd.

Shri Sameer Bharadwaj
Birla Corp Ltd.

Dr S K Chaturvedi
Secretary & Joint Director, NCB

Shri Amit Trivedi
Joint Director, NCB

Executive Committee (EC) *Since July 2023

With a view to achieve the objectives of collegiate management and to assist the Director General to deal with the various functions, the Executive Committee, comprising heads of various Divisions of activities with the Director General as its Chairman. The composition of the committee is given below:

Chairman

Dr. L P Singh

Director General-NCB

Secretary

Dr. S K Chaturvedi

HOC-CRT, UIC- NCB-Ballabgarh

Members

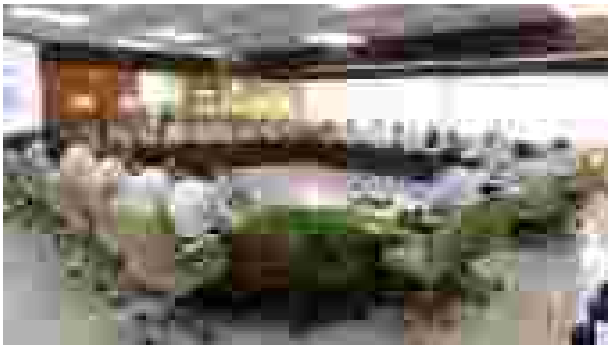
Dr. D K Panda	HOC-CME, HOC-CCE & HOS-HRS
Shri P N Ojha	HOC-CDR, UIC NCB-Ahmedabad & CVO
Shri Amit Trivedi	HOC-CQC & HOS-MMS
Dr. B Pandu Ranga Rao	UIC - NCB-Hyderabad & NCB-Bhubaneswar
Dr. Sanjay Mundra	HOS-FAS
Shri G J Naidu	HOC-CIS
Shri A K Popuri	HOS-ETS

Corporate Advisory Committee Meetings

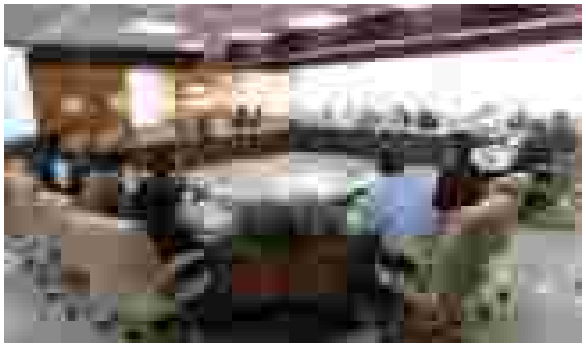
Corporate Advisory Committee Meetings

74th and 75th Meetings of Research Advisory Committee (RAC)

74th and 75th RAC meetings were held on 6th April 2022 and 23rd February 2023 respectively under the chairmanship of Sh J N Cooper, CEO & Managing Director, Heidelberg Cement India Ltd. RAC advised NCB and its Scientists and Engineers on all aspects pertaining to programmed R&D and industrial support services ongoing at NCB, with particular reference to technology forecasting, technology planning, programs, strategies, methodologies and the overall project program. Total 6 new projects of importance were approved in 74th meeting and 3 new projects were approved in 75th Meeting by the RAC (given in Appendix IV).



74th RAC Meeting



75th RAC Meeting

51st Meeting of Infrastructural Development Committee (IDC)

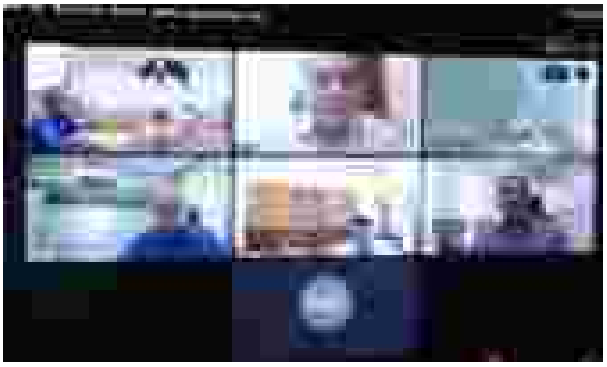
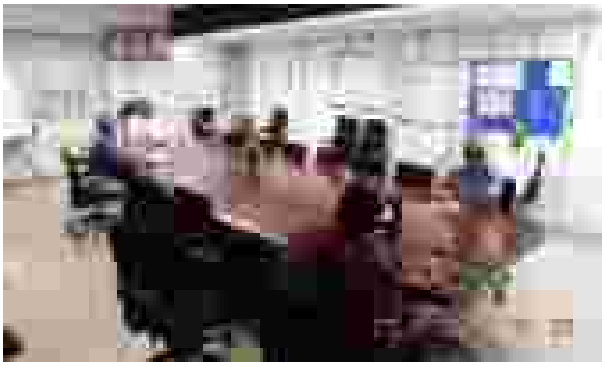
The 51st Meeting of Infrastructural Development Committee (IDC) was held on 07th July 2022 under Chairmanship of Sh. P N Chhangani, Wholetime Director, Shree Cement Limited. A presentation, highlighting the details of infrastructure up-gradation activities undertaken at NCB-Ballabgarh, NCB-Hyderabad, NCB-Ahmedabad and NCB-Bhubaneswar and status of work through visuals/photographs was made.

DG-NCB explained the requirement of funds for procurement of latest equipment as well as replacement of obsolete equipment. He also informed about the planning of Construction of permanent Infrastructure facilities at Bhubaneswar unit to cater the requirement of industry at eastern zone. Proposed list of equipment to be procured in the next three years were discussed.

66th Meeting of Administration & Finance Committee (AFC)

The Virtual meeting of 66th Administration & Finance Committee (AFC) meeting was held on 27th September 2022 under the Chairmanship of Sh. Rajendra Chamaria, Vice - Chairman & Managing Director, Star Cement Ltd.

The Committee took vital decisions on behalf of the Board of Governors on individual personnel cases and on issues of administrative nature which were referred to it by the Board and by DG-NCB.

Virtual meeting of 66th AFC

59th Annual General Meeting (AGM)

59th AGM Meeting

The 59th Annual General Meeting of NCB was successfully held on 08th December 2022 under the chairmanship of Sh. K C Jhanwar, Chairman-NCB, President-CMA & Managing Director, UltraTech Cement Ltd. The AGM was attended by senior Cement Industry Experts from UltraTech Cement, Dalmia Cement, ACC Ltd, Ambuja Cement, JK Cement, JK Lakshmi Cement, Star Cement, Orient Cement, The KCP Ltd., Gujarat Sidhee Cement, My Home Ind., Prism Johnson, AKS University and senior NCB officials. DG-NCB gave a detailed presentation on the NCB activities during the last one year, highlighting the important projects undertaken, webinars / workshops organised; new equipment facility added and increased interaction with Academia & Industry. Chairman-NCB in his address thanked Sh. Anil Agrawal, Additional Secretary and other officials of DPIIT for their constant guidance and support to research activities of NCB. He emphasized that the achievements of NCB are due to the support of various stakeholders viz. Government, Cement Industry, Construction Industry etc.

He highlighted that NCB has completed 10 R&D projects on waste reduction, improved sustainability & reduction in carbon footprint of cement industry and trained about 963 cement & construction industry professionals through 48 training programmes (online/offline). He thanked cement and construction industry professionals for supporting and banking on NCB services. He complimented DG-NCB and his team for efforts and commitment for providing quality services to cement and construction industry.

NCB's Programmes and their Fulfilment

The Corporate Programmes

NCB continues to be a preferred research & consultancy partner for the cement and construction industry. With its state-of-art laboratories and addition of modern and latest scientific equipment, reinforced by the enthusiastic experienced scientists and engineers and pro-active leadership, NCB has been providing innovative technological solution to overcome the hurdles faced by industry and nation at large.

Services were provided in the areas of development of newer products, optimal utilization of resources be it limestone, gypsum or industrial waste, Alternate Fuel & Raw materials (AFR), circular economy, process optimization, energy studies, plant maintenance, structural assessment and rehabilitation, quality assurance in construction, concrete technology, materials evaluation, application of nanotechnology, dissemination of information through seminars & training programmes and total quality management.

NCB has carried out Limestone Consumption Factor (LCF) studies for cement plants from all over the country and so far established the same for 257 cement plants. During the year, LCF studies were completed for 17 cement plants from Madhya Pradesh, Andhra Pradesh, Rajasthan, Tamil Nadu, Assam, Meghalaya and Telangana. NCB has successfully carried out investigations on Lumps in Cement Bags for cement plant which approached for study of the same. The plant was facing the problem of lump formation in cement bags within 10 to 15 days of dispatch. All the process parameters along with the packing plant, transportation and the warehouse were thoroughly

investigated. Based on the above studies, recommendations and action plans were suggested which resulted in successfully solving the problem of lump formation in cement bags of the cement plant. NCB developed plant specific secondary standards of cement raw materials and finished products. The study has been carried out so far for 16 cement plants covering 40 matrices. This year the study has been carried out for 8 cement plants from Karnataka, Uttar Pradesh, Madhya Pradesh, Chattisgarh, Maharashtra and Andhra Pradesh. NCB has taken up R&D for utilization of Lime sludge from Indian Paper Industry to achieve circular economy for Indian Cement Industry. NCB has taken initiatives for utilization of ligno sulfonate waste from paper and pulp industry by formulation with other chemical in favour of circular economy in construction sector. High MgO limestone or dolomitic limestone shows synergetic effect on the performance of different cements (blended cements). These materials are abundantly available with cement plants of some region. The main objective of the study is to investigate the feasibility of using dolomite in development of Portland Dolomite Cement in order to formulate new Indian standard for its commercialization along with lowering in clinker factor in cement for environmental sustainability. To carry out the study, different Portland Dolomite Cement blends were prepared by inter-grinding of varying percentages of dolomite collected from different parts of the country with OPC clinker and gypsum. OPC and Portland Limestone Cement (PLC) blends were also prepared as control samples. The cement blends were prepared from raw materials of central and northern region of the country and performance characterization was studied. NCB has carried out investigation on mineral carbonation mechanism of various industrial waste and by products. A project on investigations on utilization of phosphogypsum in cement manufacturing under circular economy. The laboratories are equipped with state-of-art instruments and trained competent staff to carry out the testing activities as per National and some International standards. During the year, assignments were carried out for samples from neighboring countries also. The number of samples tested during the period was 7,890.

In the areas of process & productivity, NCB is providing project management Consultancy services for installation of tyre chips to M/s Oman Cement Company SAOG, Sultanate of Oman. Further, Further, capacity assessment study was successfully conducted along with Technology selection study of new line was undertaken for M/s Star Cement Limited. NCB has taken up consultancy services for Process Audit for Capacity Enhancement of Pyro Processing and Raw mill for M/s Tanzania Portland Cement Company Ltd, Tanzania. NCB conducted heat balance study on kiln M/s JK cement limited (JKCL), Nimbahera and Mangrol Rajasthan and provided recommendations for improving thermal energy performance of the kiln system. NCB carried out the internal inspection of roller press, ball mills, vertical roller mills to identify causes for sub-optimal performance of mills of M/s Star Cement Limited, Meghalaya and carried out the plant trails for improving productivity based on the observations.

In the areas of energy management, NCB has carried out more than 200 detailed energy audits till date in various cement plants. Energy audit studies in cement plants include assessment of energy management, monitoring and target setting, detailed heat balance and gas balance studies, identification of potential for thermal and electrical energy

savings and recommendations for remedial measures, techno economic feasibility studies for waste heat recovery system (WHRS) etc. A R&D project on utilization of solar thermal energy for calcination of industry by product/waste product was explored. Phosphogypsum was taken for reference material. Impurities of phosphogypsum were converted into inert form by the temperature of 400 ^{o}C achieved through solar thermal energy. A R&D project was taken in the year 2020 and experimental trail runs were taken in the downdraft gasifier at BITS Pilani setup. A MAT lab model has been developed for RDF gasification to predict the Syn gas quality and further techonomic analysis is being carried out.

In the areas of project engineering and system design (PSD), Project Monitoring and Control (PMC) Consultancy Services is provided for setting up a 600 tpd Cement Plant in RoC for Government of Republic of Congo, preparation of marketing report for utilization of Flue Gas Desulphurization Gypsum (FGD) of NTPC power plants located in Vidhyanchal, Singrauli and Rihand (collectively known as VSR region). NCB started working on a R&D project for design and development of the transfer chute and successfully developed the design parameters for transfer chute to prevent the chute jamming and a flexible arrangement for cleaning the chute incase if it gets jammed. Project is successfully completed and outcome was presented in front of Indian Cement Industry during Research Advisory Committee meeting. The validation of developed transfer chute was carried out on working setup installed at NCB Ballabgarh by operating the chute with 19 types alternative fuels and their mix.

In the areas of environment sustainability & climate change (ESC), performance assessment of existing air pollution control equipment (APCE) was taken up for three cement plants located in Andhra Pradesh, Himachal Pradesh and Assam, under which the major APCE attached with Kiln/Raw Mill, Coal Mill, Cement Mill, Cooler were monitored. Dust monitoring of inlet and outlet of APCE was carried out to evaluate the performance of APCE. The Quality Assurance Group (QAG) comprises pool of Electrical, Mechanical and Instrumentation engineers who are primarily involved in Third Party quality assurance of electrical & Mechanical services of various types of infrastructure and nation building projects such as Hospitals, Schools, Convention centers, Street lighting works, Sewage Treatment Plant, Effluent treatment plant etc.

In the areas of advanced fuel technology (AFT), A tripartite agreement have been signed with M/s Livnsense Technologies Pvt. Ltd. and M/s J K Lakshmi Cement to develop predictive models to enhance TSR through liquid AF in the cement plant. The model has been developed with more than 80% accuracy considering the process constraints like increased CO level and temperature of 6th cyclone. The validation of developed model is currently being carried out by the cement plant. Further, 4 seminars were conducted in association with BEE on "Dissemination of Waste Heat Recovery Technologies in Indian Cement Plants". These were conducted at NCB-Ballabgarh, NCB-Hyderabad, AKS University- Satna and UltraTech Cement Ltd: Unit-Aditya Cement Works-Chittorgarh.

In the areas of Concrete Technology, NCB has conducted evaluation of wide range of concrete making materials such as natural coarse and fine aggregates, cement, flyash, GGBS, alternative aggregates like geo-polymer flyash sand etc. and has successfully carried out important projects for prestigious clients. During the period of 2022-23, more than 15 sponsored projects of material characterization and about 32 mix designs were completed. Concrete mix designs for special applications such as Self-Compacting Concrete (SCC), Under Water Pumped Concrete & Roller Compacted Concrete (RCC) have been carried out successfully for various clients. NCB over the years has developed expertise and competencies to evaluate aggregates for potential alkali aggregate reaction which includes both alkali silica reaction and alkali carbonate reaction. About 60 numbers of coarse and fine aggregates were evaluated for various prestigious clients. NCB over the years has developed the necessary expertise and competency to evaluate aggregates for potential alkali aggregate reaction which includes both alkali silica reaction and alkali carbonate reaction. NCB has also developed mechanism for the assessment of integral crystalline waterproofing compounds and their performance in concrete as well as mortar. NCB has evaluated 6 numbers of crystalline water proofing compounds for various industrial clients like Xypex, Asian paints and government clients like CPWD, PWD etc. NCB has conducted some preliminary studies on the application of composite cement in concrete. Limited investigation was carried out in the field of durability aspect of the concrete made with composite cement. The study carried out by NCB and study reported in various literatures indicates that composite cement behavior is quite similar to PPC and found to be beneficial in chloride rich environment. The study was carried out on two different sets of materials. About 20 mortar samples and 72 concrete mixes were studied. NCB has taken up the study on "Utilization of coarser fly ash (having fineness between 250 m^2/kg to 320 m^2/kg) in concrete as a cementitious material". Under this study, NCB has collected fly ash from various locations (i.e., field wise samples & sample collection from ash dyke) of six different thermal power plant located across the country. Fly ash samples from Silos were collected from six different NTPC thermal power plants. A R&D study on "Evaluation of Processed LD Slag as per IS 383: 2016 and Study its suitability to be used as fine aggregate" was carried out by NCB. In this study, processed LD slag was utilized as fine aggregate in concrete production. Physical testing of 19 coarse aggregate and 21 fine aggregate samples as per IS: 383 was carried out by NCB which was sponsored by M/s NHPC Limited. NCB carried out performance evaluation of two different integral crystalline admixture products in M30 and M50 grade concrete as part of the prestigious Central Vista Project for CPWD. Coarse aggregates were prepared from rock samples supplied by NHPC. These coarse aggregates were prepared using crushers available in NCB's unit operations Laboratory. Study was carried out by NCB for a concrete mix of grade M15 (maximum size of aggregate used was 150mm) and was sponsored by M/s Patel Engineering Limited. In this study, compressive strength test, test for Co-efficient of thermal expansion, specific heat, thermal conductivity and thermal diffusivity of concrete mix were performed using transient plane source method. NCB recently took up the R&D Project titled "Utilisation of CO_2 in Fresh Concrete and Study on Fresh and Hardened Properties of CO_2 induced Concrete". The aim of the project is to study the potential of CO_2 utilisation in concrete and its effect on fresh and hardened properties of concrete.

NCB has been working on various research projects that aims to enhance the utilisation of different cementitious and industrial bi-products (such as BF slag, LD slag, ferrochrome slag, bottom ash, electric arc furnace slag etc.) as one of the constituent materials in cement concrete as binder or aggregate. Tata Steel Limited approached NCB to carry out a sponsored R&D study on evaluation of activated GGBFS as an alternative to hydraulic binder. M/s Ferro Alloys Corporation limited, a Vedanta Group company had requested NCB to take up a study on the use of Ferrochrome Slag as a Coarse Aggregate in Concrete. NCB had conducted an experimental R&D study titled "Evaluation of Granulated Blast Furnace Slag sand as per IS 383: 2016 and study of its Suitability to be used as Fine Aggregate" which was sponsored by JSW Cement Limited.

In the areas of Structural Optimization & Design, studies on mechanical and time dependent properties of Ultra-High-Performance Concrete were carried out. This project was the extension of project completed by NCB on development of guidelines on Ultra-High-Performance Concrete wherein critical factors in achieving UHPC such as particle packing density, mixing criteria and curing regime, etc., were studied.

In the areas of Structural Assessment & Rehabilitation, a wide range of activities related to assessment of new and existing concrete structures are carried out which includes condition assessment of existing concrete structures including fire damaged concrete structures, investigation of material properties of hydraulic structures such as dams, application of non-destructive testing for conformity of quality and condition assessment of concrete structures, preparation of repair estimates including cost estimates and detailed schedule of items for repair and rehabilitation works, consultancy services involving quality inspection and third party quality assurance of repair and rehabilitation works of concrete structures, Research & Development Projects on modern repair technologies, & load testing of RCC structures like bridges, underground RCC conduits, buildings, etc.

In the areas of Construction Technology and Management, NCB provides Third Party Quality Assurance services for the wide range of construction projects such as buildings, convention centres, flyovers, dam, barrage, roads, bridges and tunnels, construction utility projects, special construction activities like pre-engineered steel structures etc. built by the various central / state / autonomous organizations across India through NCB. The scope of Third-Party Quality Assurance / Audit includes inspections, lifting and testing of samples, witness of field and laboratory testing done at site / fabrication yard, review of quality system and documents including Non-Destructive Testing (NDT) wherever applicable. The centre continues to provide specialized services in the area of quality assurance/control and thereby contributing to the durable and sustainable infrastructure in India.

NCB's SRM programme is accredited under ISO 17034:2016 as Reference Material Producers. NCB has developed Certified Reference Materials (CRMs) in the areas of cement, building materials and solid fuels (coal and pet coke). NCB's CRMs have been quoted in IS 4031(Part-2), IS 4031(Part-15) and IS 1727.

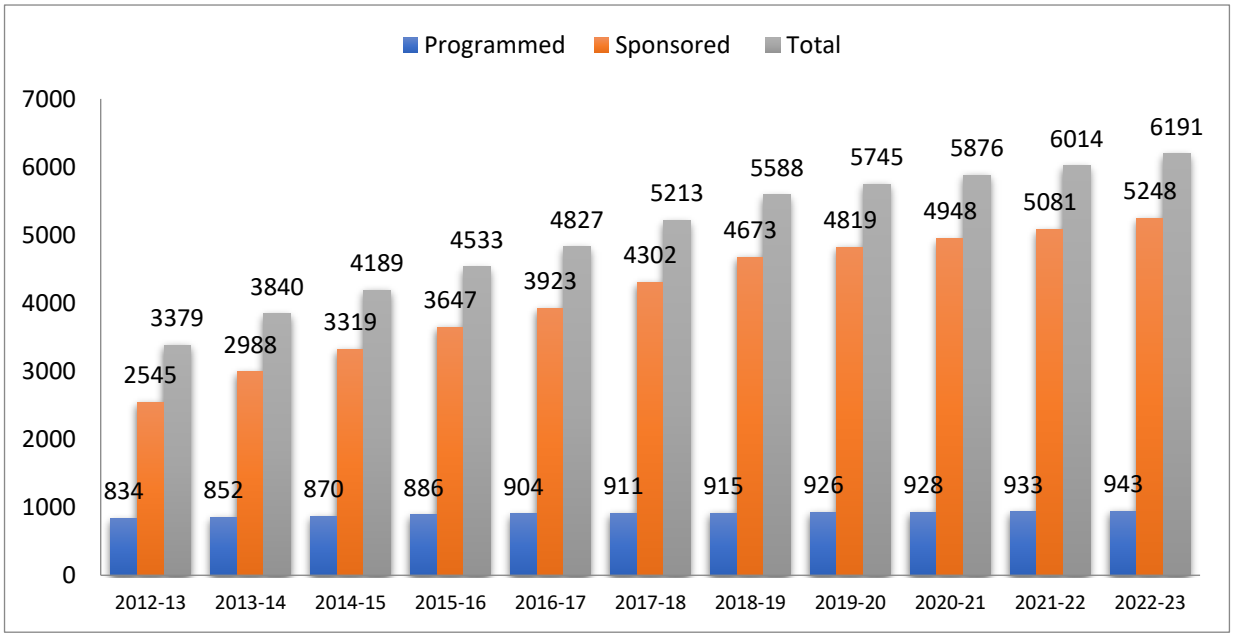
In addition, 18 Bhartiya Nirdeshak Dravyas (BNDs), the Indian Certified Reference Materials (CRMs) were developed in collaboration with CSIR-National Physical Laboratory (NPL). NCB's CRMs are being used in India by almost all cement & construction, cement plants, commercial lab, educational institutes etc. and SAARC countries (Nepal, Bhutan, Bangladesh, Sri Lanka etc.) and Middle east country etc. During the year, total 2,564 units of different CRMs and 1,274 sets of standard lime were supplied to 997 customers of cement plants, testing laboratories, public sector undertakings, R&D institutions including Nepal, Bhutan, UAE etc. More than 1500 equipment/instrument including Proving ring, Compression testing machine, Vibrating machine, Dial gauge, Blaine cell, Weights, Glassware, Pressure gauge, Test sieve, Liquid in glass thermometer, Environmental chambers, Hot air oven, Muffle furnace, Weighing balance, Rebound hammer etc. were calibrated at NCB's testing laboratories and at customer's site. The calibration services are being provided to various Central Govt., State Govt., PSUs, Cement & Construction Industries and have shown remarkable growth. It is pertinent to mention that 96% customers rated our services as excellent in the last financial year. NCB's Interlaboratory Services (ILS) is accredited under ISO/IEC 17043:2010, thus NCB is first accredited PT provider in India. In 2022-23, NCB completed 11 PT schemes. The participants were mainly from reputed private laboratories, cement plants, govt. laboratories, public sector laboratories etc.

Considering the training needs of the industry, NCB imparted training programmes on cement, concrete and construction technologies. During the year 2022-23, 31 training programmes (offline/online) were successfully organized with a total of 654 participants attending the programmes.

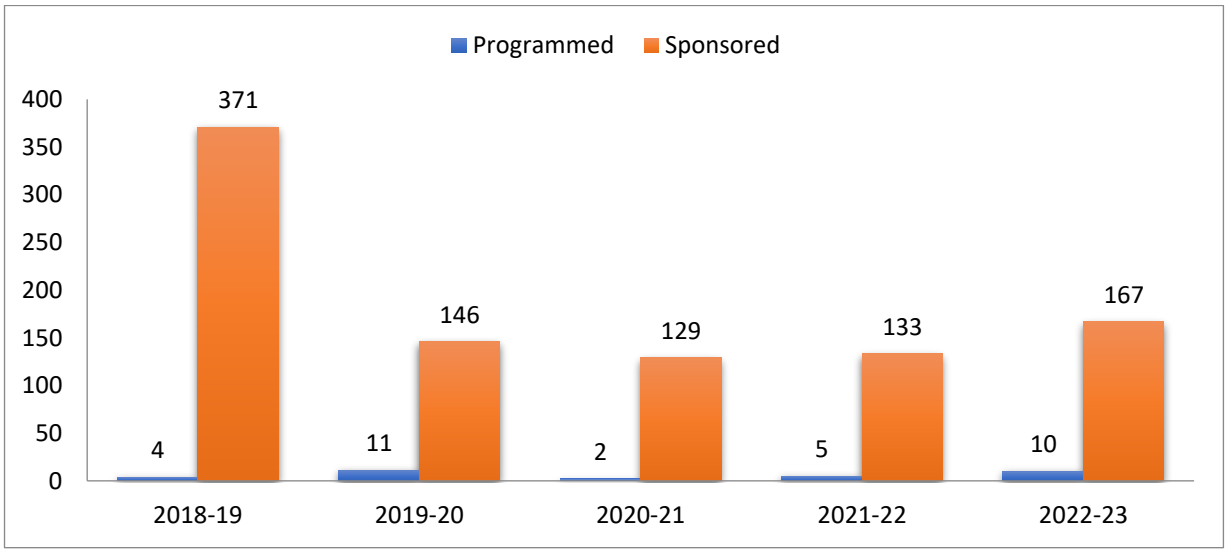
Framework of Institutional Efforts

The activities of the Council were carried out under the six Corporate Centres at NCB's Units/project offices, situated in Ballabgarh, Ahmedabad, Hyderabad and Bhubaneswar. While the infrastructure is physically distributed over these Units, all the Units are involved in the execution of projects or services as necessary following the matrix approach.

During the year, 10 R&D projects and 167 Sponsored projects were completed as listed in Appendices II and III respectively. The programmed projects carried forward along with the new ones taken-up, comprised the R&D Programme for 2022-23, as given in Appendix IV. The broad activities carried out by the six Corporate Centres are highlighted in the following sections.



Projects Completed by NCB (Cumulative)



Project Completed by NCB

NCB Ballabgarh

Centre for Cement Research and Independent Testing – (CRT)

The Centre executes its activities through five programmes viz. Cements and Other Binders, Wastes Utilization, Refractories and Ceramics, Fundamental and Basic Research and Independent Testing. During the year, 46 Sponsored Projects and 2 Programmed Projects were completed and 7 Programmed Projects were pursued.

Cements and Other Binders

Establishing Limestone Consumption Factor (LCF)

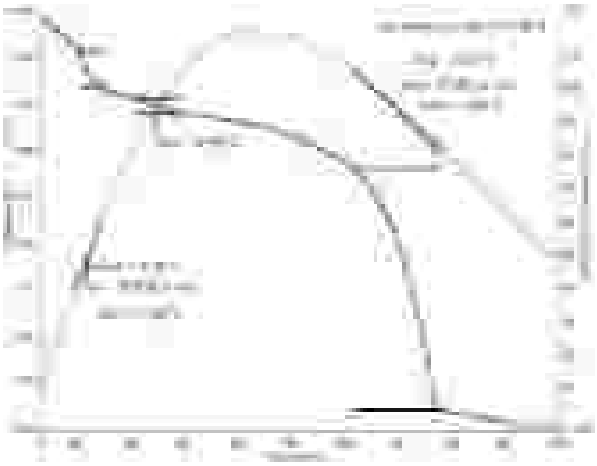
LCF studies are very important from the point of view of rationalization of limestone consumption in production of cement, estimating royalty payable to state for the limestone mined from their respective captive mines besides internal material audit of the concerned cement plants. NCB has carried out Limestone Consumption Factor (LCF) studies for cement plants from all over the country and so far, established the same for 257 cement plants. During the year, LCF studies were completed for 17 cement plants from Madhya Pradesh, Andhra Pradesh, Rajasthan, Tamil Nadu, Assam, Meghalaya and Telangana.

Visit to Prism Johnson Cement, M.P.

Visit to Heidelberg Cement, M.P.

Investigation of Lump Formation in Cement Bags

NCB has successfully carried out investigations on Lumps in Cement Bags for cement plant which approached for study of the same. The plant was facing the problem of lump formation in cement bags within 10 to 15 days of dispatch. NCB carried out complete chemico-mineralogical analysis starting from the raw materials, intermediate products, and the finished product. All the process parameters along with the packing plant, transportation and the warehouse were thoroughly investigated. Based on the above studies recommendations were given and remedial measures and action plan was suggested. These recommendations and action plans have resulted in successfully solving the problem of lump formation in cement bags of the cement plant.



Thermal analysis of Cement Lump sample in OPC

Cement Bags (14Nos) stacked in warehouse

Development of Plant specific secondary standards for XRF calibration

Chemical analysis plays an essential role in controlling the manufacturing of cement, from the full analysis of raw materials to testing each stage of the process. In cement plants all plant operations starting from mining to cement grinding, are dependent on XRF analysis. Control of the basic reaction requires accurate analysis of calcium, silicon, aluminum, iron, magnesium and other constituents in the cementitious materials. Therefore, accuracy of XRF is very crucial for process as well as product quality control. Accuracy of XRF depends on the standards used for calibration. Standard reference materials are used for this purpose. Secondary standard is a compound/chemical that has been standardized against a primary standard. Secondary standards are commonly used to calibrate analytical methods. Secondary standards are required as only limited no. of primary standards is available (one to four), range of the primary standards is not adequate, matrix and mineralogy may be different, evenly spaced samples across the calibration curve not achieved. NCB has taken up studies for development of plant specific secondary standard materials.

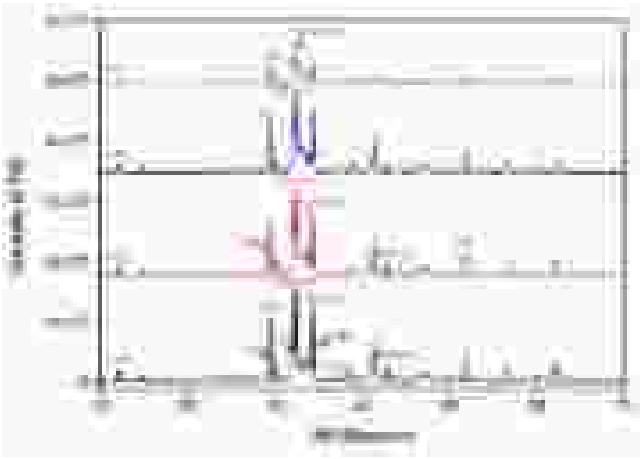
The methodology followed by NCB for developing the plant specific secondary reference standards of XRF include technical support for collection of samples, preparation of representative sample, homogeneity confirmation, accurate chemical analysis by different standard methods, review of results and planning, technical support of calibration at plant and providing fusion bead samples. NCB has successfully carried out studies on development of secondary standard reference materials for 16 cement plants in India till now. NCB develops plant specific secondary standards of cement raw materials and finished products. The study has been carried out so far for 16 cement plants covering 40 matrix. This year the study has been carried out for 8 cement plants from Karnataka, Uttar Pradesh, Madhya Pradesh, Chattisgarh, Maharashtra and Andhra Pradesh.

Waste Utilization

Utilization of Lime Sludge from Indian Paper Industry to achieve circular economy for Indian Cement Industry

The path forward for the cement industry is clear to embrace sustainability through circular economy. These two trends at the core of planning for the future will help cement players to achieve considerable productivity gains. Lime sludge (LS) is one of the industrial wastes produced in paper and pulp industries during paper manufacturing which is generally disposed outside for land filling and creates adverse impact on environment. The chemical composition lime sludge sample contains CaO in around (52-55) %, SiO_2 (1-4) %, Al_2O_3 and Fe_2O_3 make up less than 1% by weight. Minor alkalis of Na_2O, K_2O and SO_3 content are less than 1 wt%. XRD profile and TG/DTA results showed that all lime sludge samples have major calcite ($CaCO_3$) phase. Investigation by optical microscopy of microstructure and morphology revealed that calcite grains are presents as rounded shape agglomerated form. Portland cement clinker has been prepared using lime sludge from 30-50% by weight replacement of limestone and these clinkers are compared with clinkers made off conventional raw materials. Burnability investigation of clinkers are showing free lime content with the limit specified by Indian standards. Mineralogical characterizations using X-Ray Diffraction and Optical microscopy are showing desirable clinker phases formation with required quantity. The characterizations of all obtained results are encouraging for replacement of limestone in the cement and construction industry by using lime sludge which is technically suitable and economically viable for waste management in favour of circular economy. Hence, as valuable replacement of limestone, lime sludge may be utilized as raw material for Portland cement clinker. The utilization of paper industry waste lime sludge may bring sustainable development and favour circular economy if it is being effectively used in cement industry. NCB has taken up R&D for utilization of Lime sludge effectively in manufacturing of cement.

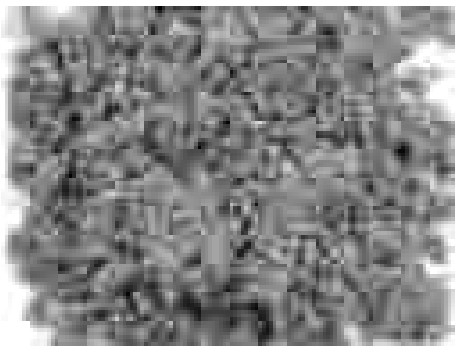
Lime sludge waste generated in paper Industry



XRD patterns of lab fired clinkers

Formulation of Chemical Admixture Using Lignosulphonate Waste from Paper and Pulp Industry for Construction Industry in Favour of Circular Economy

Construction industry is the most significant pillar to develop infrastructure of a country. Countries with a massive population such as India has invested one trillion dollars in infrastructures between 2012-2017 and India will require investment of 50 trillion across infrastructure by 2024 for a sustainable development in our country. This can be only possible through advancements in cement and concrete technology. Now a days chemical admixtures are the essential part of modern concrete to reach desirable qualities along with a view to promote sustainability in it. Small addition of chemical admixture facilitates huge impact on concrete properties in terms of performance, durability and environmental optimization. This study on utilization of lignosulfonate from paper and pulp industry compares the differences and similarities of different types of other superplasticizers like poly carboxylate ether (PCE), polyethylene glycol (PEG) and Triethylamine (TEA) in cement mortar systems, in terms of NC, setting time, and compressive strength. It was observed that PCE is less efficient in decreasing the compressive strength than lignosulfonate. More importantly, the setting time patterns and compressive strength trends are different with lignosulfonate and PCE additions; this is tied to the adsorption and dispersing mechanisms of these two types of superplasticizers. But for their formulation in the ratio of 1:1, 1:2 and 2:1 of both admixtures showed different setting time and compressive strength. The results for LS : PCE 1:2 result is encouraging in terms of delay setting time without affecting compressive strength. The utilization of lignosulfonate waste from paper and pulp industry with PCE for 1:2 composition to adjust comparable properties with PCE to cover circular economy. NCB has taken initiatives for utilization of ligno sulfonate waste from paper and pulp industry by formulation with other chemical in favour of circular economy in construction sector.

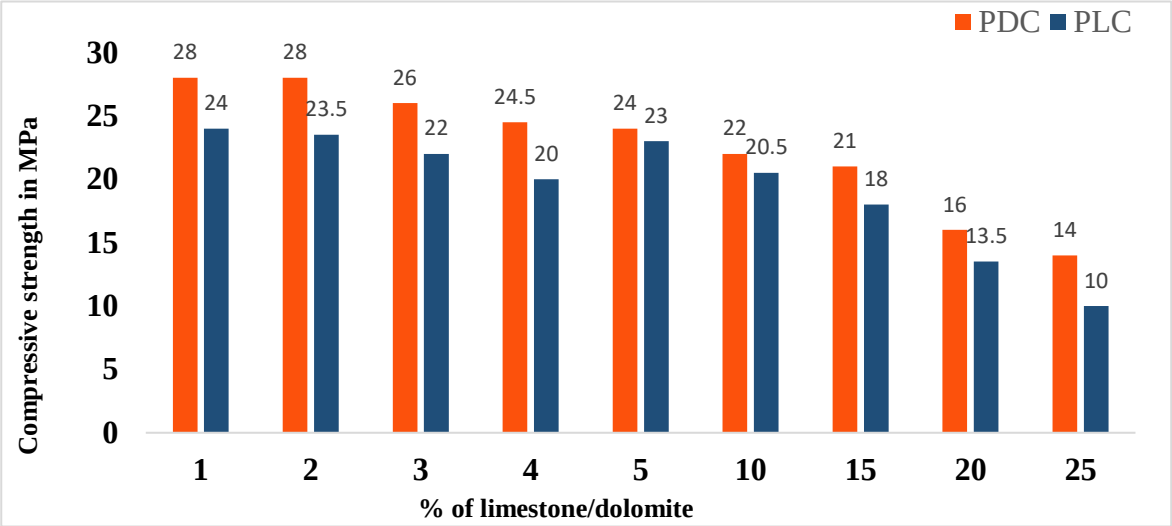


Lignosulfonate waste generated in paper and pulp Industry

Development of Portland Dolomite Cement

High MgO limestone or dolomitic limestone shows synergetic effect on the performance of different cements (blended cements). These materials are abundantly available with cement plants of some region. So far, 75% $CaCO_3$ containing limestone is allowed for the production of OPC as a PI according to Indian standard codes. The main objective of the study is to investigate the feasibility of using dolomite in development of Portland Dolomite Cement in order to formulate new Indian standard

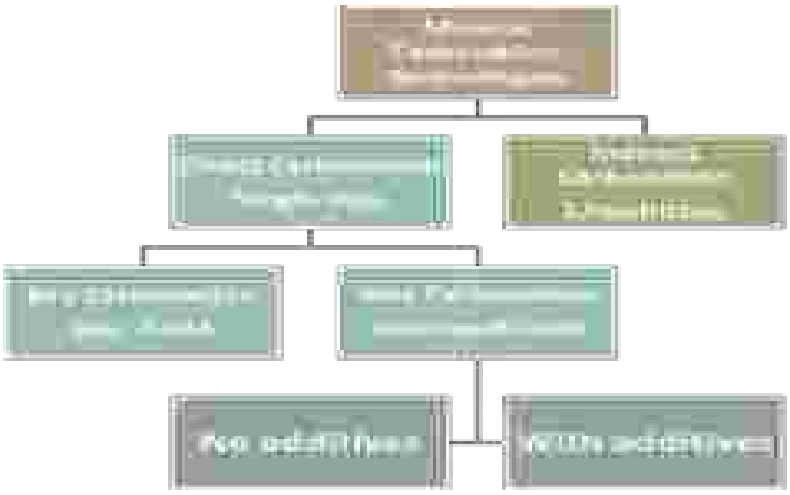
for its commercialization along with lowering in clinker factor in cement for environmental sustainability. To carry out the study, different Portland Dolomite Cement blends were prepared by inter-grinding of varying percentages of dolomite collected from different parts of the country with OPC clinker and gypsum. OPC and Portland Limestone Cement (PLC) blends were also prepared as control samples. The cement blends were prepared from raw materials of central and northern region of the country and performance characterization was studied. The trend of compressive strength development showed enhancement in compressive strength of Portland Dolomite Cement at all ages with (1-5)% dolomite addition in comparison to Portland Limestone cement blends. At higher addition levels of upto 25% dolomite there is enhancement in compressive strength at early age in comparison to Portland Limestone Cement blends. At later ages the strength of PLC and PDC are comparable. Fig 1 shows the early age (1 day) compressive strength of PDC and PLC at varying replacement levels.



Early age (1 day) compressive strength of PDC and PLC at varying replacement levels.

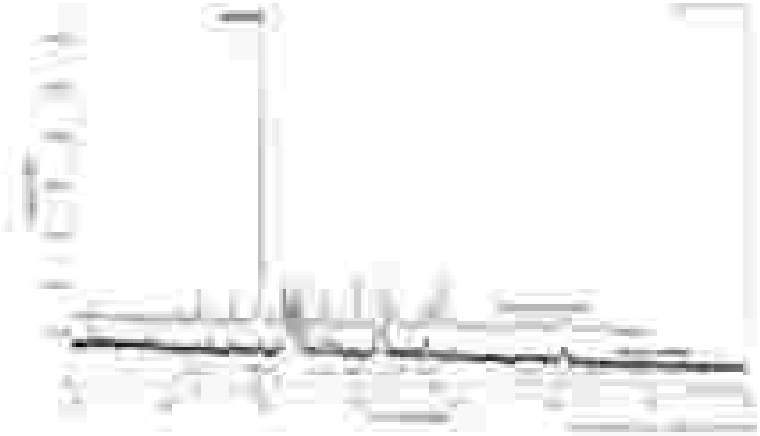
Investigation on Mineral Carbonation Mechanism of Various Industrial Waste and By Products

This project aims at identifying various industrial waste/by-product having adequate quantity generation and having desired chemistry for mineral carbonation. Accordingly, material such as various types of iron and steel slag, CKD, C&D waste etc. were utilized for mineral carbonation study. Solid industrial waste/by-product which are generally alkaline, inorganic, and rich in Ca can applied as an additional feedstock for mineral carbonation. In this project 15 different types of industrial waste selected for mineral carbonation study through direct carbonation route by dry process which is gas solid carbonation and wet process which is gas-solid-liquid carbonation. The samples were further processed for fine powdered material through crushing and grinding mechanism in jaw crusher and ball mill respectively. These samples were characterized for their constituent's oxides and mineralogy by conventional chemical and analytical instrumental techniques



Mineral carbonation methodologies

To achieve carbonation samples were kept in accelerated carbonation environment inside the carbonated chamber. The carbonation chamber operates at atmospheric pressure, 4 ± 0.5% CO_2 concentration, 27°C temperature and 65% relative humidity (RH) condition. The samples were kept for accelerated carbonation for different time period and then the carbonated samples were analyzed chemically as well as mineralogically with different instrumental methods. Further investigation is underway.



XRD diffractogram showing original sample and carbonation in carbonated sample

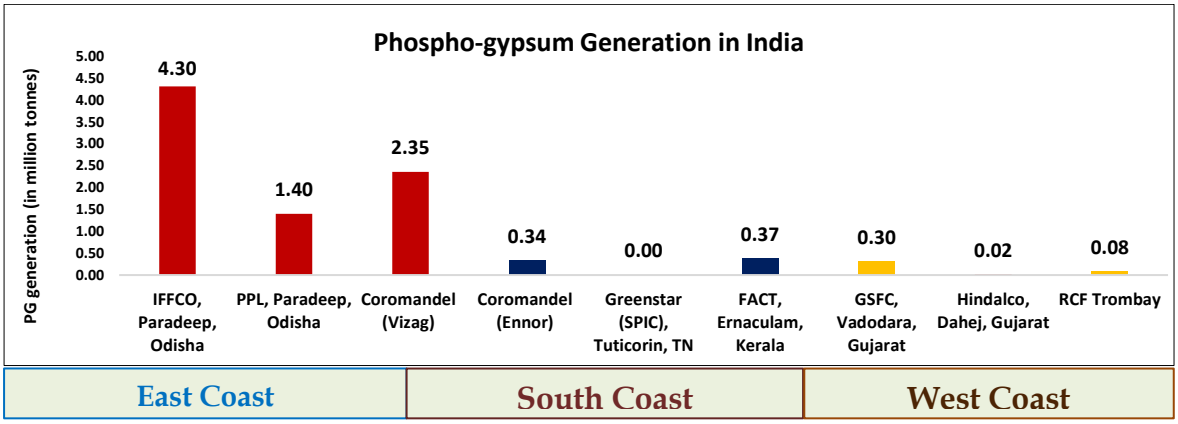
Utilization of Phospho-gypsum in Cement Manufacturing under Circular Economy

The cement industry generally uses 3-5% gypsum on weight basis of the total cement content as a setting regulator. There are several sources of gypsum include mineral (natural) gypsum and by product gypsum/synthetic gypsum (marine gypsum, phosphogypsum, Flue Gas Desulfurization (FGD) gypsum, chemical gypsum, boro-gypsum and fluoro-gypsum. Mineral gypsum or naturally occurring gypsum (CaSO4.2H2O) is the most common in the cement industry. India being the developing country and second largest producer of the cement in the world, a large quantity of gypsum is required for the sustainability of the fast growing Indian cement industry. The usable reserves of mineral gypsum is approx 37 million tonnes out of the total

reserves or resources as estimated of approx 1,330 million tonnes (IBM:2015-16). Out of this mineral reserves, Fertilizer/Pottery grade (85-90% purity) accounts for about 80% and Cement/Paint grade (70-75% purity) is account for 13%. By States, Rajasthan alone accounts for 81% resources, Jammu & Kashmir 14% and Tamil Nadu 2% resources. Due to shortage of quality mineral gypsum in India, gypsum is mainly imported from different foreign countries like Oman, UAE, Iran, Bhutan etc for cement industries.

In this scenario phosphogypsum a by-product or waste material of fertilizer/phosphoric acid plant, having large amount of reserve in major fertilizer companies in India indentified to be a potential alternative solution for the deficit of mineral gypsum to reduce foreign imports. Approximately 4.5-5.5 tons of phosphogypsum is generated per ton of phosphoric acid production using wet process. Phosphogypsum generation in India at various fertilizer plants is estimated to be ~9.1 million tonnes per annum (mtpa) in 2022-23 based on the data provided by fertilizer plants. Apart from the yearly generation of phosphogypsum, there is an additional issue of legacy stock of unutilized phosphogypsum of about 69.8 mt at various fertilizer plants especially in the eastern cost of India accumulated over the years. Gypsum is an integral component of cement production, and the sector has to rely on costly imports due to shortage of quality gypsum in India.

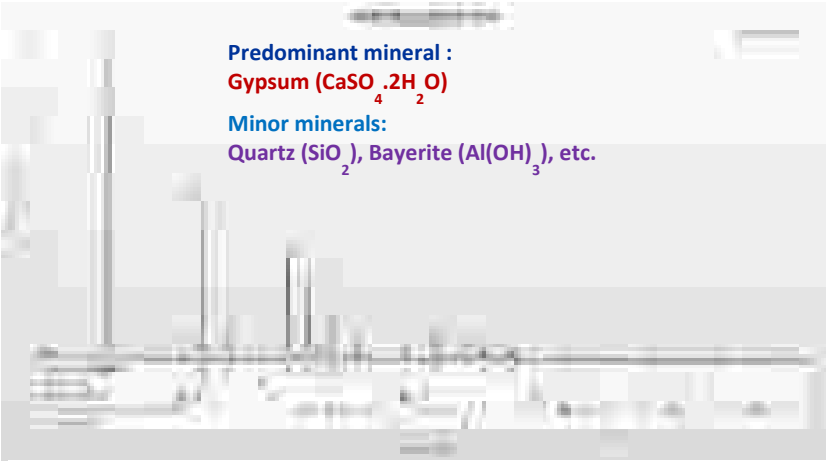
In 2021-22, the gypsum requirement of Indian cement industry is estimated to be between 14.44 to 18.5 mt (based on 4-5% gypsum addition). The cement production in India is projected to increase to 406 mt in the year 2024-25 (based on 5% CAGR of last 5 years on production, thereby increasing the estimated gypsum requirement to 16.2 – 20.30 mt. Therefore, most important and motivating use of phosphogypsum could be in the cement industry to reduced the import of mineral gypsum and contributing in "'Atmanirbhar Bharat"' or "'Self Reliant India". Phospho-gypsum along with mineral gypsum and clinker from different sources were collected for this study and their chemical, mineralogical and thermal characterizations were carried out. Mineralogical investigation of phosphogypsum sample by XRD showed that gypsum and quartz mineral present in the sample where gypsum is the predominant phase just like mineral gypsum. OPC blends were prepared using phospho-gypsum and evaluated for chemical and physical properties. Initial results were found to be very encouraging. Further investigation is underway.



Phosphogypsum generation in India

Technical feasibility of using FGD gypsum in cement manufacture

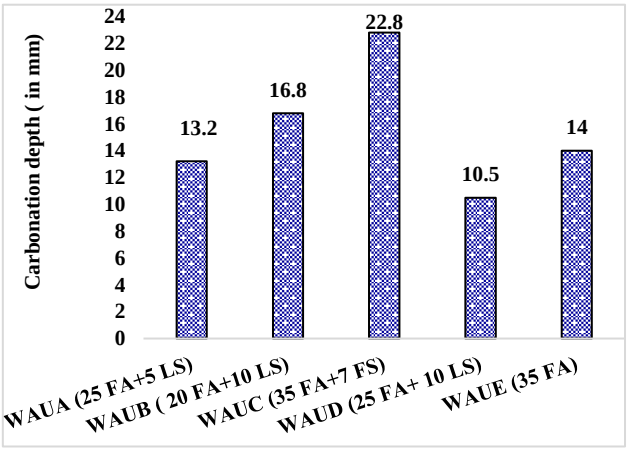
Globally, Flue Gas Desulfurisation (FGD) systems have been installed in many thermal power plants in developed countries and FGD plants have been in operation in US since 40 years. In India also the standards set by the MoEF & CC for coal-based thermal power plants came into force by which FGD systems needs to be installed in them. Accordingly, a R & D project on technical feasibility of using FGD gypsum in cement manufacture is taken up. In this project FGD gypsum is obtained from thermal power plants and other raw materials from Cement industries. The FGD is characterized for their chemico-mineralogical properties. Fig. represents a X ray diffractogram of FGD gypsum. Preparation and evaluation of different cement blends using above materials at different proportion and fineness levels are underway to study the effect of the by-product gypsum, FGD on properties of cements and concrete.



X ray diffractogram of FGD gypsum.

Investigations on Development of Portland Composite Cements Based on Fly Ash and Limestone

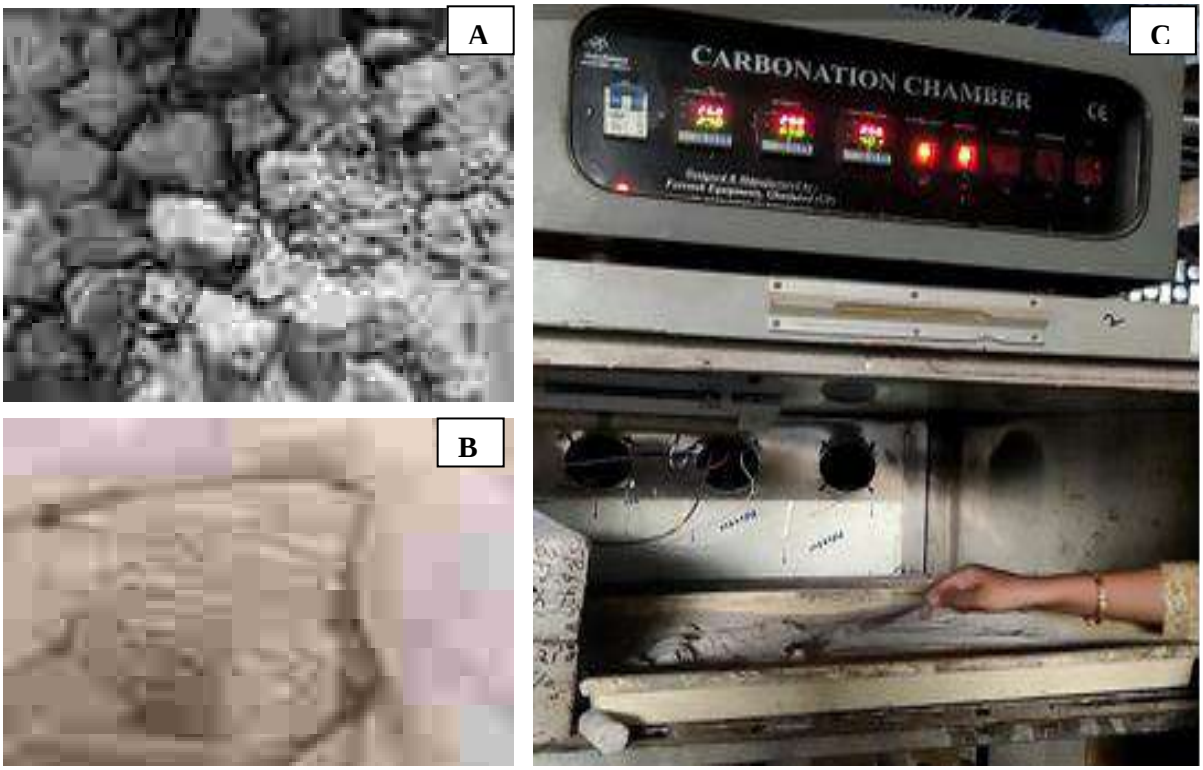
In this study, Portland composite cement blends (PCC) were prepared (140 nos) with four types of clinker from different regions of India along with the regional available fly ash (15-35%)and limestone (5, 7 & 10%). Based on the results of cement mortar and concrete durability, a total of 35% replacement of clinker by fly ash and limestone. (keeping limestone content upto7% in it) was recommended. Hydration studies showed Monocarboaluminate ($Ca_4Al_2O_6 \cdot CO_3 \cdot 11H_2O$) was found in the samples containing FA and LS, and the intensity of these peaks tend to be stronger when the amount of limestone is increased. Draft code formulation for submission to BIS is underway. Fig. representing the results of accelerated carbonation depth in the concrete specimens prepared with PCC is compared with PPC.



Accelerated carbonation depth in the concrete specimens prepared with PCC is compared

Evaluate the potential for using Indian C&D Waste Fines as Supplementary Cementitious Material (SCM)

Studies were taken up to evaluate the potential for using Indian C&D waste fines as Supplementary Cementitious Material (SCM). Concrete waste accounts for approximately 65% of C&D waste. It is a common approach to crush the concrete wastes into particles with appropriate size to be used as coarse or fine aggregates in new concretes. However, this process can generate 5% to 20% fine particles with size less than 0.15 mm, which cannot be used as aggregates in new concrete. These are C & D waste fines which were siliceous in nature with SiO_2 of 62.77%, CaO of 14.74%, Al_2O_3 and Fe_2O_3 were 5.55% and 2.38 % respectively and the insoluble residue (IR) was 63.28%. The sample showed a low lime reactivity value of 0.4 N/mm^2. The XRD shows major peak of quartz and minor peaks of calcite, albite, dicalcium silicate, chlorite, ettringite, etc.



(A) Crushed C & D waste (B) C & D fines (C) Carbonating C & D fines in the chamber

The sample fines were carbonated for two weeks in the carbonation chamber at atmospheric pressure, 4±0.5% CO_2 concentration, 27°C temperature and 65% relative humidity (RH) condition. The carbonated fines were then analyzed for their chemical and mineralogical properties. The chemical analysis was similar as non-carbonated fines and its lime reactivity value was 1.2 N/mm^2.

The compressive strength of cement blends prepared by replacing 20% of OPC with C & D fines and carbonated C & D fines showed that both the cement blends showed appreciable strength. The strength performance of both improved by age with latter ages reaching 80% of control OPC.

Assessment of Quality Control Laboratories of Cement Plant

Laboratory assessment studies, which include the visit to the laboratories, assessment of infrastructure and equipment, calibration of equipment, skill level assessment, providing necessary training and assisted the plant laboratories in getting the NABL accreditation, was carried out. These assessment has been provided in Cement plant in India and abroad. Till now these studies have been conducted for 6 cement plants.

Laboratory Assessment at Plants in Nepal and Indian Cement Plants

Petrographic evaluation to study the quality of silt sediments

Studies were taken up for providing expert services for Petrographic analysis, chemical analysis and particle size distribution of the Silt Sediments including chemical analysis of water samples from the site. In this study, we were collected water samples, silt sediment containing water samples and silt sediments. Detailed Petrographic studies of all the fractions of silt sediments were done by using Polarizing Microscope, NIKON POL 100 LV Fig 1. The major mineral constituent in all silt sediment samples was quartz. Feldspar and Mica were also present in appreciable amounts in all samples.

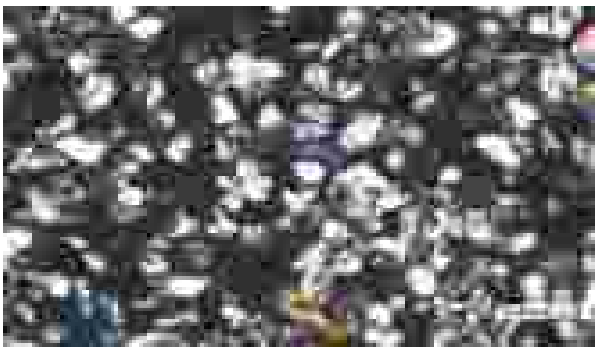
Morphology of quartz grains were subhedral to anhedral and highly fractured and shattered. Its grain size variation was too large in all fractions. The silt sediment samples were composed of five fractions viz. very coarse fraction (+300 µm), the coarse fraction (-300 µm to +150 µm), the medium fraction (-150 µm to +90 µm), the fine fraction (-90 µm to +75 µm) and a very fine fraction (-75 µm). Coarse fraction was found to be maximum. Mica grains were partially fractured, shattered, twisted, highly iron leached and sticky. The chemical analyses of silt (as per IS 1727, and IS 4032) indicated that they were rich in SiO_2. PSD indicated that average coarse particles and average fine particles

range from 363 µm to 808µm and 61 µm to 131µm respectively. The chemical analysis of water samples was carried out by using IS 456 and IS 3025. Langelier Saturation Index (LSI) of the water samples were in the range of -0.28 to +0.25. LSI within range and found suitable for use.

Collection points to collect water, silt sediment samples.

Polarizing Microscope, Make: NIKON Japan, Model: POL 100 LV

Distribution of mineral grains in the silt sediment sample (Size fraction-300 to +150µm). (5x, x-Nicols), Microphotographs captured by Polarizing microscope



Distribution of mineral grains in the silt sediment sample (Size fraction-90 to +75µm). (5x, x-Nicols) Microphotographs captured by Polarizing microscope

Independent Testing

Independent Testing Laboratories of NCB undertake complete physical, chemical, mineralogical, micro-structural thermal analysis of various types of raw materials, cement, clinker, pozzolana, aggregate, concrete, admixtures, water, refractory, bricks, coal, lignite etc. as per National and International standards. These labs also perform testing of internal samples for CRM and BND preparation, PT sample preparation and R&D/ SP projects.The INT laboratories established in 1977 on a Test House pattern, undertake testing jobs for cement, construction, and allied industries. NCB testing laboratories achieved a landmark when NABL accredited them in the year 1997 as per ISO 17025 quality system that is continued since then. These labs are also recognized by BIS for testing of 19 cement and related products. The laboratories are equipped with state-of-art instruments and trained competent staff to carry out the testing activities as per National and some International standards. During the year, assignments were carried out for samples from neighboring countries also. The number of samples tested during the period was 7,890.

Centre for Mining, Environment, Plant Engineering & Operation – (CME)

Centre for Mining, Environment, Plant Engineering and Operation carried out its activities through six Programmes viz. Process and Productivity; Energy Management; Project Engineering and System Design; Environment Sustainability & Climate Change; Advanced Fuel Technology and Quality Assurance Group and completed 30 sponsored projects along with 3 R&D projects during the year.

Process and Productivity (PRP)

- **NCB is providing project management Consultancy services for installation of tyre chips to M/s Oman Cement company SAOG, Sultanate of Oman.**

The activities under this project are given below:

- Review and approval of Design Engineering of the system
- Review and approval of Civil drawings
- Review and approval of Mechanical drawings
- Review and approval of Electrical & instrumentation drawings
- Review and approval of process flowsheets and Technical specifications
- Conducting Project review meeting with contractor and customer
- Approval of Detailed drawings
- Inspection of Civil Works and Local Fabrication
- Inspection of Erection and Commissioning of Mechanical Erection, Installation of electrical, control, instrumentation & automation systems

- **Capacity assessment study of M/s Star Cement Limited:**

- Plant has approached NCB for assessment of plant production capacity in order to submit the report to state government for claiming transport subsidy applicable as per the North East policy.
- During this study, NCB collected the historical data of production, process, quality and Breakdown analysis of the equipment installed.
- NCB inspected the plant to verify the current operational data and potential capacity of the installed equipment.

- **Technology selection study of new line for M/s Star Cement Limited:**

- Plant has approached NCB for Technology selection of new clinkerization plant. The study includes recommendation for selection of type of equipment i.e.
- Kiln, Cooler and Preheater system based on best available technologies.

- **Consultancy services for Process Audit for Capacity Enhancement of Pyro Processing and Raw mill for M/s Tanzania Portland Cement Company Ltd, Tanzania:**

  The activities involved are:

  - Process audit of pyro-section for assessment of existing system and upgradation potential to higher capacity.
  - Raw mill-4 inspection and measurements to support the improved capacity of the kiln
  - Line-3 kiln system heat balance and identification of higher losses.

- **Heat Balance study of M/s JK Cement Limited (JKCL), Nimbahera and Mangrol Rajasthan**

  - Heat Balance study of Kiln by assessing the thermal performance of kiln system.
  - Provided recommendations for improving thermal energy performance of the kiln system.

- **Optimization study of cement mills of M/s Star Cement Limited, Meghalaya**

  - Carried out the internal inspection of Roller press, Ball mills, Vertical roller mills to identify causes for sub-optimal performance of mills.
  - Carried out the plant trials for improving productivity based on the observations.

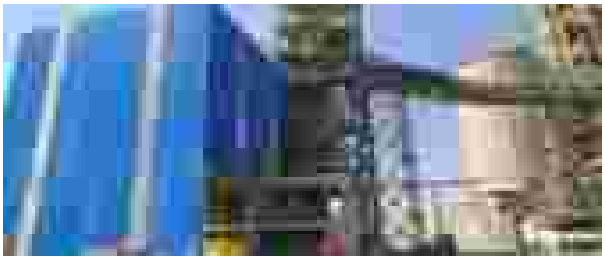
- **Process Optimization study of Pyro-processing section at M/s Nuvoco Vistas Corp. Ltd, Arasmeta, Chhattisgarh**

  The activities involved are:

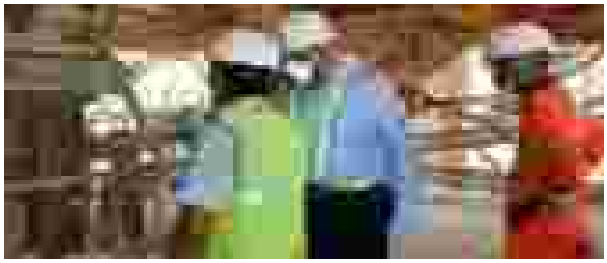
  - Process audit of pyro-section
  - Finding opportunities for Reduction of Power and fuel consumption
  - Assessment of usage of Alternate fuel and finding improvement potential

- **Heat balance & energy consumption optimization in cement kilns for M/s Kesoram Industries Ltd., Telangana and Karnataka**

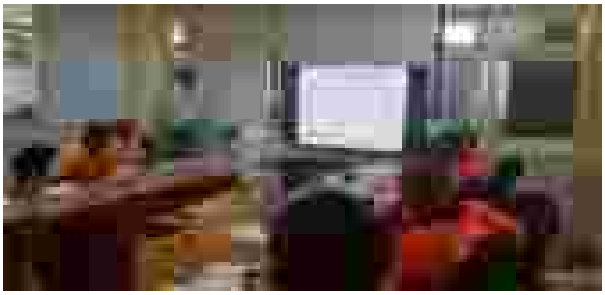
  - Heat Balance study of Kiln by assessing the thermal performance of kiln system. Formed recommendations for improving thermal energy performance of the kiln system.



Consultancy services for installation of tyre chips for M/s Oman Cement Company, Oman



Process audit for capacity enhancement of pyro processing and raw mill-4 at M/s Tanzania Portland Cement Company Limited (Twiga Cement)



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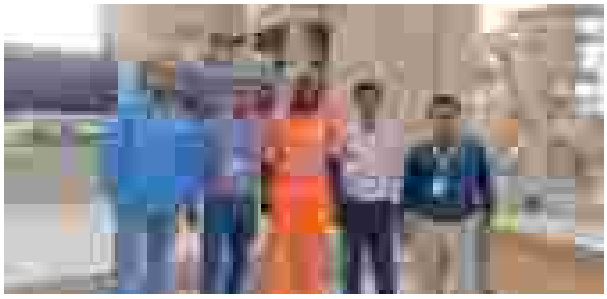
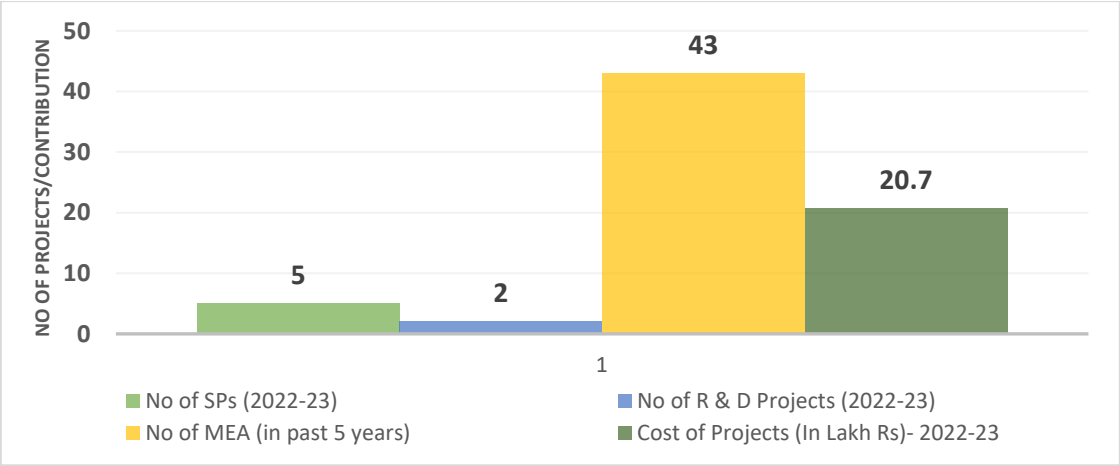


Process audit for capacity enhancement of pyro processing and raw mill-4 at M/s Tanzania Portland Cement Company Limited (Twiga Cement)

Energy Management (EMG)

NCB has been very closely associated with energy efficiency improvement of the Indian Cement Industry. NCB has an experienced team of Energy Engineers, Certified Energy Auditors and Accredited Energy Auditors certified by Bureau of Energy Efficiency (BEE, Govt of India) to conduct detailed energy audits. NCB has carried out more than 200 detailed energy audits till date in various cement plants. Energy audit studies in cement plants include assessment of energy management, monitoring and target setting, detailed heat balance and gas balance studies, identification of potential for thermal and electrical energy savings and recommendations for remedial measures, techno economic feasibility studies for waste heat recovery system (WHRS) etc.



Sponsored Projects

- **Mandatory Energy Audit of Line-1 & II M/s Prism Johnson Cement Ltd, Satna, MP**

- **Mandatory Energy Audit at M/s UTCL, Unit-APCW, Tadipatri, Andhra Pradesh**

  i. Studied the overall energy utilization within the boundary and their losses.
  ii. Form-1 data was checked for the last two years
  iii. Form-2 given in the report which givens the energy reduction measures for the plant.

- **Walk through audit at Cement Corporation of India (CCI) Tandur**

  i. The audit was conducted on the basis of data collected from the plant and site visit.

  ii. Recommended to reduce 2% of its coal consumption.

  iii. Recommended to increase 5% of addition of flyash in their system from their existing level.

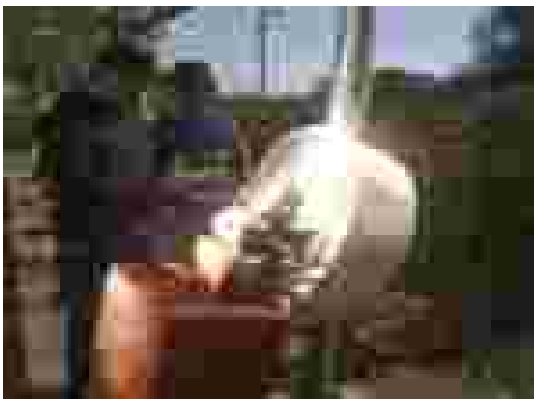
- **Form-3 verification for a cement plant in Andhra Pradesh (UTCL)**

R&D Projects

- **Solar thermal calcination of phosphogypsum for cement manufacture for enhancing utilization of PG by solar thermal calcination in cement manufacture.**

  i. Utilization of solar thermal energy for calcination of industry by product/waste product was explored. Phosphogypsum was taken for reference material.

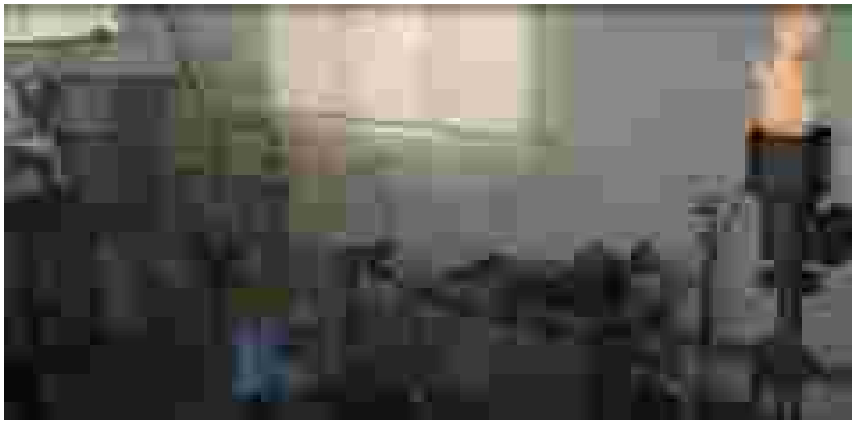
  ii. Impurities of phosphogypsum were converted into inert form by the temperature of 400°C achieved through solar thermal energy.



Solar Thermal Calcination of Phosphogypsum

- **Process design and integration of Refuse Derived Fuel (RDF) gasification in the cement manufacturing process to help overcome limitations of RDF combustion currently being practiced by Indian cement plants.**

  i. The project was taken in the year 2020 and in this year experimental trial runs were taken in the downdraft gasifier at BITS Pilani setup. A MAT lab model has been developed for RDF gasification to predict the syngas quality and further techno economic analysis has been carried out.



Setup of Downdraft Gasifier for RDF Gasification

- **03 nos R & D projects proposals submitted to BEE as below:**

  i. Use of cooler hot vent gases in AFR dryer

  ii. RDF gasification and use as AFR in cement plants

  iii. Utilization of Solar thermal energy in calcination and drying of cementitious materials.

Project Engineering and System Design (PSD)

- **Project Management Consultancy services for installation of 600 tpd Green Field Cement Plant Project at the Republic of Congo**

  The program team is working as a Project Management Consultant (PMC) to the Government of the Republic of Congo for monitoring and controlling the project implementation activities and providing the support for project supervision. Package-I (Mine development & Mining Equipment Supply) is completed successfully and activities for Package-II (Engineering, Construction and Supply of Machineries for setting up the cement plant at Louvakou district, Department of NIARI, Republic of Congo are going on which includes the following: -

  - Review of technical drawings and documents
  - Contract management
  - Project review meetings for monitoring the progress
  - Inspection of material and equipment

- Project progress reporting
- Coordination with client, contractors and all stakeholders of the project

Visit of NCB team to Cement Plant Site, RoC

Visit of Minister of Industries of ROC and Charge de Affairs of Indian embassy to Cement Plant Site, RoC

- **Preparation of Marketing Report for utilization of Flue Gas Desulphurization (FGD) Gypsum of power plants in VSR region for NTPC Ltd.**

  i. The program has successfully prepared and submitted the report to NTPC, report covers the outcome of visits in the Vindhyachal, Singrauli and Rihand region to estimate the potential of sale/ utilization of Flue Gas Desulphurization (FGD) Gypsum from the units of NTPC in the VSR region. Specific purpose of this report is to provide an overview of the various gypsum specific consumer sectors that have been identified during the study.

R&D Projects

- **Design and Development of Transfer Chute to handle Alternate Fuels and their mix in Indian Cement Plants**

  To resolve one of the major system design related issue (transfer chute jamming) while handling multiple types of alternative fuels in Indian cement plant, NCB started working on a R&D project for design and development of the transfer chute and successfully developed the design parameters for transfer chute to prevent the chute jamming and a flexible arrangement for cleaning the chute incase if it gets jammed. Project is successfully completed and outcome was presented in front of Indian Cement Industry during Research Advisory Committee meeting. The validation of developed transfer chute was carried out on working setup installed at NCB Ballabgarh by operating the chute with 19 types alternative fuels and their mix.

Experimental setup at NCB Ballabgarh

Validation of Transfer Chute Design Parameters

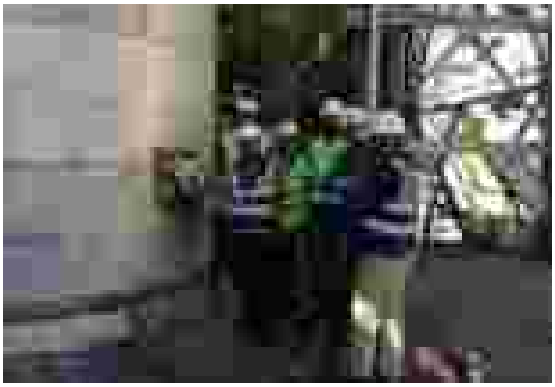
Equipment facilities added

S. No.	Name of the Equipment	End Use
1.	Experimental set up consisting of transfer chute and belt conveyors is installed at NCB-Ballabgarh	Design and optimization of transfer chute in cement industry

Environment Sustainability & Climate Change (ESC)

- **Performance Assessment of Existing Air Pollution Control Equipment (APCE)**

Performance Assessment of Existing Air Pollution Control Equipment was taken up for three cement plants located in Andhra Pradesh, Himachal Pradesh and Assam, under which the major APCE attached with Kiln/Raw Mill, Coal Mill, Cement Mill, Cooler were monitored. Dust monitoring of inlet and outlet of APCE was carried out to evaluate the performance of APCE.



Environment Monitoring at Cement Plant

Quality Assurance Group - Electrical & Mechanical (QAG)

The Quality Assurance Group (QAG) comprises pool of Electrical, Mechanical and Instrumentation engineers who are primarily involved in Third Party quality assurance of electrical & Mechanical services of various types of infrastructure and nation building projects such as Hospitals, Schools, Convention centers, Street lighting works, Sewage Treatment Plant, Effluent treatment plant etc.

Services Offered

- Pre dispatch Inspections
- In process/stage inspections
- Testing & Conformity assessments

Area's Covered

Electrical & Instrumentation	Mechanical
Inspection of electrical equipment's such as Motors, Transformers, HT/LT Panels, Cabling, Internal wiring, DG Sets, Lighting Fixtures, Solar PV Plants, Batteries, UPS, CCTV, Audio-visual systems, Building Management system (BMS), Parking Management System, Surveillance system, Information & Communication technologies equipment's - Active and Passive.	Inspection of Mechanical equipment's such as Pumps, Compressors, Blowers, Pipes & fittings, Lifts & Elevators, Structural steel works & fabrications.

Available Resources

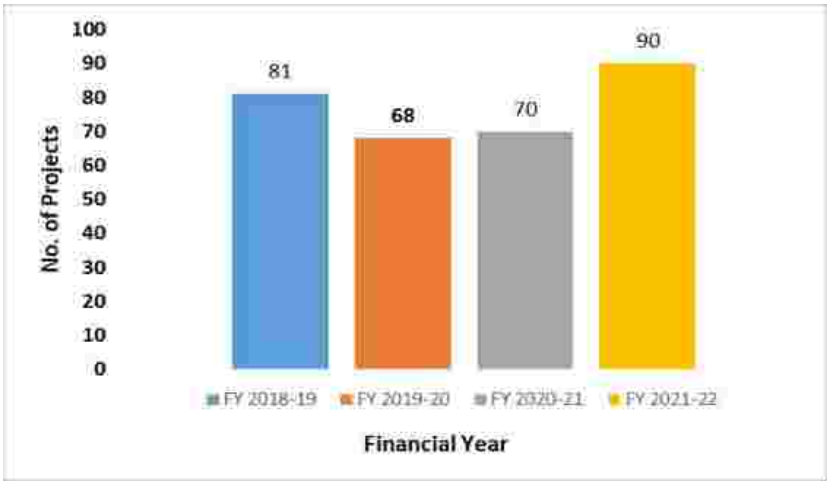
The group is equipped with various kinds of portable measuring/testing instruments which are used for quality assurance at sites. A few of them includes

- Power Quality Analyzer
- Earth Tester
- Vernier Caliper

- Gauge Meter
- Power Clamp Meter
- LUX Meter
- Coat thickness Meter
- Welding Gauge
- Laser distance Meter

Sponsored Projects Executed in Past Years

The group has been on the path of steady progression in terms of projects executed, which is depicted in the graph below.



Esteemed Clients

QAG has been engaged by reputed clients across India for its consultancy services on quality, A few of them are:

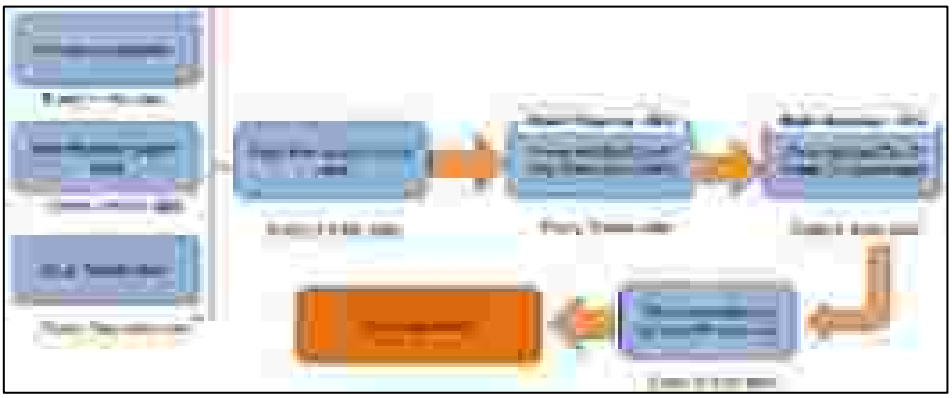
- Municipal Corporation of Delhi (MCD)
- Central Public Works Department (CPWD)
- National Industrial Corridor Development Programme (NICDC)
- India Trade Promotion Organisation (ITPO)
- All India Institute of Medical Sciences (AIIMS)
- Delhi Development Authority (DDA)
- Public Works Department (HARYANA)
- Public Works Department (DELHI)
- Delhi Transport Corporation (DTC)
- Indian Institute of Technology, Roorkee (IIT-R)
- Larsen & Toubro (L&T)

Advanced Fuel Technology (AFT)

R&D Projects

- **Improvement in clinker quality and increase % thermal substitution rate by the application of Artificial Intelligence**

  To resolve the major challenges faced by cement industry like increasing fuel costs, depleting fossil fuel reserves, the need to decarbonize the industry and to further increase the alternative fuel utilization by cement industry, AFT has taken up a R&D project on improving clinker quality and increasing the thermal substitution rate in the cement industry. A tripartite agreement have been signed with M/s Livnsense Technologies Pvt. Ltd. and M/s J K Lakshmi Cement to develop predictive models to enhance TSR through liquid AF in the cement plant. The model has been developed with more than 80% accuracy considering the process constraints like increased CO level and temperature of 6th cyclone. The validation of developed model is currently being carried out by the cement plant.



- **Activities carried out under AFT programme**

  - Presentation on "Potential of CO_2 reduction for Indian cement industry: Switch over to grid power from captive power plant" in 1st virtual Global CemCCUS Seminar.
  - Presentation on "Pathway towards decarbonisation: gasification of alternative fuels" in a 3rd Virtual Middle Eastern Cement Conference.
  - Preparation of business plan and specifications of equipment for setting up of alternate fuel testing laboratory in CME

Events / Workshops Organised

4 nos of seminars were organised in association with Bureau of Energy Efficiency (BEE) on "Dissemination of Waste Heat Recovery Technologies in Indian Cement Plants". These seminars were conducted at NCB-Ballabgarh, NCB-Hyderabad, AKS University-Satna and UTCL: Unit-Aditya Cement Works-Chittorgarh.

The presentations during the seminars covered latest technological status by leading technology suppliers & technology consultants, case studies presentation by cement plants and NCB officials. Exhibition of technologies on Waste Heat Recovery System were also organized concurrently with the seminar. The participants got aware about initiatives taken by cement industry for minimizing carbon footprint whereas the role of WHRS shall be very much important among key ingredients to achieve the target.

Seminar on Exhibition and Dissemination of Technologies in Waste Heat Recovery System in Indian Cement Plants

Contribution to Publications for Cement Industry

- The 3rd edition of Compendium "The Cement Industry – India 2022" was published by NCB in association with DPIIT, Ministry of Commerce & Industry. It contains updated information about best practices, technology roadmap, issues, challenges and opportunities for cement plants and an exhaustive directory of cement plants in India.

- The publication on "Alternative fuels –A green solution for Indian cement industry" was prepared by CME which will be very much useful and reference document for Indian cement industry covering AF characterization, system design and process optimization concepts etc.

- The first edition of "NCB Guide Norms for Cement Plant Operations" was first brought out in the year 1988. The fifth edition of the Guide Norms was subsequently brought out in the year 2005. Since, updating of the norms is a continuous and dynamic process, the revision of Guide Norms was undertaken after fifteen years to imbibe the significant changes in technology and improvements in operational practices to make the Guide Norms more useful and relevant in the present-day context. The sixth edition was released during the 17th NCB International Conference.

National Awards for Indian Cement Industry

- Coordination for National Awards for Indian Cement Industry in the field of Environment Excellence, Energy Excellence, Total Quality Excellence and Achieving Circular Economy for Integrated Cement Plants and Energy & Environment Excellence in Grinding Units were awarded to best participating cement plants.

Centre for Construction Development and Research – (CDR)

Centre for Construction Development and Research (CDR) is contributing in developing durable and sustainable civil infrastructure for the nation. The Centre provides services to the cement, concrete and construction sector through four programs namely Concrete Technology, Structural Optimization and Design, Structural Assessment and Rehabilitation, Construction Technology and Management. The centre has facilities for mechanical, physical and durability testing of concrete making materials and Non -destructive testing through advanced equipment. The Centre completed 91 sponsored projects during the year.

Concrete Technology (CON)

A. Material Evaluation and Concrete Mix Designs

Characterization of physical and chemical properties of concrete making materials, i.e., cement, fly ash, silica fume, GGBS, water, fine and coarse aggregates and chemical admixtures are essential for determination of their suitability for making concrete alongwith relative proportion with the objective of producing an economical concrete of required strength, durability and workability. Various government/semi government/private organizations like NTPC and its subsidiaries, NHPC and its subsidiaries, THDCIL, CPWD, ITD Cementation, L&T Limited and other private agencies approached NCB to study the performance of different concrete making materials and to provide recommendations for the required grade of concrete ranging from M10 to as high as M50. During the period of 2022-23, more than 15 sponsored projects of material characterization and about 32 mix designs were completed.

B. Concrete Mix Design for Special Applications

- **Design of Self-Compacting Concrete**

  Self-Compacting Concrete (SCC) of grades M45 to M50 were designed by NCB for **Central-Vista Project** (client CPWD) and SSB Residential Colony Project (Client - CPWD, Faridabad) during the period of 2022-23.

- **Pavement Quality Concrete**

  Pavement Quality Concrete of Grade M35 was designed by NCB for THDCIL during the period 2022-2023

C. Alkali Aggregate Reaction (AAR) studies on aggregates

Distress in concrete structures due to the presence of Alkali-silica reaction (ASR) is a matter of great concern to the construction industry and is one of the most prominent causes of deterioration of concrete structures after reinforcement corrosion. Aggregates prone to ASR contain reactive silica, which in the presence of alkali in the pore-solution inside the concrete results in the formation of hydrophilic alkali-silica gel, often referred to as ASR gel. The ASR gel thus formed does not by itself cause cracking. However, once the ASR gel comes into contact with water, it shows significant potential to swell. The expansion that results as a consequence, often creates pressures greater than what

the concrete can withstand, which in turn causes cracks in the concrete. ASR is a chemical reaction between the alkalis in Portland cement and certain siliceous aggregates which form a silica gel. It is well known that alkaline components of Portland cement chemically react with silica in certain forms found in certain aggregates. NCB over the years has developed the necessary expertise and competency to evaluate aggregates for potential alkali aggregate reaction which includes both alkali silica reaction and alkali carbonate reaction. The following tests are carried out to evaluate the potential Alkali Aggregate Reactivity of aggregates:

- Petrographic and Mineralogical Analysis as per IS: 2386 Part VIII.
- Accelerated Mortar Bar Test as per ASTM C1260.
- Mortar bar test as per IS: 2386 Part VII.
- Prism Bar Test as per ASTM C 1293

About 60 number of coarse and fine aggregate samples were evaluated for petrographic and mineralogical analysis as per IS:2386 Part VIII, accelerated mortar bar test as per ASTM C1260 and mortar bar test as per IS: 2386 Part VII for various prestigious clients like NTPC, CPWD, THDCIL, NHPC Ltd, L&T Ltd during the period of 2022-23.

D. Evaluation of Integral Crystalline Waterproofing compound

Integral crystalline waterproofing is a technology that involves development of crystals to achieve watertight concrete structures. The basic idea behind crystalline waterproofing is to prevent the movement of water through the concrete by plugging or blocking the natural pores, capillaries and micro cracks found in concrete. In the last 7-8 years, NCB with help of its expert scientists and engineers has developed core competency in the performance evaluation of integral crystalline waterproofing compounds. NCB has also developed mechanism for the assessment of integral crystalline waterproofing compounds and their performance in concrete as well as mortar. It includes various testing techniques and methods as per various Indian standards as well as International standards. Centre has testing facilities to evaluate their performance in terms of following parameters

- Resistance against water penetration into concrete (cyclic loading and high hydrostatic pressure of 16 bar) as per IS: 516 (Part-2/ Sec1) and ACI 212.3R
- Resistance against water penetration into mortar as per IS: 2645
- Resistance against chloride ingress into concrete as per ASMT C 1202, NT build 492, SIA 262/1-B, ASTM C 1556
- Resistance against CO2 ingress into concrete as per IS: 516 (Part2/ Sec4), ISO 1920 Part12, SIA 262/1-I
- Determination of coefficient of permeability using Mercury intrusion porosimetry techniques and as per ASTM C 642
- Utilization of Scanning electron microscopy (SEM) technique for determining the presence of integral crystals in concrete specimen

NCB has evaluated 6 numbers of crystalline water proofing compounds for various industrial clients like Xypex, Asian paints and government clients like CPWD, PWD etc. at various grade of concrete and recommendations have been given in comparison to control samples to help the construction industry.

E. Some of the Important Completed R&D and sponsored Projects

- **Carbonation induced corrosion study for composite cement**

  Portland cement is the world's most widely used manufactured material and underpins modern infrastructure like no other. Global production of Portland cement clinker stands at a little over 3.5 billion tonnes, and consequently the global cement industry is responsible for 6–7% of anthropogenic carbon dioxide emissions. The industry recognizes the need to reduce its carbon dioxide emissions, and there have been a number of technological advances in recent years that have helped to reduce the carbon footprint of cement production. Amongst these, one of the most popular and effective methods has been to reduce the clinker factor, that is, replace cement clinker with supplementary cementitious materials (SCMs). Composite cement is a type of low clinker cement in which a major proportion of the clinker is replaced by the combination of fly ash and granulated slag. In India, composite cement (conforming to IS: 16415-2015) is manufactured by either inter-grinding of Portland cement clinker (conforming to IS: 16353-2015), granulated slag (conforming to IS: 12089-1987) and fly ash (conforming to IS: 3812 (I) 2013) with addition of natural/chemical gypsum or by an intimate and uniform blending of ordinary Portland cement (conforming to IS: 269-2015), finely ground granulated slag and fly ash with addition of ground gypsum. Indian Composite cement consists of 35-65% Portland cement clinker/ ordinary Portland cement along with 15-35% fly ash and 20-50% granulated blast furnace slag whereas European code i.e. EN 197 covers a cement group CEM-V-B (composite cements) that allows 31-49% of natural Pozzolana or calcareous fly ash along with slag and remaining portion as clinker in it. Presently, IS 456, i.e., Indian standards and codes of practices recommend usage of composite cement only in plain cement concrete whereas its use in RCC is prohibited due to lack of experimental data. NCB has conducted some preliminary studies on the application of composite cement in concrete. Limited investigation was carried out in the field of durability aspect of the concrete made with composite cement. The study carried out by NCB and study reported in various literatures indicates that composite cement behavior is quite similar to PPC and found to be beneficial in chloride rich environment. However, Like in PPC, problem of carbonation induced corrosion persists, similar phenomenon was observed with composite cement. Initial investigation done by NCB indicates that concrete made with existing composite cement composition shows less resistance to carbonation in comparison to OPC. Therefore, the present specification, i.e., IS 16415 requires modification to cater to the effect of carbonation w.r.t higher clinker substitution in composite cement.

A comprehensive study has been conducted by NCB using following possible specifications and combinations:

Possible Specification	SP1	SP2	SP3	SP4	SP5
OPC content	35%	40%	45%	50%	55%
Fly ash content	15-25%	10-25%	10-25%	10-25%	10-25%
Slag content	40-50%	35-50%	30-45%	25-40%	20-35%

Based upon the possible proportions, following combinations of composite cements as mentioned in the table below have been studied:

Table: Combinations of composite cements

Sl..No	Possible Specification	Type of cement	Clinker +Gypsum (%)	Fly ash (%)	Slag (%)
1	SP1	Composite Cement	35	15	50
2		Composite Cement	35	25	40
3	SP2	Composite Cement	40	10	50
4		Composite Cement	40	25	35
5	SP3	Composite Cement	45	10	45
6		Composite Cement	45	25	30
7	SP4	Composite Cement	50	10	40
8		Composite Cement	50	25	25
9	SP5	Composite Cement	55	10	35
10		Composite Cement	55	25	20

The study was carried out on two different sets of materials. About 20 mortar samples and 72 concrete mixes were studied. The study envisages the effect of various combination as specified above on the cement mortar and concrete properties. Based on the mechanical as well as durability test results, especially carbonation as well as carbonation induced reinforcement corrosion, it was recommended to keep OPC content at least 50% or clinker content at least 45%, fly ash in the range of 10-25% and GGBS in the range of 25-40 % to achieve performance equivalent or better than PPC. Based upon NCBs study, IS 16415 has been revised and final outcome of the study has been included; refer to the following table.

Table: Material Proportion to be used in Composite Cement

SI No.	Material	Proportion (Percent by Weight)

i)	Portland cement clinker Or Ordinary Portland cement	Minimum 45 (in case of clinker is used) Minimum 50 (in case of OPC is used)
ii)	Fly ash	10-25
iii)	Granulated slag	25-40

NOTE – Chemical gypsum shall be added provided that the requirements of the final product as specified in this standard are met with.

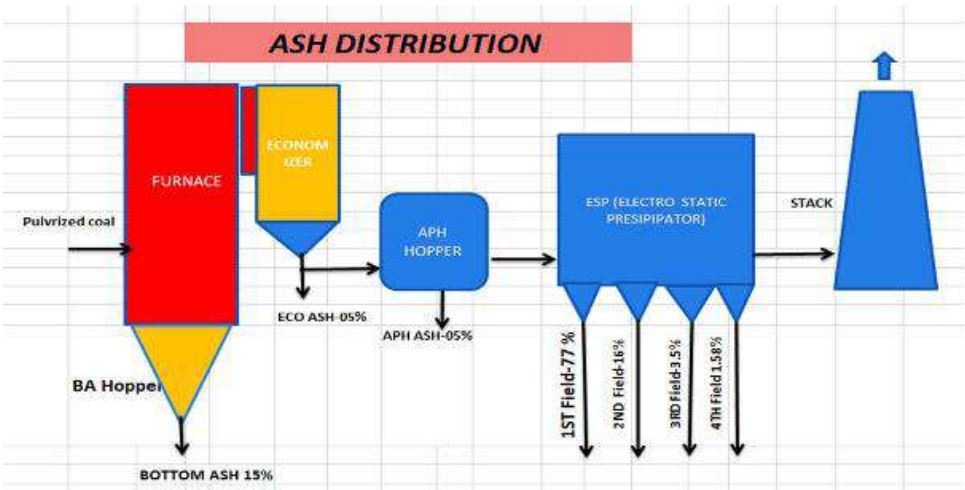
- **Utilization of coarser fly ash (having fineness between 250 m^2/kg to 320 m^2/kg) in concrete as a cementitious material.**

  In India, presently Coal and Lignite based Thermal Power generating stations contribute more than 70% total electricity generation of the country. Coal based power generation is likely to remain substantial in coming years also. Indian coal has high ash content of the order of 30-45 % in comparison to imported coals which have a low ash content of the order of 2-15 %. Therefore, Coal / Lignite based Thermal Power Stations are generating large quantity of fly ash in the country. At present, ash utilization is lower than its production on pan India basis. This leads to surplus ash stock which has been increasing every year. This ash is a matter of concern as it not only requires a large area of precious land for its disposal but is also one of the sources of pollution of air, water and soil. To address the problem of pollution caused by fly ash, the Ministry of Environment, Forests and Climate Change (MoEF & CC) has issued various Notifications on fly ash utilization. The First Notification was issued on 14th September 1999 which was subsequently amended in the years 2003, 2009, 2016 and 2021 vide Notifications dated 27th August 2003, 3rd November 2009, 25th January 2016 and 31st December 2021 respectively. MoEF & CC has issued an amendment to the Notification on 31st December 2021 in order to widen the scope of fly ash utilization and use of fly ash by construction agencies within a prescribed radius of any thermal power stations, besides engraining upon Power Utilities to bear the cost of the transportation. Also the latest notification states that every coal or lignite based thermal power plant shall be responsible to utilize 100 per cent ash (fly ash and bottom ash) generated during that year, however, in no case shall utilization fall below 80 per cent in any year, and the thermal power plant shall achieve average ash utilization of 100 per cent in a three years' cycle. Presently, in India, the cement and construction industry, fly ash is being used on a large scale, like in the manufacturing of Portland Pozzolana Cement, production of concrete, construction of roads, dams, stabilization of slopes, bricks etc. The Indian standard code (IS 3812 Part-I) gives the specification of pulverized fuel ash for use in the production of cement concrete, where it is mentioned that the minimum required fineness of fly ash should be 320 m^2/kg or more. However, it is noticed that in India, a large amount of coarser fly ash (having fineness 250 to 320 m^2/kg) is available. As this coarser fly ash is not satisfying the

minimum requirement of fineness as per IS 3812 Part-I, they are not being utilized in the production of cement and concrete. In order to address this concern, the utilization of coarser fly ash seems to be an appropriate step to utilize a large quantity of fly ash and also yield significant environmental benefits. Therefore, NCB has taken up the study on "Utilization of coarser fly ash (having fineness between 250 m^2/kg to 320 m^2/kg) in concrete as a cementitious material". Under this study, NCB has collected fly ash from various locations (i.e., field wise samples & sample collection from ash dyke) of six different thermal power plant located across the country. Fly ash samples from Silos were collected from six different NTPC thermal power plants. Collected fly ash samples have been characterized under different categories on the basis of chemical, physical, Mineralogical, and morphological properties.

During the sample collection, it was observed that 80 percent of the fly ash is collected in the first field of ESP and around 95 percent of fly ash is obtained in first three fields but fly ash coming from all the fields is collectively stored in silos. As the first field fly ash is coarser in nature, the fly ash in silos also remains coarser (fineness<300 m^2/kg). Thus, if this fly ash is used, it will result in maximizing the utilization of fly ash.

In this R&D study, seven fly ash samples have been selected which are categorized based on their fineness value obtained 216, 225, 233, 251, 270, 325 & 387 m^2/kg. Concrete mix samples were prepared at two water-binder ratios, i.e., 0.4 and 0.5 using these seven fly ash samples. The concrete mix was prepared without fly ash (i.e., with OPC only) and with fly ash by 30 percent replacement of Cement with all seven fly ash samples. The fresh properties of concrete samples in terms of workability and wet density have been determined



In order to study the hardened properties of concrete, samples have been cast and the results have been obtained. Based on the fineness of fly ash, the test results of hardened concrete samples are discussed in following five categories:

Category-I (Concrete sample cast using fly ash Fineness < 250 m^2/kg)
Category-II (Concrete sample cast using fly ash Fineness Between 251 to 300 m^2/kg)
Category-III (Concrete cast with Fly ash having fineness 325 m^2/kg)
Category-IV (Concrete cast with Fly ash having fineness 387 m^2/kg)
Category-V (Concrete sample cast with OPC only)

Based on the results obtained, it is concluded that Coarseness and Fineness of fly ash is not affecting the fresh properties in all Categories of concrete in terms of workability loss of concrete. The 7 days' compressive strength results are slightly lower in Category-I concrete compared to rest of the concrete Categories. However, the 28 days & 56 days' strength results of Category-I concrete are almost equal to Category-II, Category-III, Category-IV and Category-V of concrete. Also no significant change in the hardened properties results of concrete in terms of Flexural strength, Poisson's ratio, Water absorption of Category-I concrete as compared to Category-II, Category-III and Category-IV of concrete have been observed and the results are comparable. The Category-I concrete Modulus of Elasticity (MoE) results are comparable to Category-II, Category-III and Category-V. The Category-IV (concrete made with FA having fitness 387 m^2/kg) MoE results are slightly on the higher side when compared to all other categories of concrete. The Durability property of concrete in terms of Accelerated Carbonation depth of Category-I concrete as compared to Category-II, Category-III and Category-IV of concrete are comparable. Category-V, i.e., OPC mix concrete Carbonation depth is lowest when compared to all categories of concrete.

Conclusion of the study

1. Based on this study recommendation for the Modification / amendment in the specification of fly ash has been given to BIS. (**IS 3812 part-1, 2013**).

2. Based on this study draft code for Revision of Sampling of fly ash & Bottom ash has been submitted to BIS. (**IS 6491 - 1972**).

- **Study on the use of Electric Arc Furnace Slag (EAF slag) as a fine aggregate and coarse aggregate in concrete for Arcelor Mittal Nippon Steel (AMNS) Limited**

EAF slag is a by-product of the steel-making process. EAF slag solidifies in a similar manner to lava from a volcano. Its cooled structure is best

described as a solid solution of oxides and silicates. EAF slag presents a high content of Fe oxides and even metallic Fe. EAF slag aggregates often appear as grey or black coloured lumps, depending on its ferrous oxide content. The amount of metallic iron is minimized by crushing and is then recovered using electromagnetic fields. The average density of EAF slag is greater than that of 3.2 g/cm^3.The main elements in the EAF slag are Iron (Fe), Calcium (Ca), Silicon (Si), and Aluminum (Al) oxides, while the minor elements in the EAF slag are Magnesium (Mg) and Manganese (Mn) oxides. Extensive study on physical, chemical and mineralogical characteristics of EAF slag based coarse and fine aggregate was conducted at NCB as a part of a sponsored project. Based on the physical and chemical characterization of EAF slag based coarse and fine aggregates, it was found that Coarse and fine aggregates made from EAF and Conarc slag conformed to the physical and chemical requirements of IS 383:2016 for use in concrete, except specific gravity. However, the marginal higher value of specific gravity may not restrict the use of EAF slag as aggregates in concrete construction. In EAF and Conarc slag, presence of heavy metals and toxic elements, are found to be within the permissible limits as per MoEF and CC Schedule – II. Hence, EAF and Conarc aggregate are suitable for use in construction applications

In order to study the effect of EAF slag based coarse and fine aggregate on concrete properties, a detailed experimentation was carried out at various replacement of natural aggregates with EAF slag based coarse and fine aggregate. The study covered a broader spectrum that includes various fresh, hardened and durability aspect of the concrete made with EAF slag based coarse and fine aggregate. The properties of concrete made with EAF slag based coarse and fine aggregate was compared with conventional concrete, i.e., concrete made with natural aggregate. From the study that it was seen that EAF slag aggregates did not show adverse impact on the durability behaviour of the concrete. Durability performance of concrete made with EAF slag aggregates evaluated in terms of sulphate resistance, chloride resistance, carbonation and water penetration was found to be either equivalent or better than that of concrete made with natural aggregates. Based on the mechanical property as well as durability test results, EAF slag aggregates (coarse as well as fine) has the potential to replace natural aggregates. From the study, it can be concluded that it is possible to use 100 % coarse as well as fine aggregate made from EAF slag as a replacement to natural aggregate in concrete.

A comparative study between EAF slag and Conarc slag was also carried out. This mainly includes physical, chemical and mineralogical characterization of EAF slag and Conarc slag sourced from 2-3 steel plants located in different parts of the country.

On comparing the physical properties of the fine aggregate made from EAF slag and Conarc slag such as specific gravity, water absorption etc., it was

found similar to each other and also found complying to the requirements of Manufactured aggregates as prescribed in IS 383:2016 for use in concrete. However, the marginal higher value of specific gravity may not restrict the use of EAF slag and conrac slag as fine aggregates in concrete construction. Most of the physical properties of the coarse aggregate made from EAF slag and Conarc slag such as specific gravity, water absorption, etc., was found similar to each other and also found complying to the requirements of Manufactured aggregates as prescribed in IS 383:2016 for use in concrete. However, the marginal higher value of specific gravity may not restrict the use of EAF slag and conrac slag based coarse aggregates in concrete construction. It should be noted that mechanical properties of aggregates such as abrasion value, crushing value and impact value are very much influenced by the cooling process.Alkali content, chloride content and sulphuric anhydride content of EAF slag and Conarc slag was found to be similar and also within permissible limit as given in Table 3 of IS 383: 2016.Total Iron as FeO and MgO was found to be similar in EAF slag as well as Conarc slag and also found to be within permissible limits as given in Table 5 of IS 383:2016 whereas CaO content in EAF slag is found to be less than that of Conrac slag but within the permissible limits as given in Table 5 of IS 383:2016. It is quite evident from the XRD results of EAF slag as well as Conarc slag that they are mainly composed of calcium silicates or silicate minerals (available in the form of Gehlenite, Dicalcium Silicate, tricalcium silicate, Montocellite, Haturite, larnite Calcio olivine etc), iron oxides (available in the form of Wustite, Magnetite, Hematite etc), Tricalcium Aluminates and magnesium oxide (available in the form of periclase , Magnesite , wadsleyite etc). Oxides of Manganese are found only in Conarc slag. Both type of slags consists of free lime and periclase either in minor or major form.

From the study, it was found that physical characteristics of aggregate made from EAF slag and Conarc slag are quite similar whereas chemical & mineralogical characteristics of EAF slag and Conarc slag are slightly different from each other. Draft specifications were also formulated that includes certain recommendation in terms of physical and chemical parameters for aggregate made from EAF and Conarc slag for its application in concrete that can be used for the revision of IS 383:2016.

- **Evaluation of Processed LD Slag as per IS 383: 2016 and Study its suitability to be used as fine aggregate for M/s JSW Steel Limited**

To explore the feasibility of LD slag to be used as an alternative to conventional fine aggregate, a sponsored R&D study "Evaluation of Processed LD Slag as per IS 383: 2016 and Study its suitability to be used as fine aggregate" was carried out by NCB. In this study, processed LD slag was utilized as fine aggregate in concrete production. The processed LD slag based fine aggregate was evaluated for physical and chemical parameters as specified in IS 386: 2016 for fine aggregate. Petrographic and

mineralogical analysis was also performed on processed LD slag using optical microscopy and X-ray diffraction (XRD) technique respectively. The processed LD slag was also studied for accelerated mortar bar test as per ASTM C1260 to assess the alkali aggregate reactivity. Further, free lime and magnesia content was evaluated using XRD technique. Volumetric expansion study was also carried out to understand the potential expansion which may occur due presence of free lime and magnesia content in LD slag based fine aggregate. As explained in Annex E of IS 383: 2016 which specifies the process of sample preparation and methodology to determine volumetric expansion for coarse aggregate of a particular grading which is not directly applicable for fine aggregates. Therefore, in order to study the volumetric expansion in LD slag based fine aggregate, a suitable testing methodology was developed based upon maximum packing fraction in the test sample. The study was carried out at two w/c ratio (i.e. 0.65 and 0.40). Conventional fine aggregate was replaced by LD slag based fine aggregate at a replacement levels of 0, 25%, 50%, 75% and 100%. The concrete mixes were studied for different fresh, hardened and durability properties.

Fig: Processed LD slag as fine aggregate

Fig: XRD diffractogramme of powdered sample of processed LD slag

The physical and chemical properties of processed LD slag fine aggregate meet the various requirements specified in IS: 383-2016 except soundness (volumetric expansion due to free lime and magnesia). The hardened properties of concrete mixes containing different proportions of processed LD slag fine aggregates as replacement of conventional fine aggregates are either better or at least comparable to corresponding hardened properties of concrete mix made with conventional fine aggregates. Replacement of conventional fine aggregates with processed LD slag fine aggregates in a concrete mix does not have any negative or detrimental effect on the durability properties of concrete and the behavior of both control mixes and experimental mixes (containing processed LD slag as fine aggregate) are almost comparable and similar. Volumetric expansion studies for evaluation of potential expansion occurring due to presence of free lime and magnesia in LD slag fine aggregates showed that expansion in case of LD slag fine aggregate is in excess of 3% and is significantly higher than that of standard sand and commercially available crushed sand. Based on studies conducted on fresh, hardened and durability properties of concrete

mixes (by replacing conventional fine aggregates with processed LD slag fine aggregates), LD slag fine aggregate has been found suitable for its use as fine aggregate in reinforced cement concrete. However, suitable weathering techniques (for example: LD slag fine aggregate sample can be passed through a chamber of hot water for a certain duration of time) shall be adopted to bring down the free lime and magnesia content in processed LD slag fine aggregate for its wide application as fine aggregate in reinforced concrete structures.

- **Testing of Coarse Aggregate and Fine Aggregate Material for URI-I Stage-II HEP for M/s NHPC Limited**

  Physical testing of 19 coarse aggregate and 21 fine aggregate samples as per IS: 383 was carried out by NCB in this project which was sponsored by M/s NHPC Limited. All the coarse and fine aggregate samples were collected from 07 different sources. Further, petrographic and mineralogical analysis as per IS: 2386 Part-VIII, Accelerated mortar bar test as per ASTM C1260 and long term mortar bar test as per IS: 2386 Part-VII were also carried out for 07 coarse aggregate and 03 fine aggregate samples. Based on the results obtained, all the coarse and fine aggregate tested were found to be innocuous or non-reactive against alkali aggregate reactivity.

- **Performance Evaluation of Integral Crystalline Waterproofing Admixture in Concrete of M30 & M50 grade for Construction of Common Central Secretariat Integrated Buildings – 1, 2, & 3 at plot No. 137, New Delhi (Central Vista Project) for CPWD**

  NCB carried out performance evaluation of two different integral crystalline admixture products in M30 and M50 grade concrete as part of the prestigious Central Vista Project for CPWD. Concrete specimens of M30 and M50 grade, both with and without the addition of the integral crystalline admixtures in specified dosage, were cast using proportions based on mix design carried out previously in NCB. In order to test the performance of the integral crystalline admixtures, the samples were tested for parameters such as water penetration depth at the end of 4 cycles of application of 5 bar hydrostatic pressure and subsequent reduction in coefficient of water permeability w.r.t control specimens and water penetration depth under 16 bar hydrostatic pressure.

- **Testing of Coarse Aggregate prepared from Rock Samples (Physical Testing, Petrography and AAR Test) and water sample of Upper Siang Multipurpose Storage Project for M/s NHPC Limited**

  In this study, coarse aggregates were prepared from rock samples supplied by NHPC. These coarse aggregates were prepared using crushers available in NCB's Unit Operations Laboratory. The coarse aggregate samples thus **prepared**, were tested for physical properties as per IS: 383, petrographic

and mineralogical analysis as per IS: 2386 Part-VIII and alkali aggregate reactivity testing using Accelerated mortar bar test as per IS: ASTM C1260. Based on results obtained for 03 nos. coarse aggregate samples, the study concluded that all the coarse aggregate samples were found to be non-reactive or innocuous against alkali aggregate reactivity.

- **Studies on Thermal Properties of Mass Concrete in Luhri, H. E. Project for M/s Patel Engineering Limited**

  During the casting of mass concrete, there is a high cracking probability due to occurrence of temperature change between the inside and the outside of concrete structure. Thus, the thermal cracks produced may become the main cause of the deterioration of structural performance. To control the liberation of heat of hydration, study of thermal properties of mass concrete plays an important role in construction of mass concrete structures.

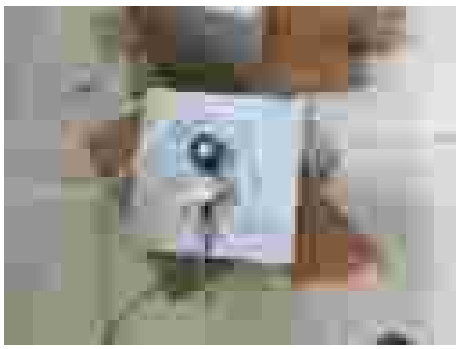


Fig: Evaluation of specific heat of concrete using TPS 500

  In view of the above, the proposed study was carried out by NCB for a concrete mix of grade M15 (maximum size of aggregate used was 150mm) and was sponsored by M/s Patel Engineering Limited. In this study, compressive strength test, test for Co-efficient of thermal expansion, specific heat, thermal conductivity and thermal diffusivity of concrete mix were performed using transient plane source method.

- **Physical Testing, Petrography, and AAR Testing of Coarse Aggregate Samples for Larsen & Toubro Limited**

  This project was sponsored by Larsen & Toubro Limited for the evaluation of 08 coarse aggregate samples for physical testing as per IS: 383, petrographic and mineralogical analysis as per IS: 2386 Part-VIII and Alkali Aggregate Reactivity using Accelerated mortar bar test as per IS: 2386 Part-VII. All the tested coarse aggregate samples were found to meet the physical requirement of IS: 383. All the coarse aggregate samples were found to be non-reactive against alkali aggregate reactivity as per accelerated mortar bar test results.

F. Some of the on-going R&D and sponsored projects

- **Study of Carbonation and Carbonation induced reinforcement corrosion in new cementitious system**

Use of Supplementary cementitious materials (SCMs) for construction activities has seen a surge for economic and environmental reasons. However, durability of RCC structures exposed to carbonation induced corrosion varies. SCMs like fly ash, slag, micro silica, limestone, etc., when used as partial replacement to OPC or ordinary Portland clinker give rise to distinct phase assemblage. Since type and amount of hydration products and their microstructure, mineralogy and morphology are somewhat different for different cement/cementitious system, the carbonation product, rate of carbonation and carbonation coefficients are also different. CO_2 in the atmosphere can cause carbonation of cement matrices. It then diffuses in gaseous form into the pore structure of concrete or mortar and dissolves, forming acids on contact with the interstitial solution contained in the cement paste. This phenomenon has the effect of lowering the pH of the medium and leading to the dissolution of the hydrates of the cement. Calcium hydroxide ($Ca(OH)_2$) is particularly affected. More commonly called portlandite, this hydrate plays a fundamental role in maintaining a high pH protecting the reinforcements of reinforced concrete or preventing the formation of microorganisms. When the portlandite has been completely consumed, or when it is no longer sufficiently accessible to regulate the pH by buffering effect, the medium becomes acidic, thus allowing corrosion of the reinforcements.

Most of the early studies have focused on determination of carbonation depth under accelerated environmental conditions for evaluating the performance of different cementitious systems. However, effect of carbonation and carbonation induced reinforcement corrosion under natural environmental conditions have not been dealt with explicitly. Studies on rate of corrosion due to carbonation during the propagation phase are very scarce. Effect of Relative humidity, temperature, rainy days or sunshine period over the propagation of carbonation and corrosion rate have also not been studied. Each SCM altogether gives rise to hydration products, pore solution chemistry as well as microstructural properties. Hence, the concrete resistivity and rate of corrosion due to carbonation during the propagation phase will be different. Therefore, this project aims to fill those research gaps & to study the microstructure of individual new cementitious systems that primarily correspond to low clinker cement.

The study investigates:

- Role of new cementitious systems or low carbon cement over mechanical and durability properties, especially carbonation.

- Role of new cementitious systems or low carbon cement over the progress of the carbonation front and corrosion rate.
- Role of various environmental parameters like Relative humidity, Temperature and alternative wetting and drying phenomenon over the progress of the carbonation front and corrosion rate.
- Relationship between laboratory studies with the field studies

In this study, new cementitious systems that are under investigation are as follows:

Composite Cement	OPC+ Fly Ash + GGBS
Portland Limestone Cement	OPC+ LS
Portland Composite Cement	OPC+ Fly Ash + LS
High Volume Fly Ash Cementitious System	OPC+ Fly ash
Portland Slag Composite	OPC + GGBS+ LS

LS= Limestone

The study is carried out at two w/c ratios of 0.40 and 0.60. Experiments were carried out in laboratory as well as in field conditions. Laboratory study (under accelerated environment) involves quantifying the effect of CO_2 concentration, Relative humidity and temperature on carbonation front whereas Field study (under normal environment) involves determination of various parameters like CO_2 concentration, No. of Rainy days / sunshine days, Relative humidity and Temperature that can influence the carbonation front and corrosion rate.

Study on composite cement has been completed and outcome of the study has been included in IS 16415. Study on Portland limestone cement (PLC) has also been completed. In the present research work, Portland limestone cement has been designed at 10 % and 15 % limestone content. The findings of the PLC study are as follows:

1. Minimum requirement of Fineness of the Limestone **= 600 m^2/kg**
2. Overall fineness of PLC blends ≥ **425 m^2/kg**

If all the above criteria are met, Performance of the concrete designed with PLC blends **(limestone content up to 15 %)** will be at par to that of concrete made with OPC.

The study conducted on high volume fly ash cement (HVFAC) where high volume fly ash cement has been designed at 40 % and 45 % fly ash

content shows that fineness of the cement blend has a significant effect on the mechanical and durability properties of the concrete. Concrete made with HVFAC blends (designed at a Blaine's Fineness in the range of 400-410 m^2/kg) containing 40 % fly ash content shows performance at par to the concrete made with Fly ash blend that contains 35 % fly ash designed at a Blaine's Fineness in the range of 300 m^2/kg. Higher fineness leads to some better microstructural properties that is quite evident from the test data. Therefore, it is suggested to have a Blaine's Fineness in the range of 400-410 m^2/kg and fly ash content 40 %, while using HVFAC for structural works.

Out of 124 concrete mixes, casting of all concrete mixes for different cementitious system such as composite cement, PLC and HVFAC has been completed while for the remaining cementitious systems study is under progress. For the field study, based upon climatic zones of India, Exposure classes for structures exposed to carbonation is being categorized into 4 (as proposed for revision of IS 456) and different locations have been selected accordingly, refer to below table.

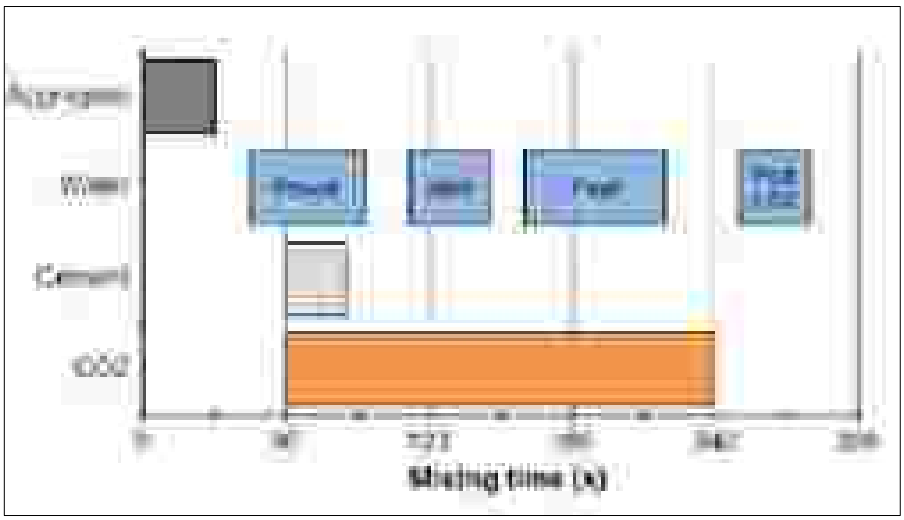
1. Hot and Dry Environment	
Ambuja Unit, Nagaur	
2. Warm humid and temperate Environment	
NCB Hyderabad NCB Bhubaneswar	
3. Composite Environment	
NCB Ballabgarh	
4. Coastal Environment	
JSW ltd, Khar Karavi	

- **Utilisation of CO_2 in Fresh Concrete and Study on Fresh and Hardened Properties of CO_2 induced Concrete**

Globally, cement sector generates about 7 percent of the total anthropogenic emissions. In India, the energy consumption and process emissions from cement industry contributed about 4.20% and 2.10% of the total Greenhouse Gas (GHG) emissions of 2531.10 million tonnes CO_2 equivalent in 2016 (Source: 3rd biennial update report of India to UNFCCC). Hon'ble Prime Minister Shri Narendra Modi Ji has announced a bold pledge that India will achieve Net-zero carbon emissions by 2070. Five Levers of De-carbonization of Cement Industry are (a) Substitution of Clinker (b) Alternate Fuel and Raw Materials (c) Waste Heat Recovery (d)

Improving Energy Efficiency and (e) Newer technologies like Renewable Energy, Novel Cements, Carbon Capture, Utilization & Storage (CCUS) Therefore, cement sector in India has an important role to achieve the committed climate targets. Global Cement and Concrete Association (GCCA), CEMBUREAU and Portland Cement Association (PCA) have announced roadmap to achieve Carbon Neutrality across the cement and concrete value chain by 2050 with major contribution from Carbon Capture and Utilization (CCU). Indian Cement Industry have already taken steps on four levers out of five identified in low carbon technology roadmap. However, to achieve the target of Net Zero, cement industry will have to go for implementation of CCU technologies.

In this area, NCB recently took up the R&D Project titled "Utilisation of CO_2 in Fresh Concrete and Study on Fresh and Hardened Properties of CO_2 induced Concrete". The project is scheduled to be completed by March 2025. The aim of the project is to study the potential of CO_2 utilisation in concrete and its effect on fresh and hardened properties of concrete. Accelerated carbonation of the cementitious phases of concrete is much more viable to contribute on a short term to mitigation of climate change than natural carbonation. A limited reaction time and effects on workability have been identified as challenges to overcome. It has been seen that a small dose of carbon dioxide could feasibly be used to provide performance benefits in concrete. Research includes not only the carbonation processes but also the properties in terms of hydration/carbonation mechanisms, concrete mix design, mixing sequence, mechanical properties and durability.



Schematic representation of batching and CO_2 injection sequence

G. Evaluation of new cementitious material and industrial bi-products for durable concrete structures

The construction industry, by its very nature, is a big user of natural resources. But with growing concerns over climate change and the finite nature of these resources, there is

increasing pressure on construction firms to reduce their environmental impact. Use of industrial waste or by-products as an aggregate or cementitious material provides solution to most of these environmental problems. Centre for Construction Development and research has been working on various research projects that aims to enhance the utilisation of different cementitious and industrial bi-products (such as BF slag, LD slag, ferrochrome slag, bottom ash, Electric Arc Furnace slag etc.) as one of the constituent materials in cement concrete as binder or aggregate. Such industrial waste or bi-products are evaluated for various physical, chemical, mineralogical and microstructural characteristics in order to understand and identify the area of its utilization (either as an aggregate (coarse or fine) or as a binder) as one of the component in cement concrete.

- **Evaluation of Activated GGBFS as an alternative to hydraulic binder for Tata Steel Limited**

  Alkali activated binders (AAB) are gaining huge research attention in recent years, due to their potential to totally be used in a zero-cement composite. Ordinary Portland cement (OPC) is characterized by high energy usage and carbon emission from its production process, which thus shows the need for AAB development. AABs are a sustainable replacement for OPC, as they can be produced from waste materials generated by various industrial processes. Granulated blast furnace slag (GGBS) which is a by-product generated during the production of pig iron has been used by cement industry in the manufacturing of Portland slag cement. Conventionally, GGBS is ground and converted to ground granulated blast furnace slag (GGBFS) which is further used as cementitious component to partially replace Ordinary Portland cement or Portland clinker for making the Portland Slag Cement (PSC). In line to the approach towards sustainability and net zero CO_2 emission, Tata Steel is working on improving the properties of GGBFS to enhance its application in cement and concrete applications. In that process, Tata Steel Limited has developed an activated binder which is a combination of GGBFS and alkalis. GGBFS is activated through a proprietary blend of alkaline chemicals developed at their indigenous laboratory.

  To assess the performance of their alkali activated GGBFS as a cement in concrete, Tata Steel Limited approached National Council for Cement and Building Materials (NCB) to carry out a sponsored R&D study on evaluation of activated GGBFS as an alternative to hydraulic binder. In this study, activated GGBFS binder was evaluated for its different physical and chemical characteristics as applicable for a hydraulic binder. Further, to assess its performance as a binder in concrete, concrete mixes were prepared at two water to binder ratios (i.e. 0.60 and 0.40) using activated GGBFS binder. The concrete mixes were evaluated for various fresh, hardened and durability properties of concrete and comparison was carried out with conventional concrete mixes, i.e., concrete made with OPC and Concrete made with PSC. Preliminary investigation shows that

compressive strength of activated GGBFS sample is lower than that of OPC 43 and PSC at all ages when tested in accordance to IS 4031. Compressive strength of concrete mixes at both water to binder ratios (i.e. w/c of 0.40 and 0.60) made using activated GGBFS binder are lower in comparison to compressive strength of mixes made using OPC 43 and PSC at all the ages. This can be attributed to the lower compressive strength of activated GGBFS as a cementitious binder itself in comparison to OPC 43 and PSC. Study on durability aspect of concrete made with activated GGBFS is under progress.

- **Study on the Use of Ferrochrome Slag as a Coarse Aggregate in Concrete for Ferro Alloys Corporation limited, a Vedanta Group company**

  Ferro Chrome Slag is a waste material obtained from the manufacturing units of ferrochromium (FeCr), which is used to increase the properties of steel such as resistance to corrosion, oxidation and to improve hardness, tensile strength at high temperatures, wear and abrasion resistance, etc. FeCr metal is produced in electric-arc furnaces by a physico-chemical process from the oxide of chromium ore with coke as the reducing agent at a temperature of about 1,500 °C. Both the molten FeCr and slag flow into the ladle. After gravity separation from the metal, the molten slag slowly cools in the air, forming a stable, dense, crystalline product. The colour of the ferrochrome slag varies from dark gray to light gray depending upon amount of carbon content. The density of the ferrochromium slag is between 2.5-2.8 g/cm^3 and that of ferrochrome 6.8 g/cm^3. Because of the presence of Fe and Mg, Ferrochrome slag exhibits relatively better specific gravity. The sponsor M/s Ferro Alloys Corporation limited, a Vedanta Group company had requested National Council for Cement and Building Materials (NCB) to take up a study on the Use of Ferrochrome Slag as a Coarse Aggregate in Concrete. The study includes characterization of the coarse aggregate made from ferrochrome slag for various physical and chemical parameters in accordance to IS 383 requirements. In addition, ferrochrome slag was also characterized for mineralogical as well as microstructural parameters through optical microscopy. Toxicity study was also carried out. Fresh, hardened and durability properties of the concrete made with ferrochrome slag based coarse aggregate at replacement level of 30%, 60 % and 100 % (by volume) was compared with concrete made with conventional aggregates. From the study, it can be concluded that ferrochrome slag based coarse aggregates can be used as a replacement to natural aggregates. Mechanical behaviour of concrete made with ferrochrome slag based coarse aggregates was found to be either equivalent or better than that of concrete made with natural coarse aggregates. Durability results shows equivalent or better performance of concrete made with ferrochrome slag based coarse aggregate than the concrete made with natural coarse aggregates

- **Evaluation of Granulated Blast Furnace Slag sand and study of its suitability to be used as fine aggregate for JSW Cement Limited**

Presently, the use of Granulated Blast Furnace slag (GBFS) based aggregate as replacement of both coarse and fine aggregate is limited to 50% in plain concrete, 25% in reinforced concrete and 100% in lean concrete. Taking into consideration, the possibility of increasing the current permissible limit of using GBFS sand by replacing conventional fine aggregate in concrete as specified in IS 383: 2016, NCB had conducted an experimental R&D study titled "Evaluation of Granulated Blast Furnace Slag sand as per IS 383: 2016 and study of its Suitability to be used as Fine Aggregate" which was sponsored by JSW Cement Limited. In this study, GBFS sand was evaluated for physical and chemical parameters as specified in IS 383: 2016. Optical microscopy and X-Ray Diffraction (XRD) technique were used for the study of Petrographic and mineralogical analysis of GBFS sand respectively. To study the alkali aggregate reactivity of GBFS sand, accelerated mortar bar test as per ASTM C1260 and long term mortar bar test as per IS 2386: Part-VII was performed. Thereafter, the concrete mixes were cast at three different water to cement ratios (i.e. 0.60, 0.40 and 0.30) by replacing conventional fine aggregate at replacement level of 0, 25%, 50%, 75% and 100% using GBFS sand and the concrete mixes were then evaluated for various fresh, hardened and durability properties of concrete.

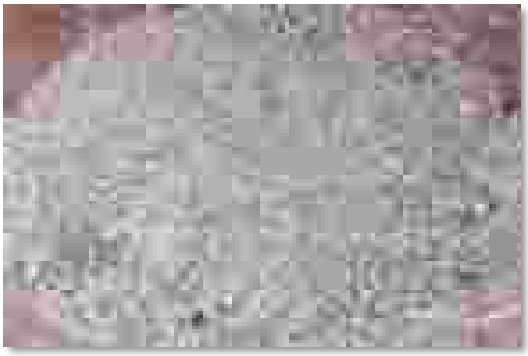


Fig: GBFS sand

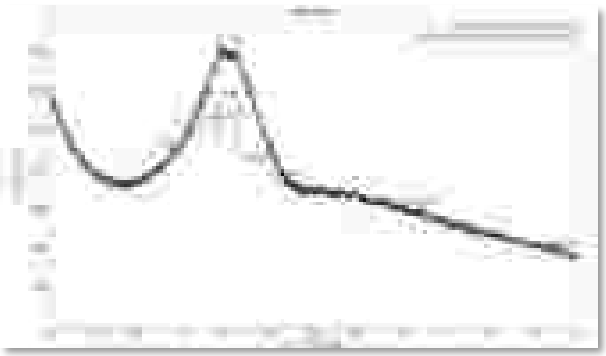


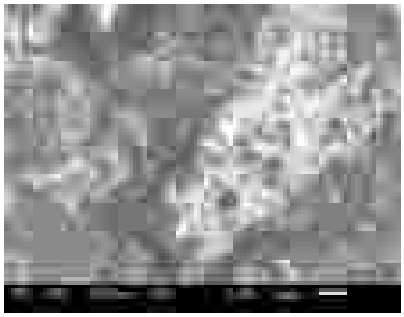
Fig: X-Ray Diffractogramme of powdered sample of GBFS sand

The physical and chemical properties of GBFS sand meets the various requirements specified table in IS: 383-2016 except alkali content which was found to be slightly higher than the permissible value. However, in particular, it did not have any adverse effect on volumetric change occurring in GBFS sand due to alkali aggregate reactivity as the expansion value was found to be less than 0.1 %. The properties of concrete made with GBFS sand was studied at 0, 25, 50, 75 and 100% replacement level of natural fine aggregate. The hardened properties of concrete mixes containing different proportions of GBFS sand fine aggregates as replacement of conventional fine aggregates are either better or at least comparable to corresponding hardened properties of concrete mix made with conventional fine aggregates. Replacement of conventional fine aggregates with GBFS sand as fine aggregate with up to 100% replacement in a concrete mix does not have any negative or detrimental effect on the durability properties of concrete and the behavior of experimental mixes (containing GBFS sand as fine aggregate) are either better or comparable to the control mixes.

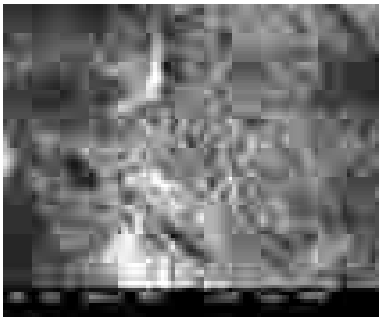
Structural Optimization & Design (SOD)

Studies on Mechanical and Time Dependent Properties of Ultra-High Performance Concrete

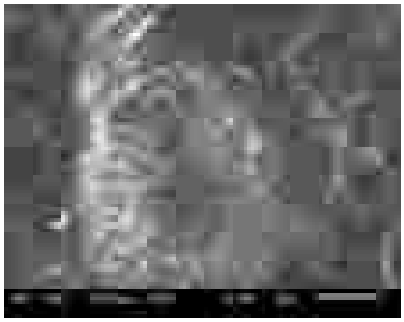
This project was the extension of project completed by NCB on development of guidelines on Ultra-High Performance Concrete wherein critical factors in achieving UHPC such as particle packing density, mixing criteria and curing regime, etc., was studied. This project covered the mechanical performance of very high strength concrete and ultra-high strength concrete with respect to stress-strain characteristics, modulus of elasticity, flexural strength, split tensile strength, fracture behaviour and time dependent properties such as creep and shrinkage. The performance of these very high grade concretes using steel fibers and performance of polypropylene fibers on fire resistance behaviour of these very high grade concrete was also studied. Currently, Indian Standard under revision covers concrete grade M100 and outcome of study will provide data for upgradation of the Indian Standard of design for higher grade concrete above M100. Study highlighted that ratio of compressive strength of steam curing to water curing for Ultra-High Strength concrete is 1.15 and ratio of compressive strength of autoclave curing to water curing for Ultra-High Strength concrete is 1.54. UHPC gives superior compressive strength after autoclaving and results indicates that ground quartz fine aggregate also contributed to the transformations of α-C_2SH to tobermorite structure which is desirable in order to achieve high compressive strength. The ratio of compressive strength of steam curing to water curing for normal strength concrete is 0.95 and ratio of compressive strength of autoclave curing to water curing for normal strength concrete is 1.06. Steam and autoclave curing accelerates the hydration of the cementitious materials and makes the distribution of hydration products uneven, and pore structure much coarser.



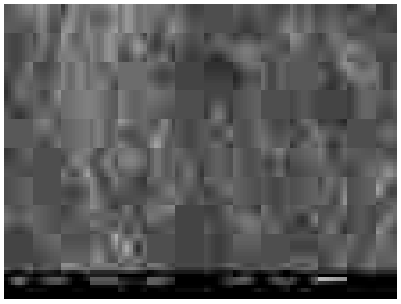
SEM images of water cured UHPC sample



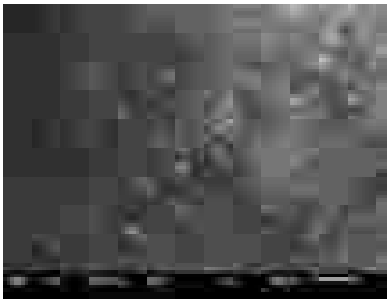
SEM images of Steam cured UHPC sample



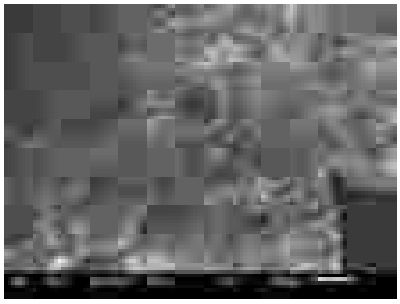
SEM images of Autoclave cured UHPC sample



SEM images of water cured NSC sample

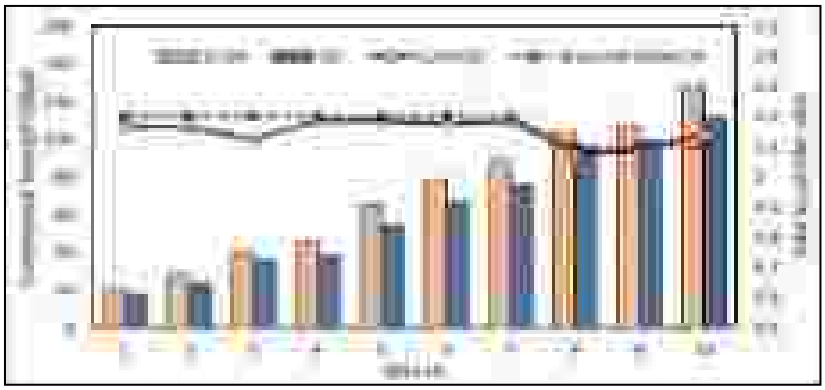


SEM images of Steam cured NSC sample



SEM images of Autoclave cured NSC sample

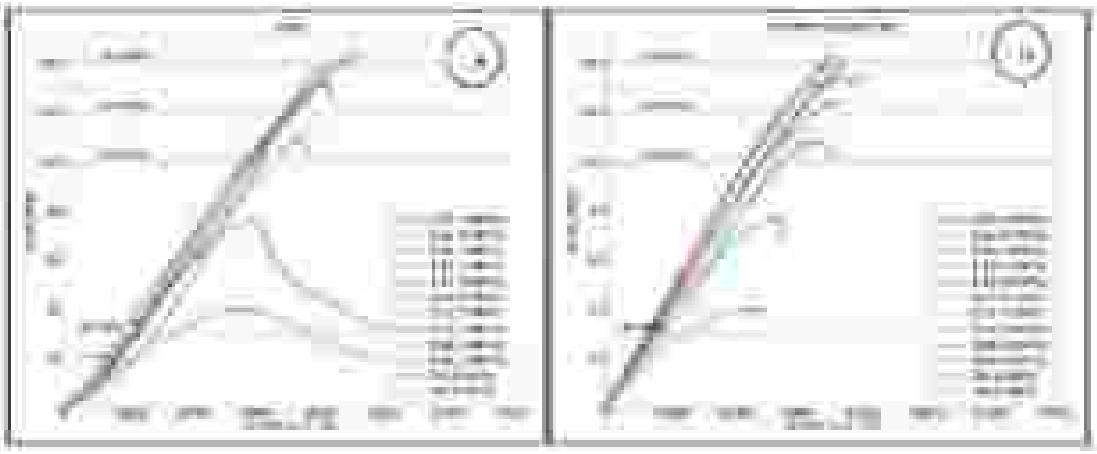
The size effect of the tested cube on the observed compressive strength of the concrete in compression testing has been studied and a conversion factor of 1.04 has been observed for the cubes of 100mm size and 150mm size for the compressive strength of 20 MPa to 120 MPa. From the results it can be concluded that there is negligible difference between the compressive strength recorded for 100 mm and 150 mm cubes for compressive strength up to 120 MPa. The current IS: 456 equation predicts the modulus of elasticity values more or less equal to the actual experimental values for normal strength concrete (upto compressive strength of 40 MPa) while it predicts higher modulus of elasticity value than the actual experimental values above compressive strength of 40 MPa including high strength concrete. Therefore, the current equation in IS: 456-2000 will not be applicable for higher grade and thus needs modification considering the high strength concrete.



Comparison of cube to cylinder compressive strength of 20-120 MPa strength

Test set-up for split tensile and flexural strength

The test results of split tensile strength are in good agreement with ACI 363R-10 report which claims that for lower strength concrete, tensile strength may go upto 10 % of compressive strength; however, for higher strength it reduces to about 5 % of compressive strength. Flexural Strength of concrete increases with addition of silica fume upto 15 percent and thereafter decreases or no major effect of silica fume addition is found. Silica fume seems to have a more pronounced effect on the flexural strength. Addition of steel fibers in concrete mix have different effects on the split and flexural tensile strength of the concrete. With the addition of steel fibers the split tensile strength increases marginally and the equation for the plain concrete can be used for predicting the approximate split tensile strength of fiber reinforced concrete also. The study indicates that the stress-block parameters which governs the flexural design of RC members needs modifications in existing standards by appropriately taking care of changes in shape factor and stress reduction factor which is depending upon the stress strain characteristics of ultra-high strength concrete wherein strain at peak stress and ultimate strain coincides. From the study it was seen that adding steel fiber tremendously increases the amount of energy needed for fracture of the beam. It also helps in arresting the cracks by increasing the characteristic length. But the formation of the initial crack is much more closely related to the grade of concrete as fiber action can only be observed after the onset of initial cracks.



Combined graphs for Strain (LVDT) vs stress and combined graphs for strain (Compressometer) vs stress

Based on the experimentally obtained creep and comparison of creep coefficients using B3 model, B-4 Model and FIB model code 2010, it was seen that all the three models seem to work well for normal strength concrete as the creep coefficients obtained using B3 model, FIB model code 2010 and B4 model are very close to experimentally obtained creep coefficients for normal strength concrete. However, the results indicate that experimentally obtained creep coefficients for high strength concrete and ultra-high performance concrete are lower in comparison to creep coefficients obtained using B3 and B4 model. Based on the comparison of experimental data of creep coefficient with all the models, it can be inferred that B3 and B4 model will not hold good for high strength concrete and ultra-high performance concrete. FIB model code 2010 seems to be reasonable for prediction of creep coefficients of normal, high strength concrete and ultra-high performance concrete.

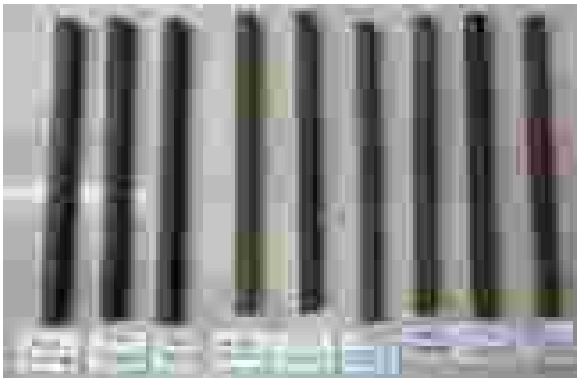
Creep Testing Arrangement for Ultra-High Performance Concrete

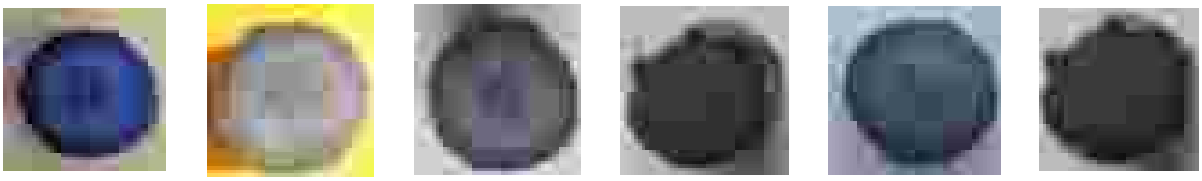
The impact of the addition of polypropylene fibers on concrete fire resistance at elevated temperatures was studied and no significant enhancement in mechanical properties like compressive strength and splitting tensile strength was observed upon addition of polypropylene fibers for High Strength Concrete. Hence, it is concluded that the addition of polypropylene is neither sustainable nor economical despite the various claims in past regarding its positive impact on fire resistance of normal strength concrete. However, the spalling resistance of the concrete at elevated temperature was improved by the addition of polypropylene fibers and the addition of an optimum percentage of fiber will be beneficial in the high strength concrete to avoid spalling. Based on the outcome of the study, the recommendations have been given for revision of Indian Standard IS: 456-2000 for incorporating polypropylene fibers mainly in high strength concrete to avoid spalling during the event of a fire which can lead to damage in cover concrete and thereby creating durability related issues during the service life of the structure.

Effect of Fire on the Residual Mechanical Properties of reinforcing bars and Structural Performance of Reinforced Concrete Beams in flexure & Shear.

Conventional fire design of reinforced concrete (RC) members typically aims at protecting the reinforcement from reaching temperatures above a critical value of around 500 °C for standard grades, by providing an appropriate concrete cover. Spalling of concrete can initiate at the temperatures as low as 250–300°C as a function of concrete porosity due to high water vapour pressure, in the form of a sudden detachment of concrete splinters. As concrete spalling occurs, the reinforcement bars are exposed directly to fire conditions, which may lead to significant loss in member strength. Current simplified approaches and design graphs do not yield reliable temperature predictions in rebar and concrete. Design graphs specified in international codes and standards such as ACI 216.1 and Eurocode 2 can be used to evaluate cross-

sectional temperatures. Reinforcement steel material properties in terms of full constitutive relationships are given in Eurocode 2, while a strength reduction factor for the yield strength is provided in ACI 216-1. In European guidelines, the stress-strain relationships are defined by three parameters: the slope of the linear elastic range, the proportional limit, the maximum stress level and corresponding strain levels. These are assigned with reduction factors as a function of temperature. Currently there is limited data for indigenously made reinforcing bars in India. Moreover, researches available in the context of sustained elevated temperature is scarce. The present research work aims to evaluate the effect of Fire on the Residual Mechanical Properties of reinforcing bars and Structural Performance of Reinforced Concrete Beams in flexure & Shear. In the present study, the effect of temperature on mechanical performance of reinforcing bars has been studied on six different brands of steel and four different commonly used diameters. The selection of reinforcing bars consists of bars from both primary and secondary manufacturers. TM-ring test method has been performed to check the Cross Sectional Phase Distribution (CSPD) of TMT/QST steel rebars.





Brand A **Brand B** **Brand C** **Brand D** **Brand E** **Brand F**

Cross sections of different brands of TMT bars obtained from Ring Test

The residual mechanical properties of reinforcing bars of different brands has been evaluated at 500°C, 750°C and 1000°C. The tensile strength, yield strength, percentage elongation, tensile strength to yield strength ratio is being compared with codal values and models available in literature for reinforcing bars exposed to elevated temperature. Effect of temperature on micro-structure of reinforcing bars is being studied for different brands. Microstructure of samples heated to beyond 750°C revealed that outer martensitic rim completely disappears and microstructure throughout the cross section gets transformed into ferrite and austenite. Further studies on different brands of steel at elevated temperature and its performance on flexure and shear behaviour have been planned.

Structural Assessment & Rehabilitation (SAR)

Under the umbrella of Structural Assessment and Rehabilitation Program, a wide range of activities related to assessment of new and existing concrete structures are carried out. These involve:

- Condition assessment of existing concrete structures including fire damaged concrete structures
- Investigation of material properties of hydraulic structures such as Dams
- Load Testing of RCC structures like bridges, underground RCC conduits, buildings, etc.
- Application of Non-Destructive Testing for conformity of quality and condition assessment of concrete structures
- Preparation of repair estimates including cost estimates and detailed schedule of items for repair and rehabilitation works
- Consultancy services involving quality inspection and third party quality assurance of repair and rehabilitation works of concrete structures
- Research & Development Projects on modern repair technologies

A. Condition Assessment & Non-Destructive Testing

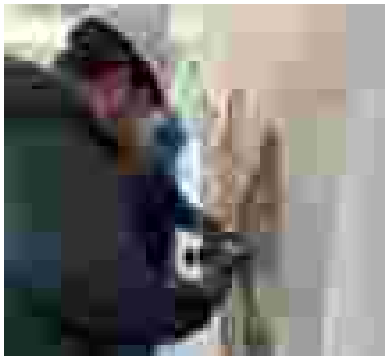
In-service structures, especially commercial, industrial and residential buildings, bridges, tunnels, dams, high-rise buildings, etc. require periodical assessment to ascertain whether they can perform satisfactorily for the intended service life. The distress in any form, such as cracks, spalling of concrete, corrosion of reinforcement, seepage, etc., not only disturbs the aesthetic appearance but also reduces the safety and integrity of the structures under use. For condition assessment of structures, investigations are done to figure out the root cause of distress and formulate effective strategies for repair & rehabilitation along with strengthening if required. The investigation process involves elaborate visual, information and documentation surveys, non-destructive evaluation techniques and collection of in-situ samples for further processing & testing at laboratory.

SAR program is well supported by a state-of-the-art non-destructive testing laboratory that has adequate facilities for carrying out Non-Destructive Testing and evaluation of concrete structures. The Non-Destructive Testing Lab has NABL accreditation and ISO 17025: 2017 certified test facilities for Ultrasonic Pulse Velocity Testing and Rebound Hammer Testing of Hardened Concrete. Besides this, the lab also has facilities for evaluation of other parameters such as Surface Electrical Resistivity of Concrete using Four-Point Wenner Probe method, Evaluation of Air Permeability of Cover Concrete using Torrent Air Permeability Tester, Pull-Off Tester to assess the adhesion of repair materials bonded to concrete substrates, Half-Cell Potential Test to assess the corrosion condition of embedded rebars, Electromagnetic rebar and concrete cover detector, concrete core extraction kits with high quality diamond concrete core bits of various diameters, portable crack width measurement microscope & DFT meter. UAV aided Infrared thermography camera can be helpful in accessing the tall RCC structures. All

these facilities are made use of extensively in non-destructive tests on new concrete structures for quality assessment as well as in condition assessment works of existing and aged structures. Besides this NCB also has facilities for chemical analysis (for evaluation of pH, Chlorides, Sulphates etc.) of hardened concrete samples collected from the site and testing of reinforcement bars. Corrosion of embedded reinforcement bars is the most widespread cause of the deterioration of reinforced concrete structures. NCB specializes in assessment of corrosion damaged reinforced concrete structures and providing cost effective solutions for their repair and rehabilitation. NCB also has adequate experience and testing infrastructure to carry out assessment of fire damaged structures. State of the art testing techniques such as Mercury Intrusion Porosimetry (MIP), Differential Thermal & Thermo-Gravimetric analysis (TG-DTA), X-Ray Diffraction (XRD) Analysis, Scanning Electron Microscopy (SEM) Imaging with elemental analysis, etc., are made use of in microstructural analysis of concrete from time to time to assess material properties of concrete in various kinds of structures like dams, bridges, etc. and also to assess the extent of fire damage and provide cost effective solutions for repair of damage caused due to fire.

Some of the photographs of the SAR projects monitored by NCB

Determination of load carrying capacity by Load Testing of railway over bridge as per IRC SP-37 in progress at a sponsored project site



Left: On-site inspection of a residential building of co-operative housing society in Faridabad

Right: Effectiveness of repair work being checked by Pull Off testing at GAIL Vihar Society Noida.

- **Preparation of detailed estimates for repair and rehabilitation works including detailed item specifications**

  SAR program offers services for preparation of detailed repair estimates including detailed item specifications for repair and rehabilitation works. This is done based upon the detailed condition assessment report on the subject structures. The detailed repair estimates are also supported by rate analysis of the non-schedule repair items.

- **Consultancy services of repair and rehabilitation works of concrete structures**

  SAR program offers consultancy services for quality inspection and quality assurance of ongoing repair and rehabilitation works. Sampling and testing of repair materials is done for source approval as well as intermediate quality checks on the input materials. Non-destructive tests are done at site for post repair quality inspection of repaired areas. On-site inspections are carried out during execution of repair and technical guidance is provided for effective implementation of repair methodology as per specifications.

B. On-Going R&D Project

Cathodic Protection to Enhance Service Life of New and Existing Concrete Structures

Normal patch repairs in corrosion damaged concrete often have lesser durability than expected as the reinforcement steel is within two chemically different environments. Cathodic protection addresses the problem of corrosion from the fundamental electrochemical aspects. Cathodic protection has the potential to offer a much greater increase in service life of corrosion affected reinforced concrete structures as compared to other methods such as coatings, sealers, corrosion inhibitors, etc. Currently following mentioned three cathodic protection systems are widely used:

- Sacrificial anode cathodic protection system (SACP)
- Impressed current cathodic protection (ICCP)
- Hybrid System

SACP systems typically have a shorter design life (15-20 years) relative to ICCP systems. However, they have significantly lower design, installation and monitoring costs compared to ICCP systems. ICCP systems are complex and require proper maintenance of its constituent parts. Some international standards (ISO, EN, Norwegian) on cathodic protection systems in reinforced concrete structures are available. However, at present, no Indian standards on the use of these systems in reinforced concrete exist. Further, the available data in international literature on the performance of these systems in different cementitious systems is scant. In the current phase of the project, only discrete sacrificial anode based cathodic protection is being studied.

The objective of the project is:

- To evaluate the performance of discrete sacrificial anodes in enhancing the service life of reinforced concrete.
- To evaluate the effectiveness of discrete sacrificial anodes in different cementitious systems.
- To come out with guidelines on the use and monitoring of sacrificial anodes in reinforced concrete.
- To frame specifications for best practice on the use of sacrificial anodes in reinforced concrete.

Experimental Phase

The experimental part of the project has been bifurcated into two phases, *"Laboratory Study"* and *"Field Study"*. The laboratory studies will be done on specimens cast with different cementitious systems. The following systems are being used:

OPC, OPC+Fly Ash, OPC + GGBS, OPC + Fly Ash + GGBS

Discrete Sacrificial Anodes from two manufacturers are being used. Parameters such as corrosion rate, corrosion current density, Half-Cell Potential of embedded reinforcement/Potential of steel w.r.t reference electrode of stable voltage, electrical resistivity will be monitored before and after installation of anodes on a periodic basis.

Laboratory Study

The laboratory study is being done for the following different cementitious systems:

S. No	OPC (%)	Flyash (%)	GGBS (%)
1	100	0	0
2	70	30	0
3	65	35	0
4	60	40	0
5	50	50	0
6	50	0	50
7	40	35	25
8	50	25	25

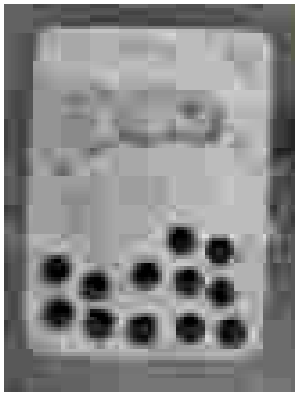
Slab specimens have been cast to carry out the experimental measurements. The above specimens have been cast with a w/c ratio of 0.60. For study under carbonation induced corrosion, specimens were cast and kept in carbonation chamber to allow the carbonation depth to reach up to or beyond the level of reinforcement. Once the Carbonation depth of the specimens reached up to or beyond the level of reinforcement, the specimens were subjected to an environment of above 90% RH to allow the corrosion rate to stabilize in the propagation phase. After stabilization of the corrosion rate, the anodes will be installed and the electrochemical measurements before and after

installation of anodes will be compared to assess the effectiveness of the anodes in the different cementitious systems.

For laboratory study under chloride induced corrosion, specimens are being subjected to alternate wetting by ponding with 3% NaCl solution on one face and subsequent drying. Each wetting and drying cycle is of 14 days. Specimens are being kept in an environment of 50±5% RH. Anodes will be installed and the electrochemical measurements before and after installation of anodes will be compared to assess the effectiveness of the anodes in the different cementitious systems. To study the effectiveness of sacrificial anodes w.r.t preventing corrosion from initiating, slab specimens are being cast with admixed chlorides using w/c ratios of 0.55 & 0.40. The chemical properties of the activation mortar of the anodes are also being studied, in particular the pH as the Zinc needs a highly alkaline or acidic pH to be active and function properly.

Concrete slab specimens selected for installation of anodes w.r.t Laboratory Study Under Carbonation Induced Corrosion

Concrete slab specimens selected for installation of anodes w.r.t Laboratory Study Under Chloride Induced Corrosion



Preparation of specimens for installation of anodes

Field Study

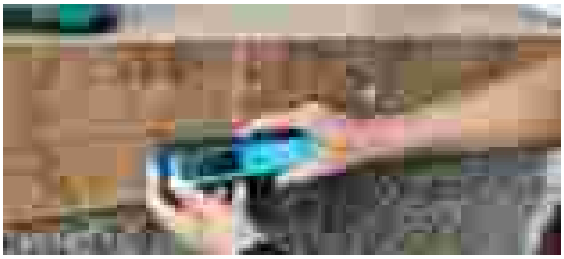
Field study under chloride induced corrosion is being done through ongoing sponsored projects where Chlorides have been found to be in excess throughout the entire concrete mass and have been found to be the main cause of corrosion damage. A sponsored project involving TPQA of repair & rehabilitation of a multi storied residential building, where chloride induced corrosion has been found to root cause of distress has been selected for field study. Few experimental columns have been identified for installation

and further monitoring of sacrificial anodes. Damaged concrete has been chipped for further repair and installation of sacrificial anodes

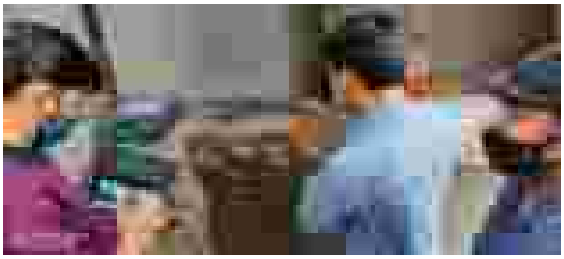
Chipping completed in a selected column at a project site

Monitoring junction box assembled for periodic monitoring of performance of anodes

Field study under carbonation induced corrosion is being done through locations identified in NCB premises where carbonation depth has reached up to the level of reinforcement. Some locations in NCB premises have been identified where the carbonation depth has gone beyond the level of outer layer of reinforcement steel. Damaged concrete has been chipped for carrying out patch repair and installation of sacrificial anodes. Some locations have been identified where corrosion has initiated but cracking has not occurred. Along with the installation of anodes at site, monitoring of the performance of the installed sacrificial anodes will be done using monitoring junction boxes. Such monitoring boxes have been assembled in-house by the project team at NCB to facilitate this work.



Measurement of surface electrical resistivity on an identified beam in NCB premises

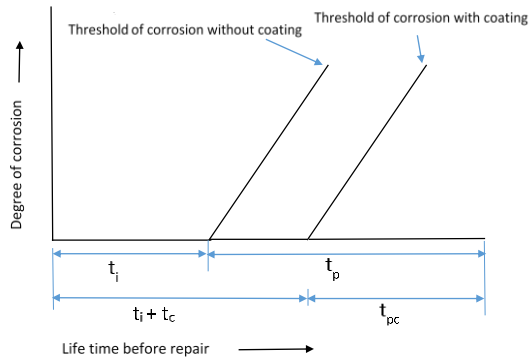


Measurement of Half-Cell Potentials of reinforcement on an identified beam in NCB premises

Evaluation of Concrete Surface Coatings for their effectiveness in service life enhancement of RCC elements under: Carbonation induced corrosion & Chloride Induced Corrosion

The aim of the study is to evaluate performance of coating in delaying corrosion in the embedded reinforcement under (a) carbonation induced corrosion environment and (b) chloride induced corrosion environment. The expected modification in Tutti service life

model for corrosion in RCC members by application of protective coating is shown as below.



Based on the literature survey, it is envisaged to carry out the experimental study on five types of coatings. The identified six coatings will be as follows:

i. Epoxy resin
ii. Polyurethane resin
iii. Acrylic resin
iv. Polymer Solution
v. Polymer modified cement composition

Performance Evaluation of Coatings under different types of environmental conditions:

a) **Carbonation:** Study will be done on uncoated control samples and coated concrete/mortar samples made with OPC & PPC which will be subjected to accelerated carbonation test. The uncoated & coated samples shall be maintained in an environment with a relative humidity of more than 90% to allow the corrosion of embedded steel. For carbonation induced corrosion environment, ingress of CO_2, oxygen and moisture have to be restricted, therefore following properties will be evaluated:

- Resistance to CO2 ingress will be measured through Accelerated Carbonation Resistance Test
- Carbonation induced corrosion rate measurement by Half-cell Potential, Electrical Resistivity & Linear Polarization Resistance.
- The transport properties will be evaluated by Water Vapor Permeability/Diffusion test, Air Permeability test and Water Absorption test.

b) **Chloride ingress:** For studying the effectiveness of coatings for preventing corrosion due to external chloride ingress, uncoated and coated samples of concrete/mortar made with OPC & PPC will be used. The study will be done on both samples, i.e., samples cast with admixed chloride and plain concrete samples subjected to alternate wetting (using 3% NaCl solution) and drying

cycles. For ingressed chloride induced corrosion environment, ingress of chloride, Oxygen and Moisture have to restricted, therefore following properties will be evaluated:

- The transport properties will be evaluated by water permeability/diffusion test and water absorption test.
- Durability properties will be evaluated by chloride ponding test & RCPT.
- Chloride induced corrosion rate measurement by Half-cell potential, electrical resistivity & Linear Polarization resistance.

c) **Inbuilt chloride:** For in-built chloride induced corrosion environment, ingress of Oxygen and Moisture have to restricted, therefore following properties will be evaluated:

- The transport properties will be evaluated by water permeability/diffusion test, air permeability test and water absorption test.
- Chloride induced corrosion rate measurement by Half-cell potential, electrical resistivity & Linear Polarization resistance

C. Sponsored Projects Undertaken

NCB carried out a large number of sponsored project works involving structural health and condition assessment of concrete structures, Non-Destructive Testing of concrete structures, quality assurance services of ongoing repair works in the year 2022-2023. Our clientele included reputed Organisations like NTPC, PGCIL, NHPC, NHAI, RBI, BHEL, GAIL, NBCC, AIIMS, CPWD, DDA (New Delhi), IPGCL, MCD, BSES, WBPDCL, THDC. 30 sponsored projects were completed during the year 2022-2023. Some of the major projects executed during the year 2022-2023 are listed below:

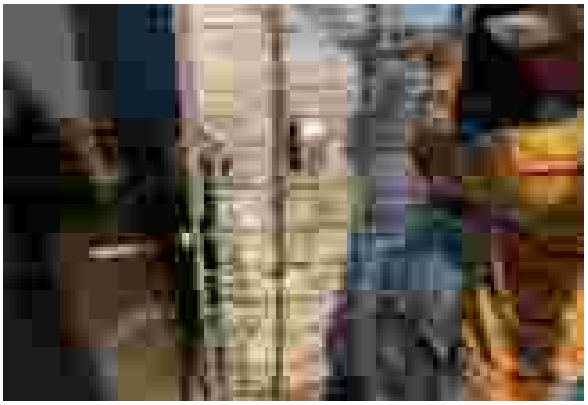
- Condition Assessment of RCC Buildings of Township at NTPC Gadarwara, Madhya Pradesh:
- This project involved the detailed condition assessment of RCC buildings of township area at NTPC Gadarwara, Madhya Pradesh. Based on the assessment carried out, effective scheme of repair & rehabilitation was recommended.
- Random quality inspection on site visit basis for the work of repair and restoration/strengthening measures of gas plant cooling tower No. 2 RCC structures at NTPC Dadri
- Condition assessment of New Ward building (G+5 storied) of RML Hospital, New Delhi.
- Condition Assessment of Residential Buildings of Thermal Colony, Sector-23, Faridabad.
- Extraction of concrete cores & their testing at NCB lab for Foundation of 400 kV Khetri- Bhiwadi Transmission Line
- Condition Assessment of existing Emergency Block building at Medical College, Alwar, Rajasthan

- Carrying out Concrete Core Extraction & Testing at four different locations (Jind, Saharanpur, Dadri & Kirti Nagar) of Central Warehousing Corporation.
- Condition Assessment of RCC members of stilt floor and peripheral RCC members of Building Envelope of Residential Towers of Vaish Group Housing Society (GHS) Apartments at Sector-45, Faridabad.
- Third Party Quality Inspection services during execution of repair & strengthening works of RCC Structures at Gail Vihar, Noida
- Condition Assessment of various structures at NTPC-SSTPS" (Singrauli Super Thermal Power Station).
- Condition Assessment of Old Press Colony Type II Quarters (Total 180 quarters) and Type I Quarters (Total 232 quarters, excluding quarter nos. 201-216) at Faridabad.
- Random Quality Inspection during execution of repair work of distressed RCC members of Residential Accommodation for NHAI staff at Pocket B-5 Sector-17, Dwarka, New Delhi.
- Detailed Condition assessment of TYPE-II Residential Quarters (Pocket 1 to IV, 2115 Nos.) in Lodhi Road Complex Area, New Delhi
- Condition Assessment of RCC Chimneys of Unit#4 & 5 at Kolaghat Thermal Power Station of West Bengal Power Development Corporation)
- Condition Assessment of RCC Deck Slab & Column of TG Foundation Unit#1 at NTPC Farakka.

Some of the photographs of the project sites and the site assessment work done by NCB team in various projects are given below:

Project site of Condition Assessment of RCC Chimneys of Kolaghat Thermal Power Station, West Bengal PDCL.

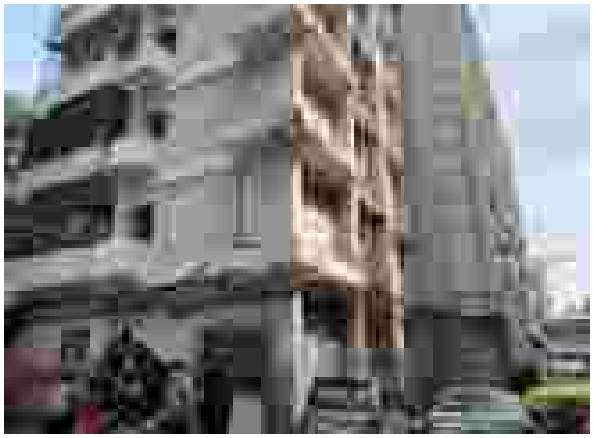
Random Quality Inspection during repair at NHAI Residential Enclave at Dwarka, New Delhi



Continuity testing being done after installation of Zinc anodes at site of NHAI Residential Enclave at Dwarka, New Delhi

UPV Test on TG Deck Slab at a power plant project site in Uttar Pradesh

Air Permeability Test on the slab of a building structure in Delhi



Project site of condition assessment work at RML Hospital New Delhi

Carbonation depth being measured on freshly extracted concrete core at a Hospital Building site

Measurement of existing rebar diameter of an RCC member at a Building site in Delhi

Construction Technology and Management (CTM)

National Council for Cement and Building Materials (NCB) provides Third Party Quality Assurance and Audit consultancy for a wide range of construction projects such as buildings, convention centres, flyovers, dams, barrage, concrete roads, bridges and tunnels, construction utility projects, special construction activities like pre-engineered steel structures, etc., built by the various central / state / autonomous organizations across India through the NCB units located at Ballabhgarh, Hyderabad, Ahmedabad and Bhubaneswar. NCB uses state-of-the-art techniques / methods to perform inspections that reduces risk and ensures quality of construction. NCB provides its clients with independent and impartial services that enable them to identify, manage and reduce risk in quality of construction. Consultancy is given in form of transparent and unbiased inspection, testing and verification of remedial measures undertaken during construction so that customers can achieve assurance in their products, processes, systems and services.

The scope of Third Party Quality Assurance / Audit includes inspections, lifting and testing of samples, witness of field and laboratory testing done at site / fabrication yard, review of quality system and documents including Non-Destructive Testing (NDT) wherever applicable. NCB devices proper plan of quality audit of input materials, checks on plants / machinery, workmanship during various stages of construction and finished products. The inspections of works are carried out at different stages to check the quality of construction and its compliance to drawing / design / technical requirements / specification. Regular check on quality of materials and its compliance with the specifications are done through sampling & testing of materials as per relevant standards / specifications. Inspection of Pre-engineered sections at fabrication yard / factory are done at specified frequency to check quality of production. Inspection of batch mix plant / RMC plant are frequently done to ensure calibrations and effective production process during concrete mix preparation as per approved mix design.

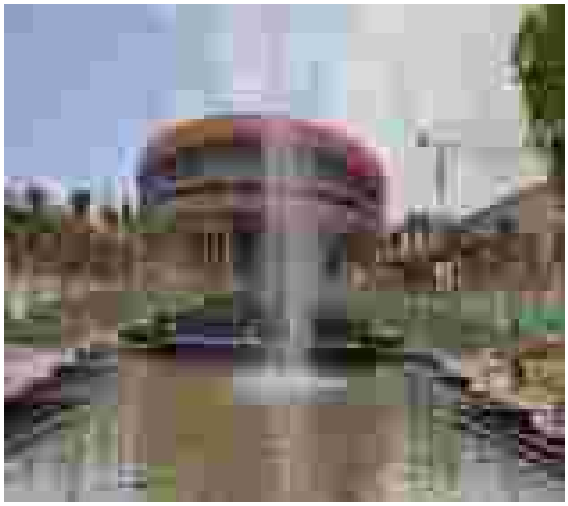
Necessary advice for quality improvement are provided during inspection. NCB provides necessary technical support during the progress / completion of work and gives its recommendations with respect to the discrepancies found at time of inspection including the corrective measures / remedies so that discrepancies can be rectified / re-done. Review / audit for regular quality control is also covered under the scope for which all the test reports, RMC batch mix printouts, Manufacture's Test Certificates (MTC), test register of input materials etc. are made available by the department at site for review. Periodical audit report (generally every week/ fortnightly / monthly are submitted containing observations on inspections, construction methodology, material testing, review of quality system and NDT. However, major non-conformances observed and also for non-conforming materials, intimation are given during site inspection itself for immediate compliance. The material testing under Third Party checking generally varies from project to project as per agreed terms and conditions. The testing for special items like concrete pipes, DG sets, bearings, pre-stressing wires, pre-engineered sections, etc., are witnessed jointly at manufacturer's production unit.

Prestigious projects of national importance have been awarded to NCB by Indian Trade Promotion Organization, India International Convention Centre, Central Public Works Department (CPWD), State PWDs, All India Institute of Medical Sciences (AIIMS), Delhi Development Authority (DDA), Uttrakhand Jal Vidyut Nigam Limited, Municipal Corporation of Delhi (MCD), Lala Lajpat Rai University of Veterinary and Animal Sciences (LUVAS), Odisha Industrial Infrastructure Development Corporation (IDCO), State Trade Promotion Organization's in Karnataka & Tamilnadu, Sports Authority of Gujrat (SAG), etc. The centre continues to provide specialized services in the area of quality assurance/control and thereby contributing to the durable and sustainable infrastructure in India.

Some of the photographs of the TPQA projects monitored by NCB

General Pool Residential Accommodation at Kasturba Nagar, Delhi

General Pool Residential Accommodation at Thyagraj Nagar, Delhi



Convention centre and halls of Indian Trade Promotion Organisation, Pragati Maidan, Delhi

Convention centre and exhibition halls of India International Convention Centre, Dwarka, Delhi

Girls Hostel at Indian Agriculture Research Institute, Pusa, Delhi

Type V staff quarter at Indian Agriculture Research Institute, Pusa, Delhi

College of Dairy Sciences and Technology at Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana

Residential Block Buildings at Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana

Hostel Block Buildings at Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana

Development and evaluation of Reinforced Geopolymer Concrete for its mechanical and durability properties

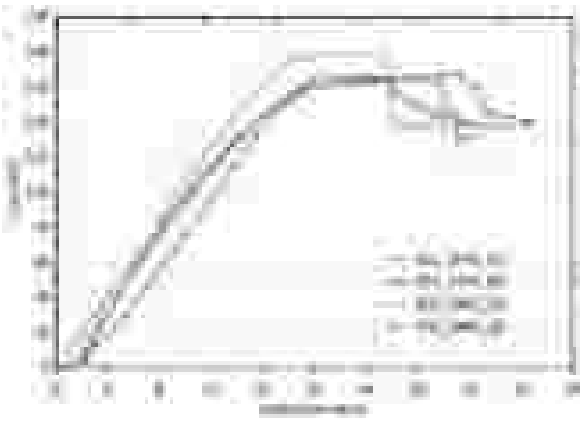
Geopolymer concrete is seen as an alternative to the conventional OPC based concrete. The geopolymer concrete uses industrial mineral waste like fly ash and Ground Granulated Blast Furnace (GGBS) as a binder material in concrete. In the present study around 60 mix trials were conducted for development of normal and high strength geopolymer concrete mix with varying proportion of GGBS and fly ash (GGBS: fly ash as 70:30, 50:50 and 30:70), by varying the total Na_2O (% by weight of total cementitious binder) from 5% to 9% and keeping activator modulus (ratio of SiO_2 and Na_2O) as 1 and varying water to binder ratio to achieve mixes of required strength and desired level of workability.

In present study, Sodium Hydroxide (NaOH) and Sodium Silicate (Na_2SiO_3) were used as chemical activators for development of normal and high strength geopolymer concrete mixes. The finalised geopolymer concrete mixes were evaluated for fresh properties of concrete (slump and air content) along with mechanical properties of hardened concrete such as compressive strength, flexural strength, split tensile strength, Modulus of elasticity, drying shrinkage, etc. Performance of geopolymeric concrete mixes was also evaluated for their long term durability behaviour in terms of

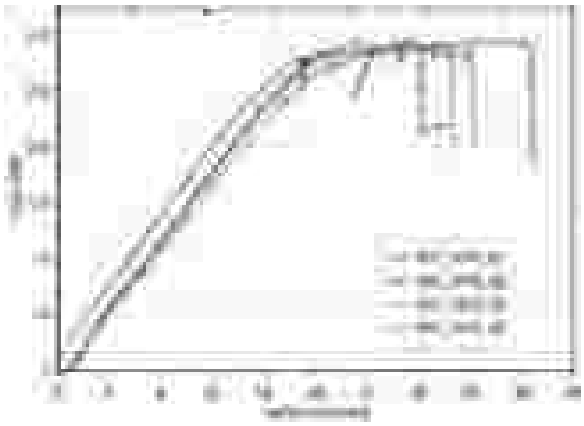
accelerated carbonation, rapid chloride penetration test, chloride diffusion, water permeability, abrasion resistance, sorptivity etc. Reinforced geopolymer concrete beams (both normal and high strength) were cast to study their behaviour in flexure and shear to analyse its failure pattern, ductility, yield moment, crack propagation characteristics, deflection, load at maximum deflection, etc.

Geopolymer concrete achieves similar and comparable compressive strength as in case of conventional concrete at lower precursor content in comparison to total cementitious content required in case of conventional concrete mixes. The modulus of elasticity of geopolymer concrete is lower than the conventional concrete of equivalent compressive strength. The split and flexural strength of geopolymer and OPC based concrete of comparable compressive strength were observed to be similar for normal strength grade i.e. M40 grade. However, in case of high strength mixes, conventional mix showed higher flexural strength in comparison to geopolymer concrete mix. Increase in flexural and split tensile strength of high strength conventional concrete is higher by 10-15% as compared to that of geopolymer concrete. This can be attributed to presence of 10-12% silica fume in high strength conventional concrete mix.

The flexural performance of conventional and geopolymer concrete was observed to be comparable in 4-point bend test. The strength characteristics in terms of yield load and yield moment capacities were also comparable. This suggests that reinforced conventional and geopolymer concrete of equivalent compressive strength behave similarly in flexure. The normalized yield strength as a percent of ultimate strength varies from 95 to 100 percent, this shows that beams are not undergoing strain hardening. The values of normalized yield deflection to ultimate displacement is in the range between 55 to 75 percent, from this it can be said that beams follow inelastic behavior for very long time after the yield points. The load deflection curves of both the conventional and geopolymer concrete are similar suggesting no significant variation in the shear capacity of different concrete systems for same structural design and comparable compressive strength. Shear strength of reinforced geopolymer concrete beams increases with increase in grade of concrete but were slightly less than conventional concrete where all parameters of structural design were kept constant.



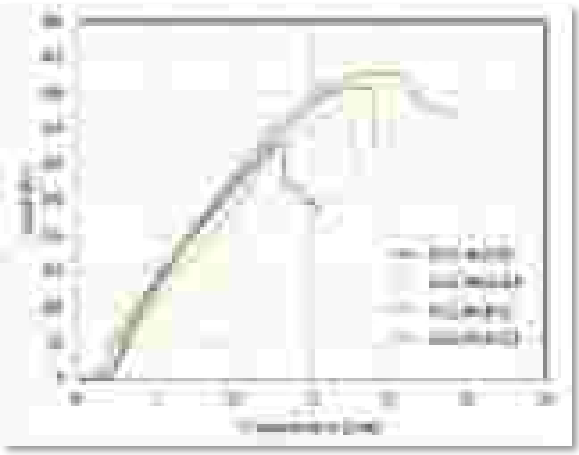
Load deflection curves for M40 RCC and RGC beams in flexure



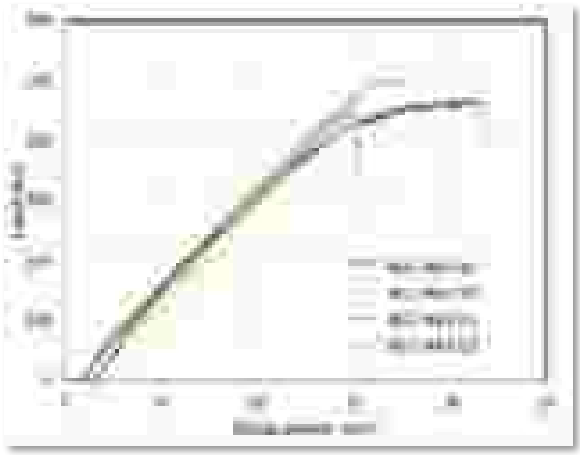
Load deflection curves for M70 grade RCC and RGC beams in flexure

Crack patterns in flexure for M40 RCC and RGC beams & M70 RCC and RGC beams

The specimens behaved linearly from the initial loading up to the occurrence of the damage. Beams hit peak load and collapsed in brittle manner with a sharp decrease in shear strength. The crack patterns, crack width and number of cracks are more or less similar for both conventional as well as geopolymer reinforced concrete beams.



Load displacement curves for M40 RCC and RGC beams in shear



Load displacement curves for M60 grade RCC and RGC beams in shear

Load deflection relationship and shear strength of the geopolymer concrete beams were comparable with the conventional concrete beams, but the cracking load corresponding to the allowable maximum crack width decreases in the geopolymer concrete beams. The measured experimental ultimate shear strength of tested beams for both conventional and geopolymer reinforced concrete beams is higher than that of design code equations of IS:456-200 and Eurocode EC-2: 2004

The carbonation depth and corrosion rate results of both geopolymer concrete mixes are observed to be similar and comparable to each other. Values of corrosion rate of rebar in OPC based concrete mixes of equivalent strength grade generally varies in the range of 0.010 to 0.030 mm/year. The corrosion rate values of rebar in geopolymer concrete mixes are observed to be comparable to corrosion rate of rebar in OPC based concrete mixes of equivalent strength grade. Values of Chloride diffusion coefficient for both the geopolymer mixes are almost similar. For conventional OPC based concrete mixes of equivalent strength grade, values of Chloride diffusion coefficient vary in the

range of 200 to 300 mm^2/year. Based on experimental results, it can be observed that values of chloride diffusion coefficient for both the geopolymer mixes are lower in comparison to that of conventional OPC based concrete mixes of similar strength grade, as both the geopolymer mixes have high proportion of slag in binder.

Laboratory Facilities

The followings are the laboratory facilities available in CDR centre to support the R&D and Sponsored Projects

1. Mechanical & Physical Properties Investigation (MPI)
2. Non-destructive Testing (NDT)

1. Mechanical and Physical Properties Investigation (MPI) Laboratory

Mechanical and Physical Investigation (MPI) laboratory is the part of center for research and development (CDR) department. It is an NABL accredited testing laboratory in accordance with the ISO/IEC 17025:2017 procedures in the field of mechanical investigation (Test Certificate No.-5296) of construction materials. The Lab has structured quality management system (QMS) and conducts frequent internal and external assessments to ensure consistent reliable laboratory results.

This lab has wide range of specialized testing facilities for conducting research. Related to R&D studies. Lab has various state of the art facilities for the study of behaviour of hardened concrete.

- **State of the art facilities**
  - Displacement Controlled Compression Testing Machine-3000kN
  - Displacement Controlled Flexural Testing Machine- 300kN
  - Chloride Ion Penetrability Testing Equipment
  - Corrosion Rate Analyzer
  - Universal Testing Machine – 1000kN
  - Mercury Intrusion Porosimetry Equipment
  - BET Apparatus for Surface Area Determination
  - Tri-axial Shear Strength of Concrete-500kN
  - Data Loggers for Recording Data Coming from various Sensors
  - Water Permeability Testing Equipment
  - Carbonation Chambers
  - Creep testing machine
  - Electrochemical Impedance spectroscopy (EIS) equipment
  - Under water abrasion testing machine
  - Long column testing compression machine

- **MPI activities**

  - Mechanical Testing of Building Materials such as Hydraulic Cement, Aggregates, Fly Ash, Bricks, Steel Bar, Ceramic Tiles, Vitrified Tiles, Cement Concrete Flooring Tiles, Autoclaved Aerated Blocks, Corrosion Inhibitor, Fresh Concrete, epoxy, latex & Hardened Concrete.
  - Determination of Alkali Aggregate Reactivity: Alkali Silica Reactivity & Alkali Carbonate Reactivity.
  - Admixture Testing.
  - Concrete Mix Design.
  - Soil Testing includes Grading, Optimum Moisture Content, CBR Test, Liquid Limit & Plastic Limit Test.
  - Fineness of cementitious and pozzolanic materials such as microfine OPC, ultrafine GGBFS, silica fume etc. by BET apparatus, etc.
  - Steel fiber testing

- **Mechanical Tests**

  - Modulus of elasticity and Poisson's ratio
  - Stress-strain characteristics
  - Fracture behaviour of beam
  - Dry and wet abrasion of concrete
  - Confined compression of concrete and rock
  - Creep and fatigue test
  - Checking the behaviour of reinforced concrete by testing of beams and columns

- **Durability tests based upon transport mechanisms and other tests**

  - Migration/ Conduction: RCPT, NT Build 492, Florida method
  - Diffusion: chloride diffusion/ ponding, accelerated carbonation (Laboratory as well as field study)
  - Sorption: sorptivity
  - Penetration: permeability, volume of permeable voids
  - Microstructure: mercury intrusion porosimetery
  - Chloride induced corrosion: polarizing resistance as per ASTM G3, LPR, EIS
  - Ingress of sulphate: sulphate immersion test, mass loss test
  - Various other corrosion related test such as long term chloride induced corrosion test for admixture as per ASTM G109/ ASTM C1582.

Apart from the testing facilities for construction materials, laboratory has also provided demonstration and training to various groups from esteemed organisation such as Bureau of Indian Standards (BIS), DMRC, NHPC, etc., and to recognized cement industry and also to many recognized academic institutions under various training programs.

Corrosion Rate using Electrochemical Impedance Spectroscopy

Initial Surface Absorption Test Facility

Salt Spray Chamber

Column testing machine for checking behaviour of reinforced column

Universal testing machine- 1000kN for testing of reinforcement steel

Strain Controlled Flexural Testing Machine for determination of flexural toughness of concrete

Water penetration testing for concrete

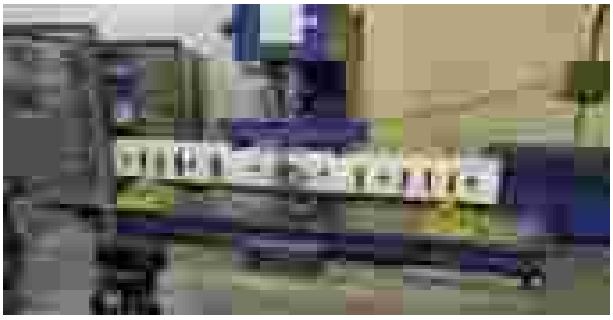
Mercury Intrusion Porosity equipment for checking porosity of concrete

Rapid chloride penetration testing (RCPT) of concrete

Accelerated corrosion testing (Florida method) of concrete

Steel fiber testing

Testing for determination of Silt content of sand



Flexural testing machine- 500kN for testing reinforced beam

Physical testing of Coarse aggregate (Abrasion testing)

Steel fiber testing

Cementitious Materials in BET Fineness Observations

Hardened Concrete Sample Accelerated Carbonation Observation

Initial Surface Absorption Test on Hardened Concrete Samples

Hardened Concrete Sample CREEP Observation

2. Non-Destructive Testing (NDT)

Non-Destructive Testing laboratory is equipped with latest state-of-art Non-Destructive testing equipments. The laboratory has NABL accreditation as per ISO 17025-2017 for UPV Testing and Rebound Hammer testing. The laboratory serves as platform in the Centre for Construction Development and Research for various sponsored projects and R&D projects. The skilled technicians in the laboratory are trained on regular basis to ensure safety during testing and to deliver accurate processed outputs. All the instruments and devices are regularly calibrated and checked to ensure quality of the test results.

The facility has following equipments:

- Ultrasonic Pulse Velocity (UPV) Tester for estimating quality of concrete, crack depth, etc.
- Schmidt Rebound Hammers (L-Type, P-Type, N-Type & M-Type) for obtaining indicative measure of the compressive strength of concrete.
- Half Cell Potential Measurement (Cu-CuSO4 based) for assessing the corrosion status of reinforcement bars.
- Concrete Cover Meter for locating reinforcement bars and measuring concrete cover depth
- Concrete Core extraction kit with diamond core bits of various diameters (25mm, 60mm, 75mm, 100mm, 120mm, 300mm) for cutting and extracting concrete cores.
- Electrical Resistivity meter based on Wenner 4-probe method.
- Air permeability tester.
- Crack width measurement by portable crack width measurement microscope
- Pull-Off tester.
- Coating thickness meter.
- Carbonation testing on concrete.
- CO_2 Analyser.

UPV Tester

Rebound Hammer

Half Cell Potential Measurement Kit

Concrete Cover Meter

Concrete Core Extraction Kit

Electrical Resistivity Tester

Air Permeability Test Kit

Pull Off Tester

Dry Film Thickness Meter

Portable Crack Width Observer

Centre for Quality Management, Standards and Calibration Services – (CQC)

The activities of the Centre for Quality Management, Standards and Calibration Services were organised under four programmes: Standard Reference Materials, Calibration Services, Interlaboratory Services and Total Quality Management. These activities address all aspects of Quality Management and provide the entire range of Standardization and Calibration services to cement industry, R&D institutions, Concrete and allied building materials laboratories in India and abroad.

Standard Reference Materials

NCB's SRM programme is accredited under ISO 17034:2016 as Reference Material Producers. NCB has developed Certified Reference Materials (CRMs) in the areas of cement, building materials and solid fuels (coal and pet coke). NCB's CRMs have been quoted in IS 4031(Part-2), IS 4031(Part-15) and IS 1727.

In addition, 18 Bhartiya Nirdeshak Dravyas (BNDs), the Indian Certified Reference Materials (CRMs) were developed in collaboration with CSIR-National Physical Laboratory (NPL), NMI of India. It is intended to be used for calibration of equipment, evaluating proficiency of analysts and evaluating/comparing various test methods etc.

BNDs would play key role in maintaining the quality infrastructure of the economy through testing and calibration with precise measurements which are traceable to SI units. These BNDs will give a boost to "Make in India" programme & harmonize the quality infrastructure of the country and fulfilling the mission of "***Atmanirbhar Bharat***".

The following BNDs are commercially available:

Sl. No.	BND No.	Material Description	Parameters
1	5001	OPC - (Lower Range) (Fineness : 250 - 300 m^2/kg)	Blaine's fineness & Specific gravity
2	5021	OPC - (Middle Range) (Fineness : 320 - 360 m^2/kg)	Blaine's fineness & Specific gravity
3	5011	OPC - (higher Range) (Fineness : 400 - 450 m^2/kg)	Blaine's fineness & Specific gravity
4	5002	PPC (Fineness : 200 - 500 m^2/kg)	Blaine's fineness & Specific gravity
5	5003	PSC (Fineness : 200 - 500 m^2/kg)	Blaine's fineness & Specific gravity
6	5006	Composite cement (Fineness : 200 - 500 m^2/kg)	Blaine's fineness & Specific gravity
7	5007	WPC (Fineness : 200 - 500 m^2/kg)	Blaine's fineness & Specific gravity
8	5004	Fly ash (Fineness : 200 - 500 m^2/kg)	Blaine's fineness & Specific gravity

9	5051	OPC	LOI, SiO_2, Fe_2O_3, Al_2O_3, CaO, MgO, Mn_2O_3, TiO_2, SO_3, IR, Na_2O, K_2O & Cl
10	5052	PPC	LOI, MgO, SO_3, IR, Na_2O, K_2O & Cl
11	5053	PSC	LOI, SiO_2, Fe_2O_3, Al_2O_3, CaO, MgO, Mn_2O_3, TiO_2, P_2O_5, SO_3, Na_2O, K_2O, Cl, Sulphur & IR
12	5055	Composite cement	LOI, SiO_2, Fe_2O_3, Al_2O_3, CaO, MgO,SO_3, IR, Na_2O, K_2O & Cl
13	5054	Fly ash	LOI, SiO_2, Fe_2O_3, Al_2O_3, CaO, MgO, SO_3, Cl, Na_2O & K_2O
14	5056	Limestone	LOI, SiO_2, Fe_2O_3, Al_2O_3, CaO, MgO,Mn_2O_3, TiO_2, P_2O_5, Na_2O, K_2O, SO_3 & Cl
15	5057	Raw Meal	LOI, SiO_2, Fe_2O_3, Al_2O_3, CaO, MgO, SO_3, Na_2O, K_2O, Cl, Mn_2O_3 & TiO_2
16	5058	Clinker	LOI, SiO_2, Fe_2O_3, Al_2O_3, CaO, MgO, SO_3, Na_2O, K_2O, Cl, Mn_2O_3 & TiO_2
17	5091	Coal	Ash content, Volatile matter, Sulphur & Calorific value (values based on dried basis)
18	5059	GGBFS	GOl, SiO_2, Fe_2O_3, Al_2O_3, CaO, MgO,SO_3, IR, Na_2O, K_2O, TiO_2, Mn_2O_3 & Sulphide sulphur

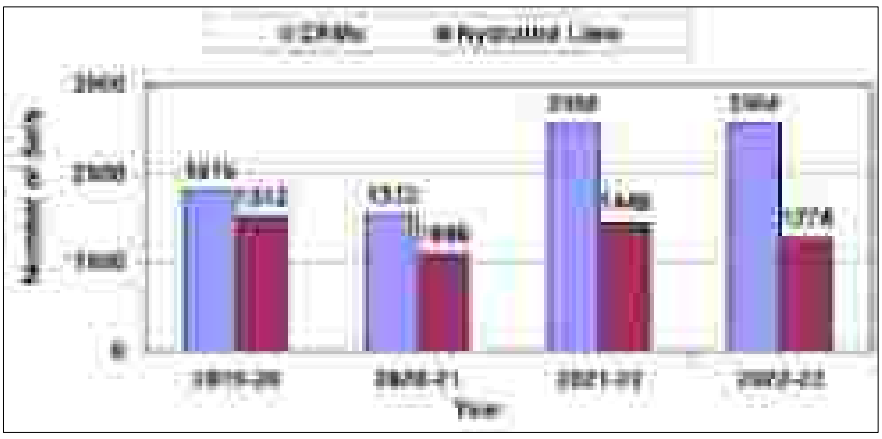
The following RMs/CRMs are also commercially available:

Sl. No.	RMs/CRMs No.	Material Description	Parameters
1	CRM 1010	Hydrated Lime (for LR test)	CaO, MgO, SiO_2 & IR
2	CRM 1042	Pet coke	Ash content, Volatile matter, Sulphur & Calorific value
3	CRM 1040	Silica Fume	LOI, SiO_2, Na_2O, & K_2O
4	CRM 1007	Gypsum	Combined water, SiO_2 +Acid insoluble, Fe_2O_3+Al_2O_3, CaO, MgO, SO_3 & Cl (as NaCl)
5	CRM 1013	White Portland Cement	LOI, SiO_2, Fe_2O_3, Al_2O_3, CaO, MgO, SO_3, Na_2O, K_2O & Cl
6	CRM 1002	Granulated Blast Furnace Slag	Blaine's fineness & Specific gravity

7	CRM 1002G	Ordinary Portland Cement	Residue on 45 µm sieve (wet sieving)
8	CRM 1011	Clay	LOI, SiO_2, Fe_2O_3, Al_2O_3, CaO, MgO, Na_2O, K_2O, TiO_2, P_2O_5, Mn_2O_3
9	CRM 1002D	Calcined Clay Pozzolana	Blaine's fineness & Specific gravity
10	CRM 1045	Bauxite	LOI, SiO_2, Fe_2O_3, Al_2O_3, CaO, MgO, Na_2O, K_2O, Cl, TiO_2, Mn_2O_3, P2O5
11	CRM 1044	Iron Ore	SiO_2, Fe_2O_3, Al_2O_3, CaO, MgO, Na_2O & K_2O
12	CRM 1037	Fly ash	ROS: 45 µm (wet sieving)
13	CRM 1036	Ordinary Portland Cement	Residue on 90 µm (Dry Sieving)
14	RM 1041	Red Ochre	SiO_2, Fe_2O_3, Al_2O_3 & CaO
15	RM 1039	Laterite	SiO_2, Fe_2O_3, Al_2O_3, CaO, MgO, SO_3, Na_2O & K_2O

NCB's CRMs are being used in India by almost all cement & construction, cement plants, commercial lab, educational institutes etc. and SAARC countries (Nepal, Bhutan, Bangladesh, Sri Lanka etc.) and Middle east country etc.

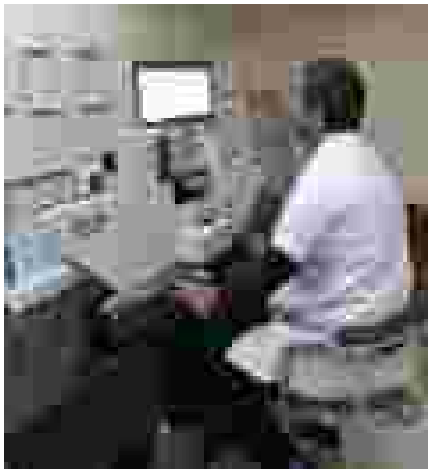
During the year, total 2,564 units of different CRMs and 1,274 sets of standard lime were supplied to 997 customers of cement plants, testing laboratories, public sector undertakings, R&D institutions including Nepal, Bhutan, UAE etc. The sale records for the past four years is represented in graph below.



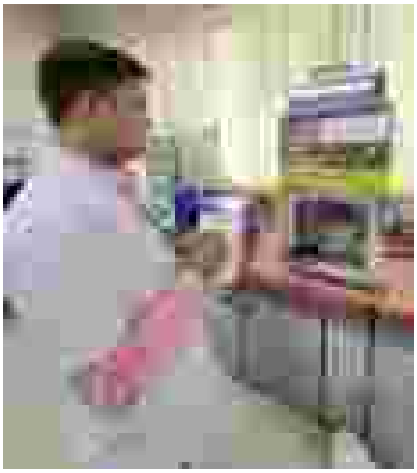
Calibration Services

The calibration laboratories of the center are state of art, equipped with the sophisticated equipment and facilities. The laboratories constantly strive to improve accuracies and uncertainties of measurement of existing calibration facilities and also expand the scope of calibration activities.

The laboratories have acquired sophisticated equipment like Dry Block Calibrator, Temp and Humidity Calibrator, Force Proving Instruments, Universal Length Machines etc. The laboratories are in advance stages of procuring equipment to provide state-of-the –art facilities in the fields of Mass Metrology, High Temperature Metrology, Force Metrology etc.



Length Measuring Machine (LMM)



Calibration of RH Indicator

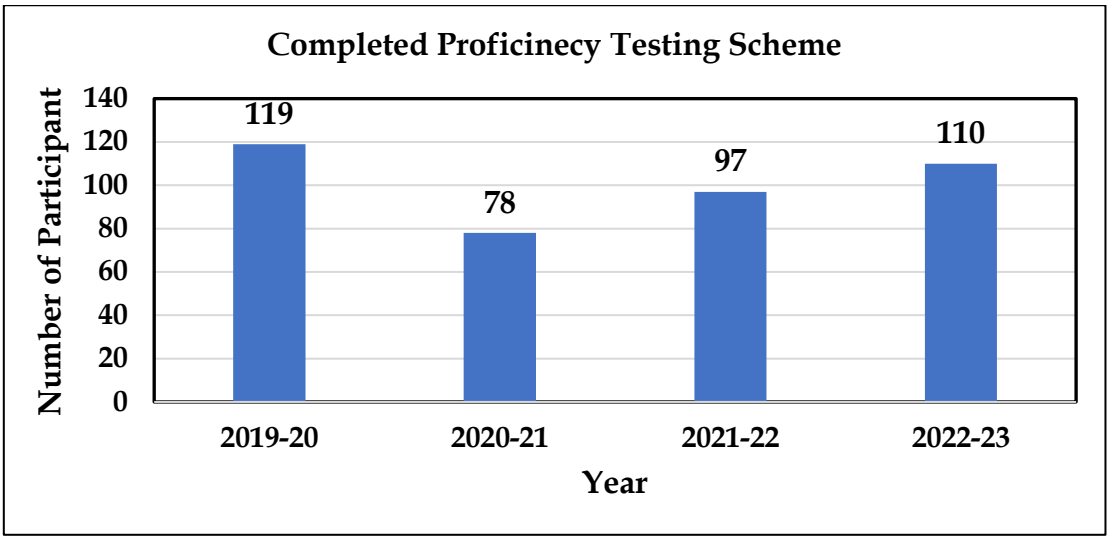
The calibration laboratories are accredited as per ISO/IEC 17025:2017 in the fields of force, pressure, temperature & humidity, dimension, mass & volume and RPM. More than 1500 equipment/instrument including Proving ring, Compression testing machine, Vibrating machine, Dial gauge, Blaine cell, Weights, Glassware, Pressure gauge, Test sieve, Liquid in glass thermometer, Environmental chambers, Hot air oven, Muffle furnace, Weighing balance, Rebound hammer etc. were calibrated at NCB's testing laboratories and at customer's site. The calibration services are being provided to various Central Govt., State Govt., PSUs, Cement & Construction Industries and have shown remarkable growth.

It is pertinent to mention that 96% customers rated our services as excellent in the last financial year.

Interlaboratory Services

NCB's Interlaboratory Services (ILS) is accredited under ISO/IEC 17043:2010, thus NCB is first accredited PT provider in India.

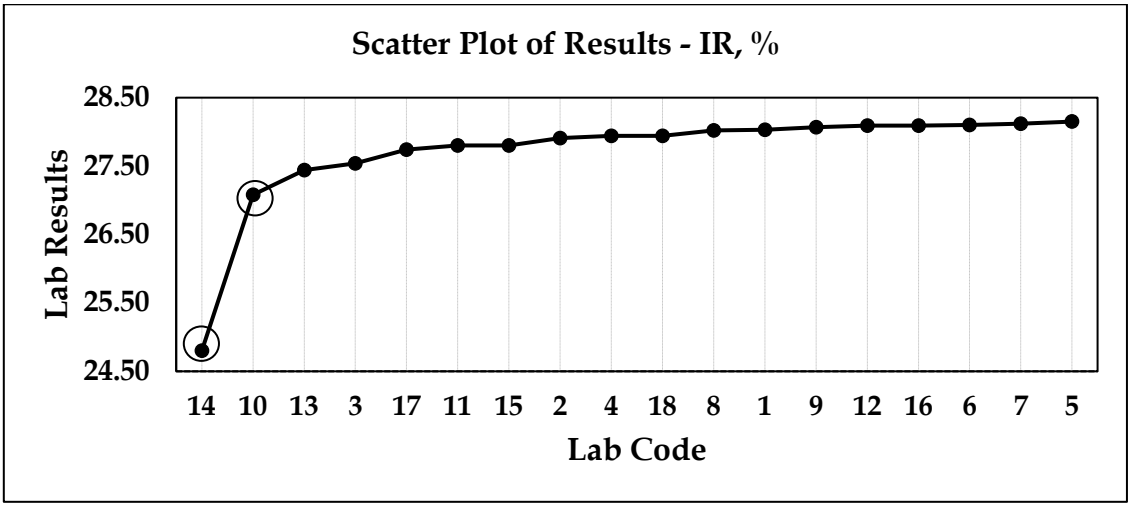
The present scope of accreditation covers: limestone, clinker, cement, fly ash, concrete admixture, water for concrete & coal/coke/pet coke in chemical field and cement, fly ash, aggregate, mortar/concrete, tile (ceramic), burnt clay building brick & steel bar in mechanical field. In 2022-23, NCB completed 11 PT schemes. The participants were mainly from reputed private laboratories, cement plants, govt. laboratories, public sector laboratories etc. No of laboratories participated in the Proficiency testing for the past three years is given in the graph below:



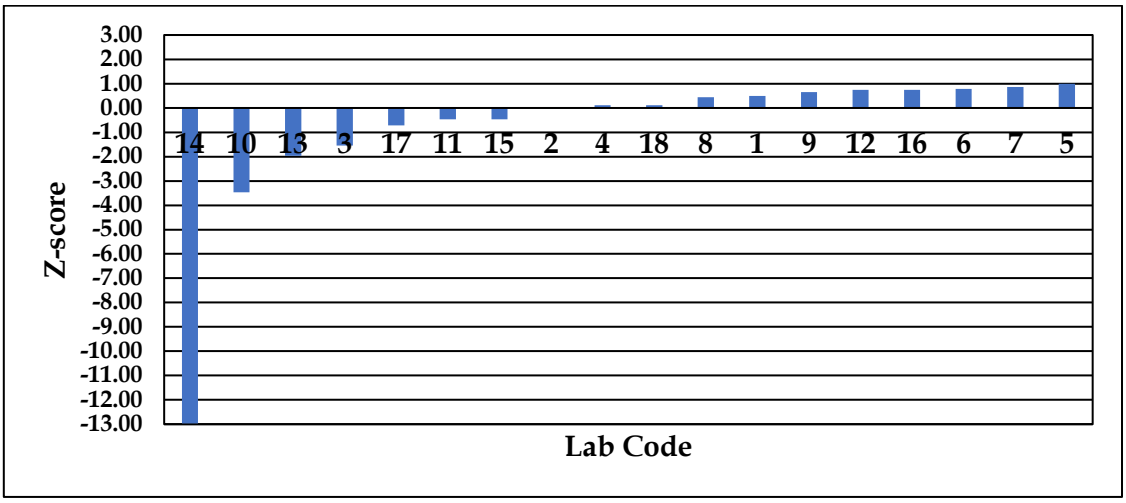
The participating laboratories were provided homogenized samples of PT items for testing in their laboratories. The test data reported by the laboratories were statistically evaluated for central tendency, spread and Z-score. The robust average and standard uncertainty for each parameter were calculated after normalizing the data as per ISO 13528:2015(E). Laboratories were evaluated on the basis of Z-Scores based on robust average and robust standard deviation.

Z-scores/Z'-scores for all the parameters in all schemes were calculated on the basis of results provided by the participant laboratories. As per the above standard, performance of the laboratories with $|Z| \leq 2.0$ is considered satisfactory. The laboratories getting $|Z| \geq 3.0$ are considered outliers and those getting $2.0 < |Z| < 3.0$ score are considered questionable performers. Outliers are encountered due to lack of statistical control and increase in variation in data.

Data received from the laboratories were studied for distribution and scatter. Out of 11 PT schemes, example for PPC-Chemical is illustrated here as under. The scatter of results in PPC-Chemical scheme show presence of bias. In the scatter plot of results, code number of the outlier laboratory (Lab code: 14 & 10) is mentioned along with the data point. Outlier's performers are put in circle. The scatter of results for Insoluble Residue (IR) test of PPC-Chemical is shown in the following figures:



Scatter Plot of Test Results – IR (%) of PPC-Chemical (ILS/PT/85)



Bar Chart of Laboratory Performance for Sample – IR (%)

Total Quality Management

This programme for Total Quality Management is providing various consultancy services on Quality Management to cement plants academic institutions laboratories, R&D organizations in India.

During the year, renewal of certification audit of Quality Management System based on ISO 9001:2015 of NCB was successfully carried out. The scope of certification covers the three units (NCB-Ballabgarh, NCB-Hyderabad and NCB-Ahmedabad).

This programme also provides services on ISO 17025, ISO 17034, and ISO 17043 Quality Management System in getting accreditation for the laboratories.

Completed project during the year:

1. Quality Audit as per ISO/IEC 17025:2017 at M/s Star Cement Limited (Guwahati Grinding Unit), Sonapur, Assam – 782 402 - (SP No. 6483)

2. Consultancy Services for assistance in getting NABL Accreditation as per ISO /IEC 17025:2017 for Mechanical and Chemical Testing Laboratories of J K Lakshmi Cement Ltd, Durg, C.G. – (SP 6246)

3. 3 Day training workshop as per ISO/IEC 17025:2017 at M/s Star Cement Ltd., Lumshnong, Meghalaya – 793 210 - (SP 6484)

Visit of NCB officials to J K Lakshmi Cement Ltd, Durg, C.G.

Visit of NCB officials to M/s Star Cement Ltd., Lumshnong, Meghalaya

Projects under progress:

1. Assistance for getting NABL accreditation as per ISO/IEC 17025:2017 for Quality Control Laboratory of M/s Star Cement Limited, Lumshnong, Meghalaya – 7936 210 - (SP No. 6485)

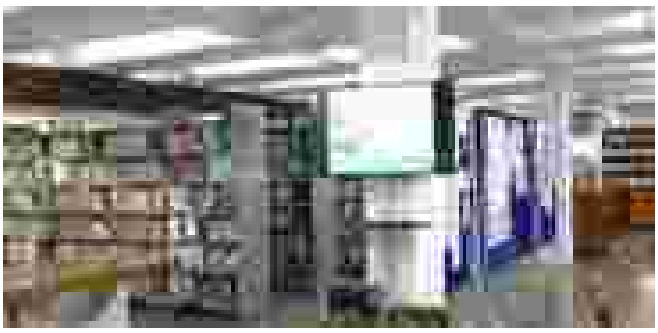
2. Assistance for getting NABL accreditation as per ISO/IEC 17025:2017 for Quality Control Laboratory of M/s Star Cement Limited (Siliguri Grinding Unit), Distt. Jalpaiguri, West Bengal – 735 102 - (SP No. 6486)

Centre for Industrial Information Services – (CIS)

The Centre pursued its activities through six programmes viz. Library, Integrated IT Solutions, Publications & Image Building, Seminars and Conferences, International and National Linkages, and Technical Insight. CIS collects and disseminates information to cement, building materials and construction industries. Besides other facilities, the Centre includes a modern library and a computer centre.

Library

NCB Library at Ballabgarh Unit serves as the national information centre for cement, building materials and construction industries. The holdings of the library have grown to 47,013 documents. The library has a bibliographic data base consisting of about 44,260 entries derived from the journals received. NCB scientists as well as cement plants and other user industries utilize it for interactive searches. A library automation system called 'LIBSYS' is being used for maintaining the library operations. The system is user-friendly and compatible to network communication.



NCB Ballabgarh Library

Memberships of Indian and Overseas professional institutions, as listed below, were served.

MEMBERSHIP	
Indian	**Overseas**
• Indian Roads Congress (IRC), New Delhi	• Precast/ Pre-stressed Concrete Institute (PCI), USA

Integrated IT Solutions

There are number of IT services offered by the CIS that connect our NCB's business and help it operate with integrity and maximum efficiency. Many of these technology services help employees to perform their duties on the job or to interact with others. Some common types of access services are E-mail services. Technical teams are also responsible for maintaining hardware and upgrading computers, modems or routers to support productivity and performance, hardware installations and maintenance, internet bandwidth management, maintaining anti-virus software.

Teams that offer these services often guide users through the process of resolving technical errors or recommend further steps to take, such as sending the IT equipment for repairs. Technical service support is provided remotely to site users, online/offline webinars, workshops and international conferences. Maintaining the NCB Intranet services through internal forms and formats for regular internal use.

The Website, www.ncbindia.com was uploaded with promotional information about NCB's activities done from time-to-time catering the following services:

- Revamping of NCCBM website as per the GIGW compliance, E- request forms for our internal organizational IT Services (E- request forms available on our Intranet platform)
- Maintaining the contacts database of different sections of cement industry, academia's and machinery suppliers, etc.
- Assistance in organisation of 17th NCB International Conference, Training Courses and quality related schemes. Further, workshops and webinars have been organized in the areas of Total Quality Management (TQM), Low Carbon Cements and Carbon Capture & Utilization and Renewable Energy.
- Uploading of employment updates, RTI related documents and other uploading requests received from various Centre's / departments time to time.
- Maintenance of hardware and software for whole of the institute.
- Efforts are being made for implementation of e Office in the institute, a Mission Mode Project (MMP) under the National e- Governance Programme of the Government of India.
- Bulk e-mailing services was continued for promotional information of 17th NCB International Conference on Cement, Concrete and Building Materials, held on 06-09 December 2022 at Manekshaw Centre, New Delhi.
- Use of social media platform for uploading latest information & activities of the institute.

Publications & Image Building (PIB)

Publications:

Information on technologies and services of NCB is disseminated through NCB Publications regularly. Efforts to widely popularize and promote NCB activities, technology and consultancy services amongst the cement and related building materials industries were continued.

The following publications were designed and printed during the year 2022-23:

- Conference Proceedings
- Compendium titled "The Cement Industry-India 2022"
- Alternate Fuels – A Green Solution for Indian Cement Industry
- Guide Norms for the Cement Industry
- NCB Annual Report 2021-22 in English and Hindi versions separately
- Special Newsletter
- Hindi Darpan

- Report on Achieving Circular Economy in Gypsum
- NCB Centre Brochure
- Other materials related to 17th NCB International Conference like Bulletin, Flyer, Notepad, etc.

Image Building:

Image Building Programme carries out dissemination of important institutional initiatives and achievements to the masses in general, and industry in particular through print and electronic media and advertisements in press, trade journals, periodicals, souvenirs, etc. The in-house publication "NCB Newsletter and Special Newsletter" is also used as an information carrier of NCB activities to the industry.

CIS also carries out photography activities and these photographs are further used in enhancing the content of quarterly newsletter, annual report, displayed on TV areas of the NCB as well as uploading on social platform like twitter and Facebook. Further, preparation and release of advertisement related to PG Diploma Course and Employment is carried out through Directorate of Advertising & Visual Publicity (DAVP)

Image Building exercise implemented by displaying latest activities of the organisation on TV areas.

National and International Linkages / Collaboration Programmes

NCB has been actively interacting and liaising with a number of international bodies and exchanging knowledge and experience particularly in the area of cement and building materials industries.

MoU signed by NCB during the year 2022-23:

- LivNsense Technologies Pvt. Ltd, Bengaluru, Karnataka

Technical Insight

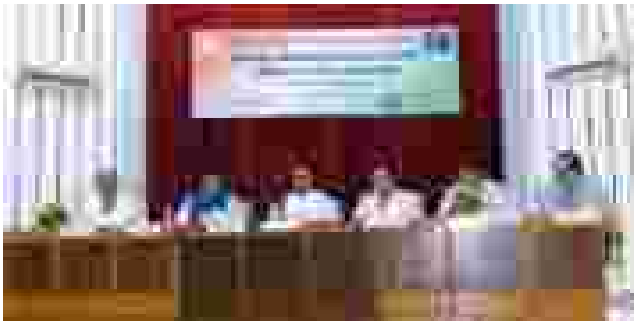
NCB has been actively interacting and disseminating information with a number of stakeholders and exchanging knowledge and experience particularly in the area of cement and building materials industries. The continued interest of participants in the areas of alternate fuels and raw materials, climate change, net zero carbon emissions, high performance concrete, nano-technology etc., has led us through to give technical insights for efficient operation of cement plants, making of concrete and other construction activities.

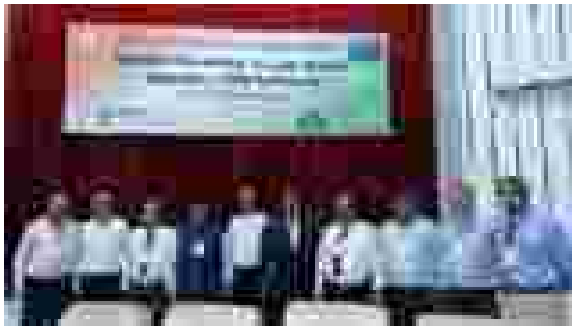
Seminars & Conferences

Followings are the workshops & webinars were organized by CIS

National Workshop on Low Carbon Cements

NCB organized a National Workshop on "Low Carbon Cement: NCB Initiatives" on 20th April 2022 at NCB Ballabgarh. The workshop was organized in the backdrop of Hon'ble Prime Minister Shri Narendra Modi's commitment for India to become Net Zero by 2070 at Glasgow in the COP26 Summit. The aim of the workshop on 'Low Carbon Cement: NCB Initiatives' was to disseminate among the cement and construction industries, the latest research and development activities, projects being carried out at NCB on low carbon cements. NCB was supported by DPIIT, NITI Aayog, BIS and BEE in organizing the workshop.





The workshop was inaugurated by Shri C Kamraj, IAS, Managing Director- TANCEM; Dr. S S Gupta, Sr. Development Officer-DPIIT, MoCI, GoI, Shri Neeraj Sinha, Sr. Advisor, Science and Technology, NITI Aayog, Dr B N Mohapatra, DG-NCB and Dr. S K Chaturvedi, Joint Director-NCB.

The workshop was attended by about 200 participants including senior officials from major cement companies of India like UltraTech Cement Ltd, Dalmia Cement (B) Ltd, Nuvoco Vistas Corp Ltd., J K Cement Ltd., J K Lakshmi Cement Ltd., Prism Johnson Ltd., JSW Cements, Ambuja Cements, ACC Ltd., Star Cement, India Cement; experts from DPIIT, NITI Aayog, BIS, BEE and PG Diploma students of Cement Technology course.

Webinar on Carbon Capture and Utilisation for Decarbonising Cement Industry

The webinar was held on 8th July 2022. Topics which were covered during the webinar are: Carbon Capture & Utilization in Cement Industry, Brief on visit to Heidelberg Group's Cement Plant and SSAB's Steel Plant in Sweden, Overview of 17th NCB International Conference and Introduction to National Awards for Indian Cement Industry.

17th NCB International Conference on Cement, Concrete and Building Materials

NCB has been organizing International Seminars on Cement and Building materials every alternate year since 1987. These Seminars have emerged as singular biennial events in this part of the globe where experts of cement and concrete sector, policy makers, engineers and scientists, academicians / students, consultants, professionals and machinery manufacturers come under one roof and discuss future action plans aimed towards clean and green production and responsible consumption of the resources utilized in cement sector to ensure long term sustainability. Cement and Construction industries of the world look forward for participation in the Seminar/Conference.

NCB organized the 17th NCB International Conference on Cement, Concrete and Building Materials as a follow-up of the Sixteen NCB International Seminars organized

earlier. Hence forth the biennial event will be known as "NCB International Conference on Cement, Concrete and Building Materials".

The 17th NCB International Conference on cement, concrete & building materials was held from 06 - 09 December 2022 at Manekshaw Centre, Parade Road, New Delhi and saw participation of around 1100 delegates including 48 overseas participants from 11 countries. The theme of 17th NCB International conference was "**Moving Towards Net Zero Carbon Emissions**".

During the span of the 4-day event, 160 presentations were made in 20 technical sessions; 4 panel discussions were held, covering key topics of concerns for the industry, and speeches were delivered by keynote speakers.

Sponsors of 17th NCB International Conference

The 17th NCB International Conference was sponsored by a number of leading cement companies, cement plant machinery suppliers/OEMs, supported by various government departments/organizations with active participation of media partners.

Sl. No.	Name of Sponsors	Category
1.	UltraTech Cement Ltd.	Chief Patron
2.	Dalmia Cement (Bharat) Ltd.	
3.	JSW Cement Ltd.	Platinum Sponsor
4.	IKN India	
5.	Saurashtra Cement Ltd. & Gujarat Sidhee Cement Ltd.	Kit Bag Sponsor
6.	Shree Cement Ltd.	Gold Sponsor
7.	Nuvoco Vistas Corp Ltd.	
8.	J.K. Cement Ltd.	
9.	HeidelbergCement India Ltd.	
10.	Star Cement Ltd.	
11.	Prism Johnson Ltd.	
12.	KHD Humboldt Wedag India Pvt. Ltd.	
13.	DCL Bulk Technologies Pvt. Ltd.	High Tea Sponsor
14.	JK Lakshmi Cement Ltd.	Silver Sponsor
15.	TRL Krosaki Refractories Ltd.	
16.	My Home Industries Pvt. Ltd.	Bronze Sponsor

Supporting Organizations / Departments

- Department of Promotion of Industry and Internal Trade (DPIIT), Govt. of India
- Ministry of Environment, Forest, and Climate Change (MoEF&CC), Govt. of India

- Council for Scientific and Industrial Research (CSIR)
- Bureau of Indian Standards (BIS)
- Bureau of Energy Efficiency (BEE)
- Cement Manufacturers' Association (CMA)

Media Partners

Industrial Angles	Indian Cement Review	Construction World
International Cement Review	World Cement	ZKG International
Civil Engineering & Construction Review (CE&CR)		

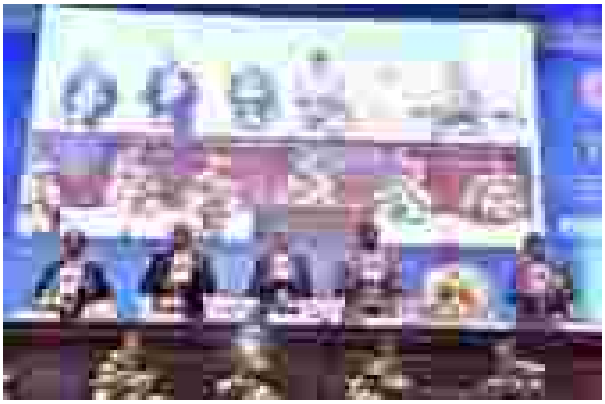
Sponsors and Supporting Organizations of 17th NCB International Conference

The conference was inaugurated on 6th December 2022 by Chief Guest Shri Anurag Jain, Secretary, Department for Promotion of Industry and Internal Trade (DPIIT), Ministry of Commerce & Industry, Govt. of India at prestigious Manekshaw centre. Shri Anil Agrawal, Additional Secretary, DPIIT, Guest of Honour shared the outlook of Indian Cement Industry. Shri K C Jhanwar, Chairman-NCB, President-Cement Manufacturers' Association & MD, UltraTech Cement Ltd. deliberated his views on "Indian Cement Industry-Future Outlook, Challenges & Opportunities". Shri Mahendra Singhi, MD & CEO, Dalmia Cement (Bharat) Ltd shared his views on "Cement Industry Global Perspective".

Release of Publications during the 17th NCB International Conference

Chief Guest Shri Anurag Jain, Secretary-DPIIT, Ministry of Commerce and Industry, Govt. of India released four NCB publications during the inaugural session of 17th NCB International Conference on 6th December 2022 at Manekshaw Centre, Delhi. These publications were:

- Conference Proceedings with Abstracts of 150 Technical papers and Background of Panel Discussions and Special Technical Sessions
- 3rd edition of the compendium titled "The Cement Industry-India 2022
- AFR Book Titled "Alternate Fuels – A Green Solution for Indian Cement Industry
- 6th Edition of "Guide Norms for the Cement Industry



Glimpses of Inaugural Session of 17th NCB International Conference on Cement, Concrete and Building Materials

Panel discussions and Keynote Sessions

During the 17th NCB International conference, four panel discussions with distinguished Panellists were organized on important topics viz.

- Moving towards Net Zero Carbon Emissions in Indian Cement Industry
- Sustainability and Circular Economy in Cement & Construction Sector
- Enhancing AF & ARM utilization in Indian Cement Industry and
- National Mission on Sustainable Habitat -2030

Keynote presentations were given on following topics:

- Promise of Energy Efficiency for addressing Climate Change by **Dr Ashok Kumar**, Dy. Director General, Bureau of Energy Efficiency
- Durability Design of Concrete Structures by **Prof. Manu Santhanam**, Professor, Department of Civil Engineering, IIT Madras
- From Pollution to Solution – Bringing Cement and SCM to Net-Zero by **Dr Sada Sahu**, Solidia Technologies, USA

Panel discussions and key note sessions during the 17th NCB International Conference

National Awards for Indian Cement Industry

Emanating from a suggestion at the first NCB International Conference in 1987, and at the instance of the Ministry of Industry, the scheme of National Awards for Energy Efficiency was started from the year 1986-87 and since then these Awards are being given regularly to the best performing cement plants.

The scheme of these awards was designed in consultation with various experts and organizations including Ministry of Power, Advisory Board on Energy (ABE), Bureau of Industrial Costs & Prices (BICP), Cement Manufacturers' Association (CMA), National Productivity Council (NPC) and Chief Executives of Cement Plants. Keeping in view, the prevalent scenario of the Indian cement industry, the scheme is revised and updated periodically, in consultation with experts from industry and consultants as well as based on suggestions from Technical Committee members.

The Technical Committee is constituted of Director General- National Council for Cement and Building Materials (NCB), Chairman and members from DPIIT, Bureau of Indian Standards (BIS), The Ministry of Environment, Forest and Climate Change (MOEF&CC), Quality Council of India (QCI), National Productivity Council (NPC), and Bureau of Energy Efficiency (BEE).

The objective of these awards is to create motivation in the industry for competitive improvement in the thrust areas of Energy, Environment & Total Quality. Total Quality Excellence Award is aimed to give special recognition to organizations that contribute significantly towards the quality movement of India. This award is in line with other prestigious quality awards like the Rajiv Gandhi National Quality Award

of India, Malcolm Baldrige National Quality Award of the United States, European Quality Award of the European Union and the Deming Prize of Japan. The scheme of awards for energy excellence and environment excellence awards were revised and two new award categories (Achieving Circular Economy in Cement Plant Operation and Energy & Environment Excellence in Grinding Unit Operation) were added.

The Government of India has been actively formulating policies and promoting projects to drive the country towards a circular economy. As cement industry is at the heart of any circular economy initiative, this year, a new award on Achieving Circular Economy in Cement Plant Operation has been introduced to motivate the sustainable development of the cement industry and utilization of industrial waste in cement plant operation.

As there are about 115 grinding units in India and the no. is increasing every year. Two new awards on Energy and Environment Excellence in Grinding Units have been introduced. The objective of these awards is to motivate competitive improvement in the energy performance and creation of better environment in and around grinding units

The National Awards for the Indian Cement Industry for the years 2019-22 were distributed by Shri Som Parkash, Hon'ble Minister of State for Commerce & Industry, Govt. of India and Shri Shashank Priya, Special Secretary & Financial Advisor, DPIIT in the Concluding Session of 17th NCB International Conference on 09 December 2022 at Manekshaw Centre, New Delhi.

Distribution of National Awards by Shri Som Parkash, Hon'ble MoS for Commerce & Industry, Govt. of India and Shri Shashank Priya, Special Secretary & Financial Advisor, DPIIT

Awards for papers of High Merit

During each technical session of 17th NCB International Conference, the chairman and co-chairman evaluated each technical paper in terms of four different parameters:

- Innovativeness/originality of the paper
- Significance, impact and relevance to industrial application
- Presentation quality and skill
- Timeliness of the presentation

Based on evaluation done by the respective Chairman and Co-chairman of the technical session, one paper from each technical session has been selected as paper of high merit out of the 160 papers presented in the 17th NCB International Conference in 20 technical sessions.

Awards for papers of High Merit

Technical Exhibition

The 17th NCB International Conference also had a Technical Exhibition, which was held concurrently at the Conference venue. The exhibition gave additional exposure to the latest in available technologies and services for efficient operation of cement plants, making of concrete and construction activities.

Technical Exhibition during the 17th NCB International Conference

Participation in Seminars / Training Programmes / Workshops:

The following NCB officials participated in Seminar & Conference shown against their names during the period.

Sr. No.	Workshop/Webinar Seminar/Events Conferences	Participant (s)
1.	Nominations for "Two Days Training Program on QA Estimation of Uncertainty in Chemical Testing, IQC and Statement of Conformity/Decision Rule as per ISO/IEC 17025:2017 Standard" Organised by EXCEL EHS SERVICES on 21st to 22nd April 2022 (Online through Interactive VC mode)	Dr Sanjay Mundra Dr pinky pandey Dr Varsha Liju Sh Anand Bohra Sh Arup Ghetak Sh Rizwan Anwar Sh KRP Nath Ms Rashmi Gupta Sh Shivang Bansal Ms Kalpana Sharma Sh Gaurav Bhatnagar Sh Ravendra Singh
2.	Nominations for "TRAINING PROGRAMMES ON PUBLIC PROCUREMENT (BASIC)"organized by AJNIFM	Sh Manish Mandre Sh Vinay Kant Sh P. Srikanth

	19-24 Dec 2022, 10-15 Oct 2022, 19-24 Dec 2022 & 14-19 Nov 2022	Sh Ravi Yadav
3.	Nomination for Online Training on "Treatment & Valorization of Wastes" from 23-27 January 2023 Organised by IIT (ISM) Dhanbad, Chennai"(online mode)	Sh Anand Bohra Sh Prateek Sharma
4.	Nomination for 5th Workshop-cum-Symposium on Analytical Instruments for Chemical and Environmental Engineers (WAICEE-2023)" organized by IIChE Pilani Regional Centre & Department of Chemical Engineering, Birla Institute of Technologuy & Science, Rajasthan from 28-29 March 2023	Sh Prateek Sharma Dr Varsha Liju Ms. Moon Chourasia
5.	Invitation as a Panelists in the Panel Discussion on "Thermal Comfort in Affordable Housing" organized by The Energy & Resources Institute (TERI) on 20th June 2022. The Claridges, New Delhi, India	Sh P N Ojha
6.	Training on Artificial Intelligence, Machine Learning, data science and big data by Analytix Labs from July 2022-March 2023	Anil Kumar Popuri, Prateek Sharma, Anand Bohra, K P K Reddy, Rayees Ahmed
7.	Conference on Best practices in Energy Efficiency in cement sector organized by BEE from 13-16 March 2023	Prateek Sharma and Bharat Bhushan

Important Visitors

Date of Visit	Name of Visitors	Organisations
8th April 2022	Shri Arun Kumar, Under Secretary Shri Deepesh Gupta, ASO Shri Pankaj Kumar, ASO	DPIIT, Ministry of Commerce & Industry, Govt. of India
4th April 2022	Shri Sanjay Joshi, Chief Manufacturing Officer & Chief of Industrial Operations	Nuvoco Vistas
19th April 2022	Shri Pranav Desai, CDIC Shri Pawan Royal, CDIC Dr Arunachala Sadangi, CDIC Ms Shital Bisen, CCP Shri Ashish Vyas, CCP	Nuvoco Vistas

19th April 2022	Shri Manish Singh, President- Head Technical Shri Pravesh Kumar Sharma , Senior GM (QC)	Prism Johnson Ltd.
04th May 2022	Shri Prashant Jain, Assistant General Manager (ERP), Alumni of NCCBM - PGDCT	Shree Cement Limited
09th June 2022	Dr. Ankush Kaushik, Chief Yoga Guru Ayurveda Yoga Acharya, HoD	Patanjali
15th June 2022	Shri MP Bhatt, Senior Secretariat Assistant Shri Pardeep Kher, Section Officer Shri Rajpal, MTS	DPIIT, Ministry of Commerce & Industry, Govt. of India
30th June 2022	Ms Ruchika Drall, Deputy Secretary	MoEF&CC, GoI
30 June 2022	Sh Satish Kumar Tanwar, Head-Ash Management	Adani Power Ltd, Adani Corporate House
5th July 2022	Sh Anil Sahoo, SO/E Sh Gopal P. Verma, SO/D Sh Anil Gupta, SO/D	Bhabha Atomic Research Centre, Mumbai
7th July 2022	Sh Sunil Khandare, Director Sh Vivek Negi, Joint Director Sh JS Kalra, Consultant	BEE
20th July 2022	Dr Rajbeer Singh, सदस्य सचिव, नगर राजभाषा कार्यान्वयन समिति, फरीदाबाद	राजभाषा विभाग, गृह मंत्रालय, भारत सरकार
29th July 2022	Sh Arun Shukla, CEO & President, JK Lakshmi Cement Dr. S. K. Saxena, Sr. Vice President (Works), JK Lakshmi Cement-Sirohi Sh Rajpal Singh Shekhawat, Sr. General Manager (Production), JK Lakshmi Cement-Sirohi Sh Vaibhav Kesharwani, General Manager (Centre of Excellence), JK Lakshmi Cement-Head Office Sh Kanish Kr. Singh, Technical Assistant to President, JK Lakshmi Cement-Head Office	JK Lakshmi Cement Ltd
17th August 2022	Dr. Kåre Helge Karstensen , Chief Scientist Dr. Christian J Engelsen , Chief Scientist Mr. Palash K Saha, Senior Adviser	SINTEF - Applied Research, Technology and Innovation
25th August 2022	Shri Ashok Dembla, President & Managing Director	KHD Humboldt Wedag

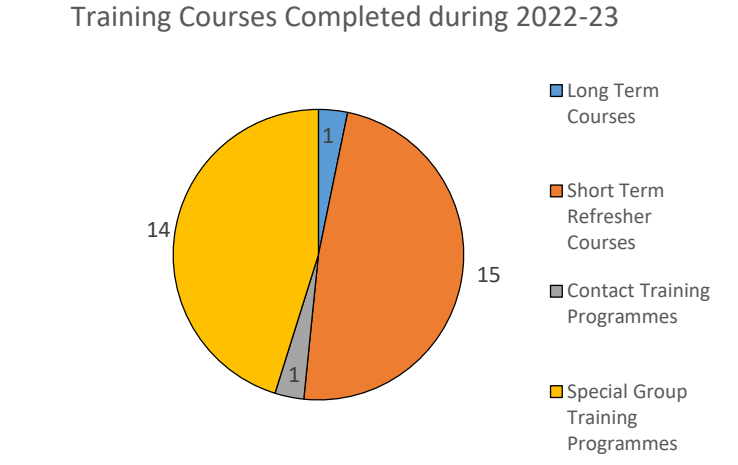
2nd September 2022	Sh V S Narang, Director- Technical, My Home Industries Ltd. Dr Ashok Kumar, Dy. DG-BEE; Sh Sunil Khandare, Director, BEE	My Home Industries and Bureau of Energy Efficiency (BEE)
6th September 2022	Dr S C Maiti, Ex-Joint Director, NCB Sh Mayank Rawal, Managing Director, Asian Laboratories	Ex-Jt. Director, NCB and Asian Laboratories
7th September 2022	Dr Subhalaxmi Pradhan, Associate Professor, Dr Pooja Agarwal, Professor	Galgotia University
13th September 2022	Dr K Mohan Dr S K Handoo	Ex-Director General, NCCBM Ex- Joint Director
29th September 2022	H.E. Mr Raymond Serge BALÉ, Ambassador Mr Gabriel ITOUA, Economic Counsellor Mrs Smriti Malhotra, Secretary In-charge, Project Monitoring	*Delegation from* The Embassy of Republic of Congo
13th October 2022	Shri Suman Kumar, Under Secretary	DPIIT, Ministry of Commerce & Industry, Govt. of India
18th October 2022	Shri Yogesh Taneja Ji, Section Officer	DPIIT, Ministry of Commerce & Industry, Govt. of India
3rd November 2022	Dr R Manikandan, National Technical Services Head	Dalmia Bharat Ltd.
15th November 2022	Prof. Dr Manoranjan Parida, Director along with other Scientists	CSIR-Central Road Research Institute (CRRI)
19th December 2022	Prof. Subhransu Ranjan Samantaray	Indian Institute of Technology, Bhubaneswar
1st March 2023	B K Poonam Ji, Lecturer Dr Nupur Agarwal, Gynaecologist	Govt. Polytechnic, Faridabad Hope Fertility and Gynea Clinic
7th March 2023	Ms Satbeer Chabbra, Deputy Director Ms Ruchika Drall, Deputy Secretary (Environment Policy)	National Institute of Public Cooperation (NIPCCD) and Ministry of Environment, Forest and Climate Change

Centre for Continuing Education Services –(CCE)

Centre for Continuing Education Services (CCE), has been organizing various need-based and industry-oriented training programmes at all levels, for the participants from cement, concrete and construction industries since its inception in 1972. Participants comprising of industry professionals and fresh graduates/post-graduates in science and different disciplines of engineering have been benefited. A number of Govt./Semi-govt./Private organizations both from India and abroad have availed the training services of NCB for their engineers and professionals.

During the year 2022-23, 31 training programmes (offline/online) were successfully organized with a total of 654 participants attending the programmes.

The highlights of the training programmes conducted are as under:



Type of Course	Number
Long Term Courses: PG Diploma in Cement Technology	1
Short Term Online/offline Courses	15
Contact Training Programmes	1
Special Group Training Programmes	14

Training Programmes completed during 2022-23

Long Term Courses

Post-Graduate Diploma in Cement Technology

In its efforts to develop technological talent for the cement industry, NCB has been regularly conducting Post-Graduate Diploma in Cement Technology since 1983. The course is duly approved by All India Council for Technical Education (AICTE), Ministry of Human Resource Development, Govt. of India.

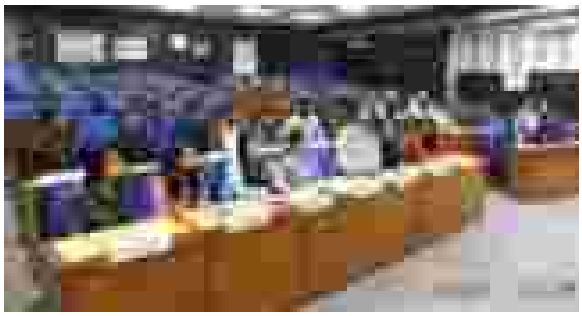
Seventeen self-sponsored participants admitted for 2020-21 session have successfully completed the course in August 2022. In the session 2022-23, nine students were admitted in the course.

Short Term Refresher Courses

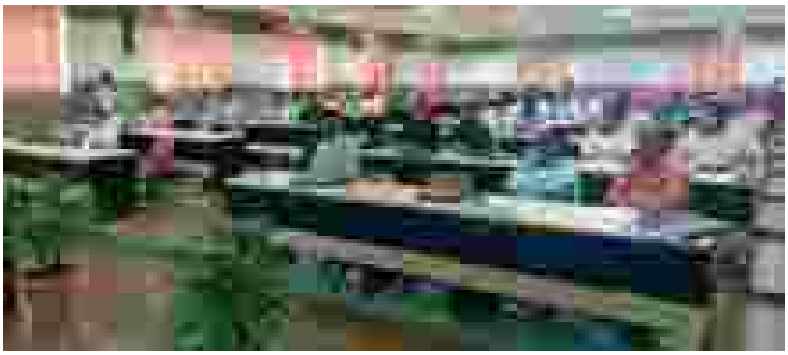
During the year, 15 Short Term Refresher Training Courses were organized wherein 350 professionals from cement and construction industries participated. In Cement Technology related area, special emphasis was given to courses such as Diagnostic

Studies on Process and Refractory related Problems in Cement Rotary Kiln; Energy Efficiency Initiatives in Cement Industry; Sampling, Testing of Cement as per BIS Standards; Instrumental Methods of Analysis in Cement Plant; Application of Renewable Energy in Indian Cement Industry; Alternate Fuels and Raw Materials in Portland Cement Manufacture; Calibration and Measurement of Uncertainty of Laboratory Equipment; Laboratory QMS and Internal Audit as per ISO/IEC 17025:2017.

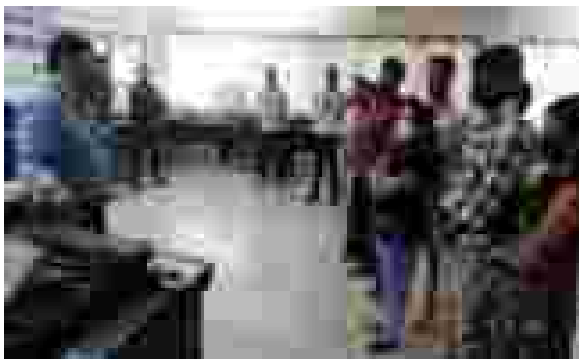
In Concrete and Construction related areas, the training programmes on specific topics such as; Durability properties of Fresh and Hardened Concrete; Corrosion in Reinforced Concrete Structures and its Remedial Measures; Cracks and Leakages in Concrete Structures: Causes, Prevention and Repair; Concrete Mix Proportions and Acceptance Criteria; Repair and Rehabilitation of Concrete Structures and Non-destructive Testing and Evaluation of Concrete Structures and Repair & Rehabilitation methods of Concrete Structures were organized.



Lectures during Training programmes at NCB-B



Lecture during Training programme at NCB-H



Laboratory Demo Sessions during Training programmes at NCB-B

Contact Training Programmes

On the request of M/s My Home Industries Pvt Ltd a contact training programme was organized for their official on EDTA methods at NCB's Hyderabad unit.

Special Group Training Courses

Fourteen special group training courses on specific topics for the group of engineers/professionals were organized online/offline for the following organizations at NCB-Ballabgarh & Hyderabad units:

Sl No.	**Organization**	**Topics of the Courses Organized**
1	M/s Oman Cement Company, Oman	Technical Assistance and Training for Officials of Oman Cement Company, Oman
2	M/s Dalmia Cement Bharat Ltd.	Cement Manufacturing Technology for GETs of Grinding Unit (2 Batches) Cement Manufacturing Technology for GETs of Integrated plant (2 Batches)
3	M/s Nuvoco Vistas Corp. Ltd.	Raw Mix Design and Burnability Investigations
4	M/s Sagar Cement Ltd.	Pragmatic approaches using advanced instruments for Improving Clinker Productivity for Sagar Cements
5	M/s Hindustan Petroleum Corporation Ltd., Mumbai	Quality Control and Quality Assurance in Concrete Structure - 4 batches
6	National Thermal Power Corporation Ltd. (NTPC)	Quality Control of Civil Construction Materials and Quality Assurance in Concrete Structure
7	Bureau of Indian Standards (BIS),	Capsule Training Programme – NCB-Hyderabad Training Facility

In addition to the above CPPRI has availed the NCB -H CCE facilities.

Participants of Dalmia Cement (Bharat) Ltd. during Special Group Training Programme for GETs at NCB-Ballabgarh Unit

Participants during Training programme at NCB-B

Training Programme on Corrosion in Reinforced Concrete Construction Structures and Its Remedial Measures at NCB-H

LIST OF NCB OFFICIALS WHO HAVE UNDERGONE TRAINING

Sl No	Name of the Official	Title of course	Name and address of Training Organisation	Duration and Period
1 2 3 4 5	Sh Suresh Kumar Shaw Sh V Naga Kumar Dr Varsh Liju Sh Abhishek Agnihotri Sh Gaurav Bhatnagar	Awareness Program on Reference Material Producers	National Accreditation Board for Testing and Calibration Laboratories (NABL), Dellhi	1 day 26 April 2022
1 2	Ms Meghna Verma Sh Jitender Goswami	Public Procurement, E-Procurement, Govt e-Marketplace (GeM) (Online)	Integrated Training & Policy Research (ITPR), New Delhi	2 Days 13 - 14 May 2022
1 2 3 4 5	Ms Deepa Kumari Sh Pavan Kumar Sh Ram Ratan Sh Ritesh Kumar Ms Priya Sharma	Sampling and Testing of Cement as per BIS Standards	Centre for Continuing Education Services (CCE), NCB	3 days 08-10 June 2022
1 2	Ms Poonam Rani Sh A K Tripathi	Laboratory QMS and Internal Audit as per ISO/IEC	NCB	4 days 11-14 October 2022

		17025:2017 - Online		
1	Dr Varsha Liju	A Resilient Future: Science and Technology for Disaster Risk Reduction" from	Centre for Disaster Management, Lal Bahadur Shastri National Academy of Administration (LBSNAA), Mussoorie	27 February – 03 March 2023

NCB Hyderabad

NCB Hyderabad

NCB Hyderabad is the regional centre established in 1982 in a sprawling campus having world class testing, R&D and training facilities. The activities of NCB Hyderabad are illustrated through the respective centers which provide various testing, R&D facilities, training, energy auditing, Third Party quality assurance and other consultancy services to the cement and construction industries. The unit has adopted quality management systems and certified with ISO 9001:2015.

Centre For Cement Research and Independent Testing (CRT)

CRT executes its activities in the areas of Research and development studies, Industry sponsored projects and testing. Laboratories are NABL accredited (TC-7692) and BIS recognized (OSL-6114835) and equipped with state-of-art facilities. The Independent testing laboratories conduct complete chemical, mechanical, mineralogical and microstructure analysis of various raw materials, in-process materials in cement production, fuels, clinker, pozzolanic materials, different industrial slag materials, industrial waste and by-products, different cements, aggregates, water used in construction, admixtures etc. Total of about 1295 samples have been analysed.

Development of Plant Specific Standards for Calibration of XRF:

XRF plays crucial role in quality control in cement plants. Accuracy of the results of XRF primarily depends on the standards used for the calibration. NCB developed a programme for preparation of plant specific standards for calibration of XRF, so as to minimize the matrix effects. NCB successfully completed several projects for the various materials being used in cement industry, viz., limestone, additives, raw meal, kiln feed, clinker, cement etc.

Raw Mix Design to Improve Clinker Productivity: In view of use of various industrial waste materials in the manufacture of cement, producing the adequate quality of clinker has become challenging. NCB is providing services in the area of raw mix design to maximize the use of AFR and to improve clinker productivity with available raw materials.

Establishing Limestone Consumption Factor (LCF): Limestone consumption factor indicates the amount of limestone consumed by the cement plant for production of 1Tonne of clinker. This study is helpful in monitoring the limestone reserves and plans the mining activities.

Centre For Quality Management, Standards & Calibration Services (CQC):

CQC calibrated around 230 Proving Rings (50kN, 100kN, 250kN, 500kN, 1000kN, 2000kN) received from cement and allied industries, testing laboratories & educational institutions to help them maintain accuracy in compressive strength measurements. The laboratory is in the process of obtaining NABL accreditation in the areas of Thermal, Dimension, Mass & Force (Proving rings) calibration.

Assisting in NABL accreditation of plant laboratories: CQC has been providing services in assistance for plant laboratories in obtaining NABL accreditation. The project covers visit to the laboratories for gap analysis, assessment of infrastructure and equipment, skill level assessment of the manpower and providing the recommendations and required training to the plant officials for improving the accuracy of the results as per various National Standards.

Centre for Construction, Development and Research (CDR)

Centre for Construction Development and Research (CDR) contributes to application of scientific and technical knowledge in developing durable and sustainable civil infrastructure in the southern region of India. The Centre provides services to the cement, concrete, Building materials and construction industry through the structured programmes namely Concrete Technology (CON), Structural Assessment and Rehabilitation (SAR) and Construction Technology and Management (TPQA).

Structural Assessment and Rehabilitation (SAR):

The distress evaluation, condition assessment, repair and rehabilitation of existing structures such as buildings and industrial structures are becoming increasingly important to make them functional and conforming to the safety and serviceability requirements as these structures are aging, affected by environment conditions, fire damaged structures and heritage structures. Structures were investigated by using visual observations, non-destructive evaluation technique (NDE), partially destructive tests and other field tests followed by laboratory tests on extracted core samples and chemical analysis of hardened concrete as per BIS and international standards. The investigation was generally followed by recommendation for repair and rehabilitation

with state of art repair materials and implementation techniques for distressed RC structures covering specifications, cost estimates and bill of quantities and quality inspection during the repair of RCC structures is also conducted. Structures have been investigated for various clients viz., NTPC plants, NSPCL plants in Chhattisgarh& West Bengal, POWERGRID Corporation of India in Tamil Nadu, NALCO in Odisha, NMDC, BOB etc.

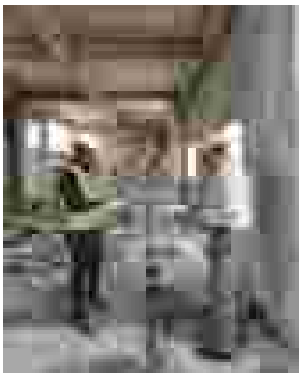
Construction Technology and Management (TPQA)

Third Party Quality Assurance/Audit (TPQA) services have been provided to enhance the program's effectiveness and the opportunities for innovation in the construction industry for a wide range of construction projects such as institutional buildings, residential buildings, skill development centers, hostel blocks, etc in southern states viz., Telangana, Tamil Nadu and Karnataka. With strong organizational and leadership capabilities in management of construction projects, the centre is associated with various Central/ State/ Autonomous Organizations in delivering durable buildings and structures to meet specified quality standards by ensuring quality workmanship, good construction practices, use of quality materials etc. and inspections done in accordance with ISO/IEC 17020:2012 Type 'A' Accreditation standards. Third Party Quality Assurance/Audit (TPQA) services have been provided for various clients Tamil Nadu Trade Promotion Organization (TNTPO), Indian Institute of Science (IISc) Bangalore, CPWD (Chennai, Bangalore &Hyderabad), Hyderabad Metropolitan Water Supply and Sewerage Board (HMWS&SB) Projects etc.,

Concrete Technology (CON)

Testing & evaluation of concrete making materials and conducting various grades of concrete mix proportions, using different types of cements like OPC, PPC, PSC and different kinds of aggregates to enhance durability including analysis and Interpretation of Test results for Civil works for various central/state/PSUs/Private limited organizations was taken up.

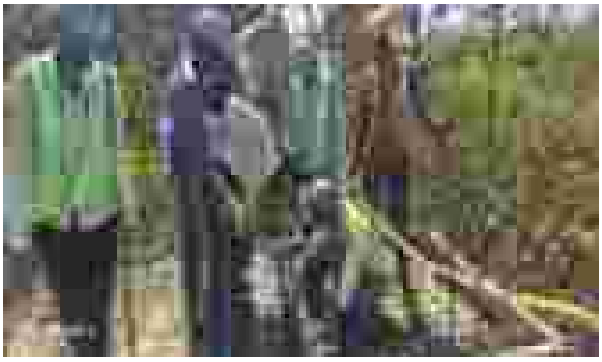
TPQA Industry Interaction/Site Visit



Construction of Additional Exhibition and Convention Convention Hall TNTPO, Tamil Nadu

(Electrical & Mechanical Work) Additional Exhibition and Halls TNTPO, Tamilnadu

Customs/Central Excise Dept. at Chennai



Construction of Additional Infrastructure at IISc Main campus, Bangalore

Construction of CBI Building, PUNE

SAR Industry Interaction/Site Visit

Condition Assessment of RCC Structures at NTPC Tanda

Half Cell Potential Test/ Strengthening Measures at NTPC Tanda

NDT Work of Construction of Additional Infrastructure at IISc Main campus, Bangalore

M35 Concrete Cubes Testing for Sponsored Projects

Centre for Mining, Environment, Plant Engineering and Operations (CME)

Sponsored projects (SP):

SP-5951: Consultancy services for using Tyre chips as alternate fuel at M/s Oman Cement Company, Oman. The objective of this project is to promote the utilization of alternate fuels and reduce gas consumption in the cement plant. NCB designed the system to feed the tyre chips into calciner. NCB-H is associated with NCB-B in execution

of this project and NCB-Hyderabad team monitored the electrical and instrumentation aspects of the project. NCB-H team also handled the testing and commissioning of the project along with performance guarantee test. The study includes evaluation of equipment as per technical specifications, monitoring of workmanship, coordination with client and contractor, ensuring timely progress and witnessing all major tests for the successful completion of the project.

SP-4249: Project management consultancy for setting up a 600 TPD cement plant in Mafoubou, Tao Tao, Republic of Congo. The objective of this project is to set up a 600 TPD cement plant in Republic of Congo. NCB is providing the project management consultancy services. NCB-H is associated with NCB-B and NCB-Hyderabad team monitored the electrical and instrumentation aspects of the project. NCB-H team handled the electrical and instrumentation aspects. The ongoing project includes evaluation of technical specifications, E&I drawings etc.

SP-6452: Walk thorugh Energy Audit was done for M/s Cement Corporation of India, Tandur unit. In order to optimize the energy consumption, CCI Tandur asked NCB to conduct walk thorugh energy audit to identify the potential energy consuming areas

and appropriate studies that can be taken up for reducing the energy consumption after detailed discussion with plant officials about the problematic areas. NCB team visited the plant and done the walk-through audit along the all the sections of the plant and advised various areas that are to be studied for improving the efficiency in terms of energy and increasing the productivity of the plant.

SP-6449: Heat Balance and Energy Consumption Optimization Study at Basanthnagar Unit of M/s Kesoram Industries Ltd

Heat Balance was done the two lines of the M/s Kesoram Industries Ltd at their Basantnagar unit in Telangana. Various process measurements across Kiln, Preheater & Cooler were carried out at Two Lines of Basantnagar Unit. Total thermal energy consumption from the fuel and heat loss was evaluated for both the units. Various areas were identified where there is scope for improvement in terms of energy efficiency and the recommendations were given to take appropriate measures for optimizing the energy consumption in the pyrosection.

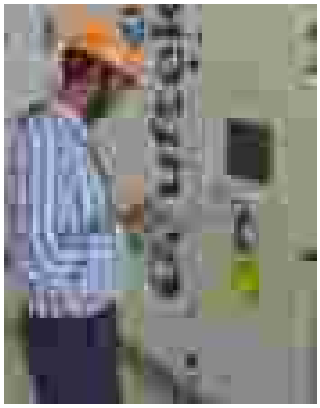
SP-6450: Heat Balance and Energy Consumption Optimization Study at Sedam Unit of M/s Kesoram Industries Ltd

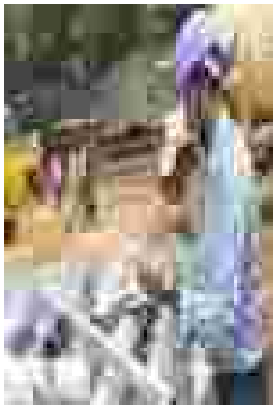
Heat Balance was done the four lines of the M/s Kesoram Industries Ltd at their Sedam unit in Karnataka. Various process measurements across Kiln, Preheater & Cooler were carried out at four Lines of Sedam Unit. Total thermal energy consumption from the fuel and heat loss was evaluated for both the units. Various areas were identified where there is scope for improvement in terms of energy efficiency and the recommendations were given to take appropriate measures for optimizing the energy consumption in the pyro-section.

SP-6480: Optimization of pyro-processing system of M/s Nuvoco Vistas Pvt Ltd, Arasmeta Unit in Chhattisgarh. Associated with NCB-B team in carrying out various process measurements across Kiln, Preheater & Cooler were carried out. Return dust was measured to evaluate the top cyclone efficiency and process parameters were studied to optimize the pyro-processing system. Recommendations were given on the basis of the field study.

Third Party Quality Assurance (Electrical & Mechanical):

The electrical & mechanical quality assurance activities have been taken up in different projects. TPQA electrical team inspected different construction projects like institutional buildings, Convention& Exhibition centers, staff quarters& hostels etc. in Karnataka, Telangana and Tamil Nadu. The activities carried out at various project sites were verification of procured items, workmanship, use of digital instruments for various measurements, testing of various samples to ensure the quality of items, factory inspection for testing of major items and submitting the detailed inspection report to clients.





Centre for Continuing Education (CCE)

Centre for Continuing Education (CCE) centre organized various training courses to meet the needs of professionals from cement, concrete & construction industry. The centre has well established training complex with excellent infrastructure of class rooms of capacities up to 100 seating capacity with video conferencing facilities. A hostel block (25 Rooms) attached to the training complex is available for providing residential facility to participants.

NCB has imparted training to various cement and construction companies across various levels of human resources to enhance the momentum of **"National Skill Development Program"**

CCE Hyderabad organised short term courses for Cement industry & Construction industry on physical mode at NCB Hyderabad unit.

CCE Hyderabad organised five short term refresher courses for Cement industry and five short term refresher courses for Construction industry in physical mode. Hands on training was imparted through Contact Training Programme on Chemical Testing of Cement by EDTA method.

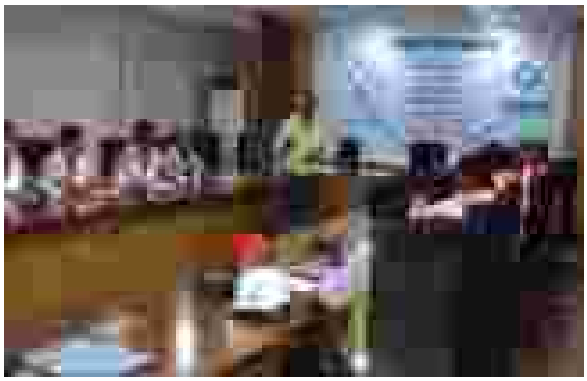
Around 37 participants benefited through NCB Training from Cement Industry representing Chettinad Cement Corp. Pvt. Ltd, Dalmia Cement Ltd, JK Cement Ltd, The Ramco Cements Ltd, Ultratech Cement Ltd, Sagar Cements, Orient Cement Ltd, The India Cements ltd, JSW Cement, etc

Around 175 participants benefited through NCB Training from Civil & Construction Industry representing Rajasthan Housing Board, State Bank of India, Vikram Sarabhai Space Centre, Military Engineering Services, West Bengal Power Development Corporation, Jawaharlal Nehru Port Authority, Tamil Nadu Housing Board, Gujarat Energy Training & Research Institute, National Highways Authority of India, Chennai Metro Rail Limited, Larsen & Toubro Limited, Mumbai Railway Vikas Corp., Rites Ltd, Reserve Bank of India,The Shipping Corporation of India Ltd.,Nuclear Fuel Complex NTPC, BPCL, NFL, IOCL, LIC, NSPCL, TS-I&CAD, Maharashtra State Power Corp. Ltd., South Eastern Coalfields Ltd., UPPTCL, Madras atomic Power Station, ISRO, Power Grid, Syama Prasad Mookerjee Port trust etc.

Cluster based training programmes initiated and organised one programme on "Pragmatic approaches using advanced instruments for improving clinker productivity" at M/s. Sagar Cements Ltd., Nalgonda. NCB & BEE jointly organised One day Seminar on "Exhibition and Dissemination of Technologies in WHRS in Indian Cement Plants" with more than 100 participants. CCE-H conducted Special Online Group Training Programme on "Uses of Supplementary Cementitious Materials for Sustainable Construction". Hands on training was imparted through one (01) Contact Training Programme on Chemical testing of Cement by EDTA method.

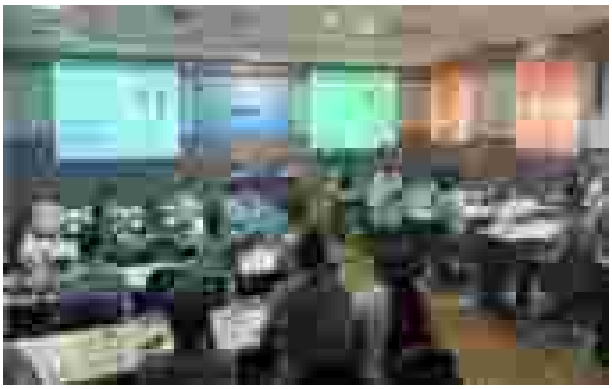
During Training Programme:

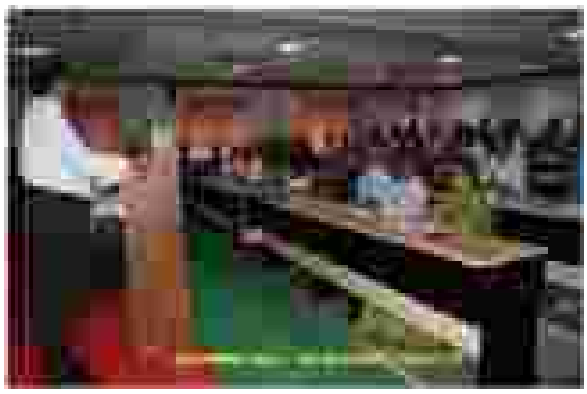
Training programme conducted in Nalgonda cluster at M/s. Sagar Cements Ltd.



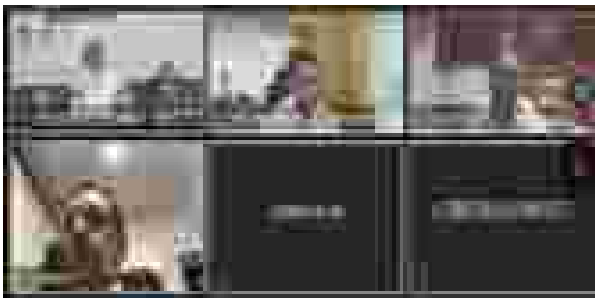
During Laboratory demonstrations

Training Infrastructure:

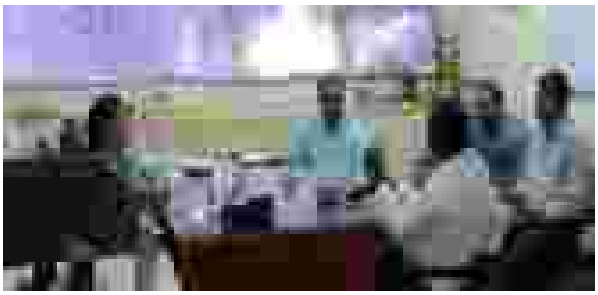




Industry Interaction



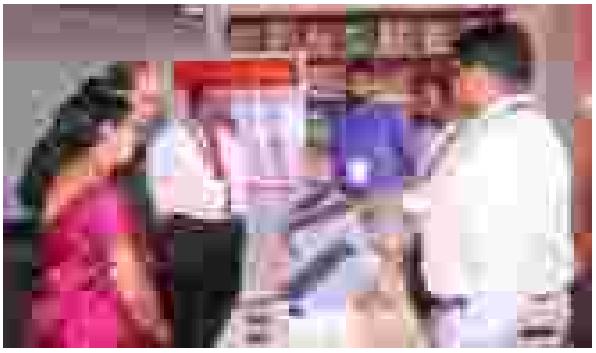
DG interacted with ACH Chairman and Senior executives of South Cement plants and briefed about upcoming 17th NCB International Conference on 24th June 2022.



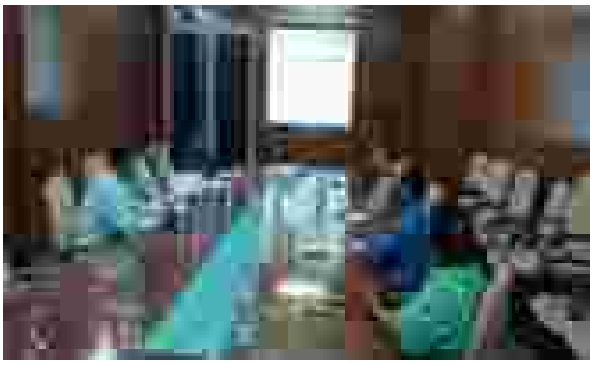
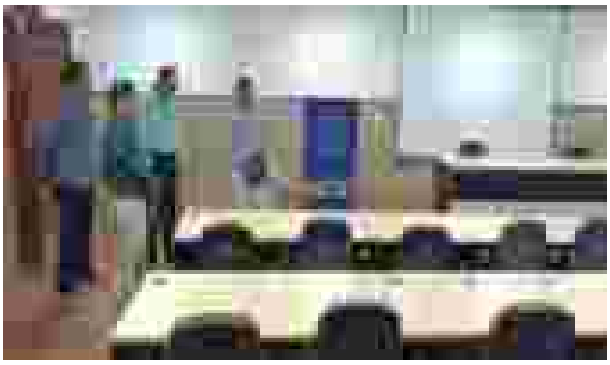
UltraTech cement official interacted with senior officials of NCB-H for their Training requirements on 20 July 2022

BIS officials organised Capsule training programme for South Cement plant officials in NCB H premises on 8-9 Sep 2022.

Sh K V Rao, Director, BIS-Hyderabad along with his colleague visited NCB-H for feasibility for utilisation of lecture hall for their meetings on 24 Aug 2022.



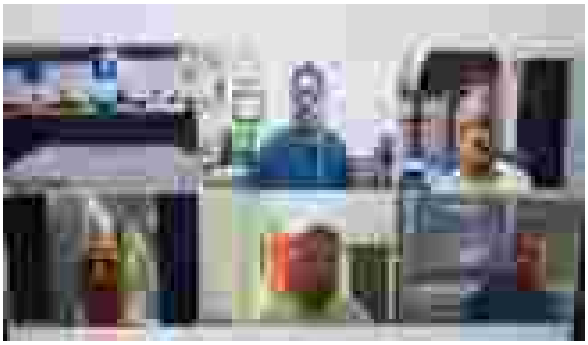
NCCBM & BEE is jointly organized a one day seminar on "Exhibition and Dissemination of Technologies in Waste Heat Recovery Systems (WHRS) in Indian Cement Plants" on 2nd September 2022, at NCCBM Hyderabad. Seminar was well attended by more than 100 participants from cement industry, technology suppliers and consultants.

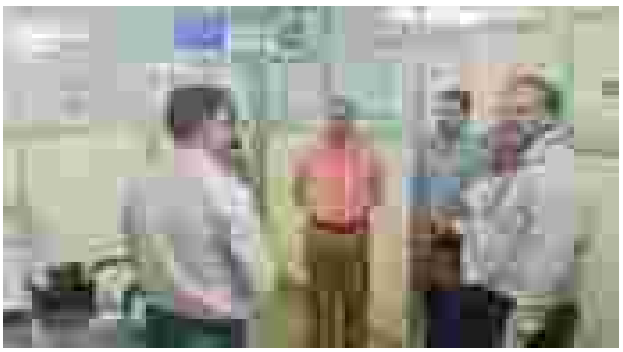
Sh Anuj Kumar, Secretary, DPIIT, Govt. of India Visited NCB-H for inspection & review of Cleanliness Activities (Special Campaign 2.0) on 26th October 2022

Shredding of Weeded out Files

Officials of Lords College of Engineering, Hyderabad visited NCB-H laboratories for collaboration of R&D, testing & training activities on 15th Dec 2022.

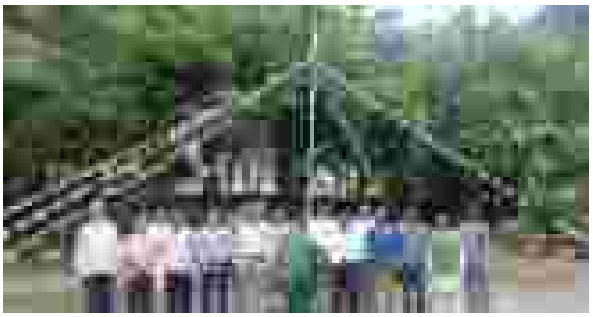


23rd Meeting of "Advisory Committee for NCB-Hyderabad & NCB-Bhubaneswar" was conducted on 25th February 2023 through virtual mode. Sh Rakesh Singh, Executive President, The India Cements Ltd, chaired the meeting. Apex level officials of various cement plants, construction sectors, Government bodies & Educational Institutes actively participated in this meeting.

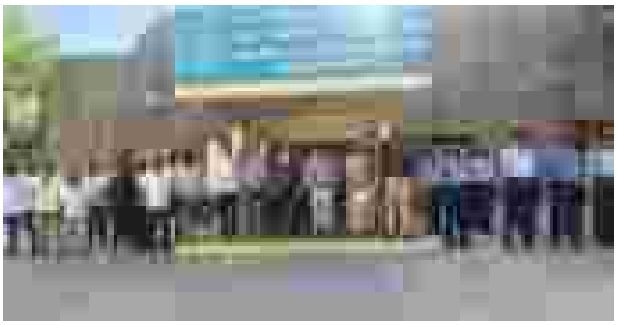


Dr M K Gupta, Director, Dr A K Dixit, Scientist F, Sh A Vjanbade, Scientist E, Sh Md Salim, Scientist B, CPPRI Officials visited NCB-H laboratories and had discussions with NCB officials regarding various testing facilities available with NCB-H on 17.02.2023

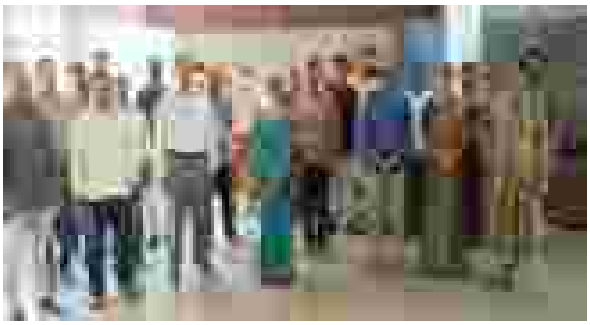
DG-NCCBM has delivered a lecture on Leadership Qualities for NCB H Officials on 25 June 2022



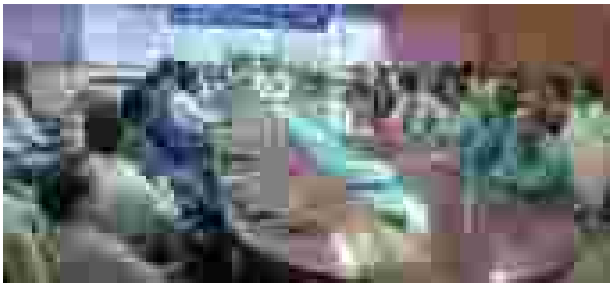
National events: NCB-H celebrated Independence Day and hoisted the National Flag.



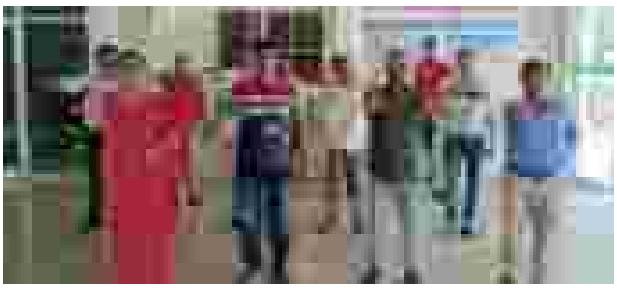
National events: NCB-H celebrated Republic day and hoisted the National Flag.



Mass rendering of 'Jana Gana Mana' on August 16 across Telangana



Review meetings on NCB-H activities

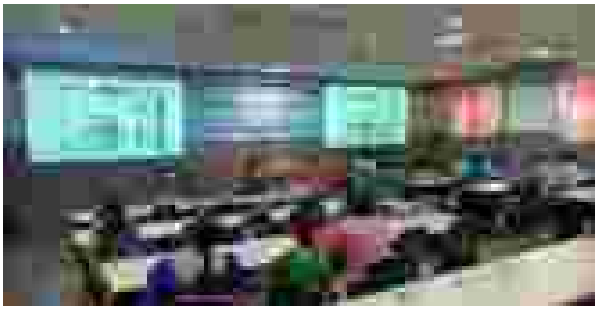
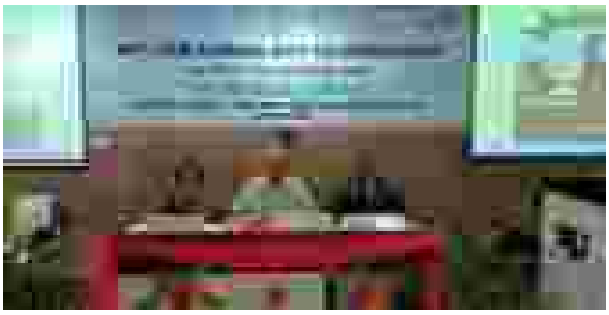
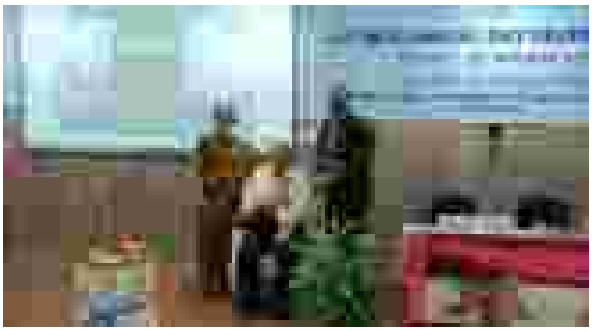


NCB Hyderabad officials participated in LiFE Pledge NCB-H on 20.10.2022

Rashtriya Ekta Diwas (National Unity Day) pledge taken by NCB-H officials on 31.10.2022

Vigilance Awareness Week 2022 pledge taken by NCB-H officials on 31.10.2022

NCB celebrated 60th NCB Annual day celebrations on 24th December 2022

NCB Ahmedabad

NCB Ahmedabad

Centre for Construction Development and Research – CDR

NCB Ahmedabad Unit is situated at Smeet Bungalow, Bodakdev in Ahmedabad, Gujarat. Presently NCB-A unit is primarily working in the areas relevant to Centre for Construction Development and Research (CDR). Very soon, NCB-A will expand its activities in the areas relevant to Centre for Cement Research and Independent Testing (CRT), Centre for Quality Management, Standards and Calibration Services (CQC), Centre for Mining, Environment, Plant Engineering and Operation (CME) & Centre for Continuing Education Services (CCE). Expansion of NCB-A is under progress.

NCB Ahmedabad Unit is contributing in developing durable and sustainable civil infrastructure for the nation. The unit provides services to the cement, concrete and construction sector through three programs of Centre for Construction Development and Research (CDR) namely Concrete Technology, Structural Assessment and Rehabilitation, Construction Technology and Management. The centre has facilities of mechanical and physical testing of concrete making materials along with Non -destructive testing through advanced equipments. The unit is ISO 9001: 2015 certified and has ISO 17025: 2017 accredited testing laboratories. Major testing facilities available at NCB Ahmedabad unit include Universal Testing Machine (UTM), Automatic Compression Testing Machine (ACTM), Physical Testing Laboratory, CBR Testing Machine and Non-Destructive Testing (NDT) equipment such as Rebound hammer, electromagnetic cover meter & reinforcement detector & Ultrasonic Pulse Velocity Test equipment (UPV).

Concrete Technology (Con)

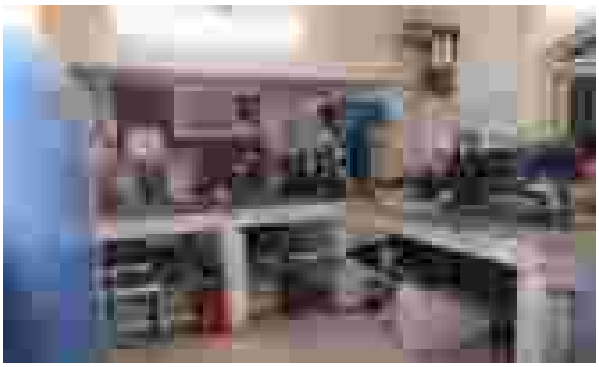
Evaluation of physical properties of concrete making materials i.e. cement, fly ash, silica fume, GGBS, water, fine and coarse aggregates and chemical admixtures is essential for determination of their relative proportion in concrete mix with the objective of producing an economical concrete of required strength, durability and workability. Various government/semi government/private organizations approached NCB Ahmedabad unit to study the performance of different concrete making materials and to provide recommendations for the required grade of concrete.

Under this program, following activities/studies are carried out:

- Characterization of cement and cementitious materials such as OPC, PPC, PSC, fly ash, GGBS, Silica-fume etc.
- Complete physical and chemical analysis of aggregates including soundness
- Testing of steel and soil
- Design and formulation of mix design for standard concrete grades high strength concrete and self-compacting concrete using OPC, PPC, PSC, OPC + Fly ash, OPC+ Fly ash + Silica fume etc.

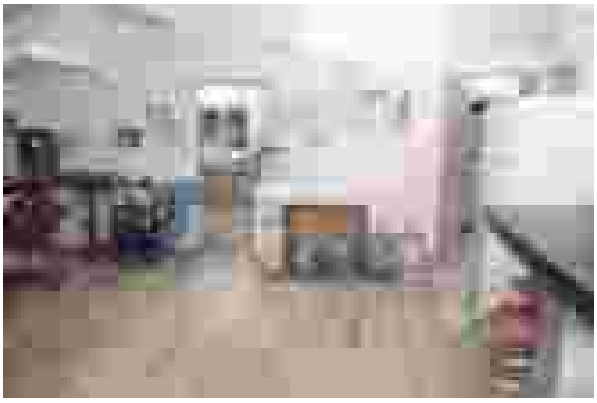
A glimpse of Laboratory Activities at NCB-Ahmedabad

Testing Facility of Compressive Strength of Concrete Cube and Cement Mortar Cube



Temperature Controlled Condition for Cement Testing Unit

Chemical Testing Laboratory



Testing Facility for Physical Parameter of Coarse & Fine Aggregate

Universal Testing Machine for Steel Testing facility at NCB Ahmedabad Unit

Structural Assessment & Rehabilitation (SAR)

In-service structures require periodical assessment to judge whether they can perform satisfactorily for the intended service life. The distress in any form, such as cracks, spalling of concrete, corrosion of reinforcement, seepage, etc., reduces the safety and integrity of the structures under use. For health and condition assessment of structures, investigations are done to figure out the root cause of distress and formulate effective strategies for repair & rehabilitation along with strengthening if required. The

investigation process involves elaborate visual, information and documentation surveys, non-destructive evaluation techniques and collection of in-situ samples for laboratory assessment.

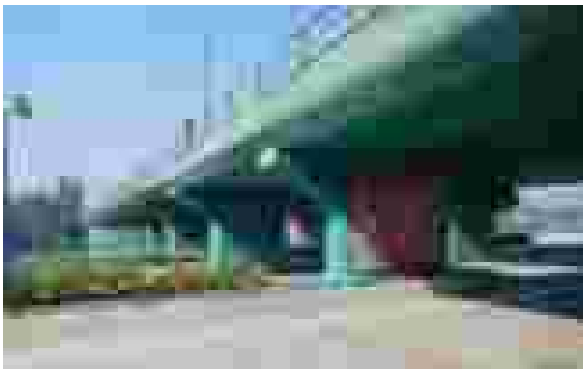
Under the umbrella of Structural Assessment and Rehabilitation Program, following activities and services related to assessment of new and existing concrete structures are carried out by NCB Ahmedabad unit:

- In-situ quality assessment, durability investigation and residual life assessment of concrete structures
- Non Destructive Testing (NDT) and pile integrity testing
- Distress investigations of buildings, bridges, dams, power plants, chimney, etc. deteriorated due to aggressive environment or fire damaged structure
- Consultancy for repairs/rehabilitation & retrofitting

Projects undertaken under this program

- Carrying out Condition Assessment using Non Destructive Evaluation Technique for various Structures (7 No's) at NID Campus, Ahmedabad.
- Carrying out Condition Assessment using Non Destructive Evaluation Technique for Stability of High Level Bridge at Rakholi on Silvassa Khanvel Main Road in the District of UT of D & NH.
- Carrying out Condition Assessment using Non Destructive Evaluation Technique for Stability of High Level Bridge at Athal on Silvassa Naroli Main Highway Road in the District of UT of D & NH.
- Stability survey report using Load bearing structural data and visual conditional Evaluation for Primary Health Center at Mandoni in in Dadra & Nagar Haveli.
- Stability survey report using Non Destructive Evaluation Technique for Police Outpost Sindoni in in Dadra& Nagar Haveli
- Stability survey report using Load bearing structural data and visual conditional of Existing building in the Government Land adjacent to the campus of Primary Health Centre at Naroli in Dadra & Nagar Haveli

A glimpse of Non Destructive Testing (NDT) carried out by NCB-Ahmedabad unit officials



Non-Destructive Testing at Athal Bridge at Silvassa

Non-Destructive Testing at Rakholi Bridge at Silvassa

Construction Technology and Management (CTM)

NCB Ahmedabad unit provides Third Party Quality Assurance services for a wide range of construction projects, built by the various central / state / autonomous organizations of Gujarat, Union Territory (UI) of Daman & Diu and Dadra and Nagar Haveli. The unit provides its customers with independent and impartial services that enable them to identify, manage and reduce risk. We provide transparent and unbiased inspection, testing, verification and certification solutions so customers can give assurance in their products, processes, systems and services. We ensure that quality of construction processes follow the latest national and international standards. Necessary advice for quality improvement are provided during inspection. NCB provides necessary technical support during the progress / completion of work and gives its recommendations with respect to the discrepancies found at time of inspection including the corrective measures / remedies so that discrepancies can be rectified / re-done.

Under construction technology and management program, the unit offers services for Technical Audit (TA), Quality Assurance & Quality Control (QA/QC) and Third Party Quality Audit (TPQA) of new constructions- residential, commercial & institutional buildings; flyovers, concrete roads, bridges, etc.

Projects undertaken under this program

- Third Party Inspection of Construction of Site Development & Miscellaneous Practice Ground at Swarnim Gujarat Sports University at Desar
- Third Party Inspection of Construction of University officer's and Staff Quarters at Swarnim Gujarat Sports University at Desar
- Third Party Inspection of Construction of Work Sports Climbing Wall at Naroda, Ahmedabad.
- Third Party Inspection of Construction of work Hostel at Gandhinagar.
- Third Party Inspection of Construction of Multipurpose hall, Swimming Pool and Synthetic Track at Desar, Dist: Vadodara for Swarnim Gujarat Sports University, Gujarat (Government of Gujarat).
- Third Party Inspection of Development of Sports Complex at Nadiad for Sports Authority of Gujarat -Gandhinagar (Government of Gujarat).
- Third Party Inspection of Construction of Sports Hostel at Vaghodia for Sports Authority of Gujarat -Gandhinagar (Government of Gujarat).
- Third Party Inspection of Construction of Administrative Building, Boys & Girls Hostel for SGSU at Desar for Swarnim Gujarat Sports University, Gujarat (Government of Gujarat).
- Third Party Inspection of Construction of V C Bunglow and Staff Quarter for Swarnim Gujarat Sports University at Desar (Government of Gujarat).
- Third Party Inspection of Construction of Gujarat Sahitya Akademi Bhavan at Gandhinagar (Government of Gujarat)
- Third Party Inspection and Monitoring of Construction of fly over Bridges at two major junctions of Ring Road stretches forming at Dokmaradi (Point F) on Silvassa Kilvani Road and at point c crossing Silvassa Sayali Road in UT of D & NH.

A glimpse of Third Party Inspection & Quality Assurance project at NCB-Ahmedabad

Sports Hostel at Vaghodia

Administration Building, Boys and Girls Hostel at Desar

Sports Hostel at Gandhinagar

Indoor Multipurpose Hall at Vaghodia (Vadodara)

Hostel Block at Nadiad

New Sports Complex at Nadiad

NCB Bhubaneswar

NCB Bhubaneswar

NCB Bhubaneswar established in 2016 and the laboratory was set up on in a space provided by IDCO at Mancheswar Industrial Estate as per the MoU (during 2016-21) signed between NCB and IDCO. NCB has established material testing laboratory in the above shed referred as Independent Testing Laboratory (ITL) NCB Bhubaneswar and the same has been accredited by NABL for both Mechanical & Chemical parameters in testing of building materials. Also, BIS certification of ITL under LRS is under process.

There are mainly four activities at NCB Bhubaneswar Unit viz.

1. Independent Testing Laboratory (ITL)
2. Third Party Quality Assurance (TPQA)
3. Structural Assessment and Rehabilitation (SAR)
4. R&D in utilization Industrial waste in constructions.

The above activities are illustrated below:

Independent Testing Laboratory (ITL):

ITL executes its activities in the areas of building materials testing from Industry sponsored projects. The Chemical Laboratory has been established to provide technical support to cement industries in Odisha and its neighboring states i.e. West Bengal, Jharkhand, Bihar, Chhattisgarh and States of North-East India.

Testing facilities available at ITL NCB Bhubaneswar are listed below:

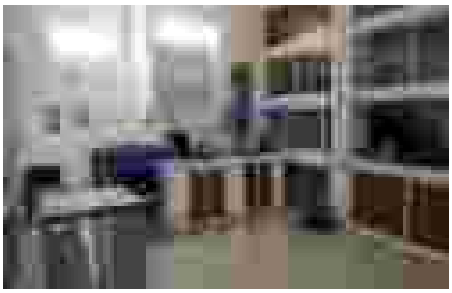
1] Mechanical Testing Laboratory of Building Materials

Mechanical Testing Laboratory for hydraulic cement, hardened concrete, building bricks (burnt cay &lime pulverized fuel ash), coarse aggregate, fine aggregate, soil, bituminous mix, tiles, granite, kotastone, marble, paver blocks, AAC blocks, etc.

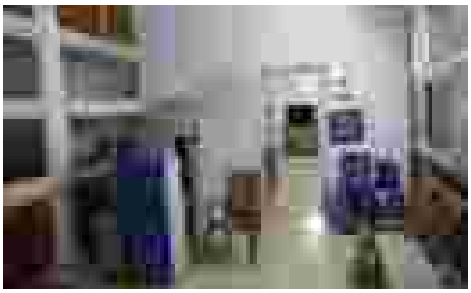
NABL Accreditation (TC-9004) obtained.

Testing services extended to customers including Odisha Industrial Infrastructure Development Corporation (IDCO). H&UD, OBCC, CPWD, NTPC, NBCC, Paradip Port Authority, Bridge & Roof, Rites etc and Cement Manufacturing plants in Odisha and neighboring states.

Mechanical & Chemical Laboratory NABL Accreditation:

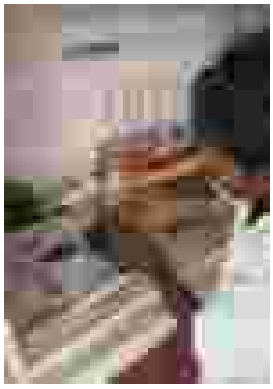


View of Cement Testing Laboratory



View of Concrete Testing Laboratory

Laboratory



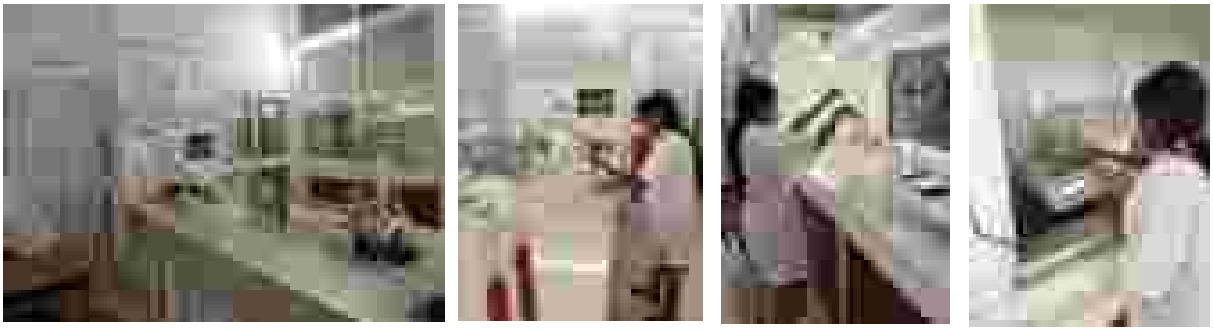
View of Soil Testing Area

View of Mechanical Testing Laboratory at ITL NCB Bhubaneswar

2] Chemical Testing Laboratory of Cement and Cementitious Materials

Chemical testing laboratory for hydraulic cement (OPC, PPC, PSC, Composite Cement), cementitious materials (Flyash, Slag), construction water, etc.

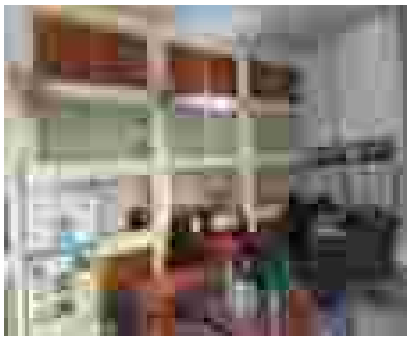
NABL Accreditation (TC-) obtained



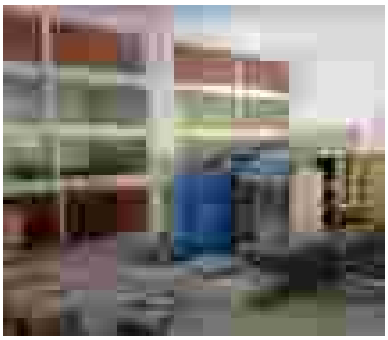
View of Chemical Testing Laboratory at ITL NCB Bhubaneswar

Renovation of old shed during Feb 2023, for use as laboratory facility

Front side view



Reception Area

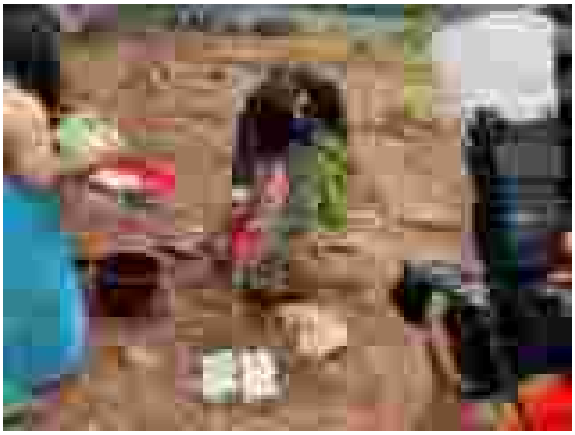


Concrete Testing Laboratory Area

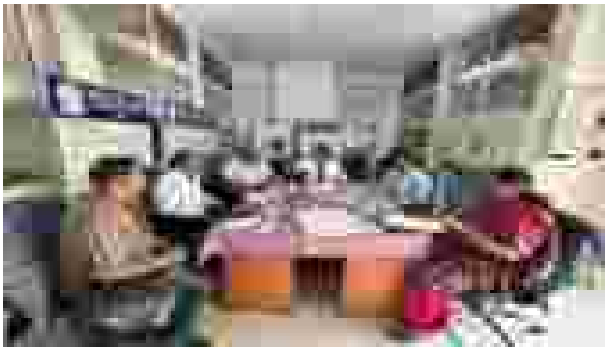
NCB Bhubaneswar Unit Expansion

During 2022 NCB has procured of about 1.0-acre land and Shed area of 3600 sqft. from IDCO at Govt. of Odisha rates for Construction of Research & Laboratory facility to setup full-fledged laboratory and office to provide technical services, testing and skill development to Cement Industries & construction sector in the state of Odisha and neighbouring states. Registration of allotted land was done on 05 Jan 2023.

Photos of Foundation Stone Laying for Construction of Research & Laboratory facility at NCB Bhubaneswar dt 23.10.2022:



Print Media Coverage Photos of Foundation Stone Laying at NCB Bhubaneswar Odisha:



1st BWC Meeting on 27.01.2023

Perspective view of the proposed Research & Laboratory building

Material testing in progress -Sponsors

- Cement Plants like Nuvoco, JSW, Sagar Cement.
- OSRTC
- H&UD, Odisha
- OBCC, Odisha
- BDA, Odisha
- NTPC Sipat
- NTPC Kaniha
- NBCC, Odisha
- Rites, Odisha

- Bridge & Roof, Odisha
- Paradip Port Authority, Odisha

TPQA Sponsored Projects in Progress

- Currently NCB Bhubaneswar is providing TPQA services to NBCC Odisha through MoU [For 5 Years w.e.f Aug 2022]
- TPQA Projects of M/s Paradip Port Trust Ltd, Odisha
- TPQA Projects of M/s OSRTC

R&D Sponsored projects in progress

Under project based support to Autonomous Institutions

- Stress-Strain Behavior of High-Performance Geo Polymer Self Compacting Concrete Mix and its performance evaluation.
  Start of Project: April 2023, Duration: 2 Years
  Project Proposed in association with KIIT [DU], Bhubaneswar

TPQA Ongoing Sponsored Projects

- Providing TPQA services to NBCC Odisha through MoU [For 5 Years w.e.f Aug 2022] for NBCC Odisha, TPQA Projects of M/s Paradip Port Trust, Odisha for PPA, Odisha and TPQA Projects of M/s OSRTC, Odisha

CRT Ongoing Sponsored Projects

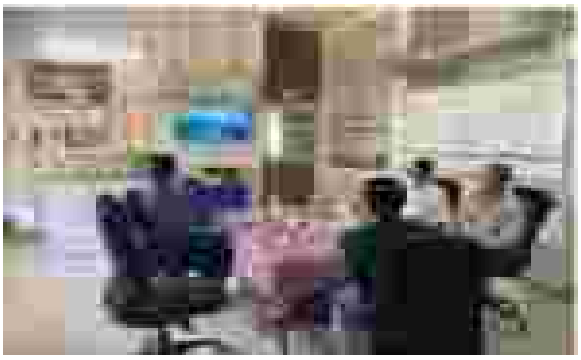
- Testing of Physical and Chemical parameters of Fly Ash of NTPC Kaniha, NTPC Sipat & Material Testing and CMP-Sagar Cements

SAR Ongoing Projects:

- ITOT, MSME, Bhubaneswar for CPWD Odisha

Completed Projects (FY 2022-23)

- SP-6409 State Level TPQA Team under pilot project for Housing and Urban Development (H&UD),Odisha, SP-6410 Material Testing and CMP ,NBCC Jajpur Project, SP-6408 Material Testing and CMP ,NTPC Kaniha Project, SP-6407 Material Testing and CMP ,NTPC Kaniha Project, Concrete Core Testing of CC road works under various ULB's of Odisha for HUDD, Odisha, Concrete Core Testing of Structural Elements of New office Building of NTPC Bhubaneswar, Odisha and Concrete Core Testing of CC roads of NTPC Dariapalli ,Odisha.



NCCBM's activity

Review and inspection of Records Management at NCCBM Bh

Review of NCB Special Cleanliness Drive by Sh. Suman Kumar, Under Secretary, DPIIT

Discussion regarding storage of files

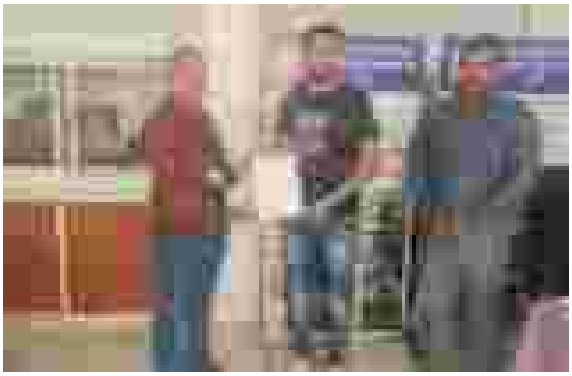
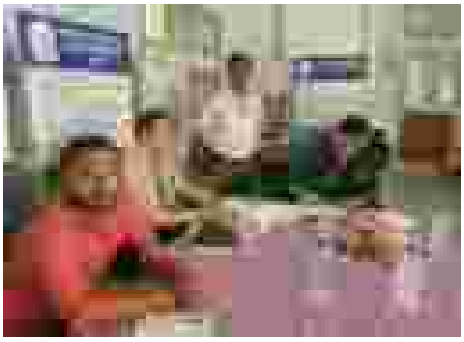
Visit to cement Mechanical Testing Laboratory

R & D Project at NCB Bhubaneswar (Under Progress):

- Project Name under RAC: BH-CON 01
  Stress -Stress –Strain Behavior of High Performance Geo Polymer Self Compacting Concrete Mix, Performance evaluation Concrete [HPGPSCC]- In association with KIIT, Bhubaneswar [School of Civil Engineering].

Student Internship Program at NCB Bhubaneswar -

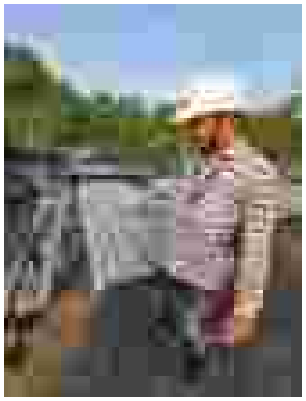
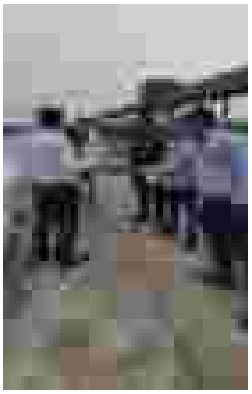
1 Month Student Internship Program was provided to total 7 Nos of Students of Civil Engineering of KiiT DU.

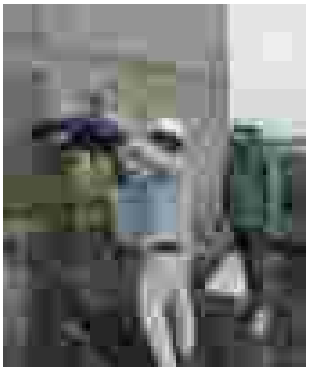
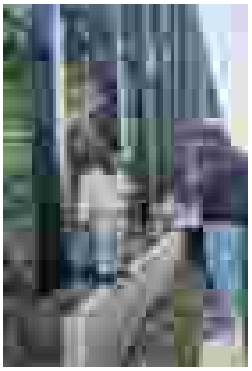
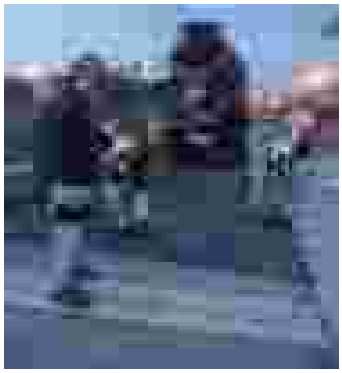



Visit of Sh Sunil Khandare Director, BEE, Ministry of Power on 18.01.2023

Photos of review meeting by DG - NCB

Sensitization and review by top management on cleanliness activities

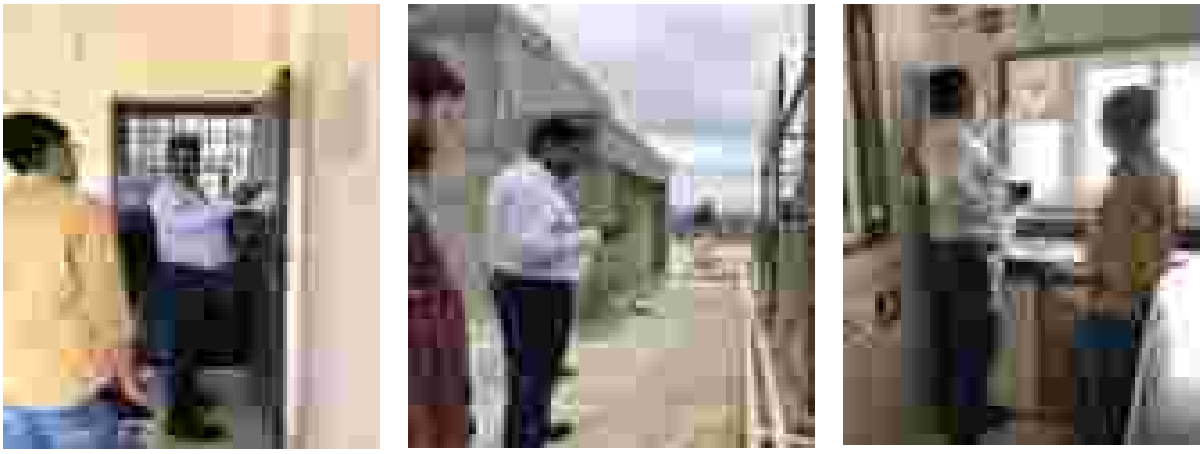



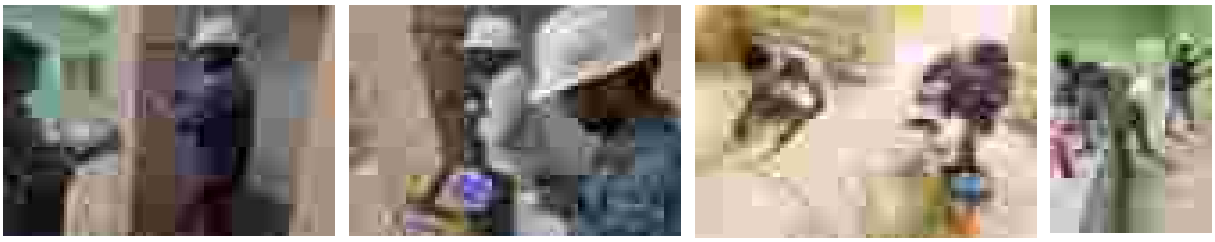
Photos of TPQA Site Inspection Project at Paradeep Port:

TPQA Site Inspection Project at NBCC Jaipur:

TPQA Site Inspection Project at CPWD Pune:



SAR(NDT) Testing of various projects:



Sample testing witnessing by party at NCB Bhubaneswar:

Independence Day at NCB Bhubaneswar:

Republic Day at NCB Bhubaneswar:

Published Research Papers

Published Research Papers

The following papers were contributed by NCB scientists in various Technical Journals/Magazines

Centre for Cement Research and Independent Testing – (CRT)

1. Synthesis of Mesoporous Phase Materials via Sol-gel Process using Indian Cementitious Raw material (2022) A. K.Dikshit*, K. Chugh, S.K.Chaturvedi and B. N.Mohapatra, Materials Today: Proceedings Journal (Elsevier) Vol.62,Part 2, 2022, 1132-1138.
2. Paper published: Characterization of Lime Sludge from Indian Paper Industry: A Step towards Sustainability Growth for Indian Cement Industry, International Journal of Science, Engineering and Management (IJSEM), ISSN 2456-1304, vol.9, issue 1,2022. Brijesh B Sahoo, A K Dikshit, V Liju, S K Gupta, S K Chaturvedi, B N Mohapatra, M K Gupta, A Dixit

Centre for Mining, Environment, Plant Engineering & Operation – CME

1. Kapil Kukreja, Manoj Kumar Soni, B. N. Mohapatra. System Design for Pre-Processing and Co-Processing of Alternative Fuels. Alternative Fuels – A green solution for Indian Cement Industry. National Council for Cement and Building Materials pg 71-107.
2. Kapil Kukreja, Manoj Kumar Soni, Mohan S. Nainegali, Bibekananda Mohapatra, Development of transfer chute design through Discrete Element Modelling for using Refused Derived fuel in Indian cement plants, Sustainable Energy Technologies and Assessments, Volume 53, Part B,2022,102567, ISSN 2213-1388, https://doi.org/10.1016/j.seta.2022.102567. (Impact factor: 7.632, SCI-E, Scopus)
3. Kapil Kukreja, Manoj Kumar Soni, Bibekananda Mohapatra, M V Ramachandra Rao. Decarbonizing of the Indian Cement Industry through Alternative Fuels-Challenge of Transfer Chute Jamming, Asian Journal of Water, Environment and Pollution (Scopus Indexed)-Accepted
4. Prateek Sharma, S., Sen, P. N. Sheth and B. N. Mohapatra (2022). "Multi-zone model of a refuse derived fuel gasification: A thermodynamic Semi-empirical approach. "Energy Conversion and Management 260: 115621. (Impact factor: 11.5)
5. Prateek Sharma, P. N. Sheth and B. N. Mohapatra (2023). "Co-processing of petcoke and producer gas obtained from RDF gasification in a white cement plant: A techno-economic analysis." Energy 265: 126248. (Impact factor: 7.2)
6. Prateek Sharma, P. N. Sheth and B. N. Mohapatra (2022). "Recent Progress in Refuse Derived Fuel (RDF) Co-processing in Cement Production: Direct Firing in Kiln/Calciner vs Process Integration of RDF Gasification." Waste and Biomass Valorization. 10.1007/s12649-022-01840-8. (Impact factor: 3.5)

Centre for Construction Development and Research – CDR

1. P N Ojha, Sumit Kumar, Puneet Kaura, Brijesh Singh and Pranay Singh, Experimental Investigation on Effect of Corrosion on Curvature-Ductility Relationship of RCC Member in Flexure, Journal of Building Materials & Structures, April 2022

2. P N Ojha, Puneet Kaura and Brijesh Singh, Durability Design of Reinforced Concrete Structures-National & International Scenario, CE&CR Magazine, April 2022

3. Amit Trivedi, P N Ojha, Abhishek Singh, Brijesh Singh, Shivang Bansal and Lopamudra Sengupta, Experimental Investigations On Mechanical Properties of Normal and High Strength High Calcium Geopolymer Concrete, Journal of Asian Concrete Federation, June 2022

4. Sanjay Mundra, TVG Reddy, Nitesh Kumar, Shivang Bansal & P N Ojha, A Case Study on Condition Assessment of Fire-Damaged RC Members of Turbo-Generator, Journal of Asian Concrete Federation, June 2022

5. P N Ojha, Brijesh Singh, Pranay Singh, Abhishek Singh and Manish Kumar Mandre, Study on effect of fly ash and limestone powder on compressive strength of roller compacted concrete for dam construction, Journal of Asian Concrete Federation, June 2022

6. Manjunath Pagadala, Sanjay Mundra & Shivang Bansal, Corrosion monitoring techniques for concrete in corrosive environments, Corrosion Reviews, July 2022

7. Brijesh Singh, P N Ojha, V V Arora, Pramod Narayan & Vikas Patel, Assessment of Material Properties of Concrete Gravity Dam-An Indian Case Study, Dam Engineering Journal, August 2022

8. P N Ojha, Pranay Singh, Brijesh Singh, Abhishek Singh, Amit Prakash, Amit Sagar, Stress-strain characteristics and energy absorption analysis of Construction and demolition waste recycled aggregate concrete in compression, August 2022

9. P N Ojha, Puneet Kaura, Suresh Kumar, Hardik Jain, Brijesh Singh, Piyush Mittal, Design of Low Carbon High Performance Concrete Incorporating Ultrafine Materials, Sustainable Structures and Materials, September 2022

10. Abhishek Singh, Brijesh Singh, P N Ojha, Amit Trivedi and Pranay Singh, Flexural and Fracture Performance of Geopolymer Concrete Cured Under Ambient Condition, CE&CR Magazine, September 2022

11. P N Ojha, Pranay Singh, Brijesh Singh, Abhishek Singh, Amit Sagar and Ravi Yadav, Statistical Characteristics of compressive strength of Normal & High strength concrete and concrete made with recycled aggregate, Revista Ingeniería de Construcción RIC Chillee, December 2022

12. P N Ojha, Brijesh Singh, Pranay Singh, Abhishek Singh, Piyush Mittal, Experimental Determination of Stress-Strain Characteristics of Very High Strength Unconfined Concrete in Compression Including Comparison with Normal and High Strength Concrete, Revista Ingeniería de Construcción RIC Chillee, December 2022

13. R Anwar, P N Ojha, Arup Ghatak, Brijesh Singh & V P Chatterjee, Investigation of Overburden Causing Rock Fall Near Nathpa Dam and Bhaba Tail Race Diversion Tunnel Pump House– A Case Study, Dam Engineering, December 2022

14. P N Ojha, Pranay Singh, Brijesh Singh, Empirical Equations for Prediction of Split Tensile and Flexural Strength Of High Strength Concrete Including Effect Of Steel Fiber, Research on Engineering Structures and Materials, February 2023

15. P N Ojha; Pranay Singh; Brijesh Singh; Abhishek Singh, Fracture behavior of hybrid fiber reinforced Normal strength and High strength concrete: comparison with Plain and steel fiber reinforced concrete, Research on Engineering Structures and Materials, February 2023

16. PN Ojha, Puneet Kaura, B N Mohapatra & Brijesh Singh, Management and Classification of Construction and Demolition Waste in India, Sustainable Structures and Materials, February 2023

17. P N Ojha, Abhishek Singh, Brijesh Singh, Subhadra Sen, Studies on PSC made with composite slag (mix of BF and LD slag), ACI Materials Journal, February 2023

18. B N Mohapatra, P N Ojha, Suresh Palla, S K Chaturvedi, GJ Naidu and Brijesh Singh, Investigation and Optimization of Cement Properties for Lower Water Demand and Higher Workability, CE&CR Magazine, February 2023

19. P N Ojha, Pranay Singh, Brijesh Singh, Abhishek Singh, Ajay, Amit Sagar, Experimental and FEM analysis for Fracture performance evaluation of Concrete made with recycled construction and demolition waste aggregates, Periodica Polytechnica Journal, March 2023

20. Puneet Kaura, P N Ojha & Brijesh Singh, Performance of High volume fly ash concrete in structural application, Journal of Building Materials & Structures, March 2023

Centre for Quality Management, Standards and Calibration Services – CQC

1. S K Shaw, Amit Trivedi, V Naga Kumar, A Agnihotri, Dr B N Mohapatra and CSIR Scientists: Ensuring the Quality of Cement and Building Materials for Civil Infrastructure. Publication of Handbook of Metrology and Applications, December 2022.

Papers Presented in Seminars and Workshops

Centre for Cement Research and Independent Testing – (CRT)

1. Investigation for the use of thermal power industrial waste Flue Gas Desulphurization Gypsum in cement as mineral gypsum replacement, G J Naidu, T M Rajan, Richa Mazumder, G Bhatnagar, O P Sharma, S K Chaturvedi, B N Mohapatra, 17th NCB International conference on Cement, concrete and building Materials, 06-09 Dec 2022, New Delhi.

2. Comparative study of Portland composite cement prepared with fly ash and different grades of limestone, V Liju, S Palla, S Vanguri, Puneet Sharma, S K Chaturvedi, B N Mohapatra, 17th NCB International conference on Cement, concrete and building Materials, 06-09 Dec 2022, New Delhi.

3. Enhancing fly ash utilization in portland pozzolana cement (PPC) beyond BIS limit of 35% using mechanical activation methodology, Varsha Liju, Suresh Palla, S K Chaturvedi, B N Mohapatra, N K Soni, Rajiv Satyakam, Pranay, A K Das, 17th NCB International conference on Cement, concrete and building Materials, 06-09 Dec 2022, New Delhi.

4. Study on the effect of accelerated carbonation on steel slag as a CO2 sequestering material through direct carbonation route, Richa Mazumder, Suresh Palla, Giasuddin Ahamed, Sandeep Gupta, Kalpana Sharma, S K Chaturvedi, B N Mohapatra, 17th NCB International conference on Cement, concrete and building Materials, 06-09 Dec 2022, New Delhi.

5. Effect of Physical, chemical and mineralogical properties of cement on the performance of concrete, B N Mohapatra, S K Chaturvedi, Richa Mazumder, Sandeep Gupta, 17th NCB International conference on Cement, concrete and building Materials, 06-09 Dec 2022, New Delhi.

6. A study on utilization of paper mill lime sludge in the manufacture of cement under circular economy, A K Dikshit, B B Sahoo, Varsha Liju, Munish Kumar, Ravindra Singh, S K Chaturvedi, 17th NCB International conference on Cement, concrete and building Materials, 06-09 Dec 2022, New Delhi.

7. Qualitative Aspects of Limestone Collected from Different Zones of India: Formulation of Portland Limestone Cement for Sustainable Development of Indian Cement Industries, Sandeep Kumar Gupta, Pinky Pandey, Ashish Goyal, S K Chaturvedi, B N Mohapatra, 17th NCB International conference on Cement, concrete and building Materials, 06-09 Dec 2022, New Delhi.

8. Estimation of OPC, fly ash and slag contents in blended and composite cements by selective dissolution method, Suresh Palla, Suresh Vanguri, Rashmi Gupta, S K Chaturvedi, B N Mohapatra, 17th NCB International conference on Cement, concrete and building Materials, 06-09 Dec 2022, New Delhi.

9. Estimation of Free Silica & Pyritic Sulphur in Limestone By XRD, Gaurav Bhatnagar, Suresh Palla, Mamta Pawar, Suresh Vanguri, G B Prasad, S K Chaturvedi, 17th NCB International conference on Cement, concrete and building Materials, 06-09 Dec 2022, New Delhi.

10. Correlation of Chemistry and Process Parameters on Formation of alite in Portland Clinker, Jaiprakash Varti, Suresh Palla, Suresh Vanguri, Ramchandra Rao, S K Chaturvedi and B N Mohapatra, 17th NCB International conference on Cement, concrete and building Materials, 06-09 Dec 2022, New Delhi.

11. A step towards synthesis of zeolite phases using Indian cementeceous raw materials: Fly Ash and Granulated blast furnace slag, A K Dikshit, Giasuddin Ahamed, Meenu Verma, S K Chaturvedi, 17th NCB International conference on Cement, concrete and building Materials, 06-09 Dec 2022, New Delhi.

12. Formulation of lignosulphonate by product for construction sector: In favour of sustainability and circular economy, A K Dikshit, B B Sahoo, Sandeep Gupta, S K Chaturvedi, 17th NCB International conference on Cement, concrete and building Materials, 06-09 Dec 2022, New Delhi.

Centre for Mining, Environment, Plant Engineering & Operation – CME

1. K.P.K Reddy, Prateek Sharma, Kapil Kukreja, Ankur Mittal, D K Panda, B.N. Mohapatra, "Refuse Derived Fuel (RDF) co-processing in kiln main burner in a Cement Plant: A Case Study". 17th NCB International Conference on Cement, Concrete and Building Materials, 06-09 December 2022, New Delhi

2. Anil Kumar Popuri, K.P.K Reddy, Saurabh Bhatnagar and Sandip Samanta, "Optimization of Cement mill VRM: A Case Study". 17th NCB International Conference on Cement, Concrete and Building Materials, 06-09 December 2022, New Delhi.

3. Kapil Kukreja, Manoj Kumar Soni, Bibekananda Mohapatra, Soubhagya Ranjan. "Right Approach for Chute Design-Handling Alternative Fuels". 17th NCB International Conference on Cement, Concrete and Building Materials, 06-09 December 2022, New Delhi

4. Kapil Kukreja, Prateek Sharma, S K Chaturvedi, D K Panda and Bibekananda Mohapatra, "Potential use of paddy stubble as an energy source in Indian Cement Industry". 17th NCB International Conference on Cement, Concrete and Building Materials, 06-09 December 2022, New Delhi

5. Kapil Kukreja, Anand Bohra, "Coal vs Renewable Energy based electrical power generation in India - Analysis of future scenario for cement industry", 3rd Virtual Global CemEnergy Seminar, May 2022

6. K.P.K Reddy, Prateek Sharma, Kapil Kukreja, Ankur Mittal, D K Panda, B.N. Mohapatra, "Refuse Derived Fuel (RDF) co-processing in kiln main burner in a

Cement Plant: A Case Study". 17th NCB International Conference on Cement, Concrete and Building Materials, 06-09 December 2022, New Delhi

7. Anil Kumar Popuri, K.P.K Reddy, Saurabh Bhatnagar and Sandip Samanta, "Optimization of Cement mill VRM: A Case Study". 17th NCB International Conference on Cement, Concrete and Building Materials, 06-09 December 2022, New Delhi.

8. Bibekananda Mohapatra, S. K. Chaturvedi, Anand Bohra, "Transition from Linear to Circular Economy in Gypsum in India". 17th NCB International Conference on Cement, Concrete and Building Materials, 06-09 December 2022, New Delhi.

9. Dr B N Mohapatra, S K Chaturvedi, P N Ojha, Brijesh Singh, Anand Bohra, "Role of Carbon Capture and Utilization (CCU) for Decarbonization of Cement Industry". 17th NCB International Conference on Cement, Concrete and Building Materials, 06-09 December 2022, New Delhi.

10. Dr Bibekananda Mohapatra, Dr S K Chaturvedi, Anand Bohra, Dr Varsha Liju, "Impact of Low Carbon Cements on Carbon Footprint of Indian Cement Industry". 17th NCB International Conference on Cement, Concrete and Building Materials, 06-09 December 2022, New Delhi.

11. Prateek Sharma, Pratik N Sheth & B.N. Mohapatra: Parametric investigation on Refuse derived fuel gasification in a downdraft gasifier, International conference on Sustainable Energy and Clean Technologies (ICSECT-22), Gandhinagar, Gujarat, 2022

12. Prateek Sharma, Pratik N Sheth & B.N. Mohapatra: Chemical Characterization of Refuse Derived Fuel (RDF) using Py-GC/MS, International Conference on technological interventions for sustainability (CHEM-CONFLUX22), 2022

13. Prateek Sharma, Pratik N Sheth & B.N. Mohapatra: Modelling and experimental studies for process integration of RDF gasification in cement manufacturing process, 17th NCB International conference on Cement, Concrete and Building Materials, New Delhi, 2022

14. Kapil Kukreja, Prateek Sharma, S K Chaturvedi, D K Panda and Bibekananda Mohapatra, Techno Economic Analysis for Co-processing of paddy stubble as an alternative fuel in Indian cement industry, 17th NCB International Conference on Cement, Concrete and Building Materials

15. Bibekananda Mohapatra, Prateek Sharma, Kapil Kukreja, S K Chaturvedi & Pratik N Sheth: Potential use of paddy stubble as an energy source in Indian cement industry, 8th International Conference on Advances in Energy Research, IIT Bombay, 2022.

Appreciation / recognition received

16. **Best Paper award** - Prateek Sharma, Pratik N Sheth & B.N. Mohapatra: Parametric investigation on Refuse derived fuel gasification in a downdraft gasifier, International conference on Sustainable Energy and Clean Technologies (ICSECT-22), Gandhinagar, Gujarat, 2022

Centre for Construction Development and Research – CDR

1. P N Ojha, Brijesh Singh, Abhishek Singh, Puneet Kaura, B N Mohapatra, Valorization Strategy for Utilisation of Ash Generated from Thermal Power Plants in India, "Valorisation of Fly Ash and Steel Slag: Challenges, Innovations, and Future Trends", 22-23 Sept 2022 at Beldih Club, Jamshedpur, India

2. P N Ojha, Abhishek Singh, Brijesh Singh, Puneet Kaura, B N Mohapatra, Current Trends and future_utilization potential of iron and_steel slag in cement and construction industry, "Valorisation of Fly Ash and Steel Slag: Challenges, Innovations, and Future Trends", 22-23 Sept 2022 at Beldih Club, Jamshedpur, India

3. P N Ojha, Brijesh Singh, Abhishek Singh & Suresh Kumar, Material Selection & Quality Requirements for Repair of Abrasion and Erosion Damaged Hydraulic Structure, International Conference on Dam Safety being organized by INCOLD at Jaipur, 10-12 October, 2022 Jaipur, India

4. P N Ojha, Brijesh Singh, Abhishek Singh, Amit Sagar, Amit Prakash & Ravi Yadav, Comparison of Creep Coefficient of Normal, High and Ultra-High Performance Concrete, 17th NCB International Conference on Cement, Concrete and Building Materials, 06-09 December 2022, Manekshaw Centre, New Delhi, India

5. Brijesh Singh, P N Ojha, Amit Sagar, Abhishek Singh, Pranay Singh & Ravi Yadav, Effect of Curing Regime On Compressive Strength of Ultra-High Strength Concrete, 17th NCB International Conference on Cement, Concrete and Building Materials, 06-09 December 2022, Manekshaw Centre, New Delhi, India

6. Manish Mandre, Brijesh Singh, Amit Trivedi, P N Ojha, B N Mohapatra, Mix Optimization for Development of 3D Printed Concrete, 17th NCB International Conference on Cement, Concrete and Building Materials, 06-09 December 2022, Manekshaw Centre, New Delhi, India

7. Amit Trivedi, Brijesh Singh, Abhishek Singh, P N Ojha, Dinesh Kumar, Shear Behaviour of Reinforced Alkali Activated Slag and Fly ash Concrete under Ambient Curing: Comparison with OPC based concrete, 17th NCB International Conference on Cement, Concrete and Building Materials, 06-09 December 2022, Manekshaw Centre, New Delhi, India

8. Rizwan Anwar, P N Ojha, Nitin Chowdhary, Brijesh Singh, Adarsh Kumar NS, Condition Assessment of Reinforced Concrete Members of a Fire Damaged Structure – A Case Study, 17th NCB International Conference on Cement, Concrete and Building Materials, 06-09 December 2022, Manekshaw Centre, New Delhi, India

9. P N Ojha, Abhishek Singh, Brijesh Singh, Amit Trivedi & Puneet Kaura, Recent Research On Iron, Steel, Copper and Ferrochrome Slag for Utilization in Construction Industry, 17th NCB International Conference on Cement, Concrete and Building Materials, 06-09 December 2022, Manekshaw Centre, New Delhi, India

10. B N Mohapatra, S K Chaturvedi, P N Ojha, Brijesh Singh, Anand Bohra, Role of carbon capture and utilisation (CCU) for decarbonisation of Cement Industry, 17th NCB International Conference on Cement, Concrete and Building Materials, 06-09 December 2022, Manekshaw Centre, New Delhi, India

11. Puneet Kaura, P N Ojha & Hardik Jain, Mechanical and Durability Performance of Portland Limestone Cement (PLC) Made with Intergrinding Having High Fineness Limestone in Concrete, 17th NCB International Conference on Cement, Concrete and Building Materials, 06-09 December 2022, Manekshaw Centre, New Delhi, India

12. Arup Ghatak, P N Ojha, Sanjay Mundra & Rizwan Anwar, Review of Design Considerations for Cathodic Protection & Case Study of Design of CP with Galvanic Anodes for Reinforced Concrete, 17th NCB International Conference on Cement, Concrete and Building Materials, 06-09 December 2022, Manekshaw Centre, New Delhi, India

13. Brijesh Singh, P N Ojha & Puneet Kaura, Assessment of Mechanical Properties and Microstructural Investigation of Concrete for Aged Dams, CSIR-CBRI: National Workshop and Exhibition on Innovative & Sustainable Construction Materials & Technologies (ISCMT2023), 6 January 2023, New Delhi, India

14. Brijesh Singh, P N Ojha, Amit Sagar & Abhishek Singh, Influence of Mixing Procedure and Curing Regime On Compressive Strength of Normal Strength and Reactive Powder Concrete, CSIR-CBRI: National Workshop and Exhibition on Innovative & Sustainable Construction Materials & Technologies (ISCMT2023), 6 January 2023, New Delhi, India

15. Puneet Kaura, P N Ojha & Brijesh Singh, Impact of mechanical treatment on properties and performance of coarse recycled aggregate, CSIR-CBRI: National Workshop and Exhibition on Innovative & Sustainable Construction Materials & Technologies (ISCMT2023), 6 January 2023, New Delhi, India.

Centre for Quality Management, Standards and Calibration Services – CQC

1. "Development of CRM – Targeting Quality Product and Excellency in Competency" by S K Shaw, V Naga Kumar, A Agnihotri, Amit Trivedi in 17th NCB International Conference, 06-09 December 2022.

2. "Implementation of Total Quality Management in NCB" by B N Mohapatra, Amit Trivedi, S K Shaw, P Srikant, Anand Bohra, KRP Nath in 17th NCB International Conference, 06-09 December 2022.

3. "Significance of Intermediate Checks of Equipment and Exploration of Various Intermediate Techniques" by P Srikanth, V Naga Kumar, Bharat Ram, Rishi Raj, Amit Trivedi in 17th NCB International Conference, 06-09 December 2022

Publication & Membership of Technical Committees

Representation of NCB Officials in Various Technical Committees

NCB is actively involved with a large number of overseas and Indian organizations in formulating and revising standards and policies through membership or otherwise. The Director General and other officials continued to serve on a number of committees constituted by the Government of India, the Bureau of Indian Standards and other organizations as follows:

Dr. B N Mohapatra, Director General (upto 31st March 2023)

a. Member of Civil Engineering Divisional Council (CEDC) of Bureau of Indian Standards (BIS), Govt. of India

b. Chairman of Cement Sectoral Committee of Bureau of Energy Efficiency (BEE), Govt. of India.

c. Member of Expert Appraisal Committee-Industry-1 sector by Ministry of Environment, Forest and Climate Change (MOEF&CC), Govt. of India

d. Member of Committee for Sustainability of fly ash management system by Central Pollution Control Board (CPCB), Govt. of India

e. Member of Working Group on Carbon Capture and Utilization (CCU) of NITI Aayog, Govt. of India

f. Member of Committee on Circular Economy in Gypsum by DPIIT, Govt. of India

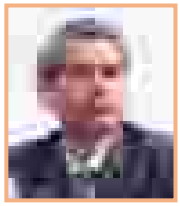
g. Member of Research Advisory Committee of CSIR-National Physical Laboratory

h. Member of Research Advisory Committee at DISIR (Dalmia institute of Scientific and Industrial Research, Odisha)

i. Member of Academic Council of AKS University Satna

j. Member of Board of Studies of Khallikote Autonomous College Brahmapur

Dr. S K Chaturvedi, Joint Director



a. Member, Cement and Concrete Sectional Committee (CED 2), Bureau of Indian Standards, New Delhi.

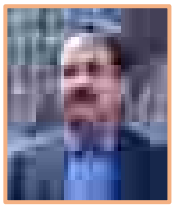
b. Member, Panel for work relating to ISO/TC71 and ISO/TC74 (CED2/P1), Bureau of Indian Standards, New Delhi.

c. Member, Cement, Pozzolana and Cement Additives Subcommittee (CED 2:1), Bureau of Indian Standards, New Delhi.

d. Member, Panel for Revision of Cement Standards (CED 2:1/P1), Bureau of Indian Standards, New Delhi.

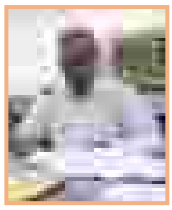
e. Member, Refractories Sectional Committee (MTD 15), Bureau of Indian Standards, New Delhi.

Dr. D K Panda, Joint Director



a. Member, Stones Sectional Committee (CED 6), Bureau of Indian Standards, New Delhi.

Sh. P N Ojha, Joint Director



a. Member, CIVIL Engg. Divisional Council (CEDC), Bureau of Indian Standards, New Delhi.
b. Member, Panel for Revision of Handbooks (CED 2/P2), Bureau of Indian Standards, New Delhi.
c. Member, Concrete Sub Committee (CED 2:2), Bureau of Indian Standards, New Delhi.
d. Member, Panel for Revision of IS: 456 and IS: 1343 (CED 2:2/P5), Bureau of Indian Standards, New Delhi.
e. Member, Cement Matrix Products Sectional Committee (CED 53), Bureau of Indian Standards, New Delhi.
f. Member, Fibre Reinforced Cement Product Sub Committee (CED 53:1), Bureau of Indian Standards, New Delhi.
g. Member, Cement and Concrete Sectional Committee (CED 2), Bureau of Indian Standards, New Delhi.
h. Member, Panel for work relating to ISO/TC71 and ISO/TC74 (CED2/P1), Bureau of Indian Standards, New Delhi.
i. Member, Panel for Aggregates from other than Natural Sources (CED 2/P3), Bureau of Indian Standards, New Delhi.
j. Member, Panel for Revision of Cement Standards (CED 2:1/P1), Bureau of Indian Standards, New Delhi.
k. Member, Panel for Revision of IS 457 (CED 2:2/P6), Bureau of Indian Standards, New Delhi.
l. Member, Panel for Revision of Indian Standards on Test Methods for Concrete (CED 2:2/P7), Bureau of Indian Standards, New Delhi
m. Member, Cement, Pozzolana and Cement additives Subcommittee (CED 2:1), Bureau of Indian Standards, New Delhi.
n. Convenor, Panel for Revision of IS 2386 (CED 2:2/P10), Bureau of Indian Standards, New Delhi.
o. Member, Structural Safety Sectional Committee (CED 37), Bureau of Indian Standards, New Delhi.
p. Member, Earthquake Engineering Sectional Committee (CED 39), Bureau of Indian Standards, New Delhi.

q. Member, National Building Code Sectional Committee (CED 46), Bureau of Indian Standards, New Delhi.

r. Member, Panel for Administration, Development Control Rules and General Buildings (CED 46:P1), Panel for Fire protection (CED 46:P2), Panel for Building Materials (CED 46:P3), Panel for Load, Forces and Effects (CED 46:P4), Panel for Soil and Foundation/Panel for Plain Reinforced & Pre-stressed Concrete (CED 46:P5) and Panel for Plain Reinforced & Pre-stressed Concrete (CED 46:P8), Bureau of Indian Standards, New Delhi.

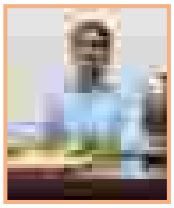
s. Member, Planning, Housing and Prefabricated Construction Sectional Committee (CED 51), Bureau of Indian Standards, New Delhi.

t. Member, Precast Concrete Products Sub Committee (CED 53), Bureau of Indian Standards, New Delhi.

u. Member, Concrete Reinforcement Sectional Committee (CED 54), Bureau of Indian Standards, New Delhi.

v. Member CED 32, Code for Precast Concrete & 3D Printing, Bureau of Indian Standards, New Delhi.

Sh. Amit Trivedi, Joint Director



a. Member, Panel for work relating to ISO/TC71 and ISO/TC74 (CED2/P1), Bureau of Indian Standards, New Delhi.

b. Member, Panel for Aggregates from other than Natural Sources (CED 2/P3), Bureau of Indian Standards, New Delhi.

c. Member, Panel for Revision of IS 3370 (Part I & Part II) (CED 2:2/P1), Bureau of Indian Standards, New Delhi.

d. Member, Flooring, Wall Finishing and Roofing Sectional Committee (CED 5), Bureau of Indian Standards, New Delhi.

e. Member, National Building Code Sectional Committee (CED 46), Bureau of Indian Standards, New Delhi.

f. Member, Panel for Administration, Development Control Rules and General Buildings (CED 46:P1), Panel for Soil and Foundation/Panel for Plain Reinforced & Pre-stressed Concrete (CED 46:P5), Panel for Masonry (CED 46:P7), Panel for Prefabrication and Systems Building (CED 46:P10), Bureau of Indian Standards, New Delhi.

g. Member, Planning, Housing and Prefabricated Construction Sectional Committee (CED 51), Bureau of Indian Standards, New Delhi.

h. Member, Cement Matrix Products Sectional Committee (CED 53), Bureau of Indian Standards, New Delhi.

i. Member, Concrete Pipes Sub Committee (CED 53:2), Bureau of Indian Standards, New Delhi.

j. Member, Precast Concrete Products Sub Committee (CED 53:3), Bureau of Indian Standards, New Delhi.

k. Member, Concrete Reinforcement Sectional Committee (CED 54), Bureau of Indian Standards, New Delhi.

l. Member, Laboratory and RAMCO subcommittee, Bureau of Indian Standards, New Delhi.

m. Member, Laboratory Subcommittee and CASCO, Bureau of Indian Standards, New Delhi

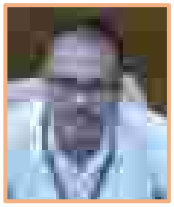
n. Member, Code of Precast Concrete & 3D Printing, CED 32, Bureau of Indian Standards, New Delhi.

o. Member - Sub-committee 3 of CASCO-National Mirror Committee, Bureau of Indian Standards, New Delhi.

p. Member - MSD 20-Reference Materials Sectional Committee, REMCO, Bureau of Indian Standards, New Delhi.

q. Member - Laboratory and RAMCO subcommittee, Bureau of Indian Standards, New Delhi.

Sh. B P Ranga Rao, Joint Director



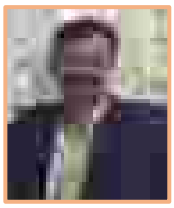
a. Member, Flooring, Wall Finishing and Roofing Sectional Committee (CED 5), Bureau of Indian Standards, New Delhi.

b. Member, Panel for Prefabrication and Systems Building (CED 46:P10), Bureau of Indian Standards, New Delhi.

c. Member, Water Proofing and Damp Proofing Sectional Committee (CED 41), Bureau of Indian Standards, New Delhi.

d. Member, SSD-06, Construction and related engineering services sectional committee, Bureau of Indian Standards, New Delhi

Sh. G J Naidu, General Manager



a. Member, Panel for Fire protection (CED 46:P2), Bureau of Indian Standards, New Delhi.

b. Member, Sieves, Sieving and other Sizing Methods Sectional Committee (CED 55), Bureau of Indian Standards, New Delhi.

Dr. Sanjay Mundra, General Manager

a. Member, Flooring, Wall Finishing and Roofing Sectional Committee (CED 5), Bureau of Indian Standards, New Delhi.

b. Member, Concrete Pipes Sub Committee (CED 53:2), Bureau of Indian Standards, New Delhi.

Sh. B S Rao, General Manager

a. Member, Panel for Masonry (CED 46:P7), Bureau of Indian Standards, New Delhi.

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a. Member (Young Professional), Cement and Concrete Sectional Committee (CED 2), Bureau of Indian Standards, New Delhi.

b. Member, Cement, Pozzolana and Cement additives Subcommittee (CED 2:1), Bureau of Indian Standards, New Delhi.

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d. Member, Panel for Revision of IS: 456 and IS: 1343 (CED 2:2/P5), Bureau of Indian Standards, New Delhi.

e. Member, Panel for Revision of Indian Standards on Test Methods for Concrete (CED 2:2/P7), Bureau of Indian Standards, New Delhi

f. Member, Structural Safety Sectional Committee (CED 37), Bureau of Indian Standards, New Delhi.

g. Member, Earthquake Engineering Sectional Committee (CED 39), Bureau of Indian Standards, New Delhi

h. Member, Panel for Fire protection (CED 46:P2), Member, Panel for Load, Forces and Effects (CED 46:P4), Panel for Plain Reinforced & Pre-stressed Concrete (CED 46:P8), Bureau of Indian Standards, New Delhi.

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j. Member, Concrete Reinforcement Sectional Committee (CED 54), Bureau of Indian Standards, New Delhi.

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Sh Manish Kumar Mandre, Group Manager

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b. Member, Code of Precast Concrete & 3D Printing, CED 32, Bureau of Indian Standards, New Delhi.

Sh Mantu Gupta, Group Manager

a. Member, Panel for Revision of IS 457 (CED 2:2/P6), Bureau of Indian Standards, New Delhi.

b. Member working group for revision of IS: 6491 Method of Sampling of Flyash

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d. Member, Solid Waste Management (CHD 33)

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b. Member, Coke Sub Committee (PCD 7:2), Bureau of Indian Standards, New Delhi.

c. Member, Coal Sub Committee (PCD 7:3), Bureau of Indian Standards, New Delhi.

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Sh. Suresh Kumar Shaw, Group Manager

a. Member - MSD 20-Reference Materials Sectional Committee, REMCO, Bureau of Indian Standards, New Delhi.

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Sh Suresh Kumar, Manager

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c. Member, Panel for Revision of IS 2386 (CED 2:2/P10), Bureau of Indian Standards, New Delhi.

d. Member Working group (WG-2) of IS:456-2000

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Sh Y N Daniel, Manager

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Sh Rizwan Anwar, Manager

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a. Member, Cement Matrix Products Sectional Committee (CED 53), Bureau of Indian Standards, New Delhi.

Sh. Anand Bohra, Manager

a. Member, Environmental Protection and Waste Management Sectional Committee (CHD 32), Bureau of Indian Standards, New Delhi.

b. Member, Environmental Management Sectional Committee (CHD 34), Bureau of Indian Standards, New Delhi.

c. Member, Air Quality Sectional Committee (CHD 35), Bureau of Indian Standards, New Delhi.

d. Member, Environmental Services Sectional Committee: SSD 07, Bureau of Indian Standards, New Delhi

e. Member, Working Group on Phosphogypsum, DPIIT, Ministry of Commerce & Industry, Govt. of India

f. Member, Working Group on FGD Gypsum, DPIIT, Ministry of Commerce & Industry, Govt. of India

Sh. Saurabh Bhatnagar, Manager

a. Member, Construction Plant and Machinery Sectional Committee (MED 18), Bureau of Indian Standards, New Delhi.

b. Member, Bulk Handling Systems and Equipment Sectional Committee (MED 7), Bureau of Indian Standards, New Delhi.

Sh. K R P Nath, Manager

a. Member, Air Quality Sectional Committee (CHD 35), Bureau of Indian Standards, New Delhi.

b. Member, Environmental Services Sectional Committee: SSD 07, Bureau of Indian Standards, New Delhi

Sh. K P K Reddy, Manager

a. Member, Environment Protection Sectional Committee (CHD 32), Bureau of Indian Standards (BIS).

Sh. Prateek Sharma, Manager

a. Member, Environmental Management Sectional Committee (CHD 34), Bureau of Indian Standards, New Delhi.

b. Member, Solid Waste Management (CHD 33)

Sh. P Srikanth, Manager

a. Member, Laboratory and RAMCO subcommittee, Bureau of Indian Standards, New Delhi.

Sh. Nikhil Kaushik, Manager

a. Member, Panel for Revision of IS 2386 (CED 2:2/P10), Bureau of Indian Standards, New Delhi.

Sh. Giasuddin Ahamed, Manager

a. Refractories Sectional Committee (MTD 15), Bureau of Indian Standards, New Delhi.

Sh. V Naga Kumar, Manager

a. Member - Sub-committee 3 of CASCO-National Mirror Committee, Bureau of Indian Standards, New Delhi.

Sh. Abhishek Agnihotri, Deputy Manager

a. Member - Sub-committee 3 of CASCO-National Mirror Committee, Bureau of Indian Standards, New Delhi.

Sh. Gaurav Bhatnagar, Assistant

a. Member, Solid Mineral Fuels Sectional Committee (PCD 07), Bureau of Indian Standards, New Delhi.

b. Member, Coke Sub Committee (PCD 7:2), Bureau of Indian Standards, New Delhi.

c. Member, Coal Sub Committee (PCD 7:3), Bureau of Indian Standards, New Delhi.

d. Member, Coal serving as member Beneficiation & Lignite Sub Committee (PCD 7.6 and PCD 7.9), Bureau of Indian Standards (BIS)

Finance and Accounts

FINANCE

CONTRIBUTIONS

Ministry of Commerce & Industry Grant

During the year 2022-23, Grant of Rs. 21.50 Crores received.

FOREIGN EXCHANGE

During the year 2022-23, the Council earned Foreign Exchange amounting to US$ 148981 towards Training Fee, Testing Charges, Sponsored R & D, Seminar, Delegate Fee, Technical Exhibition Etc.

AUDITORS

M/s P C Chhajed & Co. Chartered Accountants, New Delhi were the Auditors of the Council for the year 2022-23.

ACCOUNTS

The Accounts for the 2022-23 duly audited by the Auditors of the Council are given at Annexure (Balance Sheet as at 31st March 2023 and Income & Expenditure Accounts for the year ended 31st March 2023).

INDEPENDENT AUDITORS' REPORT

To

The Members of National Council for Cement and Building Materials

Opinion

We have audited the accompanying financial statements of **National Council for Cement and Building Materials** ("the entity"). Which comprise the Balance Sheet as at March 31, 2023 and Income and Expenditure Account for the year then ended, and notes to accounts including a summary of significant accounting policies.

In our opinion and to the best of our information and according to the explanations given to us, the aforesaid financial statements give a true and fair view of the financial position of the entity as at March 31, 2023, and of its financial performance for the year then ended in accordance with the accounting standards issued by the Institute of Chartered Accountants of India (ICAI).

Basis of Opinion

We conducted our audit in accordance with the Standards on Auditing (SAs) issued by the Institute of Chartered Accountants of India (ICAI). Our responsibility under those standards are further described in the, "Auditor's Responsibility for the Audit of the Financial Statements" section of our report. We are independent of the entity in accordance with the code of Ethics issued by the ICAI and we have fulfilled our other ethical responsibilities in accordance with the code of ethics. We believe that the audit evidence we have obtained is sufficient and appropriate to provide the basis for our opinion.

Responsibilities of Management and Those Charged with Governance for the Financial Statements

Management is responsible for the preparation of these financial statements that give a true and fair view of the state of affairs, results of operations and cash flows of the entity in accordance with the Generally Accepted Accounting Principles in India. This responsibility includes the design implementation and maintenance of internal control relevant to the preparation and presentation of the financial statements that give a true and fair view and are free from material misstatement, whether due to fraud or error.

In preparing the financial statements, management is responsible for assessing the entity's ability to continue as going concern, disclosing as applicable, matters related to going concern and using the going concern basis of accounting unless management either intends to liquidate the entity or to cease operations, or has no realistic alternative but to do so.

Those Charged with Governance are responsible for overseeing the entity's financial reporting process.

Auditors' Responsibilities for the Audit of Financial Statements

Our objectives are to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with SAs will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of these financial statements.

We further report that:

(a) We have obtained all the information and explanations which to the best of our knowledge and belief were necessary for the purpose of audit.

(b) In our opinion proper books of account as required by law have been maintained by the entity as far as appears from our examination of these books.

(c) The Balance Sheet and Income and Expenditure Account dealt with by this report are in agreement with the books of account.

For P C Chhajed & Co.
Chartered Accountants
Firm Registration No. 101800W

CA Gaurav Singh
Partner
Membership No. 545179
UDIN: 23545179BGPEOZ4272

Place: New Delhi
Date: October 27th, 2023

NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS

BALANCE SHEET AS AT MARCH 31, 2023

	Schedules		As at March 31, 2023		As at March 31, 2022
SOURCES OF FUNDS					
Capital Fund	A	68,076,146		68,076,146	
Reserves and Surplus	B	1,959,003,584		1,735,146,794	
Building Fund		4,500,000		4,500,000	
Gratuity Fund		91,295,257		90,843,144	
Provision For Leave Encashment		167,292,869		165,253,452	
Capital Grant from Govt of India	C	317,935,192		337,793,680	
Current Liabilities & Provisions	D	132,024,091	2,740,127,139	139,627,096	2,541,240,312
Total			**2,740,127,139**		**2,541,240,312**
APPLICATION OF FUNDS					
Fixed Assets					
Gross Block	E	974,334,252		928,730,929	
Less : Accumulated Depreciation		592,238,939	382,095,313	561,871,628	366,859,301
Lab Equipment Under Inspection			10,812,699		10,168,465
Gratuity Fund Investment					
(Fixed Deposit / Savings Bank / Interest Accrued)		148,526,058		231,230,074	
Leave Fund account		81,169,951		77,583,426	
Current Assets Loans & Advances					
R&D Contribution Outstanding		97,857,485		99,682,070	
Sundry Debtors	F	39,291,525		34,910,914	
Loans and Advances (unsecured and considered good)		105,661,307		122,685,593	
Cash and Bank Balances	G	1,818,147,971	2,290,654,297	1,558,196,077	2,124,288,154
FDR In lien			14,072,345		13,591,013
Interest Accrued on Bank Deposits			42,492,485		26,333,379
Total			**2,740,127,139**		**2,541,240,312**
Significant Accounting Policies	M				
Notes on Accounts	N				

The Schedules referred to above form an integral part of the Balance Sheet. This is the Balance Sheet referred to in our report of even date.

For and on behalf of
P C Chhajed & Co.
Chartered Accountants
Firm Registration no.: 101800W

Dr Sanjay Mundra
General Manager

Dr L P SINGH
Director General

CA Gaurav Singh
Partner
M.No. 545179
New Delhi
Date:

Shri K C Jhanwar
Chairman -NCB

NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED MARCH 31, 2023

			For the Year ended 31 March 2023		For the Year ended 31 March 2022
INCOME					
Research & Development Contribution	H		288,325,037		238,545,149
Other Income	I		117,483,897		109,683,739
Grant-in-Aid (Revenue) from Ministry of Commerce & Industry	J		215,000,000		170,500,000
			620,808,935		**518,728,887**
EXPENDITURE					
Employee's Cost	K		304,690,284		321,200,356
Travelling & Conveyance (Including Overseas Travelling)			13,323,240		7,661,120
Lab. Stores Serv.& Comp.(S.W.)			11,482,659		7,070,841
Symposia & Seminars			15,687,712		4,307
Training Programmes			2,008,108		1,114,035
Repairs and Maintenance			11,922,889		9,778,092
Other Expenses	L		27,144,220		25,278,353
Depreciation		30,551,520		30,326,941	
Less : Transfer from Capital Grant from Govt of India		19,858,488	10,693,032	19,712,512	10,614,429
			396,952,144		**382,721,532**
Surplus for the year transferred to Reserve Fund			**223,856,791**		**136,007,355**
Significant Accounting Policies	M				
Notes on Accounts	N				

The Schedules referred to above form an integral part of the Balance Sheet. This is the Balance Sheet referred to in our report of even date.

For and on behalf of
P C Chhajed & Co.
Chartered Accountants
Firm Registration no.: 101800W

Dr Sanjay Mundra
General Manager

Dr L P SINGH
Director General

CA Gaurav Singh
Partner
M.No. 545179
New Delhi
Date:

Shri K C Jhanwar
Chairman -NCB

NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS

SCHEDULES FORMING PART OF THE ACCOUNTS AS AT MARCH 31, 2023

Particulars	As at March 31, 2023 (Amount in Rs.)	As at March 31, 2022 (Amount in Rs.)
SCHEDULE - 4		
Capital Fund		
As per the last Balance Sheet	[illegible]	[illegible]
Industry Vehicle equipment valued at [illegible] (Previous Year [illegible])		
Model [illegible]		
TOTAL	[illegible]	[illegible]
SCHEDULE - 5		
Revenues and Surplus		
As per the last Balance Sheet	[illegible]	[illegible]
Add: Surplus for this year	[illegible]	[illegible]
TOTAL	[illegible]	[illegible]

NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS

SCHEDULES FORMING PART OF THE ACCOUNTS AS AT MARCH 31, 2023

Particulars	As at March 31, 2023 (Amount in Rs.)	As at March 31, 2022 (Amount in Rs.)
[illegible]		
[illegible]		
[illegible]	[illegible]	[illegible]
[illegible]		
[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]		
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS

SCHEDULES FORMING PART OF THE ACCOUNTS AS AT MARCH 31, 2023

Particulars	As at March 31, 2023 (Amount in Rs.)	As at March 31, 2022 (Amount in Rs.)
[illegible]		
[illegible]		
[illegible]	[illegible]	[illegible]
TOTAL	[illegible]	[illegible]
[illegible]		
[illegible]		
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
TOTAL	[illegible]	[illegible]

NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS

SCHEDULES FORMING PART OF THE ACCOUNTS AS AT MARCH 31, 2023

Particulars	As at March 31, 2023 (Amount in Rs.)	As at March 31, 2022 (Amount in Rs.)
SCHEDULE - A		
Research and Development		
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
TOTAL	[illegible]	[illegible]
SCHEDULE - B		
Other Income		
[illegible]	[illegible]	[illegible]
[illegible]		
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
TOTAL	[illegible]	[illegible]
SCHEDULE - C		
Grant from Ministry of Commerce & Industry		
[illegible]	[illegible]	[illegible]
[illegible]		
TOTAL	[illegible]	[illegible]

NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS

SCHEDULES FORMING PART OF THE ACCOUNTS AS AT MARCH 31, 2023

Particulars	As at March 31, 2023 (Amount in Rs.)	As at March 31, 2022 (Amount in Rs.)
SCHEDULE - 3		
Employees Cost		
Establishment Charges	[illegible]	[illegible]
Contributions to Provident Fund Bonded Fund	[illegible]	[illegible]
Gratuity Bonded Fund Fund Contribution (GF)	[illegible]	[illegible]
Social Security & Welfare	[illegible]	[illegible]
TOTAL	[illegible]	[illegible]
SCHEDULE - 4		
Other Expenses		
Rent, Rates and Taxes	[illegible]	[illegible]
Electricity and Water Charges	[illegible]	[illegible]
Postage, Telegrams & Telephones	[illegible]	[illegible]
Accounting	[illegible]	[illegible]
Insurance & Miscellaneous Items	[illegible]	[illegible]
Audit, Periodicals and Standard Fees	[illegible]	[illegible]
Distribution, Purchase and Administration	[illegible]	[illegible]
Legal Expenses	[illegible]	[illegible]
Interest	[illegible]	[illegible]
Audit Fees - Statutory Auditors	[illegible]	[illegible]
Bank Charges	[illegible]	[illegible]
Insurance of Assets	[illegible]	[illegible]
Security Expenses	[illegible]	[illegible]
Miscellaneous Expenses of E&U cost	[illegible]	[illegible]
TOTAL	[illegible]	[illegible]

NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS
DEPRECIATION AS AT 31 MARCH 2023

Schedule -E

(Amount in RS.)

NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS

SCHEDULES FORMING PART OF THE ACCOUNTS AS AT MARCH 31, 2023

SCHEDULE – M

SIGNIFICANT ACCOUNTING POLICIES

1. The accounts are prepared on a going concern basis as per the historical cost convention.

2. **Recognition of Income:**

   (a) Income from Sponsored Research & Development Contribution is accounted for on the basis of the percentage of work completed during the year.

   (b) Other Incomes, other than Technical Services Fees, are accounted for on accrual basis.

3. **Fixed Assets:**

   (a) Fixed Assets are recorded at cost and for the better presentation of financial statements. During the Financial year 2020-2021, the Council has decided to change the depreciation rates and has adopted the rate of depreciation of Income Tax Act 1961 for all block of assets prospectively i.e. rates as per Income Tax Act 1961 will be applied on the written down value and the additions made from the financial year 2020-21 onwards. Old rate of depreciation will continue to apply for assets purchased upto financial year 2000-2001. Depreciation is charged on written down value basis.

   Rate of depreciation is as follows:

		Old Rates % p.a.	Rates as per Income Tax Act 1961 % p.a.
*	Vehicles	20	15
*	Office Furniture and Equipment	10	10
*	Laboratory Equipment	10	15
*	Laboratory Projects Services	10	15
*	Building including Staff Housing	2.5	
	i) Residential Property		5
	ii) Other than Residential Property		10
*	Computers -		40
*	Solar Power Plant-		40

Depreciation has been provided on assets for whole year irrespective of the date of addition.

   (b) Fixed Assets include Laboratory Equipment and Energy Bus received free of cost & custom duty from the United Nations Industrial Development Organisation (UNIDO). The value adopted in the accounts is as per customs CIF assessment upon import or at value advised by UNIDO and the corresponding credit for this amount is included under Capital Fund (Refer Schedule A) Rs. 19,564,057 for Laboratory Equipment and Rs. 623,478 for Energy Bus. The title to these assets has been transferred to Government of India and the further transfer of these fixed assets from the Ministry of Commerce & Industry, Government of India to the Council is pending. However, the Council provides depreciation on these fixed assets in accordance with the rates noted in para 3 (a) above.

   (c) The organization has acquired the land and building in Bhubaneswar on a leasehold basis for Rs. 1,50,00,000 and 42,22,098 respectively during FY 2022-23. The leasehold land and building is allotted up to 14th December 2068. This leasehold land and building is being depreciated during the lifetime of the lease.

4. Liability for Gratuity and Leave Encashment is provided for on the basis of actuarial valuation.

5. **Accounting for Government Grants:**

   (a) Government Grant of Revenue nature received from the Government have been accounted for as Income for the year under the Income and Expenditure Account.

NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS

Schedules forming part of the Accounts as at March 31, 2023

SCHEDULE – N

NOTES ON ACCOUNTS

1. Purchases made during the year in respect of laboratory stores, raw materials, miscellaneous consumable stores, publications, tools and accessories are charged to the Income and Expenditure Account and closing stock of these items has not been ascertained or accounted for, as per the decision of the Board of Governors.

2. Fixed Asset Register has been updated with the complete details along with value which is to be reconciled with the Accounts. Physical verification of the Fixed Assets has been carried out in each Centre/Group.

3. Contingent liabilities not provided for in respect of:

   (a) Claims not acknowledged as debts by the Council, the liability of which is not ascertainable as pending in various Courts.

   (b) Claim for interest by the Andhra Pradesh State Government in 1998, for delay in payment for purchase of Land (amount not intimated).

4. Gratuity Fund Investment has a balance of Rs. 14,85,26,058/- (Rs. 23,12,30,074/-). There is a shortfall of Rs. Nil (Rs. Nil) in the "Gratuity Fund Investment Account" as compared to the "Gratuity Fund account" as at 31st March 2023.

5. The Council has got an actuarial valuation of the leave encashment for and upto the year ended 31st March 2023 and the liability computed is Rs. 16,72,92,869/- (Rs. 16,52,53,452/-).

6. An amount of Rs. 6,31,976 has been deposited with Hon'ble Delhi High Court in connection with a case filed by a former employee. Necessary adjustment will be made after the decision of the Hon'ble Court.

7. The encashment of valuation of UNESCO Coupons of US $132.10 are subject to ascertainment and confirmation.

8. R&D Contribution has been arrived after adjusting R&D Contribution received in advance of Rs. 77,80,834/- (Rs. 1,92,44,949/-).

9. During the year 2022-23, the council earned foreign exchange amounting to Rs. 8,79,881/-

10. Expenditure in foreign currency during the year is Rs. 7,41,626/- (Rs. 83,31,789/-).

11. As on 31.03.2023, there are certain ledgers/accounts which have been pending for reconciliation/settlement with the net debit balance Rs. 20.40 Crore (approx.) since the last many years. These unreconciled ledgers include the ledgers coming under the heads of sundry debtors, creditors, loans and advances and service tax. The Management has taken a note of it and is working for reconciliation and settlement.

12. There are some unreconciled/unidentified receipts amounting to Rs 4.46 Crores which probably could have been received from sundry debtors whose accounts are pending for reconciliation and settlement. Management is trying to reconcile/identify the parties from whom the payments have been received and also in process of taking constructive steps to mitigate such payments. For the purpose of disclosure, the amount of Rs 4.46 Crore has been deducted from the balance of sundry debtors.

13. In the past years, organization had implemented the project of Government of Karnataka under which a credit balance of Rs. 40.76 Crores and a debit balance of Rs. 40.36 Crores is showing in the books and the respective ledgers are pending for reconciliation. The management has taken a note of this and the accounts will be put up for settlement and necessary accounting entries will be passed in the books.

14. Previous year's figures have been regrouped and rearranged wherever necessary so as to conform to this year's classification.

Institutional Events

Institutional Events

National Technology Day 2022

NCB celebrated National Technology Day 2022 on 11th May 2022. The theme of National technology Day 2022 was Integrated Approach in Science & Technology for Sustainable Future. Dr. Mrutyunjay Mohapatra, Director General, India Meteorological Department (IMD) was invited as Chief Guest on the occasion. He delivered the keynote address through video conferencing. DG-IMD gave a short presentation about the technological advancement of IMD dedicated for weather forecasting in the Indian Sub-Continent. He emphasized that there is a paradigm shift in the modus operandi of IMD from Nirbharta to Aatm Nirbharta.

World Environment Day 2022

NCB celebrated World Environment Day 2022 with sapling plantation at Ballabgarh campus. The campaign slogan of World Environment Day 2022 was "***Only One Earth***" with the focus on "Living Sustainably in Harmony with Nature".

76th Independence Day 2022

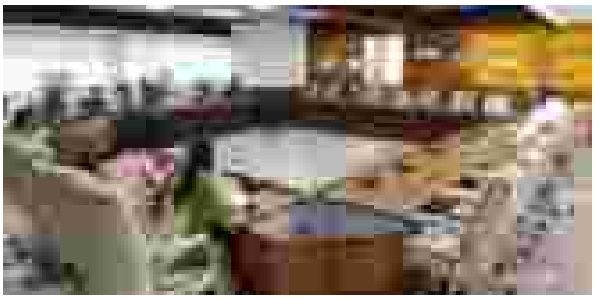
76th Independence Day celebrated at NCB Ballabgarh. Dr Bibekananda Mohapatra, DG-NCB hoisted the National Flag, distributed sweets, flags and addressed the NCB staff & their family members. During Independence Day Celebrations, cultural programme was also organized after the flag hoisting ceremony at NCB. On the auspicious occasion of 76th Independence Day, DG-NCB congratulated all for celebrating ***Azadi ka Amrit Mahotsav*** on the completion of 75 years of Independence. DG-NCB also encouraged ***'Har Ghar Tiranga'*** campaign to bring the Tricolor home and hoist it to mark the 75th year of India's independence. DG-NCB stated "As India marks 75th years of independence, NCB will be completing 60th years of its inception. We should also continue to glorify NCB's created by our predecessors."

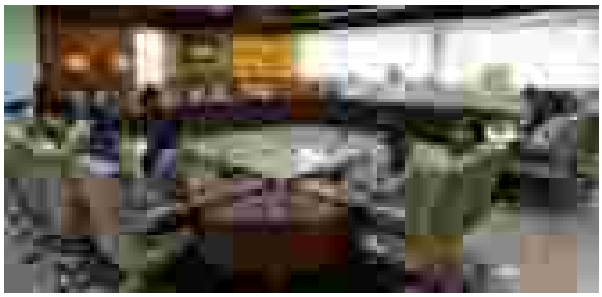
हिन्दी पखवाड़ा का आयोजन

राष्ट्रीय सीमेंट एवं भवन सामग्री परिषद्, बल्लभगढ़ में हिंदी पखवाड़े का आयोजन 16 सितम्बर 2022 से 28 सितम्बर 2022 के बीच बड़े हर्षोल्लास के साथ मनाया गया। पखवाड़े का शुभारंभ 16 सितंबर 2022 को माननीय डॉ. बीबेकानंद महापात्र, महानिदेशक के कर कमलों द्वारा किया गया। पखवाड़े का शुभारंभ करते हुये महानिदेशक ने सभी सदस्यों एवं कर्मियों से आग्रह किया कि सभी कार्यालय में अधिक से अधिक कार्य हिंदी में करें।

हिन्दी पखवाड़े 2022 के दौरान कार्यालय में निम्नलिखित प्रतियोगितायें आयोजित की गई। जिसमें कार्यालय के अधिकारियों / कर्मचारियों ने उत्साहपूर्वक भाग लिया।

- हिन्दी आदर्श वाक्य (Slogan) प्रतियोगिता
- हिन्दी निबंध प्रतियोगिता
- टिप्पणी लेखन प्रतियोगिता
- कविता पाठ / स्वविचार प्रतियोगिता





कार्यालय के वार्षिक दिवस 24 दिसम्बर 2022 के अवसर पर पखवाड़े के दौरान प्रतियोगिताओं के विजेताओं को माननीय अपर सचिव श्री अनिल अग्रवाल जी, आन्तरिक व्यापार और उद्योग संवर्धन विभाग, वाणिज्य और उद्योग मंत्रालय, भारत सरकार द्वारा प्रमाण पत्र प्रदान किया गए तथा प्रतिभागियों का उत्साहवर्धन भी किया।

एन.सी.बी. दर्पण तृतीय अंक का विमोचन

राष्ट्रीय सीमेंट एवं भवन सामग्री परिषद् की वार्षिक हिंदी पुस्तक एन.सी.बी. दर्पण के तृतीय अंक का विमोचन माननीय श्री अनिल अग्रवाल, अपर सचिव, आन्तरिक व्यापार और उद्योग संवर्धन विभाग, वाणिज्य और उद्योग मंत्रालय, भारत सरकार के द्वारा 24 दिसम्बर 2022 को एन.सी.बी. बल्लभगढ़ में किया गया।

नराकास, फ़रीदाबाद, राजभाषा शील्ड प्रतियोगिता में प्रोत्साहन पुरस्कार (22-2021 वर्ष)

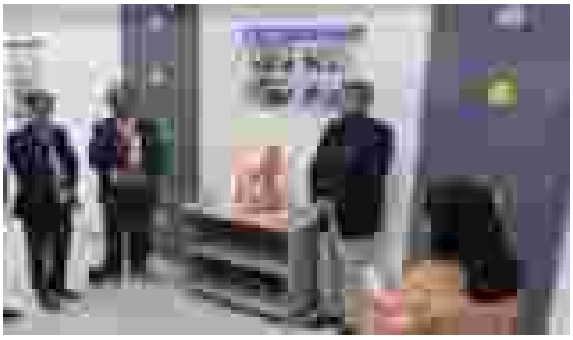
नगर राजभाषा कार्यान्वयन समिति(.का) , फ़रीदाबाद द्वारा आयोजित शील्ड प्रतियोगिता में पिछले वर्षों की भांति वर्ष 22-2021के लिए भी राष्ट्रीय सीमेंट एवं भवन सामग्री परिषद्, बल्लभगढ़ को प्रोत्साहन पुरस्कार से सम्मानित किया। दिनांक 2023 फरवरी 03को शील्ड प्रतियोगिता का पुरस्कार डॉ संजीव कुमार चतुर्वेदी, इकाई प्रभारी, बल्लभगढ़ ने नराकास से ग्रहण किया। नराकास द्वारा आयोजित हिन्दी निबंध प्रतियोगिता में श्रीमती सुरुचि राणा ने प्रोत्साहन पुरस्कार प्राप्त किया।

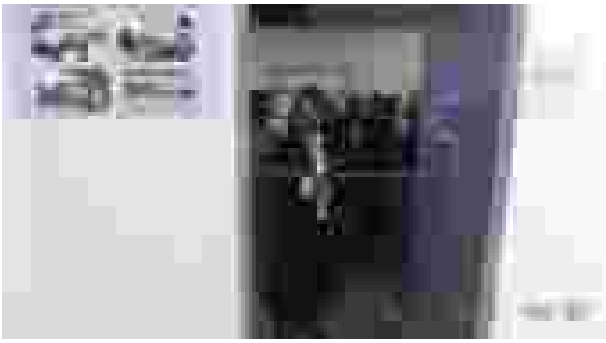
हिन्दी शिक्षण योजना

राष्ट्रीय सीमेंट एवं भवन सामग्री परिषद्, बल्लभगढ़ में राजभाषा विभाग, गृह मंत्रालय, भारत सरकार के हिंदी शिक्षण योजना के अंतर्गत प्रथम सत्र जुलाई से नवम्बर 2022 में पारंगत शिक्षण की कक्षा आयोजित की गई। इसमें कार्यालय के 22 अधिकारियों / कर्मचारियों ने भाग लिया। राजभाषा विभाग, गृह मंत्रालय, भारत सरकार के केंद्रीय प्रशिक्षण संस्थान द्वारा 31 दिसम्बर 2022 को परीक्षा परिणाम घोषित किये गए। जिसमें कार्यालय के 19 प्रशिक्षाथियों ने पारंगत परीक्षा में विशेष रुचि लेते हुए उत्कृष्ट प्रदर्शन किया। हिंदी शिक्षण योजना का मुख्य उद्देश्य कार्मिकों को हिन्दी में दक्ष बनाकर अधिकाधिक कार्यालयीन कार्य हिन्दी में करने के लिये प्रेरित करना है।

हिन्दी विभाग का उदघाटन

डॉ बीबेकानंद महापात्र, महानिदेशक, के कर कमलों द्वारा राष्ट्रीय सीमेंट एवं भवन सामग्री परिषद्, बल्लभगढ़ परिसर में दिनांक 26 जनवरी 2023 को हिन्दी विभाग का उदघाटन किया गया।

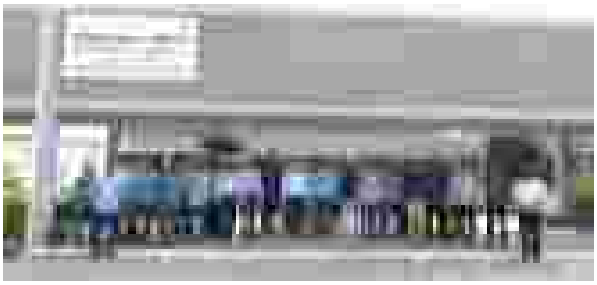




गृह मंत्रालय, भारत सरकार द्वारा आयोजित द्वितीय अखिल भारतीय राजभाषा सम्मेलन, सूरत में राजभाषा कार्यान्वयन समिति के सदस्यों श्री अभिषेक अग्निहोत्री, श्रीमती पूनम कनौजिया एवं श्रीमती रश्मि गुप्ता द्वारा कार्यालय का प्रतिनिधित्व किया गया।

Special Swachhta Campaign 2.0

NCB observed Swachhta Special Campaign 2.0 from 2nd October to 31st October 2022. Dr B N Mohapatra, DG-NCB briefed about the cleanliness drive that has been carried out under Special Swachhta Campaign 2.0.



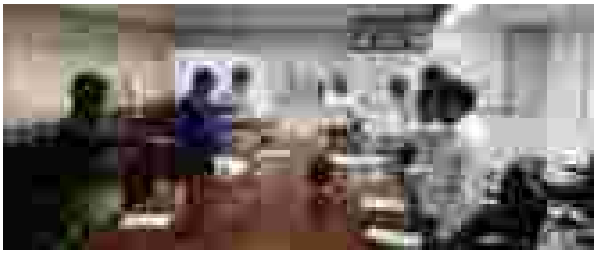
Shri Yogesh Taneja, Section Officer, DPIIT, Govt. of India visited NCCBM Ballabgarh on 18th October 2022 for Inspection and Review of cleanliness activity. Dr B N Mohapatra, DG-NCB along with Shri Yogesh Taneja Ji, Section Officer, DPIIT reviewed the activities undertaken during Special Campaign 2.0 and sensitised the staff regarding importance of Special Campaign and its benefits. A special cleanliness drive & white washing of boundary wall is carried at NCB, Ballabgarh

During the Special Swachhata Campaign 2.0, old files and records were reviewed during preparatory phase and 1050 old files were weeded out during the campaign.

World Standards Day

NCB observed World Standards Day on 14th October 2022. Each year on 14th October, the members of the IEC, ISO and ITU celebrate World Standards Day, which is a means of paying tribute to the collaborative efforts of thousands of experts worldwide who develop the voluntary technical agreements that are published as International Standards. World Standards Day is about our shared vision for a better world.

National Unity Day

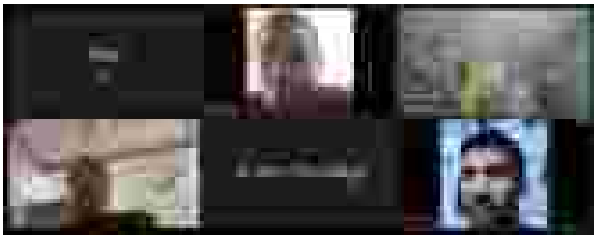


NCCBM celebrated National Unity Day on 31st October 2022. Dr B N Mohapatra, DG-NCB and Head of Centre's of NCB offered tribute to Iron Man of India Shri Sardar Vallabh Bhai Patel and administered Rashtriya Ekta Diwas pledge on 31st October 2022.

Swachhata Pakhwada

NCB observed Swachhata Pakhwada from 1st to 15th November 2022. Under Swachhata Pakhwada, special cleanliness drive was organized and swachhata plege was taken by all NCB officials.

Celebration of Constitution Day



NCB celebrated Constitution Day (Samvidhan Diwas) on 26th November 2022 to commemorate the adoption of the Constitution of India on the same day in 1949 in the Constituent Assembly of India. The preamble of the Constitution was read out by entire officials of NCB & their units.

74th Republic Day 2023

NCB celebrated 74th Republic Day. Dr. B N Mohapatra, Director General, NCB hoisted the National Flag, distributed sweets and addressed the staff present on the occasion.

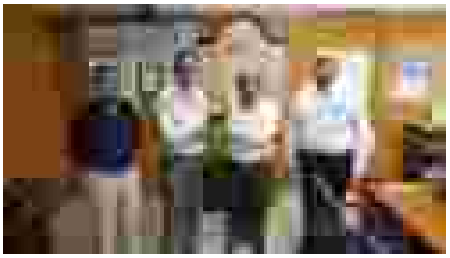
International Women's Day 2023

NCB celebrated International Women's Day 2023 on 7th March 2023. Dr B N Mohapatra, DG - NCB highlighted the social, political and economic achievements of women & their contribution in various fields. Ms Satbeer Chabbra, Deputy Director, National Institute of Public Cooperation and Child Development (NIPCCD) was the Guest of Honour and Ms Ruchika Drall, Deputy Secretary (Environment Policy), Ministry of Environment, Forest and Climate Change was the Chief Guest on the occasion.

Interaction with Stakeholders

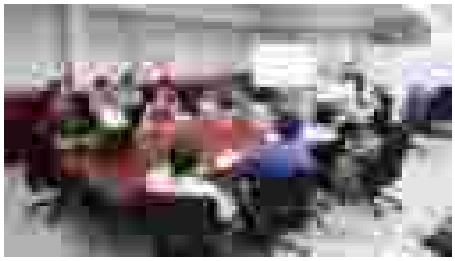
Interaction with Stakeholders

Visit of officials from Nuvoco Vistas Corp. Ltd.



Shri Sanjay Joshi, Chief Manufacturing Officer & Chief of Industrial Operations, M/s Nuvoco Vistas Corp Ltd visited NCB Ballabgarh on 4th April 2022 and interacted with scientists and engineers. Shri Sanjay Joshi expressed interest to jointly work with NCB on various projects in coming future.

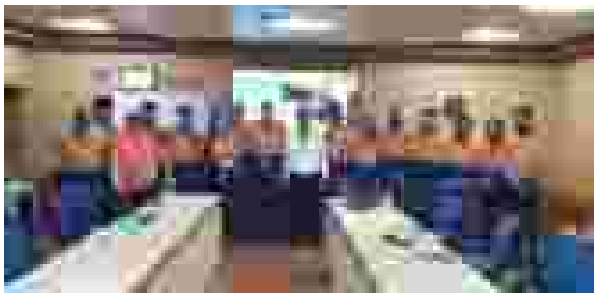
Visit of officials from Shree Cement Ltd.



Shri Prashant Jain, Assistant General Manager (ERP) & Shree Cement Limited Alumni of NCB - PGDCT, visited NCB Ballabgarh on 04th May 2022 interacted with DG-NCB, scientists and engineers.

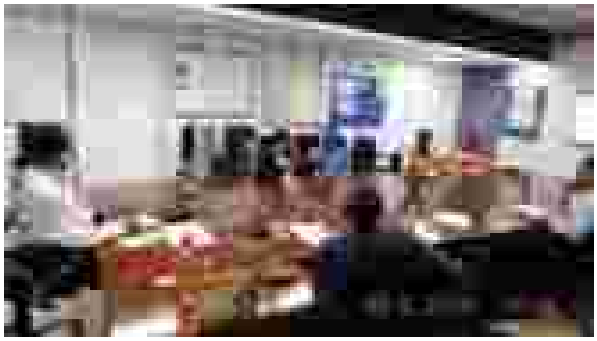
Interaction with officials of Ambuja Cement Ltd.

Dr B N Mohapatra, DG-NCB interacted with North Cluster team of Ambuja Cement, Ropar from 6th to 7th June 2022. DG-NCB gave a detailed presentation on NCB activities to unit heads and senior officials of cement plants in North cluster.



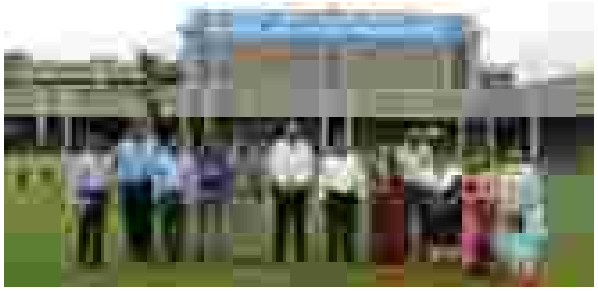
Visit of officials from Adani Power Ltd.

Sh Satish Kumar Tanwar, Head-Ash Management, Adani Power Ltd, Adani Corporate House visited NCB Ballabgarh on 30th June 2022 for discussions & interacted with scientists and engineers to jointly working on various projects in coming future.



Meeting with Ministry of Environment, Forest and Climate Change (MoEF&CC)

Ms Ruchika Drall, Deputy Secretary, MoEF & CC, Government of India visited NCB on 30th June 2022 for discussion with Dr Bibekanand Mohapatra, DG-NCB on LeadIT initiatives & activities of NCB. Ms Ruchika Drall, visited Centre for Cement Research & Independent Testing (CRT) & appreciated NABL accredited testing facilities available in the area of cement & building materials.



Interaction with BARC scientists

Scientists from BARC visited NCB Ballabgarh on 5th July 2022 and met DG-NCB & Dr. SK Chaturvedi, Secretary & Joint Director-NCB. DG-NCB briefed about the R&D activities carried out by the NCB. Scientists appreciated the NABL accredited testing facilities available in the field of cement and building materials.

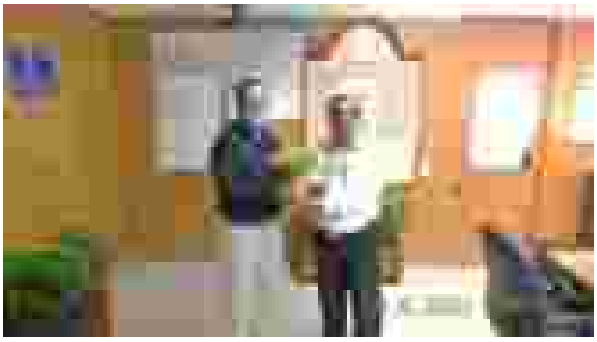
Tripartite Agreement with JK Lakshmi Cement Ltd. and Livnsense Technologies Ltd.

For demonstration of application of Artificial Intelligence and Machine Learning (AI/ML) models in cement manufacturing process at M/s JK Lakshmi Cement Ltd, Sirohi Plant, a Tripartite Agreement was signed between JK Lakshmi Cement, NCB and LivNsense Technologies on 29th July 2022. Under this agreement, a pilot project on "Improvement in Process Stabilization and Increase in % TSR by the Application of Artificial Intelligence" is being undertaken for the first time in cement industry.

The tripartite agreement was signed by Shri Arun Shukla, CEO & President, JK Lakshmi Cement ; Dr B N Mohapatra, DG-NCB and Shri Avnish Kumar, CEO, @LivnsenseT at a ceremony held at NCB Ballabgarh, Haryana on 29th July 2022. On the occasion, senior officials from M/s J K Lakshmi Cement Limited comprising of Sh S K Saxena (Senior Vice President & Unit head), Sh Rajpal Shekawat (Senior General Manager - Production) were also present.

Visit of official from KHD Humboldt Wedag India Pvt. Ltd.

Shri Ashok Dembla, President & Managing Director, KHD Humboldt Wedag India Pvt Ltd. visited NCB Ballabgarh on 25th August 2022 and met Dr. Bibekananda Mohapatra, DG-NCB & Dr. SK Chaturvedi, Joint Director, NCB. Shri Ashok Dembla also visited NCB's state of the art facilities for testing of cement, concrete and building materials.

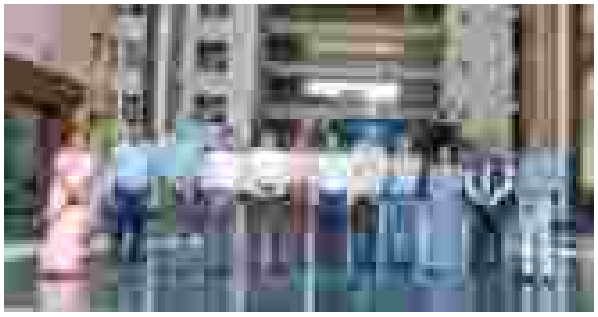


Visit of Delegation from the Embassy of Republic of Congo

Delegation from the Embassy of Republic of Congo (RoC) H.E. Mr Raymond Serge BALÉ, Ambassador, Mr Gabriel ITOUA, Economic Counsellor & Mrs Smriti Malhotra, Secretary In-charge, Project Monitoring visited NCB Ballabgarh on 29th September 2022 and met Dr. Bibekananda Mohapatra, DG-NCB & other officials of NCB. The RoC delegation was briefed about the activities carried out by the NCB for cement industry and discussion was held on cement plant project in Republic of Congo.

Interaction with Expert Appraisal Committee (Industry-1)

DG-NCB attended the meeting of Expert Appraisal Committee (Industry-1) at Ministry of Environment, Forest and Climate Change, Paryavaran Bhawan, Delhi on 14-15 July 2022.

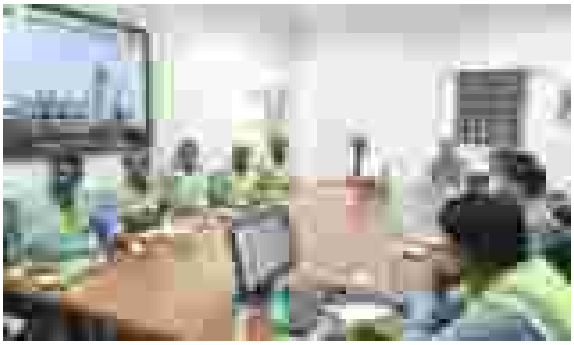


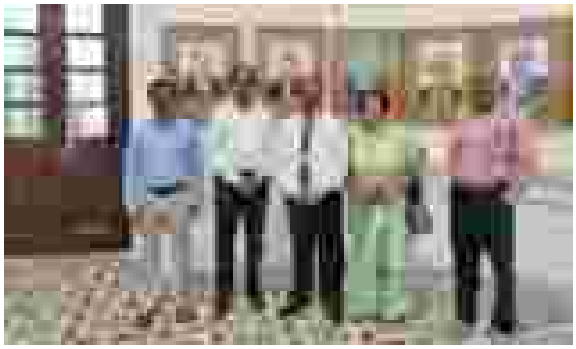
Meeting with officials of J K Cement Ltd.

Dr B N Mohapatra, DG-NCB along with Dr S K Chaturvedi, Secretary & Joint Director-NCB and Sh Anupam, General Manager, NCB, Sh Anand Bohra, Manager, NCB and Dr Varsha Liju, Manager, NCB visited J K Cement Ltd. head office in Gurgaon on 25 July 2022. NCB team held discussion with officials of J K Cement Ltd to jointly work on various projects in coming future.

Interaction with officials of Ultratech Cement Ltd., Roorkee

Dr B N Mohapatra, DG-NCB visited Ultratech Cement Ltd., Roorkee (Uttarakhand) unit on 9th September 2022.

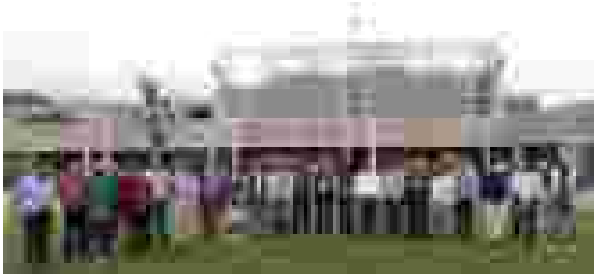




During the visit, DG-NCB also visited IIT Roorkee on 9th September 2022 & had interactive meeting with Professor Dr Manoranjan Parida, Deputy Director of IIT Roorkee, Dr Paritosh Mohanty of Chemistry Department of IIT Roorkee, and Dr D.P Kanungo of CBRI, Roorkee.

Visit of officials from CSIR-Central Road Research Institute

Prof. Dr Manoranjan Parida, Director, CSIR-CRRI along with other CRRI Scientists from Bridge & Rigid Pavement Division visited NCB Ballabgarh on 15 November 2022 for discussion with Dr. Bibekananda Mohapatra, DG-NCB & other senior officials of NCB.



Stakeholders Meet of CSIR's One Week One Lab - CSIR CBRI program

Dr Bibekananda Mohapatra, DG-NCB along with senior officials of NCB participated in "Stakeholders Meet under CSIR's One Week One Lab - CSIR CBRI program" held on 11th January 2023. The stakeholders meet was organized to engage different stakeholders from all over India to discuss current unmet issues related to buildings construction technologies and to fulfill the National Missions, SDG and IPCC Goals. The meet paved the way to forge new R&D partnership and alliances between stakeholders and research institutions.

Interaction with officials of UltraTech Cement Ltd., Rajasthan

Dr Bibekananda Mohapatra, DG-NCB visited UltraTech Cement Ltd (Unit Vikram Cement Works), Rajasthan on 16th Jan 2023 & interacted with Plant officials.

Visit to CSIR-Central Road Research Institute

Dr Bibekananda Mohapatra, DG-NCB and other senior officials of NCB visited the CSIR- Central Road Research Institute (CRRI) on 24 January 2023. Prof. (Dr) Manoranjan Parida, Director, CSIR-CRRI along with HoD RPD, PED, TPE and other officials welcomed NCB team and discussed on probable collaborations between the two institutes.

Appendices

Appendix - I

Rolling Plan of Missions within the Framework of Centres

A. CENTRE – CEMENT RESEARCH AND INDEPENDENT TESTING (CRT)

Mission 1: Utilization of Marginal Grade Raw Materials in the Manufacture of Cement and Building

Mission 2: Development of Newer Cements, Composites and Alternate Binding and Building Materials

Mission 3: Development of Newer Processes of Manufacturing Cement and other Binding and Buildings Materials

Mission 4: Raw Mix Design Optimization

Mission 5: Utilization of Industrial and other Wastes for Cement and Building Materials

Mission 6: Development of Newer Refractories

Mission 7: Improved Refractory Engineering Practices

Mission 8: Study of Fundamental Concepts in Material Science and Fundamental Studies Relating to Areas of Fuel Combustion, Pyro-processing, Size Reduction, etc.

Mission 9: Independent Testing

B. CENTRE – MINING, ENVIRONMENT, PLANT ENGINEERING AND OPERATION (CME)

Mission 1: Compilation and Updating of National Inventory of Cement Grade Limestone Deposits

Mission 2: Identification, Exploration, Evaluation and Assessment of Limestone Deposits and other Cement Raw Materials

Mission 3: Upgradation and Quality Establishment of Limestone (at Quarries) and Mineral Conservation

Mission 4: Application of Remote Sensing Techniques

Mission 5: Advanced Survey Techniques including Geographical Information System (GIS) and Global Positioning System (GPS)

Mission 6: Application of Geophysical Techniques for Mineral Exploration, Ground Water Investigation, etc.

Mission 7: Mine Planning and Scheduling

Mission 8: Improved Machinery Application and Improved Technological Upgradation for Mining Practices

Mission 9: Sustainable Development through Environmental Improvement including Survey of Land and Water Resources.

Mission 10: Pollution Control Technologies for Particulate Gaseous Emissions and Liquid Effluents

Mission 11: Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) for Industrial Projects and Mines

Mission 12: Environmental Management System (EMS) and ISO - 14001 Certification for Process Industries

Mission 13: Utilization of Hazardous Wastes as Supplementary Fuel

Mission 14: Monitoring of Environmental Parameters for Water, Ambient Air Quality, Noise and Vibration Studies

Mission 15: Rehabilitation and Reclamation of Mined out Areas

Mission 16: Improving Capacity Utilization and Increasing the Rate of Production in Kilns and Mills towards Improving Total Factor Productivity in Cement Industry through Process Optimization, Diagnostic Studies and Trouble Shooting and Improvement in Operation

Mission 17: Benchmarks, Best Practices, Operational Norms and Technical Audit including Plant Monitoring

Mission 18: Productivity Enhancement Programme (PEP)

Mission 19: Technological Upgradation

Mission 20: Improving Utilization of Coals

Mission 21: Utilization of Alternate Fuels such as Lignite, Natural Gas, Combustible Wastes etc.

Mission 22: Improvements in Fuel Combustion Efficiency

Mission 23: Optimization of Energy (Both Thermal and Electrical) Consumption

Mission 24: Energy Auditing, Management and Monitoring

Mission 25: Waste Heat Utilization including Cogeneration

Mission 26: Creating Awareness and Motivation for Energy Conservation

Mission 27: Total Productive Maintenance (TPM)

Mission 28: Preventive/Predictive Maintenance Programme, Condition Monitoring Techniques and Tribology including Computerised Maintenance

Mission 29: Inventory Control and Spare Parts Management

Mission 30: Risk Analysis and Improving Safety in Cement Plants

Mission 31: Turnkey Consultancy for Setting up Modern Medium and Large Cement Plants from Concept to Commissioning including Fund Sourcing

Mission 32: Establishing Modern Energy Efficient CRI-MVSK and Rotary Kiln based Mini Cement Plants from Concept to Commissioning

Mission 33: Improvements in System Design and Engineering of Plant and Machinery (including CRI designed indigenous Precalcinator System, Burners for

High Ash Coals, Refractory Lining System and Coal Quality Modulation System)

Mission 34: Modernization and Technological Upgradation in Cement Plants

Mission 35: Upgradation and Modification of VSK based Cement and Lime Plants

Mission 36: Developing Systems Designs for Bulk Movement of Cement by Rail, Road and Waterways

Mission 37: Marketing Strategies and Logistics

Mission 38: Improvements in Packaging of Cement

C. CENTRE – CONSTRUCTION DEVELOPMENT AND RESEARCH (CDR)

Mission 1: Analysis and Design of Structures for Safety and Economy and Development of Related Software Packages

Mission 2: Rationalizing Designs of Structures and Foundations in Cement Plants and Other Constructions

Mission 3: Performance Evaluation of Structures including Machine Foundations through Site Inspection and Testing

Mission 4: Formulation and Evaluation of Protective System for Enhancing the Service Life of Concrete Structures

Mission 5: Evaluation of Concrete Construction through Non-Destructive Investigations

Mission 6: Improving Durability of Concrete Construction through Distress Investigations and Rehabilitation Procedures

Mission 7: Improved Quality Control Procedures for Enhancing Durability

Mission 8: Rational Utilization of Cement and other Ingredients in Concrete, including Admixtures

Mission 9: Promotion of Ready Mix Concrete Technology in India

Mission 10: Development of Concrete for Special and Newer usages such as Underwater Concreting, Special Concrete Exposed to Extreme Temperature etc

Mission 11: Development and Evaluation of Prefab Systems Appropriate for Housing Programmes

Mission 12: Application of Alternative Building Materials and Development of Construction Techniques for Low Cost Housing

Mission 13: Improvements in Construction Technology of Cement Concrete Pavements and Canal Linings

Mission 14: Development of Precast Architectural Concrete Elements and Concrete Finishes

Mission 15: Preventive Maintenance Programme for Enhancing Service Life of Buildings

Mission 16: Extended Application of Concrete for Non-Structural Usage

Mission 17: Improvement in Construction Management Techniques

D. CENTRE – INDUSTRIAL INFORMATION SERVICES (CIS)

Mission 1: Collection, Documentation and Retrieval of Information for Development of Cement and Building Materials Industries

Mission 2: Establishing National Data Bank for the Cement and Building Materials Industries

Mission 3: Providing Library Services

Mission 4: Establishing Display Centre and Sample Museum and Participation in Exhibition and Trade Fairs

Mission 5: Publication of R & D Projects, Technology Digests, R & D Journals, Trend Reports, Promotional Literature etc

Mission 6: Organising Workshops and Seminars at National and International Levels on Topical Subjects in the Areas of Cement and Building Materials

Mission 7: Promoting International Linkages for Development of Technologies in the Field of Cement and Building Materials

E. CENTRE – CONTINUING EDUCATION SERVICES (CCE)

Mission 1: Improving the Talent of Personnel at Entry Level to Cement Industry

Mission 2: Improving Technical and Managerial Skills/Knowledge of NCB Officials through Inhouse/ External Programmes

Mission 3: Manpower Planning and Human Resource Development Strategies for Cement and Building Material Industries

Mission 4: Upgrading Technological Talent of Personnel in the Cement and Building Materials Industries

Mission 5: Improving Operational Skills of Personnel in the Cement Industry through Simulator Based Courses

Mission 6: Training of Personnel in Computer Programming, Application and Information Technology at Different Levels of Participation

Mission 7: Training of Personnel in Software Development, System Analysis and Information Technology Applicable to Cement Manufacturing Process Industry, Structural Design and Investigations

F. CENTRE – QUALITY MANAGEMENT, STANDARDS AN CALIBRATION SERVICES (CQC)

Mission 1: Providing Traceable Calibration Services to the Industry for Ensuring Manufacture of Quality Product

Mission 2: National and International Standardization

Mission 3: Quality Management, Quality Assessment and Quality Improvement in Cement and Building Materials Industries

Mission 4: Development of Improved Methodologies for Testing and Quality Control including Rapid Methods of Testing and Quality of Cement and Other Building Materials in the Field

Mission 5: Inter-Laboratory Proficiency Testing

Mission 6: Quality Related Services

Mission 7: Development of New Standard Reference Materials

Mission 8: Providing Standard Reference Materials (SRMs), Developed by NCB, to the Industry for Ensuring Accuracy of Testing for Quality Control

These Programmes and Missions are proposed to be achieved through the pursuit of specific projects with specified targets of time, cost and assured end products

Appendix -II

Completed R&D Project Programme 2022 – 2023

S. No.	Code	Project Title	Start Date	Completion Date
1	COB-12	Development of new clinker system using industrial by products and low limestone content	April 2020	March 2023
2	EMG-01	Process design and integration of RDF Gasification in cement manufacturing process	April 2020	Sep 2022
3	EMG-02	Solar thermal calcination of phosphogypsum for cement manufacture	April 2020	Sep 2022
4	PSD-02	Design and Development of Transfer Chute to Handle Alternate Fuels and Their Mix in Indian Cement Plants	April 2020	March 2023
5	WAU-18	Technical feasibility of using FGD gypsums in cement manufacturing	Aug 2021	March 2023
6	FBR-17	Development of Zeolite for Oxygen Concentrator by using Raw materials of Cement Industry	Aug 2021	March 2023
7	CTM-05	Studies on Mechanical and Durability properties of High Strength Geopolymer Concrete	April 2020	March 2023
8	SOD-12	Studies on mechanical and time dependent properties of Very High Strength Concrete (100 to 130 MPa) and Ultra-High Strength Concrete (130 To 180 MPa)	April 2020	March 2023
9	CON-18	Utilization of Coarser Flyash (having fineness between 250 m^2/kg to 320 m^2/kg) in Concrete as a cementitious material	April 2020	Sep 2022
10	CTM-03	Use of Advanced Electronics in Construction and Condition Assessment of Concrete Structures	April 2017	Sep 2022

Appendix –III

Sponsored Projects Completed During the Year 2022-23

National Council for Cement and Building Materials has completed 167 sponsored projects in the year 2022-23. Centre for Cement Research and Independent Testing (CRT) has completed 46 nos. of projects, Centre for Mining, Environment, Plant Engineering & Operation (CME) has completed 30 nos. of sponsored projects and Centre for Construction Development and Research (CDR) have completed 91 nos. of sponsored projects.

Centre for Cement Research and Independent Testing – (CRT)

Name of Project	Sponsors
Development of standards for calibration of XRF	M/s Kesoram Industries Ltd, Karnataka
Burnability of Raw Mix samples	M/s Ultratech Cement Ltd., Manikgarh Cement Works, Unit –II, Gadchandur, Korpana, Chadrapur, M.H.
Burnability of Raw Mix samples	M/s Ultratech Cement Ltd., Manikgarh Cement Works, Gadchandur, Korpana, Chadrapur, M.H.
Investigation on utilization of ladle furnace slag as a raw mix component in manufacture of clinker	M/s JSW Steel, Bangalore, Karnataka
Establishing limestone consumption factor	M/s Siddhi Cement
Enhancing utilization of fly ash in PPC beyond the present BIS limit of 35%,	M/s NTPC, NETRA, Noida
Burnability of Raw Mix samples	M/s Birla Corporation Ltd, Satna, M.P
Burnability of Raw Mix samples and testing of limestone sample	M/s UTCL, Maihar Cement, M.P.
Burnability of Raw Mix samples and testing of limestone and coal samples	M/s ACC Ltd., Gagal
MoU for consultancy services	M/s Nuvoco Vistas Corporation Ltd.
Establishing limestone consumption factor	M/s Penna Cement Industries Ltd, Banjarahills, Hyderabad,
Preparation of Mine Backfill Composites using grounded blast furnace slag (GBFS) and fly-ash as a replacement of cement in S K Mines	M/s Hindustan Zinc Limited, Udaipur
Establishing limestone consumption factor	M/s Birla Corporation Limited, PO-Birla Vikas, Satna-485005, Madhya Pradesh.

Development of Reference Materials of PPC	M/s ACC Ltd. Tikaria
Establishing limestone consumption factor	M/s Chettinad Cement, Dachepalli, Guntur Dist, AP
Establishing limestone consumption factor	M/s Penna Cement Ltd, Tandur, Vikarabad, TS
Development of standards for Calibration of XRF	M/s ACC Ltd., Kymore Cement worksd, M.P
NABL Assessment	M/s Rain Cement Ltd., Sreepuram Line 2 Kunoor, AP
NABL Assessment	M/s Rain Cement Ltd., Ramapuram,Surya peth,
Development of standards for calibration of XRF	M/s UTCL, Bhogasamudram, Karnool Dist, Karnataka
Establishing Limestone Consumption Factor	M/s J. K. Cement Works, Nimbahera, Rajasthan
Establishing Limestone Consumption Factor	M/s J. K. Cement Works, Mangrole, Rajasthan
Development of Reference Materials of PPC	ACC Ltd. Gagal
Establishing limestone consumption factor	M/s Vikram Cement, Neemuch, M.P.
Evaluation of burnability of raw mix, bond work index of limestone and clinker samples	M/s Prism Johnson Limited, Village - Mankahari, PO – Bathia, Satna – 485111(M.P).
Establishing Limestone Consumption Factor	M/s Prism Johnson Limited, Village - Mankahari, PO – Bathia, Satna
Establishing limestone consumption factor	M/s Birla Cement Ltd., RCCPL, Maihar
Establishing limestone consumption factor	M/s Dhandapani Cement, Samayapuram, Trichy,TN
Burnability of Raw Mix samples	M/s Ultratech Cement Ltd., Manikgarh Cement Works, Unit –II, Gadchandur, Korpana, Chadrapur, M.H.
Burnability of Raw Mix samples	M/s Birla Corporation Satna, M.P.
Investigations on Lump Formation in Cement Bags / Silos	M/s Nuvoco,Chittorghah
Development of Standards for Calibration of XRF Analyzer	M/s UltraTech Cement Ltd, (Awarpur cement works), Awarpur, Maharashtra.
Establishing limestone consumption factor	M/s Siddhi Cement
Characterization and evaluation of cement raw materials, fuels, kilnfeed and clinker samples	M/s J K Cement, Nimbahera, Rajasthan

Evaluation of burnability of raw mix, Bond work index of limestone and testing of white cement sample	M/s Ultra Tech Cement Ltd., (Unit: Birla White), Jodhpur, Rajasthan
Investigations on Cement Blends Utilizing clinker, fly ash and copper slag for Optimization of Composition as per relevant standards	M/s Adani Cement Industries Limited (ACIL), ACIL, Dahej, Bharuch 392130
Technical feasibility study of low-grade limestone for use in cement manufacture	M/s JSW CementLtd., Bilakalaguduru, Kurnool Dist, A.P.
Development of standards for calibration of XRF	M/s ICL Vishnupuram, A.P
Establishing limestone consumption factor	M/s ACC Ltd, Kymore Cement Works, Kymore, Katni, Kymore, M.P
Establishing Limestone Consumption Factor	M/s Calcom Cement India Limited (Unit of Dalmia Cement Ltd), Umarngshu, Assam
Establishing Limestone Consumption Factor	M/s Hirmi Cement Ltd
Establishing Limestone Consumption Factor	M/s Dalmia Meghalaya
Raw Mix Design M/s Shiva Cements,	JSW group, Orissa
Development of Secondary Reference Materials	RCCPL, Mukutban
Establishing Limestone Consumption Factor	M/s Maihar Cement
Petrographic examination, chemical analysis and PSD of silt and water samples from Sone river	M/s Baratiya Rail Bijlee company Ltd., Nabinagar, Aurangabad, Bihar

Centre for Construction Development and Research (CDR)

Title	Name of Sponsor
Concrete Technology (CON)	
Evaluation of Materials and Mix Designs Trials of Roller Compacted Concrete Dibang Dam	NHPC Limited, Dibang Multipurpose Project, Lower Dibang Valley, Roing
Design Mix for M25 and M40 Grade of Concrete and Testing on Hardened Concrete i.e. RCPT and Water Penetration Test	JSW Cement Limited, JSW Centre, Bandra Kurla Complex, Mumbai
Evaluation of Processed LD Slag as per IS: 383: 2016 and Study its Suitability to be used as Fine Aggregate for M/s JSW Steel Limited	JSW Steel Limited, Vijayanagar Works, P.O Vidyanagar, Karnataka
Testing of Coarse Aggregate and Fine Aggregate Material for URI-I Stage-II HE Project	URI Power Station, NHPC Limited Gingle, P.O. Mohra, Distt. Baramulla (J&K), Gingle

Testing of Construction Material & Water I.R.O. Rangit-IV HE Project at NCCBM, Ballabgarh	NHPC Limited, Rangit-IV HE Project, O/o –CEO, Rangit Nagar, PS-Himgdam, Distt. South Sikkim
Laboratory Testing of Coarse Aggregate, Fine Aggregate and Water Samples for Physical and AAR (Alkali Aggregate Reactivity) Testing of Dulhasti Stage-II HEP, Kishtwar (J&K)	NHPC Limited, Dulhasti Power Station Kishtwar (J&K)
Durability studies on Supersulphated cement, Portland slag Cement (PSC) and Portland Pozzolana Cement (PPC)	ACC Limited, Research and Consultancy Directorate, CRS Complex, LB Shastri Marg, Thane (W)
Study on Use of EAF Slag as Fine Aggregate and Coarse Aggregate in Concrete Phase-I	Arcrelor Mittal Nippon Steel India Limited, AM/NS Hazira Plant, Surat-Hazira Road, Hariza, Gujrat
Performance Evaluation of Quartz Crystalline Waterproofing Admixture in Concrete	Asian Paints Limited, Asian Paints House, 6A, Shantinagar, Santacruz, Mumbai
Testing & Evaluation of Concreting Materials & Concrete Mix Proportions for M25A20 with OPC-43 Grade Cement, M25A20 with PPC Cement & M30A20 with OPC-43 Grade Cement, M30A20 PPC Cement, & M35A20 with OPC-43 Grade Cement of Concrete for Installation and commissioning of FGD system for Singareni TPP Stage-I (2x600MW)	M/s PES Engineers Private Limited, C/o The Singareni Colliries Company Ltd, Singareni Thermal Power Project, Pegadapally Village, Jaipur Mandal, Mancherial Telangana
Evaluation of Material and Concrete Mix Design	THDC India Ltd, Village & Post Dashera, 2x660 MW Khurja STPP, Bulandshahr
Concrete mix design for M20, M25, M30 and M35 Grade of concrete for FGD	NTPC Limited, Farakka, P.O. Nabarun, District – Murshidabad, Farakka, West Bengal
Mix Design of 50 Grade of Concrete and Performance Evaluation of Integral Crystalline Waterproofing Admixture in Concrete for Construction of Common Central Secretariat Integrated Buildings – 1, 2, & 3 at plot No. 137, New Delhi	Central Vista Project Division-7, Central Public Works Department, New Delhi

Evaluation of Material and Concrete Mix Design for FGD, NTPC Rihand	Rihand Super Thermal Power Station, P.O. Rihandnagar, Dist. Sonebhadra, Uttar Pradesh
Evaluation of material and concrete mix design for Pakri Barwadih Coal Mining Project	NTPC Limited, Pakri Barwadih Coal Mining Project, Hazaribagh, Jharkhand-
Permeability and Durability Performance Evaluation of XYPEX Admix C2000NF in Concrete	Apaar Infratech Pvt. Ltd., B-92, Sector-63, Noida
Studies on Thermal Properties of Mass Concrete in Dhaulasidh HE Project for M/s Rithwik Project Pvt. Ltd.	Rithwik Projects Pvt. Ltd., Dhaulasidh Hydro Electric Project, (Across Beas River) Near Sanotu Village, Hamirpur, HP
Testing of Integral Crystalline Waterproofing Admixture in M30 and M50 Grade of Concrete for Construction of Common Central Secretariat Integrated Buildings-1, 2 & 3 at Plot No. 137, New Delhi	Central Vista Project Division-7, Central Public Works Department, New Delhi
Studies on Thermal Properties of Mass Concrete in Luhri HE Project for M/s Patel Engineering Ltd	M/s Patel Engineering Ltd., 5th Floor, J K Building, LSC Masjid Moth, New Delhi
Mix Design of Geopolymer Concrete for its use as Pavement Quality Concrete (PQC) and Dry Lean Concrete (DLC) for M/s JSW Cement Limited	JSW Cement Limited, JSW Center, Bandra Kurla Complex, Bandra (East), Mumbai, Maharashtra
Evaluation of Materials & Concrete Mix Design for Civil works of FGD System at 4x250 MW BRBCL Nabinagar FGD System, Bihar	Bhartiya Rail Bijlee Company Limited Nabinagar, Bihar
Physical Testing, Petrography and AAR Testing of Coarse Aggregate Samples	Larsen & Toubro Limited, Pakal Dul HEP Kisht, First Floor, Plot No. 427, Channi Himmat, J&K
Testing of Materials- Durability Testing i.e., Chloride Migration Coefficient on Swiss Code SIA 262/1-B, Carbonation Resistance on Swiss Code SIA 262/1-I and Water Absorption (Self-Healing) on EN 13755 Hardened Concrete with Integral Crystalline Waterproofing Admixture XYPEX Admix C-2000 NF of make XYPEX.	APAAR Infratech Pvt. Limited, E-2, Sector-63, Noida, UP

Evaluation of Coarse Aggregates and Concrete Mix Design for Concrete of Grade M35 (PQC as per MORTH) for Road Work using OPC 43 grade (Ultratech) for the work of "Stream Generator and Associated Package including site Levelling for 2X660MW Khurja Super Thermal Power Project (KSTPP)"	Khurja Super Thermal Power Project, Tehsil-Khurja, Bulandshahr, UP
Evaluation of Materials and Concrete Mix Design for Concrete of Grades M25 (for Piling), M25 (for Foundation) M30 (for Raft Concreting) for the work of Dry Ash Conveying & Transporting System Package for Stage-I	NTPC Rihand, Distt. Sonebhadra, UP
Testing of Coarse Aggregate (Physical Testing Petrography and AAR Test) and Water Sample Upper Siang Multipurpose Storage Project	NHPC Limited, Post Office - Pasighat East Siang District, Arunachal Pradesh
Physical Testing and Petrography of Coarse and Fine Aggregate Samples for Work of "Construction of Executive Enclave in Plot No. 36 & 38, New Delhi including O&M and Housekeeping for 5 Years"	Central Vista Project Divisio-5, Central Public Works Department, IP Bhawan, New Delhi-
Structural Assessment and Rehabilitation (SAR)	
Third Party Services of Repair & Restoration work of (i) Staff Quarters (B Block Covering 8 nos. quarters) at RBI Staff Quarters, Char Imli, Bhopal. (ii) Overhead Tank (OHT) at RBI Staff Quarters, Char Imli, Bhopal	Reserve Bank of India, Estate Department, Bhopal, Madya Pradesh
Condition Assessment Study of RCC Chimney at NSPCL Durgapur	NTPC Sail Power Company (P) Ltd. (NSPCL), Durgapur, Dist. Burdwan, West Bengal
Carryout Random Quality Inspection on visit basis during Repair of Cooling Tower (1No) at NTPC Dadri	NTPC Limited, P.O. Vidyut Nagar Dist.- Gautam Budh Nagar, Uttar Pradesh
Condition Assessment of RCC Structures at Township building at NTPC Gadarwara	NTPC Limited, Southern Region Head Quarters, NTPC Bhawan, Road, Secunderabad, Telangana
Random Quality inspection on site visit basis for the work of repair and restoration/strengthening measures of Gas Plant CT-02 at NTPC, Dadri	NTPC Limited, P.O. Vidyut Nagar, Dist.- Gautam Budh Nagar, Uttar Pradesh

Condition Assessment of overhead water tank (1Nos.) and underground water tank (1 Nos.) at Township of NTPC Dadri	NTPC Limited, P.O. Vidyut Nagar, Dist.- Gautam Budh Nagar, Uttar Pradesh
Carrying out Condition Assessment of (i) Zonal Office Building, Shiv Mandir Marg, Lajpat Nagar, New Delhi and ii) M&CW Center Jangpura, Bhogal, New Delhi	Executive Engineer M-I/Central Zone, South Delhi Municipal Corporation, Arjun Marg Defence Colony, New Delhi
Condition Assessment of RCC Chimneys (5 No's) at NALCO CPP, Angul, Odisha	CPP, NALCO, Captive Power Plant Division, National Aluminium Company Limited (NALCO), Angul (Distt), Odisha
To carry out condition assessment using Non Destructive Evaluation Technique for Stability for High level Bridge at Athal on Silvassa main Road in the District of UT of D & NH	Public Work Department (R & B Silvassa).
To carry out condition assessment using Non Destructive Evaluation Technique for Stability for High level Bridge at Rakholi on Silvassa main Road in the District of UT of D & NH	Public Work Department (R & B Silvassa).
Condition Assessment of Residential Buildings of Thermal Colony, Sector-23, FTPS, Faridabad.	Faridabad Thermal Power Station, Haryana Power Generation Corporation Ltd., Faridabad
Preliminary Site Inspection of various Civil Structures of Stage-I & Stage-II and 2 nos. Chimneys of Stage-II at NTPC Kahalgaon	Kahalgaon Super Thermal Power Station, NTPC Ltd., Kahalgaon, Bihar
Condition Assessment of distressed and un-distressed RCC members of stilt, corridor, terrace, staircase and common areas of 2 Nos. Residential Towers of Harmony Apartments Society at Sec-62, Noida	Harmony Sehkari Awas Samiti Limited, Society's Office, Sector 62, Noida
Carry out Survey Stability report using Non Destructive Evaluation Technique for Police Outpost Surangi in Dadra& Nagar Haveli	Public Work Department (R & B Silvassa
Carry out Survey Stability report using Non Destructive Evaluation Technique for Primary Health Center at Mandoni in Dadra& Nagar Haveli	Public Work Department (R & B Silvassa).

Carry out Survey Stability report using Non Destructive Evaluation Technique for Police Outpost Sindoni in Dadra& Nagar Haveli	Public Work Department (R & B Silvassa).
Carrying out Non-Destructive Testing as per information given through email at 336 MS HIG Houses (Signature View Apartment), Mukherjee Nagar, New Delhi.	Executive Engineer, Northern Maintenance Division-2/DDA, Office of Executive Engineer, OPP BBM Depot, Outram Lines, Mukharjee Nagar, Delhi
Carry out condition assessment using Non Destructive Evaluation Technique for various Load Bearing Building Structures of Bank's Residential Colony at Navrangpura, Ahmedabad	Reserve Bank of India (Ahmedabad)
To carry out condition assessment using Non Destructive Evaluation Technique for Stability and Visual Conditional Evaluation for Existing Building (Residential & Non Residential) of ITI Campus at Silvassa in DNH District	Public Work Department (R & B Silvassa)
Preliminary Site Inspection for Condition Assessment of RCC Chimneys of Unit #4,5&6 at Kolaghat Thermal Power Station of West Bengal Power Development Corporation	Kolaghat Thermal Power Station, Distt. Purba Mednipur, West Bengal
Carry out Survey Stability report using Visual Conditional for Existing Building in the Government Land adjacent to the campus of Primary Health Center at Naroli in Dadra& Nagar Haveli	Public Work Department (R & B Silvassa)
Carrying Out Non-Destructive Testing covering UPV Test and RHT on Columns, Beams, Slabs, CC pavement & Kerb Stone at Shivaji College Project site	RITES Ltd., RITES Bhawan, 1, Leisure Valley Rd, Sector 29, Gurugram, Haryana
Preliminary site inspection for Condition Assessment of residential quarters of Stage I and Stage II and Public buildings in PTS NTPC Kaniha	Assistant General Manager (TAD), NTPC Limited, Kaniha, PO-Deepsikha, Dist. Angul, Odisha
Carrying out UPV and Rebound Hammer Test at 765/400 KV GIS substation, Orai Distt. Jalun (Uttar Pradesh).	Power Grid Corporation India Limited. Tehsil Orai, Distt. Jaluan,
Carrying out Ultrasonic Pulse Velocity (UPV) Testing of TG Deck Unit#1 and its supporting RCC Columns at 2x660MW Khurja STPP, as per IS 516 (Part-5/Sec-1): 2018	THDC India Limited, Khurja Super Thermal Power Project, Village & Post Dashera Kherli, Distt. Bulandshahr,

Extraction of concrete cores & their testing at NCB lab for Foundation of 400 kV Khetri- Bhiwadi Transmission Line.	Powergrid Corporation of India Ltd, 400/220 kV Sub-Station, Distt - Alwar Rajasthan
Carry out Stability report using Non Destructive Evaluation Technique for stability and visual conditional Evaluation for existing Girls Hostel Building at Silvassa Zanda Chawk School Campus in DNH District	Executive Engineer PWD Work-Civil division, (R & B) Dadra & Nagar Haveli, Silvassa
Condition Assessment using Non-Destructive Testing for checking of effectiveness of the repair works carried out at Salaria Officers' Enclave Building at Dwarka, New Delhi	Garrison Engineer, MES Delhi, HQ Chief Engineer Delhi Zone, Gopinath Bazar, Delhi Cantt, New Delhi
Condition Assessment of "Emergency Block building at Medical College, Alwar, Rajasthan	HSCC (India) Limited, 205, Eastend Plaza, Plot No.4, DDA – LSC Centre-II, Vasundhara Enclave, Delhi
Carrying out Concrete Core Extraction & Testing at four different locations of Central Warehousing Corporation	Executive Engineering (Vig.), Central Ware Housing Corporation, 4/1, Siri Institutional Area, August Kranti Marg, Hauz Khas, New Delhi
Construction Technology and Management (CTM)	
Third Party Quality Assurance/Audit for Work of "Construction of 100 bedded Balak Ram Hospital in Tmarpur". SH: Const. of ward Blcok.	Executive Engineer (Pr-I) CLZ, North Delhi Municipal Corporation, Sawan Park, Delhi
Third Party Quality Assurance and Audit (TPQA) for the work of Construction of Office Building for Central Excise and Custom, DRI, CBN, NACEAN etc. at Vibhuti Khand, Gomtinagar, Lucknow	Central Public Works Department, Central Division-1, Central Bhawan, Sector-H, Lucknow
Third Party Quality Assurance and Audit (TPQA) for the three work of "Construction of Central University of Haryana at Village Jant-Pali Mahendergarh"	Central Public Works Department, CUH Project Division, Mahendergarh (Haryana
Third Party Quality Assurance and Audit (TPQA) for the work of "Construction of National Museum Institute Building at A-19, Sector-62, Institutional Area, Noida (UP) Distt. Gautam Budh Nagar" SH: Civil Works, Electrical Works, (Internal & External),	Central Public Works Department, Noida Central Division, New Delhi

Fire Fighting, Fire Alarm & PA system, DG Set, Lift UPS & HVAC"	
Third Party Quality Assurance / Audit for Work of "Construction Central University of Haryana at Village Jant Pali, Mahendergarh (Hr) (SH: Construction of 24 Nos Type III, 24 Nos Type V (Stilt+6) Staff Quarters each and Health Centre (Single Storeyed) RCC Framed Structure i/c Water Supply & Sanitary Installation, electrical Installations, Lifts, Fire Fighting & fire Alarm System, Solar Water Heating System, Horticulture Work, External Development Works, etc. and Road Work along New Girls Hostel Blocks behind Sport Complex Area)"	Central Public Works Department, CUH Project Division, Mahendergarh (Haryana)
Third Party Quality Assurance Services for C/O 346 (M.S) MIG Houses i/c internal development and internal electrification at sector-16B, Pocket II, Dwarka Phase II	Executive Engineer, Western Division No. 8, Delhi Development Authority, Dwarka, New Delhi
Third Party Quality Assurance / Audit for work of "Construction of 200 bedded Balak Ram Hospital in C-10/Civil Line Zone" SH: (A) External development work such as plumbing, rain water harvesting, water supply, sewage disposal, approach road, C/o ramp and opening of MS gate for additional entry/exit of the hospital towards transport site, MS gate for additional entry (Civil work) (B)-SITC for street lighting and façade lighting (Electric work)	Executive Engineer (Pr.),CLZ, North Delhi Municipal Corporation, Shakti Nagar, Delhi
TPQA for Work of "Construction of M C Pry. School at Radhey Puri in Ward no. 21-E AC-60 Shah-S Zone"	Executive Engineer (Pr-II), Shah-S, East Delhi Municipal Corporation, Krishna Nagar, Delhi
TPQA for work of "Construction of M & CW Centre at B-Block Sultanpuri ward no. 47 N in Rohini Zone"	Executive Engineer (Pr), RZ, North Delhi Municipal Corporation, Sector-17, Rohini, Delhi
Third party Services (Monitoring and supervision) of Repair work of Seven High rise Towers at NBCC Green view, Sector-37D, Gurugram	CGM (Engg) SBG, NBCC (I) Ltd, New Delhi
Third Party Quality Assurance for Various works of Construction of Steel Structure Non Residential Buildings using Pre-Engineered Construction Technology at KG Marg (near Asia House) and	Executive Engineer cum Senior Manager, RPD-I, CPWD, D-Wing, Room No. 141, Vidyut Bhawan, Shankar

Africa Avenue (near Sarojini Nagar Depot), New Delhi	Market, Central Public Works Department, New Delhi
Third Party Quality Assurance / Audit for work of "C/o multilevel underground car parking at Subhash Nagar Community Hall and construction of community hall above the underground car parking in west zone" SH: Balance civil & Electrical works"	Executive Engineer (Pr-II)/WZ, South Delhi Municipal Corporation, Under Dabri Flyover, New Delhi
Third Party Quality Assurance for Various works of Construction of International Boys Hostel at 500 Capacity & Food Court at IARI Pusa, New Delhi	Construction Division-IV, Central Public Works Department, IARI, Pusa, New Delhi
Third Party Quality Assurance for Various works of Construction of New Office Building for the Agriculture Scientist Recruitment Board at Pusa, New Delhi	Construction Division-IV, Central Public Works Department, IARI, Pusa, New Delhi
Third Party Quality Assurance / Audit for the Work of "Supply of Treated Effluent Water from Keshopur STP to various parks of Vikas Puri in West Zone."	Executive Engineer (M-III)/WZ, South Delhi Municipal Corporation, Vishal Enclave, New Delhi
Third Party Quality Assurance / Audit for the Work of "Land Scaping/Face lifting/Beautification of park on Najafgarh Road Adjacent to Petrol Pump in Ajay Enclave and Opposite to Pacific Mall as "DELHI FATEH SMARAK STHAL" in ward no. 013-S/WZ Tilak Nagar."	Executive Engineer (M-III)/WZ, South Delhi Municipal Corporation, Vishal Enclave, New Delhi
Third Party Quality Assurance / Audit for work of "Construction of Additional Class rooms & Hall in M C Pry. School, Block-12, Kalyanpuri in W.No. 08-E, Shahdara(S) Zone	Executive Engineer (Pr-II), Shah-S, East Delhi Municipal Corporation, Shakarpur, Delhi
Third Party Quality Assurance / Audit for work of "Construction and providing multilevel electro mechanical car parking system in new upcoming office building complex of MoD at KG Marg (near Asia House) and Africa Avenue (near Sarojini Nagar depot), New Delhi.	Executive Engineer cum Senior Manager, Redevelopment Project – IV, CPWD, IP Bhawan, New Delhi
Carrying Out Site Inspection for Preparing Structural Elements Details of Mc Primary Girls School, Ghittorni Village Part and Structural analysis for The Detailed Evaluation of the Building at Ghittorni Village New Delhi	M-IV/South Zone, South Vihar Municipal Corporation, Pushp Vihar, New Delhi
Third Party Quality Assurance / Audit for work of "Improvement of road and drainage system from	Executive Engineer (Pr.-II), Central, South Delhi

Bhagwan Balmiki Mandir to Sewage Pumping station Delhi Jal Board near SDMC Dhalao in Tughlakabad Village ward no. 93-S, Central Zone"	Municipal Corporation, Under Sewa Nagar Flyover, New Delhi
Third Party Quality Assurance / Audit for work of "Construction of roads by construction pavement with RMC to Mitigate Air Dust Pollution in A, B and C Block, Phase-I, Sanjay Gandhi Transport Nagar in CLZ".	Executive Engineer (Project) KPZ, North Delhi Municipal Corporation, Ashok Vihar, Delhi
Third Party Quality Assurance / Audit for work of "Renovation/strengthening of external column by retrofitting construction of Chajjas and Improvement of roof terrace in M.C. Pry. School at Jagatpur in C-8N/CLZ"	Executive Engineer (Project) CLZ, North Delhi Municipal Corporation, Shakti Nagar, Delhi
Third Party Quality Assurance / Audit for work of "Imp. Dev. Of Protection wall arrangement [--] by Pdg. From pre-coated GI profile sheet with steel tabular frames newly allotted land by DDA at Geeta Colony near DM office in Khichripur".	Executive Engineer (M-IV), Shah-S, East Delhi Municipal Corporation, Shakarpur, Delhi
Third Party Quality Assurance / Audit for work of "Improvement development of Arakashan Road from Qutab road to Multani Dhanda road by Pdg. And laying RMC and Imp. Of drainage system in ward no. 91-N/City-SP Zone"	Executive Engineer (Project) SP Zone, North Delhi Municipal Corporation, Kashmere Gate, Delhi
Third Party Quality Assurance / Audit for work of "Construction of room for Bone storage (Asthi Sangreh) and improvement of parking space and raising of boundary wall along parking in Ghazipur Crimination ground at Ghazipur in ward no. 05-E Shah South Zone".	Executive Engineer (Pr.-II), Shah-S, East Delhi Municipal Corporation, Shakarpur, Delhi
Third Party Quality Assurance/Audit for work of "Development of Heritage Park, Parade Ground, Opposite lal Quila, Chandni Chowk, Delhi" SH: Balance work for development of park '7' and adjoining park area in triangular shape.	Executive Engineer (Project) SP Zone, North Delhi Municipal Corporation, Kashmere gate, Delhi
Third Party Quality Assurance/Audit for work of "Construction of 14 Classroom, 2 Nursery Room, 1 computer room, 1 office room, 1 library, 1 staff room, 1 science room, 1 medical room, 1 sports room, 1 Hall etc. in M C Pry. School C-2 block, Ashok Vihar in C-73N/KPZ"	Executive Engineer (Project), KPZ, North Delhi Municipal Corporation, Ashok Vihar Phase-III, Delhi
Third Party Quality Assurance/Audit for work of "Construction improvement of Nallah in Garhi Village from outfill near captain Gaur Marg to entry	Executive Engineer (M-I), South Delhi Municipal

gate to Garhi Village Neem Chowk to Sheetla Mata Mandir and upto H.No. D-19 Dashghara Mohalla in Ward No. 59-S, Central Zone"	Corporation, Defense Colony, New Delhi
Third Party Quality Assurance/Audit for work of "Construction of Yoga Centre at Shiv Puri Sagarpur West in W. No. 31 – S in NGZ"	Executive Engineer (M-II), NGZ, South Delhi Municipal Corporation, Mangla Puri, New Delhi
Third Party Quality Assurance/Audit for work of "Construction of Civil Structure for fixed compactor Transfer station (FCTS) at Bus Body Khyala in ward no 008-S in West Zone"	Executive Engineer (Pr-II)/WZ, South Delhi Municipal Corporation, Under Dabri Flyover, New Delhi
Third Party Quality Assurance/Audit for work of "Providing greening and paving in different areas of EDMC." SH: providing greening and paving in A Block Dilshad Colony Shahdara-North	Executive Engineer(Pr-I), Shah-N, East Delhi Municipal Corporation, Shahdara, Delhi
Third Party Quality Assurance/Audit for work "Refurbishment work from Spillways Glacis to end-sill of Gate No. 5 of Pashulok Barrage, Rishikesh"	Executive Engineer (Civil), Pashulok Barrage, UJVN Limited, Rishikesh
Third Party Quality Assurance/Audit for work of "Construction of multilevel underground car parking at Subhash Nagar Community Hall and construction of community Hall above the underground car parking in West Zone" SH: Construction of meter room, RMU Room. Improvement of Kaccha Portion and other mise, works	Executive Engineer (Pr-II), West Zone, Municipal Corporation of Delhi, Under Dabri Flyover, New Delhi
Third Party Quality Assurance/Audit for work "Redevelopment of Pragati Maidan (international exhibition-cum-convention centre), Pragati Maidan, New Delhi" Reg-additional work to convert mezzanine floor of hall 3 & 4 to conference halls, civil and electrical parts	Senior Manager (Civil), India Trade Promotion Organization, Pragati Maidan, New Delhi

Centre for Mining, Environment, Plant Engineering and Operation (CME)

Project Title	Sponsor
Preparation of Marketing Report for utilization of Flue Gas Desulphurization (FGD) Gypsum of power plants in VSR region for NTPC Ltd.	NTPC Limited
Measurement of dust load at various ducts	M/s Rajashree Cement Works, Ultratech Cement Ltd, Karnataka

Project Title	Sponsor
Performance Assessment of existing APCE (RABH)	M/s Dalmia Cement (B) Ltd., Kadapa
Performance Assessment Study of APCE attached with coal mill stack	M/s UltraTech Cement Ltd., Baga Cement Works, H.P.
Construction of 100 bedded hospital at Tilak Nagar, New Delhi	South Delhi Municipal Corporation
Procurement of ceiling fans for M.C.(P) schools under jurisdiction of Narela zone.	North Delhi Municipal Corporation
Annual Contract for operation of lift at 250 ward and Casualty block at Hindu Rao Hospital for the period 2019-2020	North Delhi Municipal Corporation
Improvement and modification of the existing crematorium for conversion of electric crematorium to CNG based crematorium at Green Park Extension	South Delhi Municipal Corporation
Establishment of CNG based crematorium at Subhash Nagar, West Zone. Sub Head: Tender for design, supply, installation, testing commissioning and maintenance of compressed natural gas (CNG) based Crematorium	South Delhi Municipal Corporation
Providing and fixing of lighting arrangement with galvanized poles on roads Bharthal village Dhoolsiras village Bamnuali village shahbad Mohmadpur village and parks in sector -09 Dwarka in ward no 47 under NGZ dwarka C(Part-A)	South Delhi Municipal Corporation
Annual Comprehensive operation and maintenance contract of MEP equipments at Multilevel underground parking at J-8 Rajouri Garden under West Zone	South Delhi Municipal Corporation
Provision of Octagonal poles for lighting arrangement (with fitting) at various Parks in Ward No. 101 S Sarita Vihar under Central Zone.	South Delhi Municipal Corporation
Design, Supply, Installation, Testing, Commissioning with post Commissioning 05 year operation and comprehensive maintenance of compressed Natural Gas (C.N.G.) based human body crematorium system with two numbers furnaces including Electrical work at Dwarka SDMC crematorium ground under Najafgarh Zone	South Delhi Municipal Corporation
Comprehensive AMC (Annual Maintenance Contract) for Repair and Maintenance of Tubewells installed at various Mpl Parks under Rohini Zone	North Delhi Municipal Corporation
Construction of Bharat Darshan Park at Panjabi Bagh Ward no. 02-S in West Zone under Waste to Art.	South Delhi Municipal Corporation

Project Title	Sponsor
Subhead: Provision of ongrid Solar Photovoltaic Power Plant and Grid Connected Solar Power Tree.	
1. Provision of smart class rooms at EDMC Primary School Dilshad Colony, Nand Nagari E-Block and Sunder Nagari F-1 block in ward No.28,32&33 under Shahdara North Zone 2. Provision of smart class rooms at EDMC Primary School Mohanpuri, EDMC primary school jyoti colony and EDMC Primary School Awasiya Parisar Seelampur (Gen) in Ward No.48-E, 49-E & 43-E under Shahdara North Zone. 3. Provision of smart class rooms at EDMC primary school Balbir Nagar Ext (Gen) and EDMC Primary School Babarpur in Ward No.51-E & 50-E under Shahdara North Zone.	East Delhi Municipal Corporation
Construction of M&CW Centre in F-block, Sultanpuri Ward No.- 48 in Rohini Zone. Sub head: P/o EI and other allied works, Fire Fighting with wet riser system and tubewell	North Delhi Municipal Corporation
Construction of Community Hall at H-Block, Jahangirpuri in C-16N / CLZ. S.H:- SITC of Air Conditioning Plant.	North Delhi Municipal Corporation

Appendix – IV

Research and Development Programme 2022–2023: In Progress

S. No.	Code	Project Title	Date of commencement	Target Date of Completion
PROJECTS UNDER DCCI				
1.	WAU-19	Investigations on Utilization of Phospho-gypsum in Cement Manufacturing	Aug 2021	July 2024
2.	WAU-20	Utilization of lime sludge generated from paper industry in the manufacture of Cement	Aug 2021	July 2023
3.	FBR-16	Formulation of chemical admixture using by product lignosulfonate from paper industry for improved performance in mortar and concrete	Aug 2021	July 2023
4.	PRP-07	Enhancement of plastic waste utilization as Alternative Fuel in Indian Cement Industry and its impact assessment	Aug 2021	July 2023
5.	WAU-21	Investigations on development of Portland Dolomitic Cements (PDCs) using high MgO limestone and dolomitic grade limestone from different geographical regions.	April 2022	Sep 2023
6.	WAU-22	Investigation on mineral carbonization mechanism of various industrial waste and by-products	April 2022	Mar 2024
7.	AFT-01	Improvement in Clinker quality and Increase % TSR by the Application of Artificial Intelligence.	April 2022	Mar 2024

PROJECTS UNDER: PROJECT BASED SUPPORT FOR AUTONOMOUS INSTITUTES				
1.	CON-17	Study of Carbonation and Carbonation induced reinforcement corrosion in new cementitious system	April 2020	Sep 2023
2.	SAR-01	Cathodic Protection (CP) of RCC structures to enhance service life of new and existing structures using three system (Sacrificial anode, ICCP and hybrid system)	Oct 2020	Sep 2023
3.	SOD-13	Effect of Fire on the Residual Mechanical Properties of reinforcing bars and Structural Performance of Reinforced Concrete Beams in flexure & Shear.	April 2022	Mar 2025
4.	SAR-02	Evaluation of Concrete Surface Coatings for their effectiveness in service life enhancement of RCC elements under: Carbonation induced corrosion & Chloride Induced Corrosion.	April 2022	Mar 2025
5.	CON-19	Utilization of CO2 in fresh concrete and study on fresh and hardened properties of CO2 induced concrete.	April 2022	Mar 2025

Appendix –V

NCB Patents Granted/ Filed During 2011-2022

Patents Granted:

Sl. No.	Patent No	Title	Names of Inventors
1.	344069	Mineralizing effect of "barium sludge- an industrial byproduct" in the manufacture of ordinary Portland cement	Sh. A Pahuja Dr. M M Ali Dr. V P Chatterjee Sh. S K Chaturvedi Sh. S K Agarwal
2.	314591	Rationalizing formulations and curing conditions for improving properties of hardened Geopolymeric Cement	Sh. Ashwani Pahuja Dr. M M Ali Dr. R S Gupta Dr. S Vanguri Dr. V Liju
3.	337143	Process for the Preparation of sulphoaluminate - belite cement utilizing high magnesia / dolomitic limestone	Sh. Ashwani Pahuja Dr. M M Ali Sh. P S Sharma Dr. V P Chatterjee
4.	340210	Nanosilica blended ordinary Portland cement compositions with improved performance characteristics and a process thereof	Sh. Ashwani Pahuja Dr. M M Ali Dr. S Harsh Sh. Suresh Vanguri Dr. Varsha Liju
5.	344307	Fast process for determining expected 28-days compressive strength of concrete made with Portland Pozzolana Cement (PPC)	Sh. V V Arora Sh. Suresh Kumar Sh. Manish Kumar Mandre
6.	294833	A process for producing of Ordinary Portland Cement	Sh M Vasudeva Dr M M Ali Dr D Yadav Dr J M Shatma NALCO Officials
7.	295058	A process for preparation of synthetic slag from low grade limestone and dolomite	Sh. A Pahuja Dr. M M Ali Sh. P S Sharma Sh. S K Chaturvedi Sh. S K Agarwal Dr. V P Chatterjee Dr. D. Yadav Sh. Tashi Tshering Sh. Udai Kaflay

Sl. No.	Patent No	Title	Names of Inventors
8.	347356	Marble dust as mineral additive in the manufacture of ordinary Portland cement	Sh. A Pahuja Dr. M M Ali Sh. P S Sarma Sh. S K Agarwal Sh. Ashish Goyal
9.	355368	Method for rapid estimation of Na_2O and K_2O in different types of cement and raw materials	Sh. Ashwani Pahuja Dr M M Ali Sh. S K Chaturvedi Sh. S. C. Sharma

Patents Filed:

	Application No.	Title	Name of Inventors
1.	1195/DEL/2015	Investigations on the use of limestone mine reject on the properties of OPC clinker and resultant cement	Sh Ashwani Pahuja Dr M M Ali Dr V P Chatterjee Sh S K Chaturvedi Sh S K Agarwal
2.	201711000524 Dt:05-01-2017	A Process for Preparing Tiles	Sh Ashwani Pahuja Dr. S K Chaturvedi Dr S Harsh Dr. R S Gupta Sh. S Vanguri Dr. V Liju Dr. M N K Prasad Bolisetty
3.	201811047884 Dt:18-12-2018	Geoploymer concrete paving block and a process for preparation thereof	Sh. V.V. Arora Sh. Amit Trivedi Sh. Lalit Kumar
4.	201911049295	Composition of PPC and PSC using High Magnesia (MgO) clinker	Dr B N Mohapatra Dr S K Chaturvedi Sh G J Naidu Sh Giasuddin Ahamed
5.	202211044873	Sustainable Concrete composition and method for preparation thereof	Ms Sonal Saluja Dr Arun Gaur Dr Sanjay Mundra
6.	202311023188	A flexible Material Transfer Apparatus for Handling Solid Alternative Fuels & their mix	Sh Kapil Kukreja Dr Manoj Kumar Soni Dr B N Mohapatra

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