ANNUAL REPORT 2021-22

आज़ादी का अमृत महोत्सव

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एक कदम स्वच्छता की ओर

NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS

Annual Report 2021-22

1 April 2021 to 31 March 2022

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 the Chairman

As a premier body for research, technology development & transfer and capacity building in areas of cement, concrete and building materials, the constant focus at National Council for Cement and Building Materials (NCB) our key focus is on innovation. This is accomplished through programmed projects and by extending technical services with efficiency to the industry. It is indeed heartening to see the dedication of NCB's scientists and engineers to the promotion of innovation, keeping pace with latest ones in the interest of industry and nation such as conservation of mineral wealth, energy & environment, improving productivity, quality control & quality assurance.

NCB is contributing significantly to the development of newer technologies and materials such as composite cements, high volume fly ash cements, geo-polymeric cements and so on. The institute is also providing services to industry by executing projects on sponsored basis, testing materials in its NABL accredited & BIS recognized laboratories, providing calibration services, making CRMs & BNDs, providing training and solving problems wherever required. I am delighted to learn that NCB has completed five Research Projects and 133 Sponsored Projects during financial year apart from carrying out 42 Training Programs, disseminating knowledge to a total of 1033 professionals in cement and concrete sector.

Keeping the needs of the industry and stakeholders in mind, NCB has taken up programmed projects in areas of waste utilization like FGD gypsum, phosphogypsum and lime sludge in cement manufacture and development of belite calcium sulpho-aluminate cement using low grade limestone & industrial waste. NCB also initiated development of zeolite for oxygen concentrators by using cementitious raw materials. It has carried out experimental trail runs in downdraft gasifier at BITS Pilani and developed a MAT lab model for RDF gasification to predict Syn gas quality. It is also studying design of transfer chute catering maximum types of solid alternative fuels without jamming issue. In the field of concrete, it has developed Ultra High-Performance Concrete (UHPC) with compressive strength in excess of 150 MPa and is presently studying mechanical and durability properties of High Strength Geopolymer Concrete.

Recently, NCB has provided valuable support to the industry by conducting studies on LCF, energy audits, pre-feasibility, techno-economic feasibility, DPRs and marketing reports. I am satisfied with the progress and services that NCB is providing as a PMC to cement plants abroad for complex projects on usage of alternative fuels, carving a niche for itself as a reliable consultancy service provider to cement industry internationally.

NCB has been carrying out pioneering work for concrete and construction industries. It has successfully conducted evaluation of range of concrete making materials and concrete mix designs for special applications. NCB has expertise to evaluate aggregates for potential alkali aggregate reaction and performance of integral crystalline water

proofing compounds. It has conducted studies on Normal and High Strength Concrete (HSC) using different indigenous aggregates for concrete grades from M35 to M100 and carried out a wide range of activities related to assessment of new and existing concrete structures.

In Quality Management, apart from providing excellent calibration services to the industry, NCB has developed 79 types of CRMs and 18 Bhartiya Nirdeshak Dravyas (BNDs) to cater various needs of the industry. Currently, in India, it is the only leading organization which develops CRMs in the area of cement & cementitious materials as per ISO 17034:2016 and BND trademark.

'NCB International Seminars' has emerged as a singular biennial event in this part of the globe which cement and construction industry the world over looks forward to for participation. The forthcoming 17th International Conference has received an overwhelming response from various industrial sectors, Government, academia, machinery manufacturers & consultants from India and across the globe. It is expected that the event like its predecessors, will see the captains of cement and concrete sector, policy makers, academicians, professionals, engineers and scientists come under one roof and discuss future action plans aimed towards net zero carbon emissions in production and responsible consumption of resources utilized in the sector to ensure long term sustainability.

At this point, I extend my admiration to scientists and engineers including other technical and non-technical staff of NCB. I also thank my fellow members in the Board of Governors and its Committees for their valuable advice and guidance in decision making on various issues from time to time. The achievements and progress made by NCB to a great extent are due to the active support and cooperation from the Government, industry and other organizations. I also extend my sincere thanks to the Department for Promotion of Industry and Internal Trade, Government of India, for providing their support and direction. I am confident that NCB will continue in its pursuit of excellence in all its endeavors covering: Research, Technology Transfer, Continuing Education, Calibration & Testing Services in areas of Cement, Construction and Building Materials, thus, satisfying all stakeholders.

K C Jhanwar
Chairman

12 October 2022

Message from desk of Director General

The courage and efforts of our medical fraternity and swift comprehensive implementation of vaccination programme by the government has helped us tiding above the waves of global pandemic. The government's spending on infrastructure projects and affordable housing schemes with enhanced budgetary allocations will drive the growth for the cement industry. Post-pandemic, the industry has seen increase in volThe industry must end reliance on polluting, financially volatile and costly fossil fuels and adopt cleaner and newer technologies, thus reducing its carbon footprint.

I'm pleased to present to the cement and concrete fraternity, government, academia, scientific institutions, civil society and all our stakeholders, the Annual Report for the year 2021-2022. Built on pillars of knowledge, ethics, infrastructure, energy, and drive of its people, NCB's Annual Report this year is emblematic of adaptability, creativity, resilience and effectiveness showcased by NCB employees working in all its units across the country, embracing novel ideas and flourishing in face of impossible odds.

In the year gone by, we at NCB have provided sound technical solutions to our clients, fresh and old alike. With enterprising customer centric approach and constantly upgraded infrastructure facilities, NCB satisfactorily completed 133 sponsored projects for the industry and is in pursuit of a number of programmed projects. The projects covered all important research areas like utilization of industrial wastes, LCF & process optimization studies, energy conservation, environmental improvement, feasibility studies, diagnostic studies on distressed structures and quality audit.

CRT completed 16 LCF studies, carried out development of cements using low grade limestone and industrial waste, investigations on development of Portland Composite Cements based on fly ash and limestone. Emphasis was particularly laid down on investigations carried out to utilize wastes in making clinker and cement. Projects on using lime sludge, FGD & phospho gypsum in cement manufacture are taken up in line with standards set by the MoEF&CC. State-of-the-art, Independent Testing Laboratories undertook testing as per National and International Standards of more than 7,605 samples during the period. During the pandemic, NCB took initiative under Atmanirbhar Bharat in mission mode and successfully developed zeolite for oxygen concentrators by economical green sol-gel method.

CME carried out projects of Project Management Consultancy services for international cement plants, performance evaluation of air pollution control equipment, Energy Audits, capacity enhancement studies, heat and gas balance studies, techno-economic feasibility and detailed project reports for setting up cement plants, grinding units as well as marketing report for utilization of FGD Gypsum. R&D projects like MAT lab model development for RDF gasification to predict the Syn gas quality and further techno economic analysis as well as design of chute catering maximum types of solid alternative fuels without any jamming issue are being carried out.

CDR is carrying out evaluation of wide range of concrete making materials and conducting studies on Normal and High Strength Concrete. It recently completed an R&D project for development of Ultra High-Performance Concrete. Further, new research on Mechanical and Durability Properties of High Strength Geopolymer Concrete and use of advanced electronics such as 3D Printer are taken up for construction of concrete structures. Structural Assessment & Rehabilitation of new and existing concrete structures is carried out including condition assessment of existing concrete structures such as dams. The Centre is providing durable repair strategy for distressed RCC structures and specialized services in quality assurance/control, thereby contributing towards building durable infrastructure in India for prestigious projects of national importance.

CQC developed 79 types of CRMs and 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 CRMs was continued to the laboratories in India and abroad. Calibration services were also provided to clients where 96% of them rated NCB services as excellent.

CCE imparted training on cement, concrete and construction technologies through its various special, short-term and refresher courses. During the year 2021-22, 42 training programmes (*online/offline*) were successfully organized with a total of 1033 participants attending the programmes. CIS also organized webinars & workshops, disseminating information on technologies and services through various modes.

The Research and Innovation projects of NCB are well aligned with the vision and mission of Government of India like decarbonization, implementation of circular economy, increased sustainability etc. I extend my deepest gratitude to each of my colleagues who have exhibited rigor, passion and dedication during the year. I am grateful to the Board and its Committees, DPIIT, MoC&I, Govt. of India, for their support, guidance and encouragement. I thank industry for restoring faith in NCB and their continued patronage, thereby invigorating our long-standing relationship and allowing to continuously foster our common vision to further work for the good of society.

In times to come, we look forward for support and to live up to the expectations of our stakeholders by delivering key sustainable ideas to help businesses and society grow. I hope that this report, like its predecessors, will introduce you to the engines that keep us running strong. Our people!

Dr. B N Mohapatra
Director General

12 October 2022

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

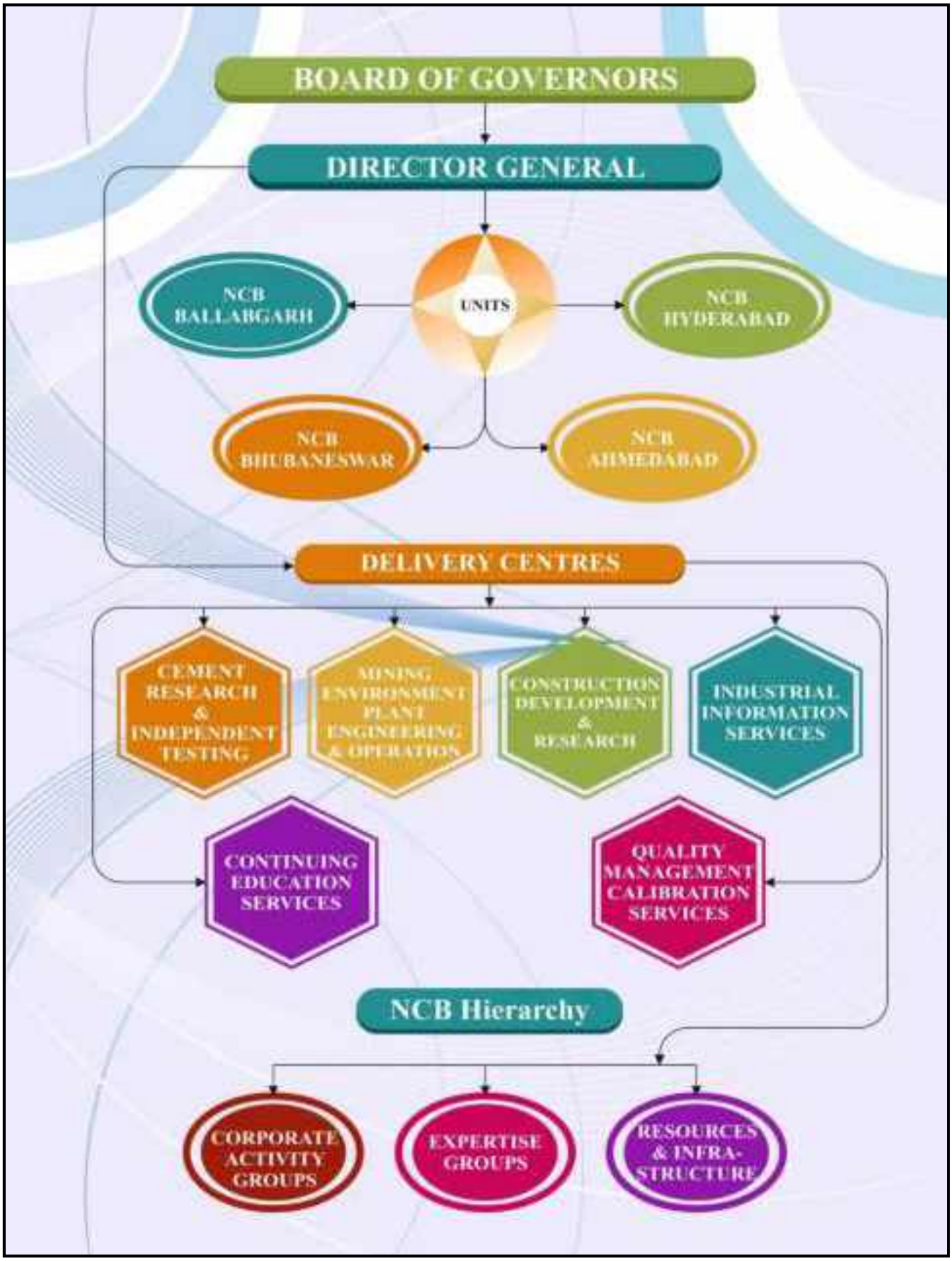
Be a preferred technology partner to cement and construction sectors in the sustainable development of a better infrastructure and housing.

OUR MISSION

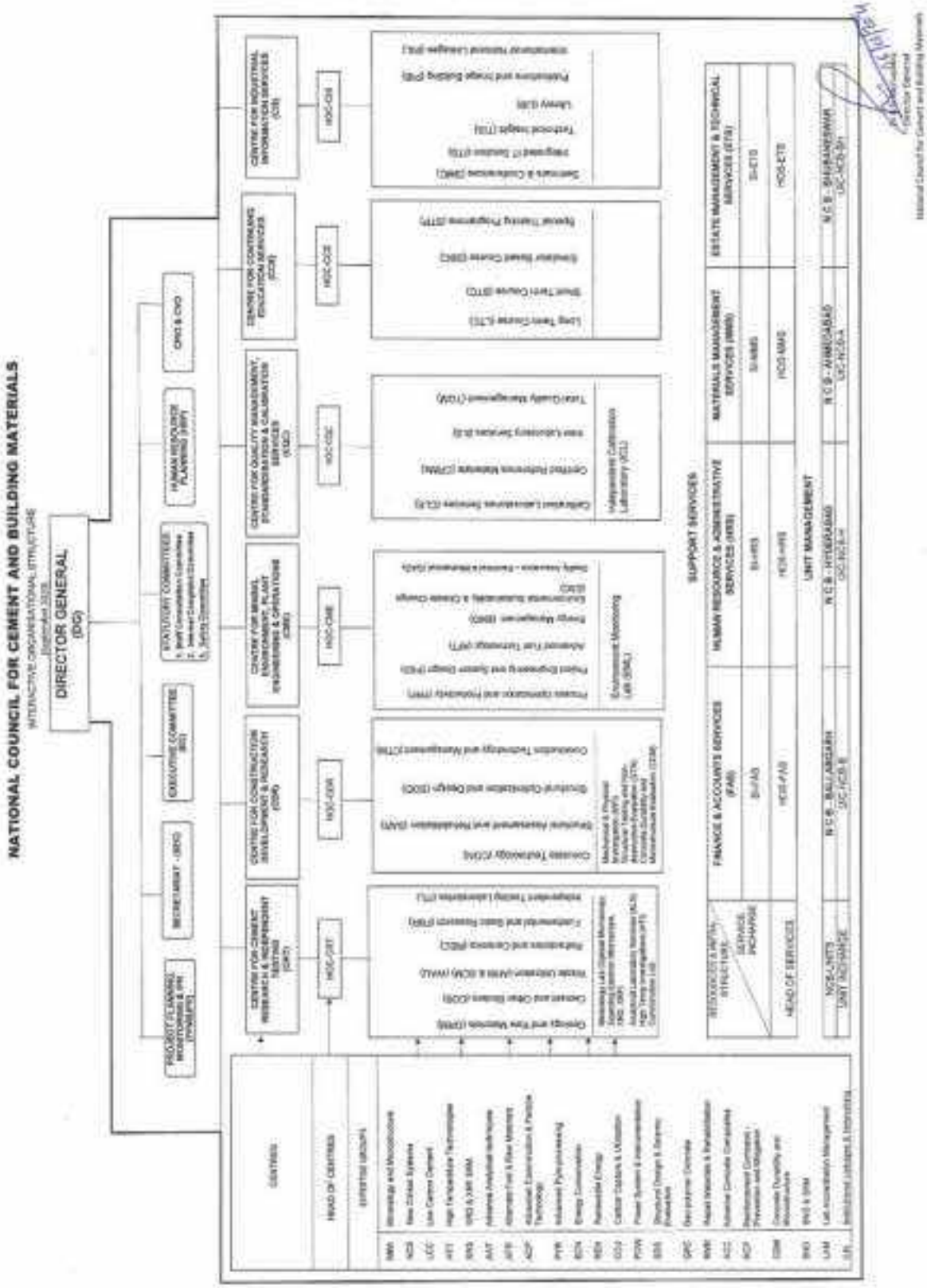
Research and Development of innovative technologies, their transfer and implementation in partnership with cement and construction industries.

- 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 Board of Governors



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 the premier autonomous R&D organisation, under the administrative control of Ministry of Commerce and Industry, Govt. of India, for 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) & regional units at Hyderabad (Telangana), Ahmedabad (Gujarat) and at 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 on cement, concrete and building materials. It has organised 16 editions of this seminar, 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 geology, mining and raw materials, environmental management, process utilization and productivity, energy management, plant maintenance and project engineering and system designing.

- **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

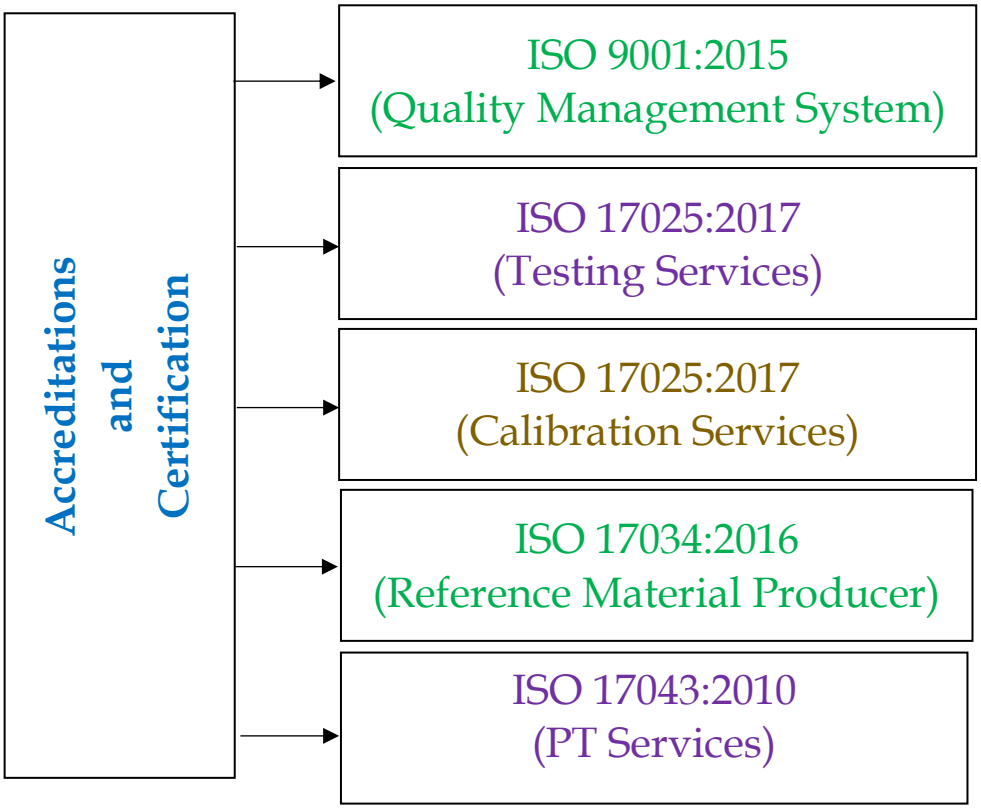
- **Human Resource and Administrative Services (HRS):** HRS-GEN provides the transportation resources and HRS-PER is responsible for human resources activity such as recruitment, promotion, appraisal etc.

- **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.**

BMSCERT

CERTIFICATE OF REGISTRATION

National Council for Cement and Building Materials

ISO 9001:2015

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.

National Accreditation Board for Testing and Calibration Laboratories

NABL

CERTIFICATE OF ACCREDITATION

NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS (TESTING LABORATORIES)

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2017

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

34 KM MILE STONE, DELHI MATHURA ROAD, BALLABGARH, FARIDABAD, HARYANA, INDIA

in the field of

TESTING

Certificate Number: TC-5298

Issue Date: 17/03/2022 Valid Until: 16/03/2024

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the relevant requirements of NABL.
(To see the scope of accreditation of this laboratory, you may also visit NABL website www.nabl-india.org)

Name of Legal Entity : NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS

Signed for and on behalf of NABL

N. Venkateswaran
Chief Executive Officer

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.

National Accreditation Board for Testing and Calibration Laboratories

CERTIFICATE OF ACCREDITATION

INDEPENDENT CALIBRATION LABORATORIES, NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS

ISO/IEC 17025:2017

"General Requirements for the Competence of Testing & Calibration Laboratories"

CALIBRATION

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.**

National Accreditation Board for Testing and Calibration Laboratories

CERTIFICATE OF ACCREDITATION

STANDARD REFERENCE MATERIAL, NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS

ISO 17034: 2016

"General Requirements for the Competence of Reference Material Producers"

REFERENCE MATERIAL PRODUCER

Signed for and on behalf of NABL

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.**

National Accreditation Board for Testing and Calibration Laboratories

CERTIFICATE OF ACCREDITATION

INTERLABORATORY SERVICES, NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS

has been assessed and accredited in accordance with the standard

ISO/IEC 17043: 2010

"Conformity Assessment - General Requirements for Proficiency Testing"

for its facilities at

34 KM STONE, DELHI-MATHURA ROAD, BALLABGARH, FARIDABAD, HARYANA, INDIA

in the field of

PROFICIENCY TESTING PROVIDER

Signed for and on behalf of NABL

N. Venkateswara
Chief Executive Officer

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

Dr (Ms) Vandana Kumar*
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

Shri P N Chhangani
Wholetime Director
Shree Cements Ltd.

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

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

Shri Anil Meshram
Managing Director
Tamil Nadu Cements Corporation Ltd.

Dr B N Mohapatra
Director General, NCB

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

Chairman
National Highways Authority of India

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

Shri Jayakumar Krishnaswamy
Managing Director
Nuvoco Vistas Corp Ltd.

Shri Rakesh Singh
Executive President
The India Cements Ltd.

Shri Deepak Khetrapal
Managing Director & CEO
Orient Cement Ltd.

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

***Member of 121st BOG, held on 30 June 2021** **# Member of 122nd BOG, held on 16 November 2021**

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 121st & 122nd meetings of Board of Governors (BOG) were held on 30th June 2021 & 16th November 2021 respectively under the Chairmanship of Shri K C Jhanwar, Chairman-NCB & Managing Director, UltraTech Cement Ltd. Many important discussions were held during the meetings which led to key decisions made in both the BOG meetings.

Corporate Advisory Committees

Research Advisory Committee (RAC) (2021-22)

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 of eminent and learned technocrats representing Indian cement and concrete industry, technology suppliers, officials from Ministry of Commerce and Industry, Government of India, Elite 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

Sh Ashwani Pahuja
Executive Director & CSO
Dalmia Bharat Group

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

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

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

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

Dr K Mohan
Ex Director General-NCB

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

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

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

Dr. N. Gopalkrishnan
Director
Central Building Research Institute
Roorkee

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)
Dept. for Promotion of Industry and Internal Trade (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 Corporation

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
National Center of Excellence in Geoscience Research, Geological Survey of India

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

Prof. Satish Chandra
Director
Central Road Research Institute

Shri Shalabh Mundra
Sr. Vice President
Ultratech Cement Ltd.

Shri S K Rathore
President & Unit Head
Kailash Nagar-I, J.K Cement Works,
Nimbahera, Rajasthan

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

Advisory Committee for NCB–Hyderabad & Bhubaneswar

In an endeavor to reach out to the cement and construction sectors in South India and share 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
Odisha Works Dept.

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
M/s Kesoram Cement Ltd

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

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

Dr Manish Karandikar
Vice President
ACC Ltd.

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

Shri Sathia Raj
CPC Head
UltraTech Cement Limited

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

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

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

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

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

Dr. S S Gupta
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

Shri Aakash Gupta
Senior Research Associate, Cement Manufacturers' Association

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

Shri A K Tiwari
VP & Tech Head
Ultratech Cement Ltd.

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

Shri Ashish Kumar
Senior Vice President – Manufacturing
The Ramco Cement Ltd.

Shri Ashutosh Saxena
Joint Director, NCB

Shri Balmukund Tiwari
Member, Cement Plant

Shri B L Murthy
Sagar Cement

Dr B N Mohapatra
Director General, NCB

Shri C V Subba Reddy
Member, Cement Plant

Shri Dakshinamoorthy
The India Cements Ltd.

Shri Deepak Khetrapal
MD & CEO
Orient Cement Ltd.

Shri Ganpati Raju
Ultra Tech Cement

Shri J Krishnaswamy
Managing Director
Nuvoco Vistas Corp Ltd.

Shri Jai Prakash Vrati
Head–Quality Assurance
Ambuja Cements Ltd

Shri Jamshed N Cooper
MD & CEO
HeidelbergCement India Ltd.

Shri Kamal Dangi
Member, Cement Plant

Shri K Srinivas Rao
Bhavya Cements Ltd.

Ms K V Kalyani
Joint Director & Unit Incharge, NCB

Shri Lokesh Bahety
Technical Head
Dalmia Bharat Ltd.

Ms. Lopa Mudra Sengupta
Vice President – Technical Services
JSW Cement Ltd.

Shri Manish Singh
President – Head Technical
Prism Johnson Ltd.

Shri M Tirupati Rao
The India Cements Ltd

Shri N Srinivas Rao
Plant Head
My Home Industries Pvt. Ltd.

Shri P N Chhangani
Whole Time Director
Shree Cement Ltd.

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

Shri Ravi Chandran
Tamilnadu Cement Corporation ltd.

Shri R Sridhar
Kesoram Cement

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

Shri Shashi Gaggar
Vice President
Ultratech Cement Ltd.

Dr S K Chaturvedi
Secretary & Joint Director, NCB

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

Shri Madhusudan Kulkarni
Vice President- Works
The Ramco Cement Ltd.

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

Shri MV Murali Prasad Reddy
Plant Head
Penna Cement Industries ltd.

Shri Pankaj Kejriwal
Director, Star Cement

Shri Prakhar Srivastava
Head (QA & QC)
JK Cement

Shri Raju Goyal
Chief Technical Officer
UltraTech Cement Ltd.

Shri R Rayapat
Member, Cement Plant

Shri Rajendra Chamaria
VC & MD
Star Cement Ltd.

Shri Shashank Priya
Special Secretary & Financial Advisor
DPIIT

Shri Shivbalan
Member, Cement Plant

Dr S K Handoo
Advisor
My Home Industries Ltd.

Shri Sudhindra V Mirjikar
Member, Cement Plant

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

Sh Vivek Kumar
Plant Head
Cement Corporation of India Ltd.

Shri V V Prasad
Sr. General Manager
Sagar Cements ® Limited –
Gudipadu

Shri V H Choudhary
AVP (Works)
My Home Industries Pvt. Ltd.

Shri V K Chowdhury
Chettinad Cement

Shri Y C Naidu
Hemadri Cement

Executive Committee (EC)

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. B N Mohapatra
Director General-NCB

Secretary

Dr. S K Chaturvedi
HOC-CRT & HOS-FAS

Members

Shri Ashutosh Saxena*	HOC-CME & HOS-HRS
Mrs. K V Kalyani	Unit In-Charge, NCB-Hyderabad
Dr. D K Panda	HOC-CCE
Shri P N Ojha	HOC-CDR & Unit In-Charge, NCB-Ahmedabad
Shri AVS Manian	HOS-ETS
Shri Amit Trivedi	HOC-CQC & HOS-MMS
Dr. B Pandu Ranga Rao	Unit In-Charge, NCB-Bhubaneswar
Shri Anupam	HOC-CIS

** Retired on 31st March 2022*

Corporate Advisory Committee Meeting

Corporate Advisory Committee Meetings

73rd Research Advisory Committee (RAC)

Virtual meeting of 73rd RAC

73rd RAC was held on 26th July 2021 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 by the RAC *(given in Appendix IV).*

65th Meeting of Administration & Finance Committee (AFC)

Virtual meeting of 65th AFC

The 65th Administration & Finance Committee (AFC) meeting was held on 29th October 2021 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.

57th and 58th Annual General Meeting (AGM)

The 57th and 58th Annual General Meeting of NCB were successfully held on 30th June 2021 and 16th December 2021 virtually 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

Virtual meeting of AGM

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 05 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 industy and naton at large.

	Commitment to become Net Zero by 2070, reduction of CO_2 intensity by 45% by 2030 and reduction of 1 billion tonnes of CO_2 emissions by 2030	NCB's Centre for Cement Research and Independent Testing (CRT) has undertaken extensive research for Clinker Substitution to achieve specific CO_2 emissions to 0.35 tCO_2/t of cement by development of: • Portland Composite Cement based on fly ash and Limestone • Portland Limestone Cement • Portland Dolomite Cement • Composite Cement based on fly ash and slag • Multi component blended cement • Geopolymer Cement • Low Carbon Clinker
	Make in India	To promote "Atma Nirbhar Bharat" and "Make in India" programmes by reducing the import of foreign Standard Reference Materials, NCB's Centre for Quality Management, Standards & Calibration Services (CQC) developed 18 Bhartiya Nirdeshak Dravya (BNDs) for cement and cementitious materials. CQC provides Proficiency Testing services as well as Calibration services traceable to National / International Standards in various fields of force, temperature, mass & volume, dimension, pressure and RPM.
	Pradhan Mantri Kaushal Vikas Yojana (PMKVY)	NCB's Centre for Continuing Education (CCE) has been organizing various industry-oriented training programmes for professionals of all levels & students and Seminars / Workshops / Online Training/Webinars forcement, concrete, construction and building material sectors. Beneficiaries: Entire Cement Industry, IAF, RBI, BRO, Indian Post, Indian Railways, CPWD, PWD & Water Resources Department of various State Governments, BPCL, HPCL, IOCL, DMRC, NBCC India Ltd., NHPC Ltd., NTPC, GAIL India Ltd. etc.
	PAT Scheme of BEE under National Mission for Enhanced Energy Efficiency (NMEEE)	NCB's Centre for Mining, Environment, Plant Engineering & Operation (CME) has carried out over 200 Energy Audits of cement plants for improving Energy Efficiency under the Perform Achieve & Trade (PAT) scheme of Bureau of Energy Efficiency (BEE), Ministry of Power, Govt. of India. CME is also carrying out research on ways to maximize Waste Heat Recovery and utilize Renewable Energy in cement related operations
	Transition to Circular Economy from Linear Economy	NITI Aayog has taken the lead to expedite the transition of the country from a linear to a circular economy and identified 11 focus areas including Municipal Solid Waste & Liquid Waste, Electronic Waste, Scrap Metal (Ferrous & Non-Ferrous), Solar Panels, Gypsum, Lithium-Ion Batteries, Agriculture Waste, Toxic Hazardous Industrial Waste, Used Oil Waste, Tyre and Rubber Recycling and End-of-life Vehicles (ELVs). Each of the focus areas is assigned to the concerned line Ministry. NCB has done extensive research on Gypsum under the aegis of DPIIT and C&D waste under the aegis of MoHUA and organized stakeholder consultations, formulated comprehensive action plans and prepared reportcompiling all the recommendations from various stakeholders for submission to NITI Aayog.
	Swachh Bharat Mission	NCB's Centre for Construction Development & Research (CDR) has done extensive research on utilization of C&D waste as well as other industrial waste such as iron slag, copper slag, bottom ash, ferrochrome slag etc. asan alternative to natural fine and coarse aggregates; utilization of sintered flyash as coarse aggregates in structural light weight concrete and development of Geopolymer Cement and Concrete systems; NCB's CRT & CME are actively working with cement industry for utilization of various wastes as AlternativeFuels and Raw Materials to enhance %TSR from 6% to 25%.
	Smart Cities Mission	NCB's Centre for Construction Development & Research (CDR) has undertaken research projects such as High Strength Concrete & Ultra High Performance Concrete and is providing reliable technical services to ensure durable and sustainable infrastructure by undertaking Third Party Quality Assurance and Audit of Construction Projects such as Convention Centres, Buildings, Bridges, Tunnels, Roads etc. Beneficiaries: CPWD, PWD, IDCO Odisha, Telangana, Power Grid Corp. Ltd., ITPO (Pragati Maidan), International Convention Centre Dwarka, Ambedkar Memorial, NTPC, AIIMS, MCD, DDA etc.

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 webinars & online 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 240 cement plants. During the year, LCF studies were completed for 16 cement plants from Madhya Pradesh, Andhra Pradesh, Rajasthan, Karnataka and Telangana. Apart from this, development of belite calcium sulpho-aluminate cement using low grade limestone and industrial waste, investigations on development of portland composite cements based on Fly Ash and limestone where 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. A R&D project on technical feasibility of using FGD gypsum in cement manufacture is taken up in line with the standards set by the MoEF&CC for coal-based thermal power plants in which FGD systems needs to be installed in them. NCB has also taken up R&D for utilization of Lime sludge (generated from Paper Industry) effectively in manufacturing of cement and looking forward to production application of lime sludge. A project on investigations on utilization of phosphogypsum in cement manufacturing was taken up as in the manufacturing process of cement, phosphogypsum could be used as a replacement of natural gypsum which plays the role of a set retarder. During Covid-19 in India in 2021, there was scarcity of oxygen concentrator due to which zeolite was imported from abroad. In view of this, NCB took initiative under Atmanirbhar Bharat in mission mode for the development of zeolite for oxygen concentrator by using cementitious raw materials. NCB has successfully developed zeolite for oxygen concentrator by economical green sol-gel method. Assignments were carried out for samples from neighbouring countries also. The number of samples tested during the period was more than 7,605.

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 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).

Further, detailed project report for setting up a 60 tph Cement Grinding Unit at KINFRA, Taliparamba, 1000 tpd (0.3 mtpa) Bulk Cement Terminal and allied materials handling unit at Cochin Port Trust Complex was successfully completed. The report covers detailed study of various aspects like loading/ unloading, handling,

storage, blending, packing and transportation of raw materials (like OPC, dry fly ash, laterite, coal, clinker, gypsum etc.) and finished product (PPC). Apart from this, detailed feasibility study was carried out to install AFR system for rotary kiln firing in the preheater kiln based cement plant for M/s Clean Kerala Company Ltd. which partly handles the Municipal Solid Waste of Kerala. NCB has taken a R&D project with the target outcome of a design of chute which may cater maximum types of solid alternative fuels without any jamming issue. The Quality Assurance Group (QAG), pool of Electrical, Mechanical and Instrumentation engineers, primarily involved in Third Party quality assurance of electrical & mechanical services of various types of infrastructure and nation building projects. This group is equipped with various kinds of portable measuring/testing instruments which are used for quality assurance at sites.

In the areas of Process & Productivity, NCB got first of its kind project for providing project management Consultancy services for installation of tyre chips to M/s Oman Cement Company SAOG, Sultanate of Oman. 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

In the areas of Environment Sustainability & Climate Change, performance evaluation of existing air pollution control equipment was taken up for a cement plant in Andhra Pradesh under which the major Air Pollution Control Equipment (APCE) RABH attached with Kiln/Raw Mill was monitored for different cases. Further, NCB has carried out studies on return dust measurements to measure the efficiency of Top Cyclones of Pre-heater at two cement plants. Under these studies, the dust concentration is measured in the pre-heater downcomer and the efficiency of Top Cyclone is calculated using the dust load and kiln feed rate.

In the areas of advanced fuel technology, new programme was created to provide service to cement industry in the areas of process feasibility studies for utilization of alternate fuels, fuel conservation studies/audits, audit of green fuels usage in the cement manufacturing including logistics & study of advanced fuel characteristics.

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 2021-22, more than 28 sponsored projects of material characterization and about 77 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 50 numbers of coarse and fine aggregates were evaluated for various prestigious clients. NCB has developed expertise and competencies to evaluate the

performance of integral crystalline water proofing compounds & has taken up the testing & evaluation the performance of three integral crystalline water proofing compounds from different manufacturers for Central Vista Project (client CPWD) and PWD R.G.S.S. Hospital, Tahirpur, Delhi to help the construction industry.

In the areas of Structural Optimization & Design, NCB conducted studies in past on Normal and High Strength Concrete (HSC) using different indigenous aggregates for concrete grades from M35 to M100. NCB had also completed an R&D project for development of Ultra High-performance concrete (UHPC) with compressive strength in excess of 150 MPa. Whereas, 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. Prestigious projects of national importance were awarded to NCB by Indian Trade Promotion Organization (ITPO), India International Convention Centre (IICC), Central Public Works Dept. (CPWD), State PWDs, All India Institute of Medical Sciences (AIIMS), Delhi Development Authority (DDA), Uttrakhand Jal Vidyut Nigam Limited (UJVNL), 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 infrastructure in India. Further, NCB has taken up a new research project titled "Studies on Mechanical and Durability Properties of High Strength Geopolymer Concrete" to study the hardened and durability properties of normal and high strength geopolymer concrete and preparation of guidelines for structural design using geopolymer concrete based on its mechanical properties, whose validation has been done by limited testing on reinforced geopolymer concrete beams of selected grades. A R&D project, the use of advanced electronics such as 3D Printer was taken up for construction of concrete structures. This 3D printer will provide a state-of-the-

art facility for R&D in 3D printing technology for construction. NCB has developed printable mortar using indigenous technology under Make in India programme of Government of India. Several testing equipment related to study of cement and concrete characteristics and behaviour have been added in the year 2020-2021 such as initial surface absorption test (ISAT) apparatus to evaluate the rate of water absorption by concrete samples, flexural testing machine to evaluate transverse strength of cement concrete tile. Further, NCB has provided demonstration and training to various groups from esteemed organisation such as Bureau of Indian Standards (BIS), DMRC, NHPC and many recognized academic institutions.

In the areas of Standard Reference Materials, 79 types of CRMs have been developed to cater the various needs of cement and construction industries. NCB's CRMs have been quoted in IS 4031(P2), IS 1727 and IS 4031(P15). 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. 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". 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.), African country (Tanzania) and GULF country (UAE) etc. During the year, total 2558 units of different CRMs and 1448 sets of standard lime were supplied to 950 customers of cement plants, testing laboratories, public sector undertakings, R&D institutions including Bangladesh, Bhutan, Nepal, UAE etc. Currently in India, NCB is only leading organization which develop CRMs in the area of cement & cementitious materials as per ISO 17034:2016 and BND trademark. Subsequently, increasing supply of BNDs to domestic and international market is contributing to the country GDP and boosts the economy of India. Calibration services are continued. 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. It is pertinent to mention that 96% customers rated NCB services as excellent in the last financial year.

Considering the training needs of the industry, NCB imparted training programmes on cement, concrete and construction technologies. During the year 2021-22, 42 training programmes (online/offline) were successfully organized with a total of 1033 participants attending the programmes.

NCB's Contributions

NCB'S Contribution in Important Committees & Sub-Committees of NITI Aayog

Technical Report on "Circular economy in Construction and Demolition waste" under Swacch Bharat Mission

This report prepared by CDR for Ministry of Housing and Urban Affairs, Govt. of India focuses on the preparation of a practically implementable and dynamic action plan for management of C&D waste in the country. It is based upon the identified challenges and roadblocks in the current scenario of C&D waste management. The report consists of a comprehensive action plan for increasing effectiveness of C&D waste management in the country. These action plans are primarily for dismantling phase i.e. at the end of the service life of a structure for recycling and reuse of demolition waste, and covers only the last "2R" (i.e. recycle and reuse). To cover the first "R" i.e. "Reduce", another action plan needs to be made and implemented for first three phases of the lifecycle of construction projects i.e. Planning phase (in appraisal of the project and preconstruction activities), Construction Phase (during construction) and Operation, Repair and Maintenance Phase (during the lifespan of a structure). The execution of above two plans as an integrated approach will make a complete action plan to achieve sustainability & circularity in C&D waste management. Some of the action plans for dismantling phase i.e. at the end of the service life of a structure for recycling and reuse of demolition waste as a part of C&D waste management are as follows

a) **Quantification of C&D Waste Generation and Utilization pattern of C&D waste-based Aggregates and products**
Demolition Plans and Segregation Plans should be prepared as the part of building plan approvals submitted to the municipality/ competent authority, as applicable. In order to have accurate date on C&D waste generation, baseline concept like "Material passport" must be encourage

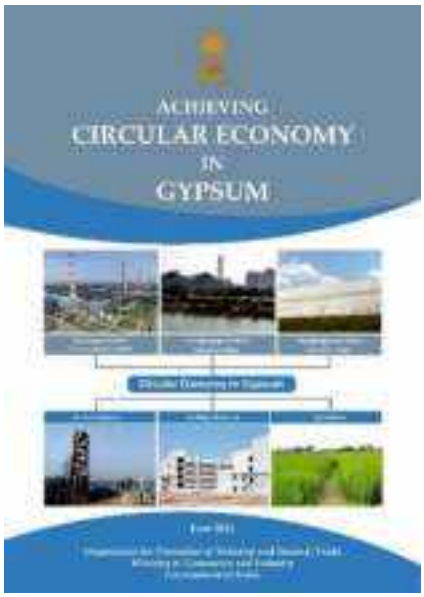
b) **Collection of low volume C&D Waste and its outbound logistics to the processing plant**
Waste generators must pay economic charges for collection, transportation, processing, and disposal as notified by the concerned authorities. The Local Authority must be responsible for proper management and segregation of C&D waste within its jurisdiction including transportation to appropriate sites for processing and disposal.

c) **Promoting utilization of C&D waste recycled products**
The utilization of C&D waste recycled products should be promoted at three levels namely ULB/District level, State Level and National Level by including such products in their Schedule of Rates and Construction Tender document(s).

d) **Policy Interventions are also required from Government of India / State government / ULBs.**
   - Reduction of GST on C&D value added products from present applicable rate of 18% to 5%.
   - Exemption of Green tax on empty vehicles
   - Electricity load in C&D waste plant charged at industrial rate shall be reduced suitably.
   - Provide single window environmental clearance for setting up of a C&D waste processing plant.

e) **Standardization and Research needs**
   - Products of processing plants should be covered under BIS norms and research requires in the area of enhanced utilization.

Committee on Circular Economy in Gypsum: NITI Aayog has taken the lead to expedite the transition of the country from a linear to a circular economy and identified 11 focus areas including Municipal Solid Waste & Liquid Waste, Electronic Waste, Scrap Metal (Ferrous & Non-Ferrous), Solar Panels, Gypsum, Lithium-Ion Batteries, Agriculture Waste, Toxic Hazardous Industrial Waste, Used Oil Waste, Tyre and Rubber Recycling and End-of-life Vehicles (ELVs). Each of the focus areas was assigned to the concerned line ministry.



Department for Promotion of Industry and Internal Trade has been assigned Gypsum as the focus area. Consequently, a committee was formed under DPIIT comprising of domain experts, academics, representatives from industry, regulatory bodies, officials from MoEF&CC, NITI Aayog and others. Two major by-product streams have been identified as challenge areas for detailed action plans – Phosphogypsum-a by-product from fertilizer plants and Flue Gas Desulphurization (FGD) gypsum-a by-product from thermal power plants. Phosphogypsum generation is already posing threat to environment and ecosystem due to its generation and huge legacy stocks whereas FGD gypsum is expected to pose a grave threat in near future once all FGD systems get installed in thermal power plants.

DG-NCB volunteered to house the Secretariat of the Committee on Gypsum at NCB. Under his leadership, NCB has done extensive research on global scenario of utilization of phosphogypsum and FGD gypsum, organized stakeholder consultations, compiled all recommendations, and prepared the final report containing comprehensive action plans for achieving circular economy in each of the by-product gypsum. The report has been submitted to NITI Aayog. The monitoring of action plans is being done on monthly basis by NITI Aayog.

NCB's Contribution to MORTH, GOI & Indian Road Congress

Ministry of Road Transport and Highways through Indian Roads Congress constituted an Expert Committee for formulating guidelines for Use of Fiber Reinforced Polymer Bars in National Highway works during March 2021. The first meeting of this Expert Committee (01st May 2021) deliberated the International Practices regarding the use of FRP reinforcement in concrete structures as an alternate to carbon steel mainly due to its corrosion resistance in countries like Japan, USA, Canada and Australia.

FRP composites have been used for rehabilitation of bridges even in India. Though, it is not a new material and predominantly used in aerospace applications, the extent of the use of FRP rebars for structural applications needs to be studied. The mechanical properties and behaviour of FRP rebars is different from that of carbon steel rebars. Therefore, a change in the traditional design philosophy of concrete structures is needed for use of FRP reinforcement in highway infrastructure components after identifying the various suitable applications.

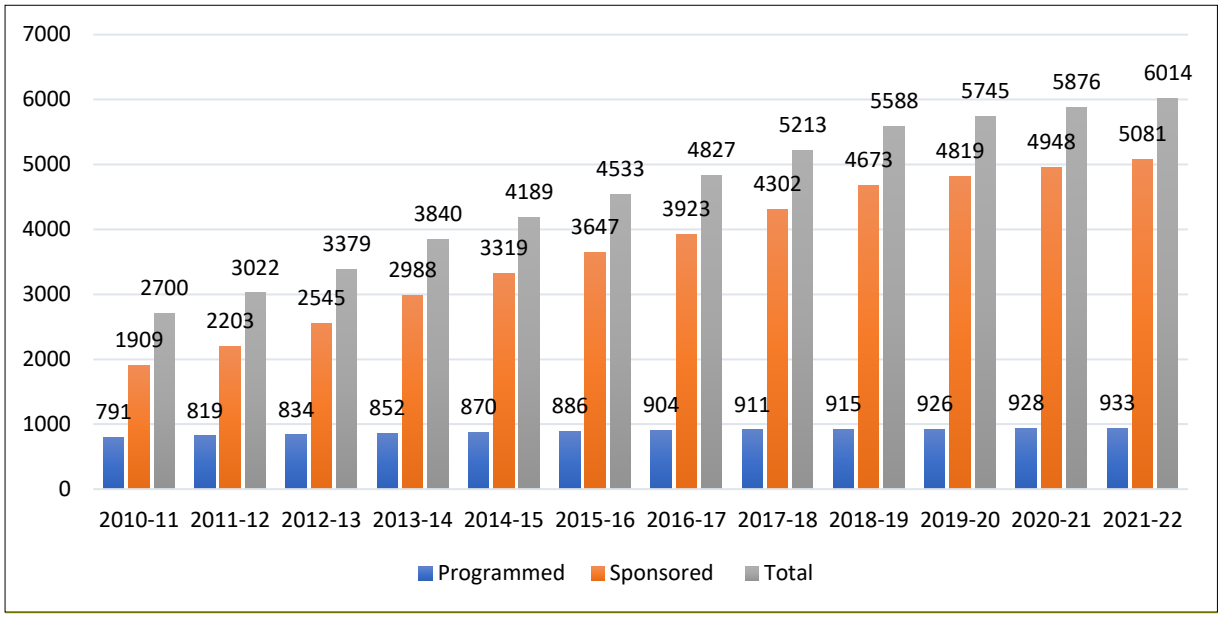
NCB team comprising of Sh. P N Ojha & Sh. Brijesh Singh is contributing currently along with CRRI, IIT Bombay and other eminent experts in preparation of State-of-the-Art Report (SOAR) on the use of Fibre Reinforced Polymer (FRP) bars in Highway Projects for developing "Guidelines for use of Fibre Reinforced Polymer in NH Works in Different RCC Structures". The State-of-the-Art Report (SOAR) contains number of chapters and covers materials, manufacturing, design methods, quality control and quality assurance, and site requirements. Thereafter, this State-of-the-Art Report will help in framing specification and test method for evaluation of GFRP bars for Bureau of Indian Standard and Indian Road Congress. NCB team is also contributing as member in working group on Bureau of Indian Standard (BIS) FRP Standard committee under sectional committee CED-54.

Along with NCB team of Sh P N Ojha, Sh Amit Trivedi & Sh Brijesh Singh working in CED 54; the members who visited the manufacturing yard were Mrs Madhurima Madhav from BIS-Delhi, Dr RKG Pillai from IIT Madras, Dr. Suriya Prakash from IIT Hyderabad and Dr A Laskar from IIT Bombay. Working group members discussed on various aspects such a pultrusion process, mixing and preparation of resin, fibre content of GFRP bars, surface characteristics of GFRP bars, safety aspects of manufacturing etc. which will enable them in further strengthening the new code on method and specification of GFRP bars. Working group members also visited in-house testing facility and witnessed test for tensile strength and modulus of elasticity of GFRP bars including facility for determining fibre content, shear strength etc.

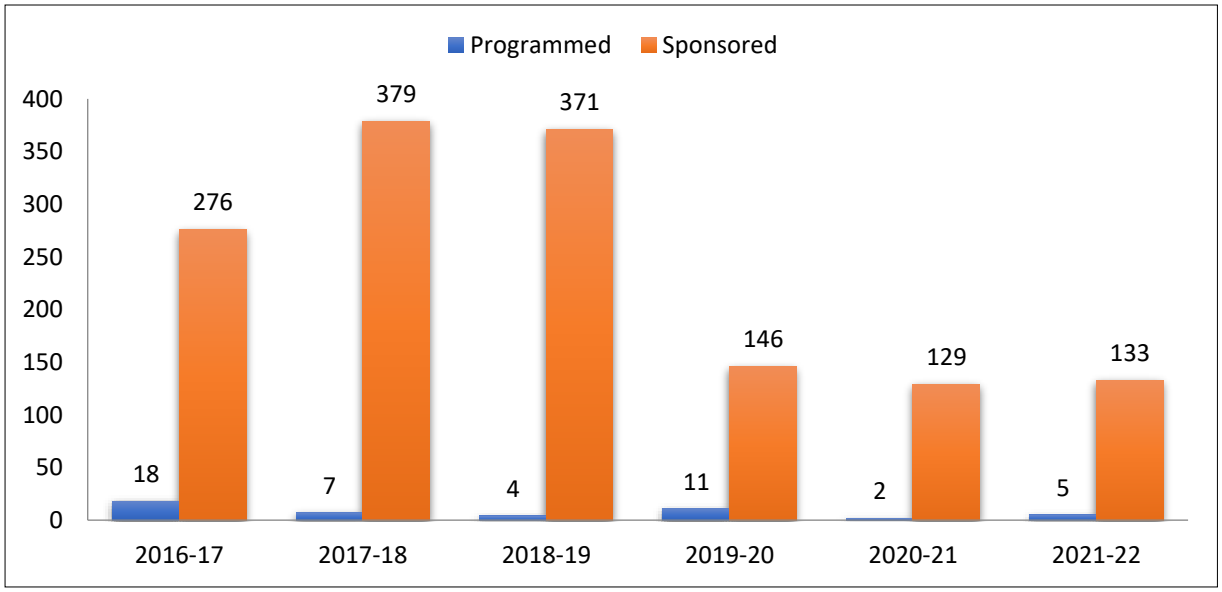
Framework of Institutional Efforts

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, 133 Sponsored projects were completed as listed in Appendices III respectively. The programmed projects, carried forward along with the new ones taken-up, comprised the R&D Programme for 2021-22, 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, 30 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 240 cement plants. During the year, LCF studies were completed for 16 cement plants from Madhya Pradesh, Andhra Pradesh, Rajasthan, Karnataka and Telangana.

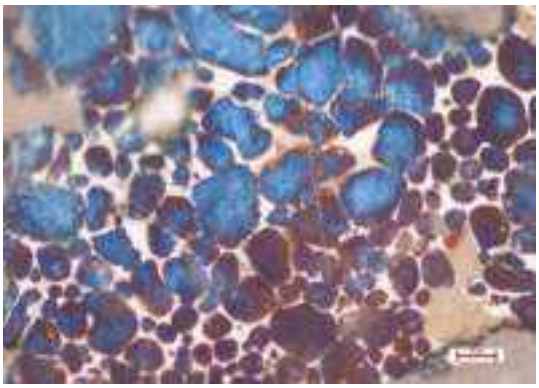
Development of Belite Calcium Sulpho-Aluminate (BCSA) Cement Using Low Grade Limestone and Industrial Waste

In this work 23 sets of raw mixes were designed with lower LSF and using different types of industrial waste and studied burnability at 1250°C and 1280°C. The optimized raw mix was used to prepare bulk BCSA clinker and different cement blends using BCSA clinker, Portland Clinker (PC), fly ash and GBFS. It was observed that the BCSA clinker can be prepared by gainful use of 6-26% of Industrial by-products and it contains phases such as ye'elimite, belite, C4AF, anhydrate, alite etc.

For a free lime content of below 1.5%, BCSA requires about 200°C lower temperature and 20% lower CO_2 emission than conventional clinker. Finer belite grains (<10μ) were observed in BCSA clinker than in Portland clinker as shown in Fig.

The BCSA cement blends showed very fast setting behavior. However, the cement prepared using combination of BCSA and PC showed better initial age mechanical performance than its PC counterpart.

The use of supplementary cementations materials like fly ash and GBFS resulted along with BCSA clinker showed a little enhanced setting time values and better initial age strength values.

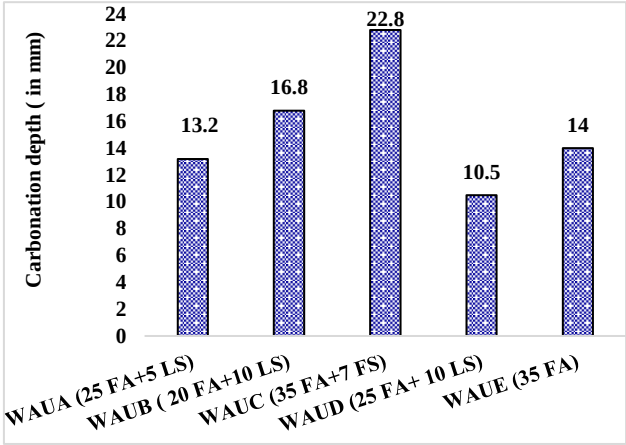


Optical Micrograph of Lab Fired BCSA Clinker

Waste Utilization

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

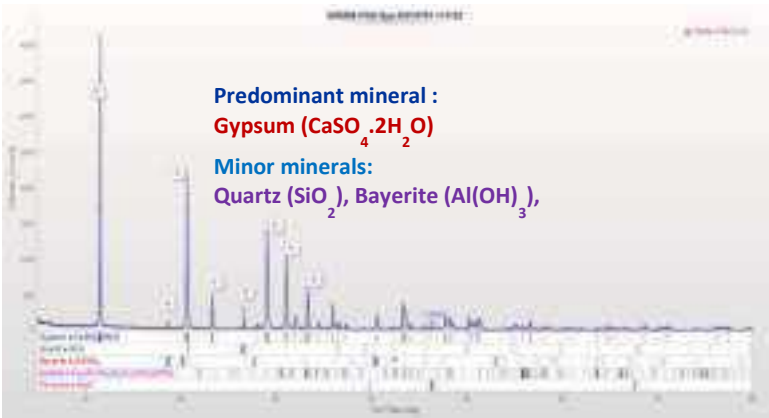
In this study, Portland Composite Cement (PCC) blends were prepared (140 nos) with four types of clinker from different regions of India along with the regional available fly ash (15-35%) and limestone (5, 7 & 10%). Based on the results of cement mortar and concrete durability, a total of 35% replacement of clinker by fly ash and limestone. (keeping limestone content upto 7% in it) was recommended. Hydration studies showed Monocarboaluminate ($Ca_4Al_2O_6 \cdot CO_3.11H_2O$) 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 with PPC

Technical feasibility of using FGD gypsum in cement manufacture

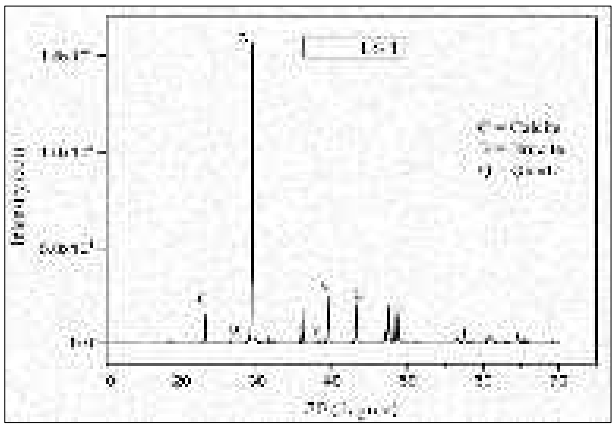
Globally, Flue Gas Desulfurization (FGD) systems have been installed in many thermal power plants in developed countries and FGD plants have been in operation in US for 40 years. In India also the standards set by the MoEF&CC for coal-based thermal power plants came into force by which FGD systems needs 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 plants. 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.



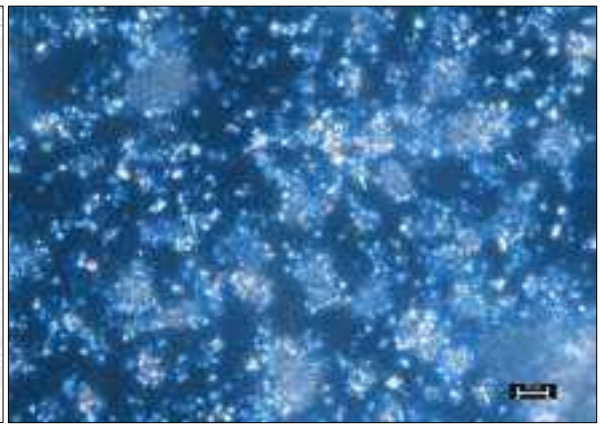
X ray diffractogram of FGD gypsum.

Utilization of Lime Sludge Generated from Paper Industry in the Manufacture of Cement

Lime sludge is a waste material generated in pulp and paper industry during the kraft process of wood. This industrial lime sludge is a hazardous waste, which is usually disposed in dump yards or used in disorganized landfills thus creating environmental pollution. Lime sludge is available in considerable amount with a legacy stock of 67 MT and annual production of 5 MTPA. It is having more than 50% lime content which is present in the form of calcite phase as shown in Fig 4 a. Along with its decarbonation temperature varies between 750°C to 850°C. Fig 4 b shows the distribution of calcite grains in lime sludge samples observed through optical microscope. All these above properties of lime sludge are in line with high grade limestone which is a major raw material for cement production. As cement production is growing, the limestone reserve will be depleted and it can only sustain for the next 30-40 years. Hence, as valuable replacement of limestone, lime sludge may be utilized as raw material for Portland cement clinker or as a performance improver in Ordinary Portland Cement. 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. Hence, NCB has taken up R&D for utilization of Lime sludge effectively in manufacturing of cement and looking forward to production application of lime sludge.



XRD pattern of lime sludge



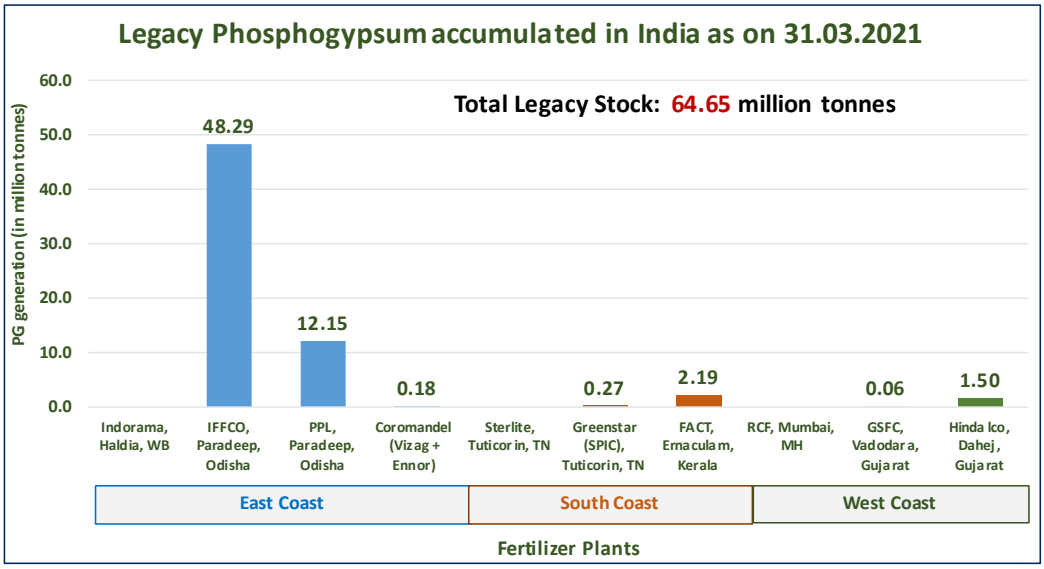
Optical micrograph of lime sludge

Investigations on Utilization of Phosphogypsum in Cement Manufacturing:

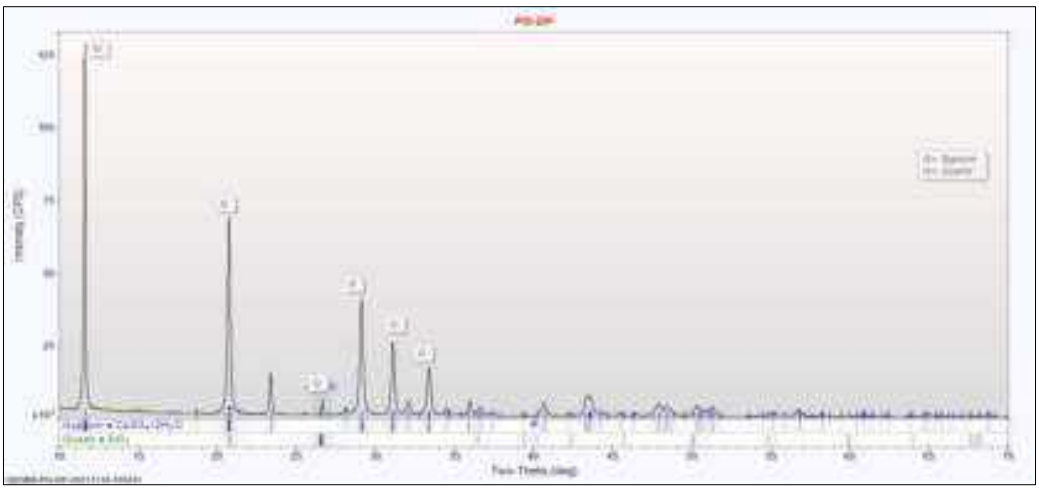
Phosphogypsum is generated as a by-product during the manufacture of phosphoric acid. Approximately 4.5-5.5 tonnes of phosphogypsum is generated per tonne of phosphoric acid produced using wet process. Apart from the yearly generation of phosphogypsum, there is an additional issue of legacy stock of unutilized phosphogypsum of about 64.65 mt at various fertilizer plants accumulated over the years.

In the manufacturing process of cement, phosphogypsum could be used as a replacement of natural gypsum which plays the role of a set retarder. Therefore, a project on investigations on utilization of phosphogypsum in cement manufacturing

was taken up. Phosphogypsum along with mineral gypsum and clinker from different sources were collected for this study and their chemical, mineralogical and thermal characterizations were carried out. OPC blends were prepared using phosphogypsum and evaluated for chemical and physical properties. Initial results were found to be very encouraging. Further investigation is underway.



Legacy Phosphogypsum accumulated in India



XRD of Phosphogypsum

Fundamental and Basic Research

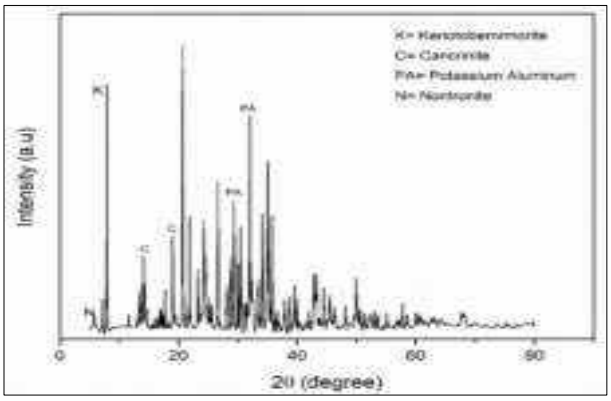
Development of Zeolite for Oxygen Concentrator by using Raw materials of Cement Industry

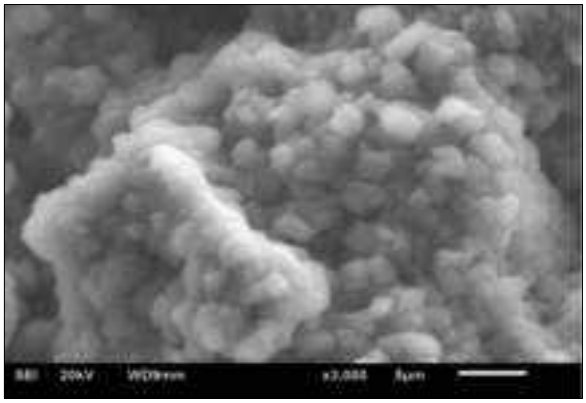
Zeolites are highly crystalline, porous aluminosilicate earth metal minerals framework open structures. It has cations positioned within the material's pores based on a three-dimensional network structure of tetrahedral [SiO_4] and [AlO_4] in the phase structure. The porous materials are formed in nature in association with volcanic activity, but also can be synthesized in the laboratory. There are two hundred different

zeolite structures known, not necessarily composed of SiO_4- and AlO_4- tetrahedra as many elements from the periodic table. They are useful for O_2 purification from air, ion exchange and good catalytic properties. Generally, zeolites have different crystal form, different crystal size, external surface with relative roughness and also have presence of other zeolite phases. The estimated crystal size is the crystallite size which reflects the aggregate of particle size. The zeolite synthesized using Kaolin clay in aqueous media have cancrinite and hydroxyl–sodalite released Al and Si species during crystallization. The synthesized zeolite has multiphase structure, crystal morphology, surface area with various porosity which helps for oxygen purification from air.

Due to the scarcity of oxygen concentrator during Covid-19 in India in 2021, zeolite was imported from abroad. Therefore, NCB took initiative under Atmanirbhar Bharat in mission mode for the development of zeolite for oxygen concentrator by using cementitious raw materials. NCB has successfully developed zeolite for oxygen concentrator by economical green sol-gel method.

The following figure shows the XRD phase profile of synthesized zeolite using Metakaoline clay. It has different mixed phases of sodium aluminate and sodium aluminate silicate. SEM micrograph reveals crystal morphology which have good regular shape hexagonal crystal lattice and porous surface morphology. The crystals sizes are in micron size and its average pore diameter is in nanometer scale range in this porous zeolite phases which is useful for oxygen concentrator.





XRD phase profile of zeolite synthesized and SEM micrographs of synthesized zeolite using Metakaoline clay

Independent Testing

Independent Testing Laboratories of NCB undertake 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 etc. as per National and International standards.

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. The laboratories are equipped with state-of-art instruments to carry out the tests as per National and International standards. During the year, assignments were carried out for samples from neighbouring countries also. The number of samples tested during the period was more than 7,605.

Inauguration of prototype of zeolite

The prototype of zeolite developed under the R & D project entitled "Development of Zeolite for Oxygen Concentrator by using Raw materials of Cement Industry" was inaugurated by Sh. Anil Agarwal, Additional Secretary, DPIIT, Govt. of India on 24th Dec 2021 on the occasion of 59th NCB day. NCB is working on the technology of using the cheap and abundantly available raw materials used in cement manufacture for developing zeolite that can be used in the manufacture of oxygen concentrators. A prototype of the same was prepared and displayed in CRT.

Inauguration of a prototype of zeolite by Addl. Secretary, DPIIT, Sh Anil Agrawal

NABL Audit of Testing Laboratories

The National Accreditation Board of Testing and Calibration Laboratories (NABL) conducted audit of five NCB testing laboratories on 5th and 6th March 2022. Dr Sushil Kumar Tyagi was the lead assessor and was accompanied by five other assessors from mechanical and chemical disciplines. The audit was successfully completed and suggested corrective actions were timely completed and its record submitted to NABL.

DG-NCB, HOC-CRT and lead assessors along with his team during NABL audit 2022

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 Optimization and Productivity (PRP), Energy Management (EMG); Project Engineering & System Design (PSD), Environment Sustainability and Climate Change (ESC), Quality Assurance Group-Electrical & Mechanical (QAG), Advanced Fuel Technology (AFT) and one activity viz. Geology & Mining and completed 12 sponsored projects during the year.

Process Optimization 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 in this financial year 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

- **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 virtually 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 clinkerzation 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
- ✓ Raw mill-4 inspection and measurements for capacity enhancement
- ✓ Line-3 heat balance study

Process measurements at Cement plant

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) 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.

R & D Project

- **Design and integration of RDF gasification in cement manufacturing process:** The project was taken in the year 2020 and in this year experimental trail runs were taken in the downdraft gasifier at BITS Pilani setup. A MATLAB

model has been developed for RDF gasification to predict the Syn gas quality and further techno-economic analysis is being carried out.

- **EMG-02 Solar thermal calcination of phosphogypsum for cement manufacture:** The project activities started in Year 2020. The purpose of taking up project was to explore the thermal calcination of phospho gypsum through renewable energy source i.e. solar thermal energy. This will benefit to cement plants in India for getting promising alternative of mineral Gypsum that is no available indigenously to meet out the requirement. At the same time it will help fertilizer industry by giving sustainable solution for minimizing legacy stock of phosphogypsum.
  The experiments were held with proto type setup at NISE Gurugram and results received are quite encouraging.

Project Engineering and System Design (PSD)

- **Project Monitoring and Control (PMC) Consultancy Services for setting up a 600 tpd Cement Plant in RoC for Government of RoC**
  The programme 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) are almost completed 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 have already begun.

- **Preparation of Marketing Report for utilization of Flue Gas Desulphurization Gypsum (FGD) of power plants in VSR region for NTPC Ltd.**
  The programme has successfully carried out visit 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 at Vidhyanchal, Singrauli and Rihand (collectively known as VSR region). The present study analyses the scope for consumption of FGD gypsum generated through coal-based thermal power plant located in NTPC VSR region. The 500 kms area around VSR region was subject area of market research for the possible utilization of gypsum produced at NTPC plants. Specific purpose of this report is to provide an overview of the various gypsum specific consumer sectors that have been identified during the study.

- **DPR for setting up a Cement Grinding Unit at Kannur, Kerala for M/s Malabar Cements Ltd, Kerala**
  The programme successfully completed detailed project report for setting up a 60 tph Cement Grinding Unit at KINFRA, Taliparamba covering major aspects like availability and logistics for the raw material input source, basic infrastructure, market potential, project technical concept and project financial analysis.

- **Preparation of Detailed Project Report for setting up a 0.3 mtpa Bulk Cement Terminal at Ernakulam wharf, Cochin Port Trust, Kerala for M/s Malabar Cements Ltd, Kerala.**
  The program has successfully completed a project for preparation of Detailed Project Report for setting up a 1000 tpd (0.3 mtpa) Bulk Cement Terminal and Allied Materials Handling Unit at Cochin Port Trust Complex. The report covers detailed study of various aspects like loading/ unloading, handling, storage, blending, packing and transportation of raw materials (like OPC, dry fly ash, laterite, coal, clinker, gypsum etc.) and finished product (PPC).

- **Detailed Project Report for Installation of Alternative Fuel Resource Supply Plant & Co-Processing of RDF/AFR at Rotary Kiln System for M/s Malabar Cements Ltd, Kerala.**
  In this project, a detailed feasibility study was carried out to install AFR system for rotary kiln firing in the preheater kiln-based cement plant. Site visit was carried out to cement plant and M/s Clean Kerala Company Ltd. which partly handles the Municipal Solid Waste of Kerala. The report covers project technical concept, system design, impact assessment and detailed cost economics for system installation.

R&D Projects

- **Design and Development of Transfer Chute to Handle Alternate Fuels and their mix in Indian Cement Plants**
  Handling of different AFs and their mix of varying physical properties with same conveying system, leads to operational problems at transfer points i.e. chute jamming, flushing, excessive wear, dust generation etc. To resolve the issues with transfer chutes, NCB has taken a R&D project with the target outcome of a design of chute which may cater maximum types of solid alternative fuels without any jamming issue. Project is likely to be completed by September 2022.

Environment Sustainability & Climate Change (ESC)

Performance Evaluation of Existing Air Pollution Control Equipment (APCE)

- Performance Evaluation of Existing Air Pollution Control Equipment was taken up for a cement plant in Andhra Pradesh under which the major APCE RABH attached with Kiln/Raw Mill was monitored for different cases. Total four cases were formulated and dust monitoring of inlet and outlet of APCE was carried out to evaluate the performance.

Dust Measurements in Process Ducts

- To measure the efficiency of Top Cyclones of Pre-heater, the return dust measurements were carried out at two cement plants. Under these studies, the

dust concentration is measured in the pre-heater downcomer and the efficiency of Top Cyclone is calculated using the dust load and kiln feed rate.

Environmental measurements at cement plant

Quality Assurance Group-Electrical & Mechanical (QAG)

The 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, STP/ETP etc. The group is equipped with various kinds of portable measuring/testing instruments which are used for quality assurance at sites.

Measurement/Testing Instruments

- Power Quality Analyzer
- Earth Tester
- Vernier Calliper
- Gauge Meter
- Power Clamp Meter
- LUX Meter
- Coat thickness Meter
- Welding Gauge
- Laser distance Mete

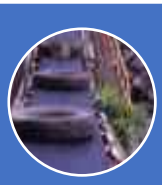
Sponsored Projects Executed in Past Years

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

Sponsored projects executed in recent years

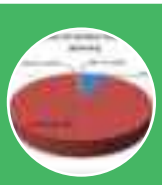
Advanced Fuel Technology (AFT)

New programme was created to provide service to cement industry in the following areas:



Process Feasibility Studies for Utilization of Alternate Fuels

Fuel Conservation Studies/Audits.



Audit of Green Fuels Usage in the cement manufacturing including logistics

Study of Advanced Fuel Characteristics

Equipment facilities added:

A working model of cement plant has been designed, fabricated and installed to demonstrate the process, flow and technology to the students and visitors.

Working model of cement plant

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 programmes namely Concrete Technology, Structural Optimization and Design, Structural Assessment and Rehabilitation, Construction Technology and Management. The centre has facilities of mechanical, physical and durability testing of concrete making materials and Non-destructive testing through advanced equipment. The Centre completed 85 sponsored projects during the year.

Concrete Technology (CON)

A. Material Evaluation and Concrete Mix Designs

Characterization 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 relative proportion with the objective of producing an economical concrete of required workability, strength and durability. Various government/semi-government/private organizations like DRDO, NTPC and its subsidiaries, NHPC and its subsidiaries, THDCIL, PWD, CPWD, MCD, PGCIL, NBCC, 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 M90. During the period of 2021-22, more than 28 sponsored projects of material characterization and about 77 mix designs were completed.

B. Concrete Mix Design for Special Applications

Design of Self-Compacting Concrete

Self-Compacting Concrete (SCC) of grade M40 to M50 were designed by NCB for **Central-Vista Project** (client CPWD) during the period of 2021-22.

Design of Under Water Pumpable Concrete

Underwater Pumpable Concrete (3-days strength 15MPa) for the repair work of damaged Tail Race Tunnel (TRT) Apron & Cutoff wall was designed by NCB for NHPC ltd. during the period of 2021-22.

Roller Compacted Concrete

Roller Compacted Concrete (RCC) refers to a special class of concrete, which is compacted by the vibratory rollers. To achieve this behavior, RCC in fresh state should be dry enough to resist the sinking of the roller. Also, it need to be wet enough to be able to get compacted by the vibration of the roller. NCB carried out a sponsored R&D project for design and development of high volume fly ash (using fly ash up to

65%) concrete mix with limestone dust as a filler material to be used in Roller Compacted Concrete for Dibang Multipurpose project in Arunachal Pradesh to be constructed by M/s NHPC Ltd.

In this study, RCC mixes (prepared using fly ash samples from different sources) were evaluated for different properties such as Vee-Bee time, initial setting time, final setting time and compressive strength. Further, selected mixes were studied for mechanical and thermal properties. These tests include split tensile strength, direct tensile strength, modulus of elasticity, Poisson's ratio, apparent cohesion, angle of internal friction, specific heat of concrete by Transient Plane Source (TPS) method and Coefficient of Thermal expansion of concrete. It was observed that average increase in compressive strength of RCC from 28 days to 365 days was twice, i.e. 365 days' compressive strength was nearly two times in comparison to 28 days' compressive strength. The compressive strength of RCC mix increased with increase in total cementitious content, however cement to fly ash ratio is critical in achieving specified strength.

Further, studies were conducted to understand the effect of the variations in the fly ash and limestone content on the fresh and hardened properties of RCC. The findings suggest that the varying proportions of fly ash and limestone in total cementitious binder does not seem to have any significant impact on the air free density and degree of compaction as total air free density and degree of compaction for all mixes were almost similar and comparable. Also, both initial and final setting time of RCC mixes having OPC and limestone in varying proportions are significantly lower in comparison to mix having fly ash and OPC. However, for mixes having combination of OPC, fly ash and limestone as cementitious binder, setting time is somewhere in between setting times of concrete mixes made with binary cementitious systems (i.e. OPC and limestone & OPC and fly ash). Optimum performance in terms of compressive strength at all the ages was observed for mixes with ternary cementitious system having both fly ash and limestone with OPC as cementitious binder.

C. Alkali Aggregate Reaction (AAR) studies on aggregates

Alkali-silica reaction (ASR) related distress is a matter of great concern to the concrete industry and regarded as second most deterioration issue after corrosion. Reactive silica in the presence of alkali in the pore-solution inside the concrete creates a hydrophilic alkali-silica gel, often referred to as ASR gel. Formation of the ASR gel alone does not cause cracking; however, when the gel absorbs water, it shows significant potential to swell. The resulting expansion often results in 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 expertise and competencies to evaluate aggregates for potential alkali aggregate reaction which includes both

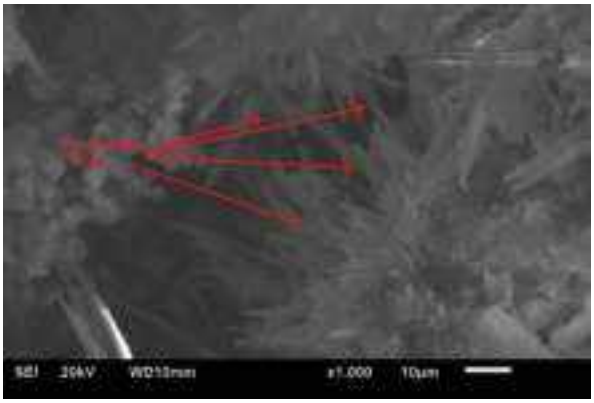
alkali silica reaction and alkali carbonate reaction. The following test were carried out to evaluate the Alkali Aggregate Reactivity:

- Petrographic and Mineralogical Analysis as per IS: 2386 Part VIII.
- Accelerated Mortar Bar Test as per ASTM C1260 and ASTM C1567.
- Mortar bar test as per IS: 2386 Part VII.
- Prism Bar Test as per ASTM C 1293

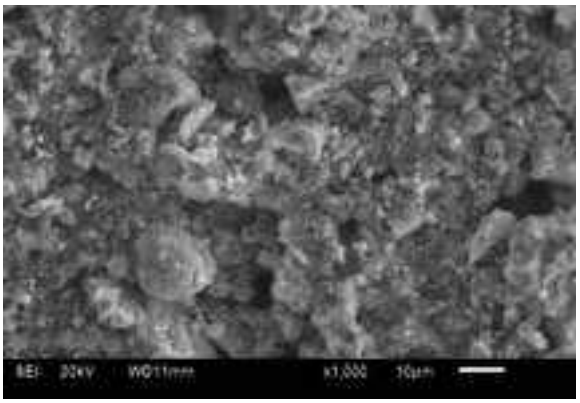
About 50 number of coarse and fine aggregates were evaluated for ASR for various prestigious clients like NTPC, NORTHERN RAILWAY, THDCIL, NHPC Ltd during the period of 2021-22.

D. Evaluation of Integral Crystalline Waterproofing compound

Integral crystalline water proofing compounds were used widely in these days to overcome the problem associated with concrete such as waterborne chemicals seepage in concrete through pores, micro-cracks and capillary tract, resulting in many problems that deteriorate the concrete or the underlying reinforcement. NCB has developed expertise and competencies to evaluate the performance of integral crystalline water proofing compounds. Centre has the testing facility to evaluate their performance in terms of resistance against water penetration into concrete and mortar specimen as per IS: 516 (Part-II, section 1) and IS: 2645 respectively in comparison to reference mixes. Various parameter such as resistance against chloride penetration, porosity, coefficient of permeability using Valenta equation, presence of integral crystal into concrete specimen using SEM after subjected to hydrostatic pressure and other such properties of concrete specimens made with crystalline/integral water proofing compounds were tested and compared with reference mix of different grades of concrete.



SEM image of concrete mix made with integral waterproofing crystalline



SEM image of reference concrete mix

NCB has taken up the testing & evaluation the performance of three integral crystalline water proofing compounds from different manufacturers for Central Vista Project (client CPWD) and PWD R.G.S.S. Hospital, Tahirpur, Delhi to help the construction industry.

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

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

The composite cement is a new type of low clinker cement which is blend of fly ash and GGBS. The composite cement (conforming to IS: 16415-2015) can be produced either by 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.

The composite cements are manufactured using 35-65% Portland cement clinker/ ordinary Portland cement along with 15-35% fly ash and 20-50% granulated blast furnace slag together as the blending component. In comparison to the Indian standards, the European code covers a greater number of blended cements and it is also noted that cement group CEM-V-B, composite cements, allows the 31-49% of natural Pozzolana and calcareous fly ash along with slag and clinker in it. On the other hand, in the Indian standards, composite cement allows not more than 35% of fly ash usage.

The Indian standards and codes of practices recommend usage of composite cement only in plain cement concrete and not in reinforced cement concrete due to lack of experimental data on application and durability performance of composite cement. Preliminary durability studies and literature has indicated that composite cement similar to PPC is beneficial in coastal environment prone to corrosion due to chloride ingress. Like in PPC, in Composite cement, there is apprehension on durability of reinforced concrete structures with respect to carbonation induced corrosion owing to higher clinker substitution.

The preliminary study conducted at NCB found that use of composite cement found to be advantageous for RC structures located in coastal or chloride laden environment. However, concrete made with composite cementitious systems shows lesser resistance against carbonation as compared to OPC. The carbonation depth of concrete made with composite cement as per present specification was found higher in comparison to OPC at same exposure period. Therefore, the present specification i.e. IS 16415 requires modification to cater the effect of carbonation w.r.t higher clinker substitution in composite cement.

A comprehensive R&D 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 combination of composite cements as mentioned in below table has 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

Presently, lab scale study w.r.t composite cement has been completed. The study has been carried out using two sets of materials. About 72 concrete mixes have been studied. The results indicates that in case of composite cement it is suggested to have 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.

- **Fresh hardened and durability performance evaluation of concrete made with Portland limestone cement (PLC)**

Sustainability encompasses many aspects designed to improve construction practices, including more efficient use of natural resources, better thermal performance of structures, and reduced environmental impacts, with a focus on embodied carbon. One area of growing concern to environmental leaders is CO_2 emissions. Like all building materials, Portland cement has an environmental footprint, and it's often described in terms of Greenhouse Gas (GHG) equivalents. Cement is made by grinding clinker—the main energy intensive ingredient—to a fine powder. Producers know that replacing some of the clinker in Portland cement with ground limestone offers benefits, the most important being that it reduces the embodied CO_2 of the cement. Numerous international standards for cement have specifications for PLC and promoted its use. EN 197-1 (2000) allows limestone addition at two replacement levels, CEM II/A-L and CEM II/A-LL (6 20% limestone), and CEM II/B-L and CEM II/B-LL (21-35% limestone). In 2008, Canada's cementitious materials compendium, CSA A3000, adopted provisions for Portland-limestone cements. Portland-limestone cements are defined by CSA as cements containing more than 5% and up to 15% limestone. In Mexico, NMX C-414 defines cement Type CPC, termed a blended Portland cement, which may contain limestone between 6% and 35%. The 2012 revisions of ASTM C595 and AASHTO M240 have

listed cement type designation: Type IL, which contains limestone between 5% and 15%. South Africa has adopted the limits for limestone cement from the EN 197-1 standards. In New Zealand, Portland-limestone cement is produced with up to 15% limestone, and in Brazil a maximum of 10% limestone is permitted. It is to be noted these standards permit the use of cement grade limestone only i.e., limestone having at least 75% of calcite. However, the research being carried out at NCB is focused on using limestone of other than cement grade (i.e., calcite less than 75%) to be utilized in cement production and its application in production of durable concrete. The benefits of this include reduction in clinker content and energy, natural resources conservation, utilization of large unused reserves of limestone and ultimately reduction in emission of greenhouse gases.

Limestone for a long has been considered as inert filler material. However, many studies with respect to role of limestone in cement have shown that limestone of appropriate quality and fineness does take in the hydration process. Physical presence of limestone is responsible for dilution of cement and particle packing. Studies on phase assemblage have pointed out that limestone does react to some extent depending on dissolution rate of limestone, particle size, availability of aluminates and space for hydrates to precipitate. Apart from providing nucleation sites for hydration, limestone reacts with C_3A to form carboaluminates ($C_3A.CaCO_3.xH_2O$) on the surface of C_3A grains. The ongoing research on PLC is focused on three areas (i) role of limestone in the hydration reactions (ii) effect of limestone addition on the cement performance, and (iii) the production process of PLC.

In a previous study conducted on PLC mortar, it was concluded that 15% addition of low grade and dolomitic limestone could perform to the level of OPC 43. In order to validate the findings of the previous study and to study the performance of PLC concrete a comprehensive study on PLC cement and concrete was taken up in order to cover the quality variation of materials. Five different OPC clinkers and eight samples of limestone (covering cement, dolomitic and low grade) samples were procured from five different cement plants located in different geographical locations of the country. A total of 53 blends (05 of which were control and 48 were PLC blends) were prepared in the NCB laboratory by inter grinding clinker, limestone and gypsum. Comprehensive study on these blends was carried using physical, chemical and mineralogical characterization. Apart from the study on PLC blends, fresh, hardened and durability properties of concrete were also studied on18 concrete mixes, 9 each at w/c of 0.4 and 0.6 (out of which 2 were control) were prepared using PLC produced by adding 15% of different grades of limestone. The study yielded many important results and conclusions related to PLC. Fresh and hardened properties of concrete made with PLC is similar to that of control mixes. In terms of durability, limestone incorporation led to increase in RCPT, Sorptivity, water penetration values and carbonation depth is on higher side for PLC concrete whereas abrasion resistance of PLC concrete is found to be similar / higher to that of control concrete. Sulphate expansion of PLC concrete is similar or marginally higher to that of control concrete whereas thaumasite expansion values are higher side for PLC concrete. The study concluded that limestone addition mainly influences the

compressive strength of mortar and concrete, however, limestone addition of appropriate quality and fineness up to 15% is possible.

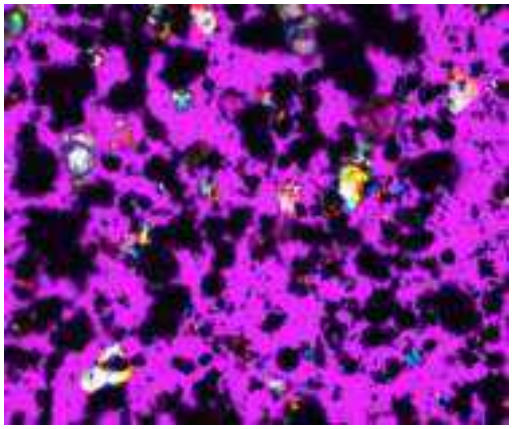
Specimens exposed to sulphate environment i.e., at 6°C temperature highly distorted comparison to those at 23°C.

Following points should be considered while formulating the standard on PLC:

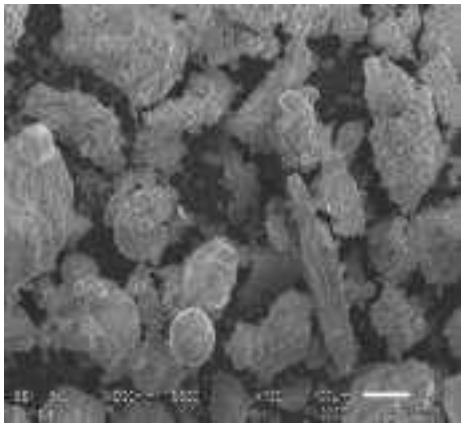
- Quality and maximum quantity of limestone – not more than 15 % addition of limestone having minimum CaO content 36%.
- Fineness of PLC – PLC shall have minimum fineness of 450 m^2/Kg. In case when cement is manufactured by intermixing, fineness of limestone should not be less than 700 m^2/kg.
- Application - PLC shall not be used in in concrete in service of sulphate concentration severity class-3 and above as per IS 456:2000. In order to avoid formation of thaumasite, it is not advised to use PLC in concrete in service where temperature falls below 15 °C throughout the day for more than one months in a year. To avoid Delayed ettringite formation (DEF) formation, PLC shall not be used for concrete when steam curing is to be employed

- **Durability studies on concrete prepared using coal based bottom ash as fine aggregate and preparation of mix design guidelines of PPC and PSC based cement concrete for M/s NETRA-NTPC Limited**

Before taking up above study, NCB had carried out two R&D studies sponsored by NTPC-NETRA on use of bottom ash as replacement of fine aggregate in cement concrete. In first project, studies were carried out to assess the feasibility of utilisation of bottom ash as fine aggregate based on study conducted on bottom ash samples collected from two thermal power plants.



Distribution of mineral grains (5x) in bottom ash sample using Optical microscope



Bottom ash sample under Scanning Electron Microscope

In second study, bottom ash samples were collected from ten different thermal power plants of NTPC and studies were conducted for preparation of specifications for bottom ash to be used as partial replacement of conventional fine aggregate in concrete and development of guidelines for mix design of concrete made with Ordinary Portland Cement (OPC) using coal based bottom ash as replacement of fine aggregate in concrete made. Since, out of total cement production in the country, more than 65% are blended cement. Therefore, it was imperative to extend the above-mentioned study to blended cement.

In view of above, a third study was taken up for formulation of guidelines for designing concrete mixes with Portland Pozzolana Cement (PPC) and Portland Slag Cement (PSC) using bottom ash as a fine aggregate. This study was conducted using bottom ash samples collected from 8 thermal power plants (NTPC Jhajhar, NTPC Solapur, NTPC Dadri, NTPC Kudgi, NTPC Sipat 1, NTPC Sipat 2, NTPC Unchahar and NTPC Ramagundam). Mix trials of concrete were carried out using commercially available two brands each of PPC and PSC each at four different water cement ratios of 0.40, 0.45, 0.50 and 0.55. Out of various composite fine aggregates compositions, 5 composite fine aggregate were selected for making concrete (one from each fineness modulus range of 1.33-1.69, 1.70-1.89, 1.90-2.09, 2.10-2.49 and 2.50-3.01). With these 5 composite fine aggregate, 80 concrete mix trials were performed and mixes were evaluated for fresh, hardened and durability properties. Based on the study, mix design guidelines for PPC and PSC based cement concrete using coal based bottom ash as fine aggregate were formulated. Based on study it was recommended that, minimum requirement of fineness modulus of composite fine aggregate shall be 1.35. Along with that, it was also recommended that maximum replacement of fine aggregate by bottom ash in composite fine aggregate while using OPC as cementitious binder shall be 50%. Whereas maximum replacement of fine aggregate by bottom ash in composite fine aggregate while using OPC + fly ash / PPC and OPC + GGBS / PSC as cementitious binder shall be 25%.

- **Studies on Mechanical and Thermal Properties of Mass Concrete in Arun 3 - H.E. Project Dam for M/s SJVN Limited**

In mass concrete structures such as dams, thermal properties of concrete play an important role as construction of a concrete dam requires a large volume of concrete and a large amount of heat is liberated during hydration of the cement which may affect the properties of concrete adversely, if not taken care of. If the timely dissipation of heat generated at the interior of concrete is restrained due to high thickness and larger blocks, it may result in high thermal gradient between the centre and surface which may ultimately lead to thermal cracks if thermal stress exceeds tensile strength in the concrete. To reduce the risk of thermal cracking, and to ensure the safety of the dam structure, a concrete dam is often constructed using low heat generating cement and separated blocks having relatively lower lift thickness. Therefore, studies on thermal properties such as specific heat, thermal conductivity, thermal diffusivity and coefficient of thermal expansion become critical for mass concreting.

In view of above, SJVN Ltd. approached National Council for Cement and Building Materials (NCB) to take up the study on mechanical and thermal Properties of mass concrete in Arun 3 - H.E. Project. In this study, heat of hydration of three different PPC samples were evaluated. Further concrete mix design of M15 grade (having maximum size of aggregate of 150 mm & 80 mm) and M20 (MSA 40 mm) & M25 (MSA 40 mm) grade concrete mix was carried out using PPC having least heat of hydration. Further, mixes were evaluated for different hardened properties of concrete such as compressive strength, split tensile strength, static modulus of elasticity and density. Mixes were also evaluated for different thermal properties such as Co-efficient of thermal expansion, specific heat thermal conductivity and thermal diffusivity of concrete using Transient Plane Source Method.

Butyl sheet wrapping to prevent moisture loss from specimen

Determination of thermal conductivity and specific heat of concrete using TPS method

Values of thermal parameters of concrete reported by NCB, were used as one of the input parameters by SJVN Limited for design and evaluation of lift height, pouring time and time interval between placements of subsequent lifts in dam construction, which is also dependent on site environmental conditions.

- **Testing of Coarse Aggregate and Fine Aggregate Material for URI-I Stage- II HE Project and Dulhasti Stage-II HEP, Kishtwar (J&K) for M/s NHPC Limited**

NCB has carried out two project sponsored by M/s NHPC Limited on physical testing of more than 65 coarse and fine aggregate as per IS 383. These aggregates are provided from more than 12 different sources. In this study, more than 15 coarse and fine aggregate were also evaluated for potential alkali aggregate reactivity test i.e. accelerated mortar bar test as per ASTM C1260, petrographic and mineralogical analysis as per IS:2386 Part VIII and mortar bar test as per IS:2386 Part VII. All the coarse and fine aggregate from each source was found to be non-reactive against alkali aggregate reaction.

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

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

Supplementary cementitious materials (SCMs) have already a long history of being used as partial replacement of ordinary Portland cement (OPC) in concrete. While focusing on the durability of low clinker concrete, special attention should go to environments subject to atmospheric CO_2 ingress and carbonation-induced steel corrosion. Carbonation process in concrete is the reaction between the calcium hydroxide ($Ca(OH)_2$) present in the cementitious matrices and carbon dioxide (CO_2). CO_2 ingresses into concrete through its pores. The cement hydration products in contact with CO_2 form $CaCO_3$, changing the physical and chemical properties of concrete. In the carbonation reaction, $Ca(OH)_2$ is consumed and Ca_2+ and hydroxyl ions are released. 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.

In most of the previous studies conducted so far, focusses lie on the determination of carbonation depth under accelerated environmental conditions for different cementitious systems. However, very limited studies have been carried out under natural environmental conditions. No studies were conducted for rate of corrosion due to carbonation during the propagation phase. Effect of individual environmental parameters over the rate of carbonation and corrosion rate was also not studied. For different cementitious systems, the proportions of hydration products, concentration of ions in pore solution, porosity and pore size distributions in its microstructure is different. 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 system that are primarily corresponds to low clinker cement.

The study investigates the following parameters:

- Effect of new cementitious systems and environmental parameters like Relative humidity, Temperature and alternative wetting and drying phenomenon over the rate of carbonation.
- Effect of new cementitious systems over the carbonation induced corrosion rate and to determine the various factors affecting the corrosion rate in propagation phase.
- To correlate the laboratory studies with the field studies

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

New Cementitious system	
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 Calcined Clay Limestone Cement	OPC+ Calcined Clay+ LS
Portland Slag Composite	OPC + GGBS+ LS

LS= Limestone

The study is carried out at two w/c ratio of 0.40 and 0.60. Experiments will be carried out in laboratory as well as in field with a brief objective as follows:

Laboratory study (under accelerated environment): It aimed to quantify the following:

- Degree of hydration and amount of CH produced/ consumed in uncarbonated and carbonated system
- Effect of CO_2 conc, Relative humidity and temperature on carbonation front

Field study (under normal environment): It aimed to determine various parameters like CO_2 concentration, No of Rainy days / sunshine days, Relative humidity and Temperature over the ingress of carbonation front and corrosion rate.

Study on composite cement has been completed. Study on Portland limestone cement (PLC) and highvolume fly ash cement (HVFAC) is under progress. In the present research work, Portland limestone cement has been designed at 10% and 15% limestone content whereas high volume fly ash cement has been designed at 40 % and 45% fly ash content. In case of PLC, fineness of the cement will be kept as 425±10 m^2/kg and in case of HVAC, fineness of the cement will be kept as 400±10 m^2/kg.

Out of 140 concrete mixes, casting of 86 concrete mixes for different cementitious system such as composite cement, PLC and HVFAC as discussed up had been taken up and remaining cementitious system study will be taken up in due course of time. For the field study, selection of cement plant 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) has been done and mentioned in below table. For each environmental conditions, two numbers of cement plants have been selected and letter for collaboration with selected cement plants for field study has been sent.

Table – Selected Cement Plants in Different climatic Zones of India

1. Hot and Dry Environment	
Ambuja Unit, Mundwa	J K Lakshmi Cement Ltd, Sirohi
2. Warm humid and temperature Environment	
Star Cement, Lumshong	Dalmia Cement, Kadappa
3. Composite Environment	
Shree Cement, Beawer	Ultratech ltd, Mohanpura , Rajasthan
4. Cold/ mountainous Environment	
Ambuja ltd, Suli , H.P	ACC ltd, Gagal H.P
5. Coastal Environment	
JSW ltd, Khar Karavi	Ultratech ltd, Ratnagiri

- **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, the electricity generation comprises about 72% from Coal / Lignite based Thermal Power stations. Indian coal is of low grade with 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%. A large quantity of ash is, thus being generated at Coal / Lignite based Thermal Power Stations in the country, which 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.

In order to reduce the requirement of land, for the disposal of fly ash in the ash ponds, and 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. The amendment Notification of year 2009 prescribes the targets of Fly Ash utilization in a phased manner for all Coal / Lignite based Thermal Power Stations in the country so as to achieve 100% utilization of fly ash. The Thermal Power Stations in operation, before the date of the Notification (i.e. 3rd November 2009) are to achieve the target of fly ash utilization in successive 5 years; 50% in the first year; 60% in the second year; 75% in the third year; 90% in the fourth year and 100% in the fifth year from the date of notification. The new Thermal Power Stations coming into operation after the MoEF's notification (i.e. 3rd November 2009) are to achieve the target of fly ash utilization as 50% in the first year, 70% in the second year, 90% in the third year and 100% in the fourth year from their date of commissioning. Ministry of Environment, Forest and Climate Change (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 to 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 there is 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.

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 R & D project, NCB has collected fly ash from various locations (i.e., field wise samples, samples from silos, sample collection from ash dyke) of three different thermal power plant located across the country. Collected fly ash have been characterized under different categories on the basis of chemical, physical, Mineralogical, and morphological properties.

Sample Collection from Ash Dyke at one of the NTPC Plant

Sample Collection from ESP at one of the NTPC Plant

Sample Collection from Silos at one of the NTPC Plant

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 in 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. Hardened concrete properties shall be studied. Once all test results received comparison shall be done on various mechanical and durability properties with the control mix. Based on the results obtained, recommendation will be submitted to BIS for the modification / revision in the specification of fly ash. (IS 3812 Part-1, 2013). This study will also help in revision of Indian Standard IS: 6491-1972 methods of sampling of fly ash and bottom ash.

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

Centre for Construction Development and research is also continuously working on research projects aiming 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. Aforementioned industrial bi-products are characterized for their physical, chemical, mineralogical and microstructural characteristics in order to understand and identify the area of its utilization (either as an aggregate or as a cementitious binder) as one of the component in cement concrete.

- **Evaluation of Processed LD Slag and study of its suitability to be used as fine aggregate for JSW Steel Limited**

LD slag is a by-product of primary steel making in the basic oxygen furnace (BOF) and therefore it is also known as BOF slag. It is being produced during the separation of the molten steel from impurities in basic oxygen furnace in which lime is injected to act as a fluxing agent. Free calcium and magnesium oxides are not completely consumed in the steel slag, and hydration of unslaked lime and magnesia in contact with moisture is largely responsible for the expansive nature of most steel slags. LD slag is also not found suitable for direct use as aggregates in construction due to the presence of free lime and magnesia which can cause large volume changes and contributes to expansion in LD slag when used as aggregate in concrete. To overcome the effect of free lime and magnesia, a new processing methodology has been developed at JSW Steel to process LD slag of fraction below 4.75 mm which can be used as a fine aggregate in concrete.

Visit of NCB team at Basic Oxygen Furnace (at plant of JSW Steel Limited at Bellary, Vidyanagar) where molten iron is converted to steel and BOF Slag or LD Slag is generated as by-product.

Visit of NCB team at sand plant set up by JSW Steel Limited at Bellary, Vidyanagar for production of processed LD slag and Blast Furnace slag sand.

To investigate the feasibility of utilization of LD slag as an alternative to conventional fine aggregate, NCB is carrying out a sponsored R&D study titled "Evaluation of Processed LD Slag as per IS 383:2016 and study its suitability to be used as fine aggregate" in which processed LD slag has been characterized to understand and identify the utilization of processed LD slag as a fine aggregate in concrete. In this study, processed LD slag fine aggregate has been evaluated for different physical and chemical parameters as laid down in IS 383: 2016 for fine aggregates. It has also been subjected to mineralogical and petrographic examinations using X-ray diffraction (XRD) analysis and optical microscopy. Further, LD slag fine aggregate sample has also been assessed for alkali aggregate reactivity using accelerated mortar bar test as per ASTM C-1260. Free lime and magnesia content in LD slag sample has been determined using XRD. Volumetric expansion studies for evaluation of potential expansion occurring due to presence of free lime and magnesia in LD slag fine aggregates has been carried out. Annex E of IS 383: 2016 specifies the specifications for sample preparation and methodology to determine volumetric expansion ratio of coarse aggregates of a particular grading. However, it is not directly applicable to fine aggregate. Therefore, the specification for preparation of sample for evaluation

of volumetric expansion in fine aggregate of a particular grading has been suitably modified to achieve maximum packing in the test sample. Concrete mixes have been prepared at two water to cement ratios (i.e. 0.65 and 0.40) by replacing conventional fine aggregate with processed LD slag (provided by sponsor) at replacement levels of 0, 25%, 50%, 75% and 100%. Mixes are being evaluated for different fresh, hardened and durability properties of concrete.

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

The use of blast furnace slag, which is generated as a byproduct during production of pig iron in blast furnace, is relatively well known. The traditional way to utilize blast furnace slag is to further grind it and convert it into ground granulated blast furnace slag (GGBFS) which is further used as cementitious material to partially replace Portland cement for making Portland Slag Cement (PSC). In line with the above, Tata Steel is working on further 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.

To assess the cementing characteristics of aforementioned activated GGBFS binder and its performance in cement 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 will be characterized for its different physical and chemical characteristics as applicable for a hydraulic binder. Further, to access its performance as a binder in concrete, concrete mixes will be prepared at two water to binder ratios (i.e. 0.60 and 0.40) using activated GGBFS binder and those concrete mixes will be evaluated for different fresh, hardened and durability properties of concrete. To compare the performance of activated GGBFS binder, all these studies will also be carried out using commercially available OPC and PSC cement samples.

- **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 non-metallic by-product that consists mainly of silicates and oxides formed during the process of refining the molten steel using Electric arc furnace method. Production of EAF slag consists of collection of liquid slag from EAF in slag pots which are positioned below the furnace. The slag pots are then carried to the slag pits and the slag is then poured and allowed to cool in air/water sprays. After the slag cools down and solidifies, it is broken down into smaller pieces and sent to the slag processing unit. Here preliminary separation is done through a grizzly screen where +250 mm boulders are separated out. The boulders are broken down using balling crane in various size fractions (such as 0-6 mm, 6-20 mm, 20-40 mm etc.) for various possible utilizations. EAF slag aggregates often appear as grey or black coloured lumps, depending on its ferrous oxide content. This type of slag generally has a rough surface texture, with a surface pore diameter of 0.01–10 µm. EAF slag

from different regions and different manufacturers can exhibit a different appearance and physical properties, depending on the composition of steel scrap that is used as feed materials, the type of furnace, steel grades and refining processes. Nonetheless, EAF slag typically has Mohs hardness values in the range of 6–7, regardless of the differences in chemical compositions. The water absorption of EAF slag is around 0.5–4.0%, while its density is in the range of 2.8–3.9 g/cm3. 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. The crystalline phases in EAF slag can be divided into those that consist of iron oxides (i.e., wustite, magnesioferrite, magnetite, and hematite), silicates (i.e., larnite, bregedite/merwinite, and gehlenite), and manganese oxides (i.e., birnessite, hausmannite, rutile/hollandite, and groutellite). However, the mineralogy and crystalline phases in the EAF slag are dependent on the chemical compositions of the molten slag and the cooling process. Extensive study on physical properties of EAF coarse and fine aggregate was conducted at NCB as a part of a sponsored project. Based on the physical and chemical characterization EAF coarse and fine aggregates were found to be complying with the specifications laid down in IS 383 for use in concrete. With respect to presence of heavy metals and toxic elements, EAF was found to be within the permissible limits as per MoEF and CC Schedule–II. The EAF slag can be reused as replacement of fine or coarse aggregates in concrete production; this has both advantages and disadvantages. The density of the EAF slag concrete is higher than that of standard concrete due to the higher density of the slag if compared to natural aggregates. This entails a greater own weight of the elements, a greater seismic vulnerability, and higher transportation costs, effectively limiting the possibility of reusing this type of slag in concrete. Another problem is related to the presence of free CaO and MgO, if present, can cause volumetric expansion. In the study conducted at NCB, properties of concrete at partial as well as full replacement of natural coarse and fine aggregates by EAF slag coarse and fine aggregates were studied. The mechanical and durability properties of plain cement concrete were found to be on par or similar to that of control concrete.

Visit by NCB Team to Arcelor Mittal Nippon Steel (AMNS) Plant located at Hazira, Surat

EAF slag and Conrac slag – coarse as well as fine aggregate

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

Blast furnace slag is a by-product of metallurgical processes, which are being carried out for production of pig iron in blast-furnaces. Blast furnace slag is a nonmetallic material having alumino silicates of calcium and magnesium together with other compounds such as sulfur, iron, manganese, and other trace elements. Blast Furnace Slag is produced in hot molten state and is rapidly quenched under water to obtain Granulated Blast Furnace Slag. JSW is processing Granulated Blast Furnace Slag of fraction below 4.75 mm which can be used as a fine aggregate in concrete. IS 383: 2016 "Coarse and Fine Aggregates for Concrete- Specification" permits the use of blast furnace slag as an aggregate for concrete. Blast Furnace slag has been permitted to be used up to 50% in plain concrete, 100% in lean concrete and 25% in reinforced concrete as replacement of both coarse and fine conventional aggregates.

In view of investigating the possibility of increasing the above mentioned current permissible limits of IS 383: 2016 for utilization of Granulated Blast Furnace slag sand as replacement of conventional fine aggregates in concrete, JSW Cement Limited approached National Council for Cement and Building Materials (NCB to carry out a sponsored R&D study. This research study is an experimental work in which Granulated Blast Furnace Slag sand will be characterized for its suitability to be used as fine aggregate in concrete. Further, concrete mixes of different grades will be prepared by replacing 0, 25, 50, 75 and 100% of conventional fine aggregates using Granulated Blast Furnace slag sand and mixes will be evaluated for different hardened and durability properties of concrete.

- **Studies on Thermal Properties of Mass Concrete in Dhaulasidh H.E. Project for Rithwik Projects Private Limited**

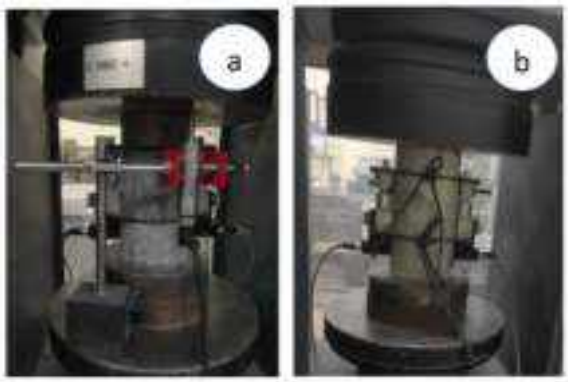
Rithwik Projects Private Limited approached National Council for Cement and Building Materials (NCB) to take up a sponsored R&D study to evaluate thermal properties of mass concrete in Dhaulasidh H.E. Project. In this study, concrete mix of M15 grade (having maximum size of aggregate of 80 mm) will be prepared using two different PPC cement samples and mixes will be evaluated for different thermal properties such as co-efficient of thermal expansion, specific heat thermal conductivity and thermal diffusivity of concrete using Transient Plane Source Method.

Structural Optimization & Design (SOD)

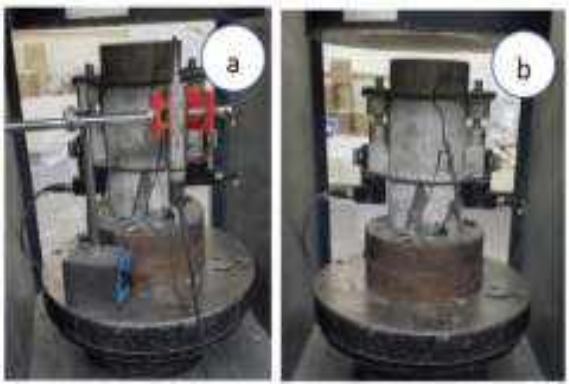
Studies on mechanical and time-dependent properties of Very High Strength Concrete (100 to 130 Mpa) and Ultra High Strength Concrete (130 to 180 MPa)

NCB conducted studies in past on Normal and High Strength Concrete (HSC) using different indigenous aggregates for concrete grades from M35 to M100. NCB had also completed an R&D project for development of Ultra High-performance concrete (UHPC) with compressive strength in excess of 150 MPa. Based on knowledge and

expertise gathered in these studies a new project was taken to evaluate mechanical and time-dependent properties of Very High Strength Concrete (100 to 130 Mpa) and Ultra High Strength Concrete (130 to 180 MPa). Currently, Indian standard under revision covers concrete grade M100 and outcome of study will provide data for up-gradation of Indian Standard of design for higher-grade concrete above M100. One of important aspects of structural design using higher strength concrete is development of stress block parameters and their standardization. The development of stress block parameters requires an extensive study on stress-strain response for developed mix. Based on performed experimental examination, results from stress-strain study suggest that a change in compressive strength changes stress-strain behavior of concrete. For strength rise from 40 MPa to 80 MPa strain at peak stress increased by 18%. Where for strength 110MPa, 130MPa, and 140MPa the increase is 31%, 52%, and 58% of strain values for concrete with 40MPa strength. Also, stress-strain curves obtained gets steeper with an increase in strength of concrete. At a higher strength, curves follow a straight-line path contrary to the parabolic path for normal and some extent for HSC. With increase in strength of concrete, post-peak behavior shrinks and finally coincides with very high strength concrete. This results in approximately equal strain at peak stress and ultimate strain at failure. The decrease in ultimate strain and increase in strain at peak stress of high to very high strength concrete will have a direct impact on depth of neutral axis for a balanced section which is directly related to maximum capacity of member. It was also found that LVDT and compressometer give slightly different strain values for same load and same concrete material. This is due to difference in gauge length ratio used in these strain measuring devices. Compressometer is incapable of capturing post-peak behavior of concrete, whereas LVDT shows errors at starting of loading in experiment.



Testing setup for stress strain curve
(a) View-1 (b) View-2



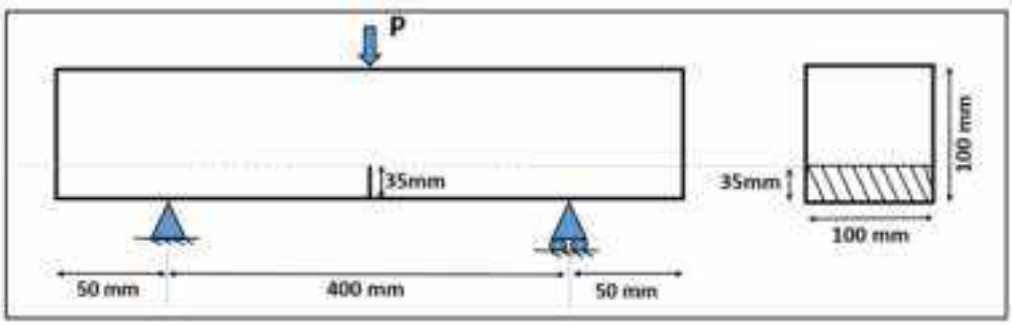
Failure mode of tested concrete specimen
(a) View-1 (b) View-2

Fracture parameters are evaluated for concrete mixes with different w/b ratios without and with 1% steel fiber by volume. The three-point bending test method with central point loading is used in study. Adding steel fibers significantly increases fracture energy. The observed increase in fracture energy was 850%, 770%, and 450% respectively for a w/b ratio of 0.47, 0.36, and 0.20. Comparing concrete with different w/b ratios, with increase in strength of concrete a consistent increase in fracture energy is observed. The addition of fiber increases strain carrying capacity of

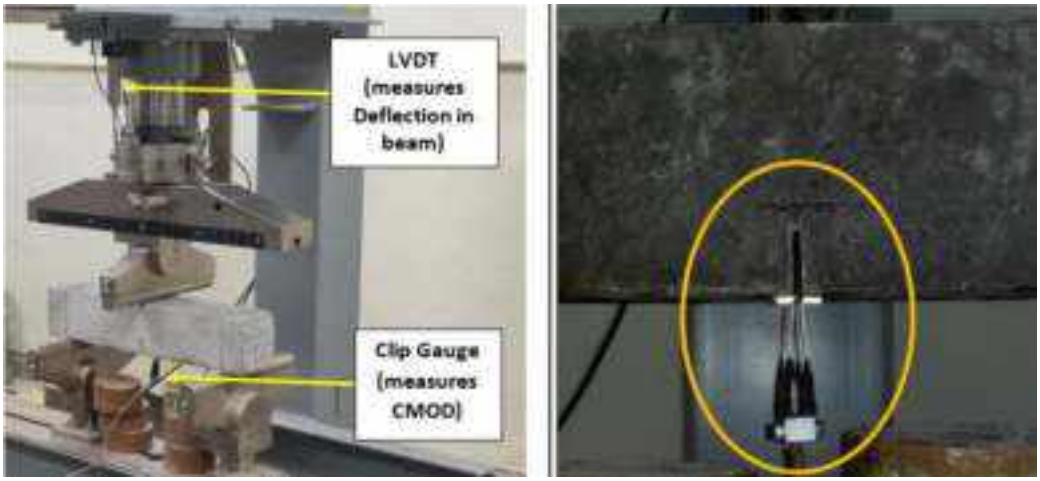
concrete and with increase in concrete compressive strength, peak load in load-deformation curve increases. Stress intensity factor and energy release rate shows a similar trend and these two parameters improve with addition of steel fiber but observed increase is less when compared to increase in fracture energy. Results suggest that compressive strength of concrete is an equally important factor for increase in values of these parameters along with addition of fiber. Characteristic length of concrete shows an opposite trend from other parameters when concrete with different strengths is compared. For higher-strength concrete characteristic length is less. Comparing normal concrete with fiber reinforced concrete for a particular w/b ratio, a significant increase in characteristic length of order of increase in fracture energy was observed. From the study it can be concluded that adding steel fiber tremendously increases amount of energy needed for fracture of beam. It may also help in arresting cracks by increasing characteristic length. But formation of initial crack is much more closely related to grade of concrete as fiber action can only be observed after onset of initial cracks. In further studies, the fracture performance of hybrid fiber reinforced concrete with strength in three different ranges investigated. The hybrid fiber use in the study constitutes a mix of polypropylene fiber & steel fiber. The obtained fracture parameters are compared with findings for a similar mix of plain and steel fiber reinforced concrete.

(a) Polypropylene fibre **(b) Steel Fibre**

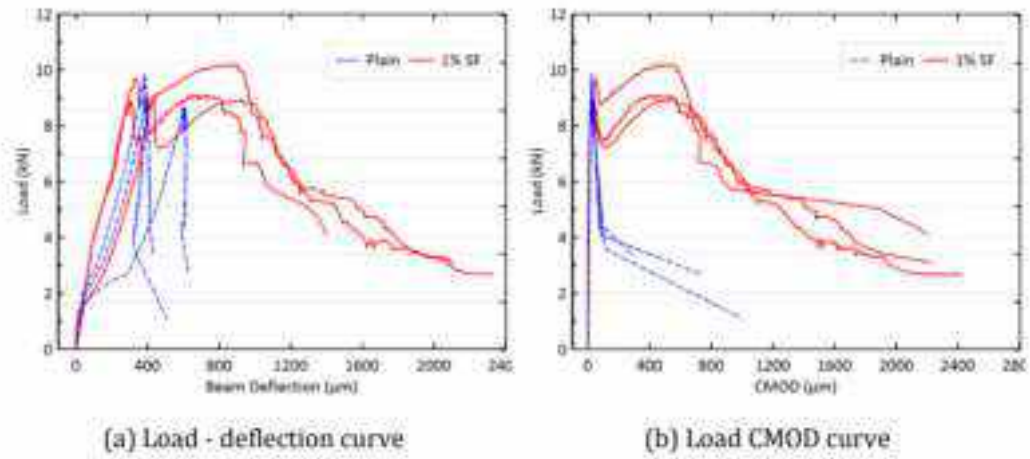
Addition of hybrid fibers (0.25% Polypropylene + 0.75% steel by volume of concrete) in concrete reduces compressive strength marginally when compared to plain concrete and concrete with steel fiber (1% by volume of concrete). Maximum reduction was observed in case of HSC with lowest w/c ratio.



Three-point bend test on notched beam



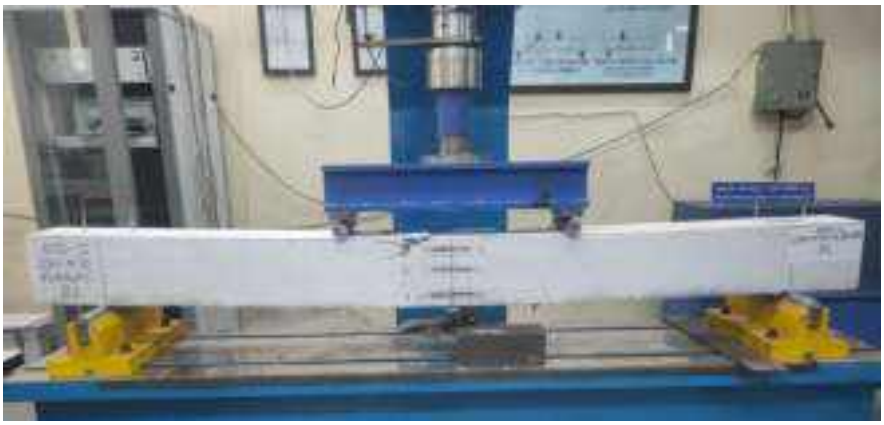
Experimental setup for evaluation of fracture parameters



Load-Deflection and Load-CMOD curves

This reduction in strength for HSC can be attributed to disturbance created in optimized cementitious material and aggregate matrix for HSC due to addition of hybrid fiber. Also, high-strength concrete consists of silica fume whose functionality in matrix is most likely to get affected by these hybrid fibers. Such significant alteration in split tensile strength is not observed in mix with hybrid fiber and it can be concluded that fiber action helped in compensating for matrix strength reduction. The load-deflection and load CMOD curves for hybrid fiber reinforced concrete shows similar behavior to steel fiber reinforced concrete and show a significant improvement in peak load, and maximum deflection compared to plain concrete. For normal and normal to HSC, hybrid fibers even show a higher peak load but in case of HSC, curves were located in between curves for plain and steel fiber reinforced concrete. The reason is similar to compressive strength reduction. The addition of hybrid fiber tends to disturb cementitious materials and aggregates matrix, giving a slightly lower peak in curves. The fracture parameters–fracture energy, stress intensity factor, energy release rate, and characteristic length show similar trends. For high and normal to high strength concrete addition of hybrid fibers gave slightly better results than steel fiber reinforced concrete. This can be attributed to an improvement in cementitious matter-aggregate matrix in these mixes due to filling up of voids by hybrid fibers. On contrary, already optimized mix for high-strength

concrete gets disturbed by addition of hybrid fiber. Although for densely packed HSC fracture parameters reduced by replacement of a small amount of steel fiber by polypropylene fiber, reduction is marginal. Also, for all mixes studied hybrid fiber reinforced concrete performed much better than plain concrete without any fiber addition. Also, for normal and normal to high strength concrete fracture parameters improved marginally by hybrid fibers compared to steel fiber. Further, to evaluate and compare difference between the flexural and shear behavior of conventional and geopolymer beams a full-scale four-point bend test on reinforced conventional concrete and reinforced geopolymer beams has been performed.



Four Point Bend test on Reinforced Concrete Beams

NCB team comprising of Sh. P N Ojha, Sh. Amit Trivedi & Sh. Brijesh Singh is currently working for Committee No.CED-54 of Bureau of Indian Standard (BIS) along with experts from IIT Chennai, IIT Bombay, IIT Hyderabad & GFRP bar manufacturer's for developing new standards on test method and specification of Glass Fibre Reinforced Bars for application in Different RC Members.

NCB team visit to GFRP bar manufacturing unit at Kolkata along with Professors from IIT Chennai, IIT Hyderabad, IIT Bombay and BIS representative

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

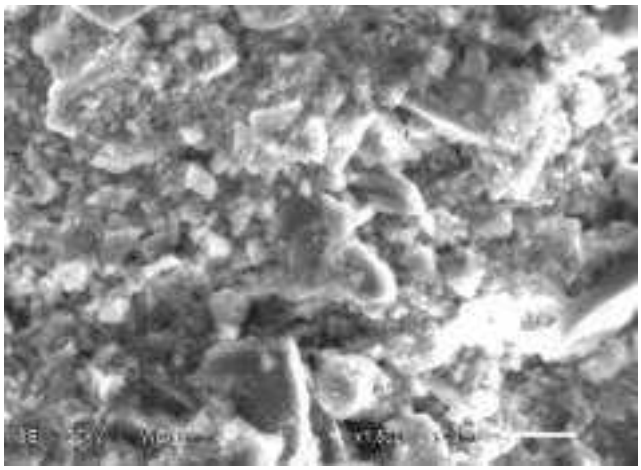
In-service structures, especially commercial, industrial and residential buildings, bridges, tunnels, dams, high-rise buildings, etc. require periodical assessment to judge whether they can perform satisfactorily for the intended service life. The distress in any form, such as cracks, spalling of concrete, corrosion of reinforcement, seepage, etc., not only disturbs the aesthetic appearance but also 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.

SAR program is well supported by a state of the art non-destructive laboratory that has adequate facilities for carrying out Non-Destructive Testing and evaluation of concrete structures. The Non-Destructive Testing Lab has NABL accredited 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. 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 fire damaged building
Right: SEM image of sample from column indicating absence of hexagonal morphology. Micro-structure found to be relatively less densified and porous due to effect of fire.

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 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 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". Both Laboratory study as well as Field Study involves experimental studies under Carbonation induced and Chloride induced corrosion. 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

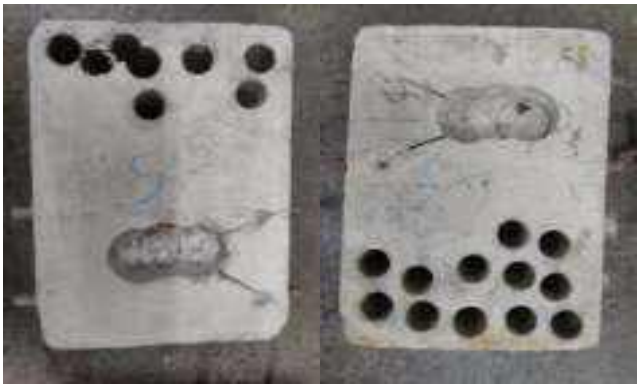
Slab specimens have been cast used to carry out the experimental measurements. The above specimens have been cast with a w/c ratio of 0.60. For study under carbonation induced corrosion, specimens were cast and kept in carbonation chamber to allow the carbonation depth to reach up to or beyond the level 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. Macro-cell corrosion current is being measured periodically in accordance with ASTM G-109. 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, beam 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 Gas Plant cooling tower, 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

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 2021-2022. Our clientele included reputed Organisations like NTPC, PGCIL, NHPC, NHAI, RBI, BHEL, GAIL, NBCC, AIIMS, CPWD, DDA (New Delhi), IPGCL, MCD, BSES, UPRUVNL, THDC. 19 sponsored projects were completed during the year 2021-2022. Some of the major projects executed during the year 2021-2022 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.
- Condition Assessment of Natural Draft Cooling Towers at IGSTPP, Jharli, Haryana. A detailed condition assessment of two Natural Draft Cooling Towers at Indira Gandhi Super Thermal Power Project at Jharli, Haryana was done. Based on the assessment and root cause analysis done, recommendation on cost effective repair scheme including preparation of detailed specification of repair items was given.
- Condition Assessment of Residential Accommodation for NHAI staff at Sec-17, Dwarka, New Delhi. Detailed condition assessment of Residential Towers and common double storey basement of NHAI Residential enclave at Sec-17, Dwarka, New Delhi was done. Root cause of distress observed in some of the RCC members was diagnosed and suitable scheme of repair, including use of novel technology like cathodic protection was recommended.
- Preparation of Specifications and Cost Estimate for repair of NHAI Staff quarters at Sec-17, Dwarka, New Delhi. Based on the detailed condition assessment done, a cost estimate of repair along with detailed specifications and rate analysis of non-schedule items of repair was prepared. The detailed repair methodology was also provided for execution of repair work. This work also included the detailed item specifications, cost & quantity estimate and rate analysis of discrete sacrificial anodes as cathodic protection measure.
- Third Party Quality Assurance of Repair of Gas Plant IDCT at NTPC Dadri, Uttar Pradesh. In this project, quality inspection of the repair and rehabilitation work of Induced Draft Cooling Tower (IDCT) of Gas Plant at NTPC Dadri was done on random visit basis. The post repair quality evaluation of the executed repair work was done using Non-Destructive techniques like UPV, Pull-Off Test, measurement of coating thickness using metallic coins and DFT meters and extraction of concrete cores of 25 mm diameter to observe the thickness of repair overlay. On-site inspection of the repair process was also done during the visits to provide technical guidance on appropriate measures to be taken for improvement.
- Third Party Quality Assurance of Repair of Gas Plant IDCT at NTPC Faridabad. This is an ongoing project that has been taken up in the year 2021.

The project involves Third Party Quality Assurance Services for execution of repair and rehabilitation of Induced Draft Cooling Tower at NTPC Faridabad on visit basis. The scope of work also involves quality inspection of installation of sacrificial anodes.

- Condition Assessment of RCC structures of plant area at NTPC Singrauli. This project has been taken up in the year 2021 and is ongoing. This involves detailed condition assessment of RCC structures of plant area such as DM plant building, PT plant building, Clariflocculators, O&M store building, Administrative Building, Fire Station Building, Clarified water pump house, Service water pump house, ID, FD & Mill fan foundations, etc.
- Concrete core extraction and testing of PSC poles for BSES at Haryana.This is an ongoing project taken up in the year 2021. The project involves extraction of concrete cores from 76 nos. PSC pole foundations of transmission line of BSES at various locations and testing of the cores for compressive strength.
- Carrying out NDT (UPV test & Rebound Hammer Test) and Concrete Core extraction and testing for transmission line foundation near Phalodi, Jodhpur, District, Rajasthan for PGCIL.This project involved carrying UPV Test, RHT and concrete core extraction and testing at 15 nos. foundations of PGCIL transmission line near Phalodi, Jodhpur District.

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 Natural Draft Cooling Towers at IGSTPP, Jharli Haryana

Project site of Residential Blocks at NHAI Residential Enclave at Dwarka, New Delhi

UPV testing on wall of Clariflocculator structure NTPC Singrauli

Concrete Core Extraction form RCC Column of Township Building at NTPC Gadarwara

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

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

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)

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 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 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.

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, checking of 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 Section 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 advices 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 month / fortnightly) 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 were awarded to NCB by Indian Trade Promotion Organization (ITPO), India International Convention Centre (IICC), Central Public Works Dept. (CPWD), State PWDs, All India Institute of Medical Sciences (AIIMS), Delhi Development Authority (DDA), Uttarakhand Jal Vidyut Nigam Limited (UJVNL), 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 infrastructure in India.

Some of the photographs of the TPQA projects monitored by NCB

Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana

India International Convention and Expo Centre (IICC) Dwarka, Delhi

Central Public Work Department – Residential Colony at Thyagrajnagar and Mohammadpur, Delhi

Central Public Work Department – Central University of Haryana (Mahendergarh), Haryana

Central Public Work Department – Office Building for Central Excise and Custom, Lucknow and President's Estate, Delhi

IECC at Pragati Maidan, ITPO, Delhi

Uttarakhand Jal Vidyut Nigam Limited Pashulok Barrage, Rishikesh, Uttarakhand

Central Public Work Department – Boys and Girls Hostel, Indian Agricultural Research Institute (IARI), PUSA, Delhi

Bharat Darshan Park, Punjabi Bagh, Delhi

Studies on mechanical and durability properties of High Strength Geopolymer Concrete

Alkali activated (Geopolymer) concrete is a viable alternative to Portland cement based concrete as it can be produced using industrial by-products such as Ground Granulated Blast Furnace Slag (GGBS) and fly ash (source of reactive aluminosilicates) along with less energy craving ingredients such as alkali activators (for ex. Sodium hydroxide, Potassium Hydroxide, Sodium Silicate, Potassium Silicate etc.). In view of enhancing the utilization of industrial byproducts and lack of standard guidelines for development and design of geopolymer concrete, NCB took up an initiative to conduct a research study on development of geopolymer concrete and study its properties for precast products. Out of various industrial byproducts, fly ash and GGBS were selected as cementitious binder for geopolymer concrete, due to their uniform availability all across the country. Several mix trials were conducted for development of geopolymer concrete mixes of different strength range, by varying the proportions of GGBS and fly ash in total cementitious content, at different concentrations of chemical activators. Some of the optimized geopolymer concrete mixes were evaluated for various fresh, hardened and long term durability properties. An experimental pavement stretch was cast in NCB premises using geopolymer paver blocks. Based on study, a patent has been filed for interlocking paver blocks and is under consideration. NCB drafted guidelines for developing geopolymer concrete mixes for precast products. Based on those guidelines and recommendations, IS 17452 (Use of alkali activated concrete for precast products-Guidelines) was formulated in 2020.

Based on expertise gathered in previous study, a new research project titled "Studies on Mechanical and Durability Properties of High Strength Geopolymer Concrete" was taken up with an aim to study the hardened and durability properties of normal and high strength geopolymer concrete and preparation of guidelines for structural design using geopolymer concrete based on its mechanical properties, whose validation has been done by limited testing on reinforced geopolymer concrete beams of selected grades.

IS 17452:2020

Around 50 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 SiO2 and Na_2O) as 1 and varying water to binder ratio to achieve mixes of required strength and desired level of workability. In this 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.

(a)

(b)

(c)

(d)

Cementitious binder and alkali activators used for development of geopolymer concrete mix: (a) Ground granulated blast furnace slag (b) Fly ash (c) Sodium Hydroxide (d) Sodium Silicate solution

The finalized 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, soprtivity 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. Paste samples prepared using GGBS: Fly ash as 70:30, 50:50 and 30:70 were subjected to microstructure analysis using XRD, SEM, OM & MIP.

Testing of reinforced geopolymer concrete beam to study its behaviour in flexure under progress

Based on studies conducted till date, it can be concluded that fresh, hardened and durability properties of geopolymer concrete mixes of equivalent strength will be different for geopolymer concrete prepared using different types of binders and activators and will depend upon the proportion of individual cementitious binders, type and dosage of chemical activators. Based on experimental study, it can be concluded that geopolymer concrete of a particular strength/grade can be developed at significantly lower binder content in comparison to cementitious binder required to produce conventional Portland cement-based concrete of equivalent strength/grade which leads to development of sustainable concrete with low CO_2 footprint. Early age compressive strength of normal strength high calcium geopolymeric concrete mixes is higher in comparison to conventional concrete mix. Higher early strength in case of geopolymeric concrete mixes can be attributed to quick dissolution of reactive alumino silicate ions (present in fly ash and slag) in alkaline media and occurrence of geopolymeric reactions at early age in geopolymer concrete mix. The ratio of split tensile strength to compressive strength is same for both Portland cement concrete and high calcium geopolymer concrete. In case of normal strength concrete, tensile strength may go up to 10% of compressive strength; however, for higher strength it reduces to about 5 % of compressive strength. Modulus of elasticity and Poisson's ratio of geopolymeric mixes of both normal and high strength are observed to be lower in comparison to their corresponding conventional concrete mixes. The lower value of modulus of elasticity for geopolymer concrete than conventional concrete can be attributed to the low intrinsic modulus of N-A-S-H gel and higher initial micro-cracks formulation in geopolymer concrete.

In case of drying shrinkage, geopolymer mixes of normal and high strength showed drying shrinkage comparable to their corresponding conventional concrete mixes.

Use of Advanced Electronics in Construction and Condition Assessment of Concrete Structures

Under this R&D project the use of advanced electronics such as 3D Printer was taken up for construction of concrete structures. NCB developed printable mortar using indigenous technology under Make in India programme of Government of India.

3D printing is also known as Additive Manufacturing (AM), which refers to various processes used to synthesize a three-dimensional object. In 3D printing, successive layers of material are formed under computer control to create an object. 3D printing is a construction method that has the capability of fabricating a predesigned building element in 2D layers on top of each other, the repetition of which completes a 3D model. The mortar, which is poured out of a printing nozzle, doesn't need any formwork or subsequent vibration. This 3D printer will provide a state-of-the-art facility for R&D in 3D printing technology for construction. The behaviour of fresh mortar can be studied by this printer. This technology will help to save a lot of time and cost for construction industry.

NCB developed some mortar mixes using supplementary cementitious materials and other chemical additives for 3D printable mortar. The cementitious content in these mixes are varying from 800 -1100 Kg/cum, and fine aggregate content passing through 2.36mm was used in this study. Further the study of fresh mortar parameter like Extrudability, Printability and Buildability was carried out and some modular articles were printed with the help of this lab scale 3D Printer.

Inauguration of 3D Printing facility by Additional Secretary DPIIT Sh Anil Agrawal on NCB Day Celebration

3D printed modular objects

Laboratory Facilities of CDR

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

(i) Mechanical & Physical Properties Investigation (MPI)
(ii) Non-destructive Testing (NDT)

(i) Mechanical and Physical Properties Investigation (MPI) Laboratory

Mechanical and Physical Investigation (MPI) laboratory is the part of CDR department. It is a NABL accredited testing laboratory in accordance with the ISO/IEC 17025:2017 procedures in the field of mechanical investigation (Test

Certificate No.-5296). The Lab has structured quality management system (QMS) and frequent internal and external assessments, ensuring consistent reliable laboratory results.

The lab has wide range specialized tests for conducting research. For R&D purpose, lab has been designed for the state of the art facility for the testing of hardened concrete behaviour.

State of the art facility

- 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 Equipment
- Carbonation Chambers
- Creep testing machine
- Electrochemical Impedance spectroscopy (EIS)
- 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, Fresh Concrete & 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
- Testing of corrosion inhibitors as per Modified Japanese Standard Z1535, ASTM G1 and ASTM G 3

1. **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 test
- Checking the behaviour of reinforced concrete by testing of beams and columns

2. **Durability tests based upon transport mechanisms and other tests**

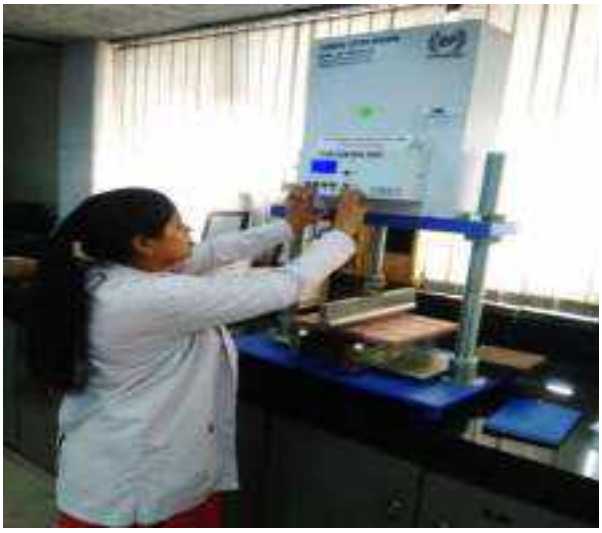
- Migration/ Conduction: RCPT, NT Built 492, Florida method
- Diffusion: chloride diffusion/ ponding, accelerated carbonation
- Sorption: sorptivity
- Penetration: permeability, volume of permeable voids
- Microstructure: mercury intrusion porosimetery
- Chloride induced corrosion: polarizing resistance 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.

To enhance the experimental capability of the lab, several testing equipment related to study of cement and concrete characteristics and behaviour have been added in the year 2020-2021 such as initial surface absorption test (ISAT) apparatus to evaluate the rate of water absorption by concrete samples, flexural testing machine to evaluate transverse strength of cement concrete tile.

Apart from the testing facility, lab has provided demonstration and training to various groups from esteemed organisation such as Bureau of Indian Standards (BIS), DMRC, NHPC and many recognized academic institutions.

Corrosion Rate using Electrochemical Impedance Spectroscopy

Initial Surface Absorption Test Facility



Flexural testing of cement concrete tile

Column testing machine for checking behaviour of reinforced column

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

Flexural testing machine- 500kN for testing reinforced beam

Salt Spray Chamber

Mercury Intrusion Porosity equipment for checking porosity of concrete

Universal testing machine- 1000kN for testing of reinforcement steel

Creep Testing Machine for creep behaviour of concrete

BET Apparatus for determining fineness of ultra- fine powder materials

Steel fiber testing

(ii) 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 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-$CuSO_4$ 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 Resisitivity 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 have been developed Certified Reference Materials (CRMs) in the areas of cement, building materials and solid fuels (coal and pet coke). So far 79 types of CRMs have been developed to cater the various needs of cement and construction industries. NCB's CRMs have been quoted in IS 4031(P2), IS 1727 and IS 4031(P15).

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***".

On 4th January 2022, two nos. of NCB's BNDs released by Hon'ble Minister of State (IC) for the Ministry of Science & Technology, Dr Jitendra Singh Ji on National Metrology Conclave in CSIR-NPL, Delhi.

The following BNDs are commercially available:

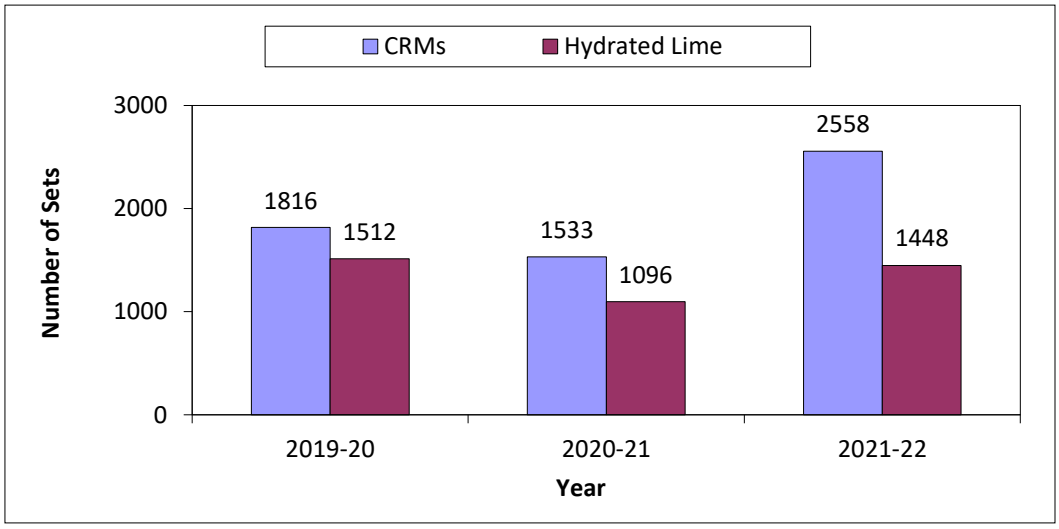
Sl. No.	BND No.	Material Description
1	5001	OPC - Blaine fineness (Lower Range)
2	5021	OPC - Blaine fineness (Middle Range)
3	5011	OPC - Blaine fineness (higher Range)
4	5002	PPC - Blaine fineness
5	5003	PSC - Blaine fineness
6	5006	Composite cement - Blaine fineness
7	5007	WPC - Blaine fineness
8	5004	Fly ash - Blaine fineness
9	5051	OPC - Chemical
10	5052	PPC - Chemical
11	5053	PSC - Chemical
12	5055	Composite cement - Chemical

13	5054	Fly ash - Chemical
14	5056	Limestone - Chemical
15	5057	Raw Meal - Chemical
16	5058	Clinker - Chemical
17	5091	Coal- Chemical
18	5059	GGBFS - Chemical

Releasing of BNDs by Hon'ble Minister Dr Jitendra Singh

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.), African country (Tanzania) and GULF country (UAE) etc.

During the year, total 2558 units of different CRMs and 1448 sets of standard lime were supplied to 950 customers of cement plants, testing laboratories, public sector undertakings, R&D institutions including Bangladesh, Bhutan, Nepal, UAE etc.



Number of Units of CRMs & Hydrated Lime Supplied

Currently in India, NCB is only leading organization which develops CRMs in the area of cement & cementitious materials as per ISO 17034:2016 and BND trademark. The top most contributors in the area of reference materials are NIST (National Institute of Standards and Technology, USA), Certipur Reference Materials, PTB, Germany, China Reference Materials, NIM, China, European reference Materials, JRMM, Belgium, Thailand Reference Materials, NIM, Thailand etc. Thus, our BNDs products have been substituted the foreign import as well as create a market capitalization to overseas industries and laboratories. Subsequently, increasing supply of BNDs to domestic and international market is contributing to the country GDP and boost the economy of India.

Calibration Services

The calibration laboratories of the center are state of art, equipped with the latest and 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. In recent years, calibration laboratories have added facilities for calibration of steel scale, measurement tape, height gauge and weighing balance of 5kg with resolution of 0.1 mg.

The laboratories have acquired sophisticated equipment like Mass Comparator-5 kg with least count of 0.1mg, Universal Length Machine, Dry Block Calibrator, Temp and Humidity Calibrator, Load Cells etc.

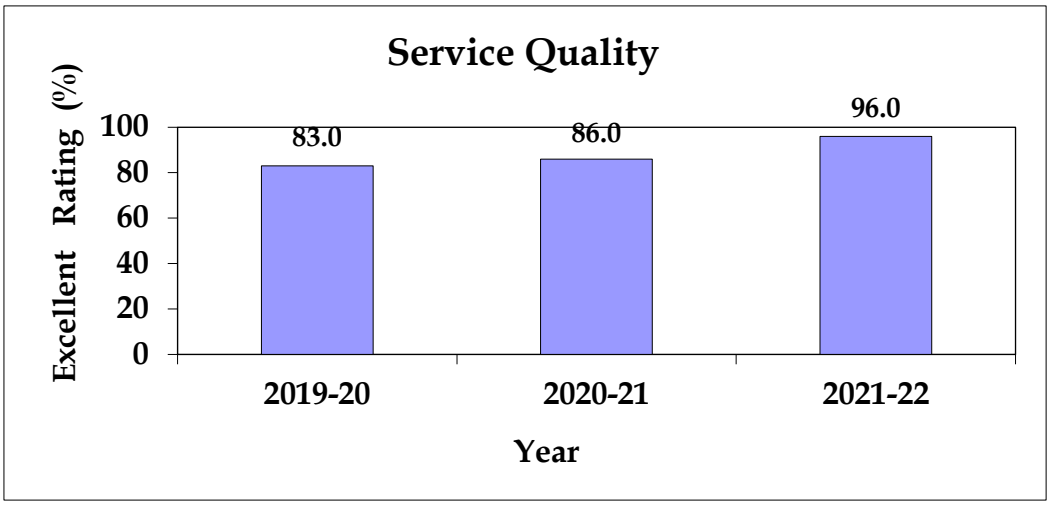
Length Measuring Machine (LMM)

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.

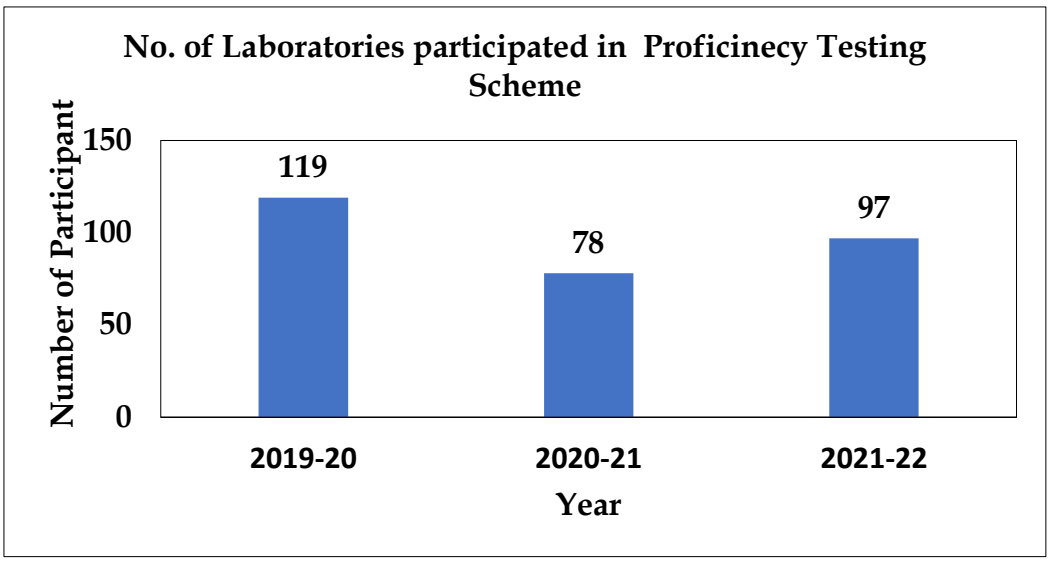
It is pertinent to mention that 96% customers rated our services as excellent in the last financial year.



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 2021-22, NCB completed 12 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 figure 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 12 PT schemes, example for OPC-Chemical is illustrated here as under. The scatter of results in OPC-Chemical scheme show presence of bias. In the scatter plot of results, code number of the outlier laboratory (Lab code 2 & 16) is mentioned along with the data point. Outlier's performers are put in circle. The scatter of results for Insoluble Residue (IR) test of OPC-Chemical is shown in the following figures.

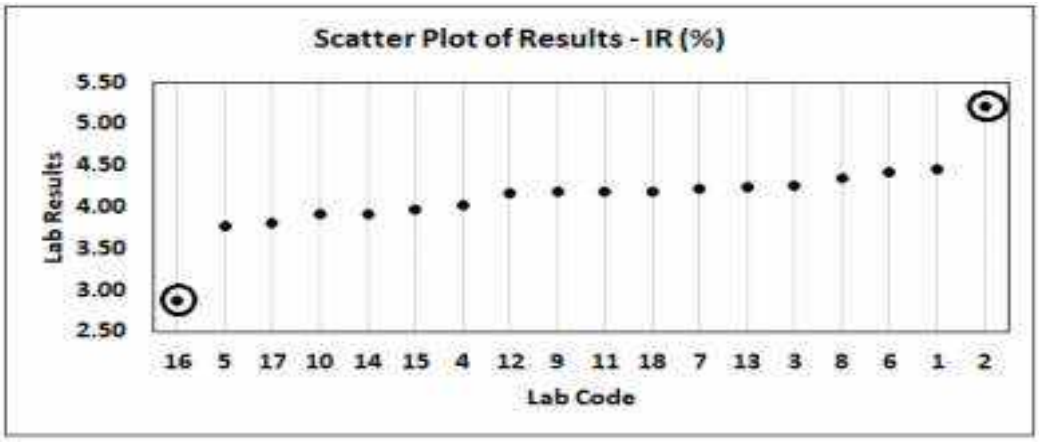


Fig: Scatter Plot of Test Results – IR (%) of OPC-Chemical (ILS/PT/74)

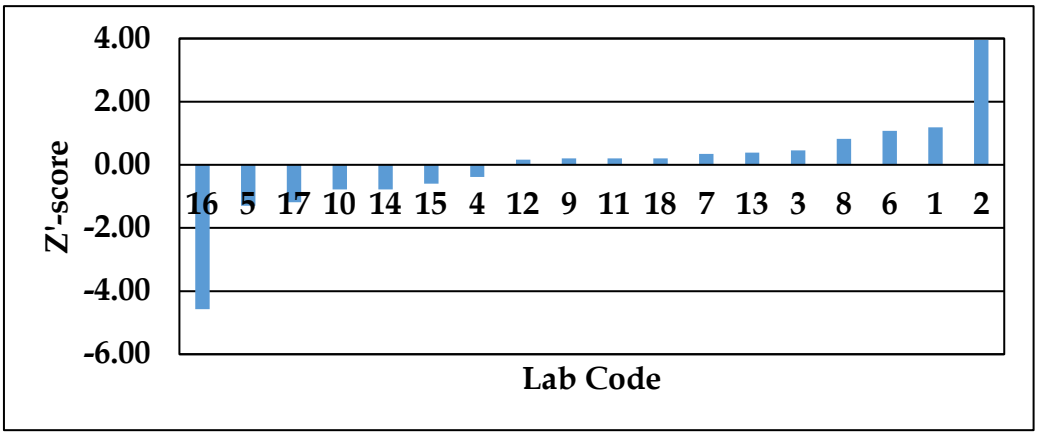


Fig: Bar Chart of Laboratory Performance for Sample – IR (%)

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.

NCB-CQC imparted training programme on "ISO 17034:2016; General Requirements for the Competence of Reference Material Producers" and Internal Auditing for M/s National Physical Laboratory during 24-27 August, 2021, organized by CSIR-Human Resource Development Centre, Ghaziabad. Sh Amit Trivedi, HOC-CQC-NCB, Dr Rina Sharma, Head HRD-NPL, Dr Nahar Singh Head, BND-NPL chaired the inaugural session. Scientist of around 40 nos. have successfully received training and commemorate the training programme.

Training Programme on ISO 17034:2016 for Scientist at National Physical Laboratory, New Delhi

NCB-CQC also imparted 4-day training programme on Laboratory Quality Management System and Internal Audit as per ISO/IEC 17025:2017 for Senior Executives at J K Lakshmi Cement Ltd., Durg, (C.G.). This training was part of a sponsored project for providing consultancy services to M/s J K Lakshmi Cement Ltd., Durg, (C.G.) for accreditation of their cement testing laboratories as per ISO/IEC 17025:2017. The training was organized in the plant premises for 19 nos. of laboratory personnel of M/s J K Lakshmi Cement Ltd., Durg, (C.G.) during 24-27 August, 2021. The plant officials appreciated the training programme as effective.

Conducted 4-day Training Programme on Laboratory Quality Management System and Internal Audit as per ISO/IEC 17025:2017 for Senior Executives at J K Lakshmi Cement Ltd., Durg, (C.G.)

NCB-CQC completed the sponsored project on "Consultancy Services for getting accreditation of Testing Laboratiories of M/s Orient Cement Ltd., Chittapur".

M/s Orient Cement Ltd., Chittapur sent NCB a special word of appreciation for the NCB team, praising the coordination, co-operation and round the clock support for getting the accreditation from NABL. The feedback highlighted the fact that not a single Non-conformity was raised in Laboratory Quality Management System documentation and records, by the assessors of NABL during the assessment. The Laboratory Quality Management System documentation was developed by NCB in coordination with concerned officials of the plant.

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 46,970 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' has been installed. 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

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

- Indexing Services from Library, through Intranet site and www.ncbindia.com site.
- Announcements on 17th NCB International Conference, Training Courses and quality related schemes.
- Employment opportunities & RTI related documents.
- Maintenance of hardware and software for whole of the institute including LIMS and LIBSYS.
- Bulk e-mailing services was continued for promotional information.

Publications & Image Building

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 brought out during the year are as follows:

- NCB Annual Report 2020-21 in English and Hindi versions separately
- News Letter
- Report on Achieving Circular Economy in Gypsum

Participation in Workshops, Webinar Seminars and Conferences

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

Sr. No.	Workshop/Webinar/Seminar/Events/Conferences	Participant(s)
1.	Webinar on "World Class Maintenance Management System – 6 Half Day Program", 25-06-2021 to 30-07-2021, Guwahati Organised by National Productivity Council (NPC)	Sh Saurabh Bhatnagar Sh P K Singh
2.	Online Workshop being Organised by National Academy of Human Resource Development (NAHRD). 01-07-2021 to 02-07-2021 & 07-07-2021 to 08-07-2021	Sh Anupam Dr Sanjay Mundra
3.	Online Training Programme on "Preventive Vigilance: A Tool to Good Governance" 24-08-2021 to 25-08-2021, Patna Organised by National Productivity Council (Under Ministry of Commerce & Industry, Govt. of India)	Sh P N Ojha
4.	11th International Conference on Sustainable Waste Management & Circular Economy and IPLA Global Forum 2021, 01-04 December 2021, Jadavpur University, Kolkata, West Bengal (Virtual Mode)	Sh P N Ojha Sh Puneet Kaura
5.	International Conference on Geological and Environmental Sustainability (ICGES-21), 04 December 2021, Bangalore (Virtual Mode)	Sh Brijesh Bishal Sahoo
6.	Second International Conference on Engineering Materials, Metallurgy and Manufacturing (ICEMMM-2021), 16-17 December 2021, (Virtual Mode)	Ms Kirti Chugh
7.	Online Advanced Course" Use of Alternate Reinforcement in Concrete Application (ALTERCON 2022)", during 22-23 February 2022, Chennai Organised by CSIR-SERC. (online mode)	Sh Amit Prakash Sh Puneet Kaura Sh Rizwan Anwar

Webinars Organised

Webinar on "Carbon Capture & Utilization and Renewable Energy"

NCB organized a webinar "Carbon Capture & Utilization and Renewable Energy" on the occasion of World Environment Day 2021 on 05th June 2021. The webinar was attended by total 546 participants from Cement Industry, Scientists / Engineers, Academic Institutions, Research Organisations / Government Deptt. /Companies. Overwhelming response received from the participants on the informative content of the webinar

Webinar on "Total Quality Management"

NCB organized a webinar on "Total Quality Management" under the leadership of Dr Bibekananda Mohapatra, Director General, National Council for Cement & Building Materials on 27th August 2021. The webinar was attended by 375 professionals from all the major Indian Cement Companies.

Webinar on NCB Methodology for Development of Plant Specific Secondary Standards for Calibration of XRF

NCB organized a webinar "NCB Methodology for Development of Plant Specific Secondary Standards for Calibration of XRF" on 13th September 2021 on 13th September 2021, under the Leadership of Dr. Bibekananda Mohapatra, DG-NCB. Total 568 participants from all the major Indian Cement Companies attended the webinar. The webinar was dedicated for Professionals of all levels of Indian Cement Industry which highlighted "NCB methodology for Development of Secondary Standards of all the materials in cement industry". All plant operations starting from mining to cement grinding, are dependent on XRF analysis. Therefore, accuracy of XRF is very crucial for process as well as product quality control. Accuracy of XRF pivot on the standards used for calibration.

Webinar on "Futuristic Low Carbon Cements: A Step Towards Decarbonization of Cement Industry"

NCB & IIT-Delhi jointly organized a webinar "Futuristic Low Carbon Cements: A Step Towards Decarbonization of Cement Industry" on 22nd October 2021. The webinar was attended by 286 professionals from all the major Indian Cement Companies. The webinar was inaugurated by DG-NCB along with Dr. S K Chaturvedi, Joint Director & Head-Cement Research & Independent testing & Dr. Shashank Bishnoi, Professor (Civil Engineering Department) IIT-Delhi.

Webinar highlighted new technologies in the area of low carbon cement developed by NCB and IIT-Delhi with the objective of Decarbonising the Indian cement industry.

Important Visitors

Date	Name of Visitors	Organisation
23 July 2021	Sh Pranav Desai, Head (R&D) & Dr Arunachala Sadangi, Asst. GM (Cement	Nuvoco Vistas Corp. Ltd.
10 August 2021	Ms Shalini Goyal Bhalla, MD	International Council for Circular Economy (ICCE)
19 August 2021	Sh Anindya Chakrabarti, Scientist-E, Head Management System Certification Department	Bureau of Indian Standard (BIS), New Delhi
24 August 2021	Sh Rahul Goel, Vice President-Technical Services	UltraTech Cement
21 September 2021	• Shri Arunkumar S, Scientist 'E', Head - Civil Engineering • Shri Sinam Hudson Singh, Scientist 'D', Civil Engineering • Shri Ashish Kumar Kanar, Scientist 'C', CMD-3, Civil Engineering	Bureau of Indian Standards

1 October 2021	Dr. Mohammed Altaf Khan, Professor, Department of Commerce & Business Studies	Jamia Millia Islamia
13 October 2021	Dr. Prakhar Shrivastava, Assistant Vice President (QA) & Corporate Quality Head	JK Cement Ltd
14 October 2021	Dr Abhishek Rai, General Manager, Corporate Quality Head	Dalmia Cement Bharat Ltd
25 October 2021	Sh Shailendra Kumar Gupta, Chief Operating Officer & Cluster Head-North Zone	UltraTech Cement Limited
2 November 2021	• Sh Raju Goyal, President & Chief Technical Officer • Dr V Ramachandra, Joint Executive President • Dr Awadhesh Kumar Singh, Senior Vice President & Head QA & Product Development • Sh Ashwin Moghe, Senior Vice President & Head-Technical Services-Key Accounts • Sh Rahul Goel, Vice President, Technical Services • Sh Devendra Pandey, Asst. Vice President, Head-Technical Services-RMC	UltraTech Cement
11 November 2021	• Mr Pierre Narcisse LOUFOUA, Chief of Staff • Mr MILANDOU Wilfrid ADOLPHE, Chief Executive Officer of Industry • Ms Gouadi Bouzimbou Koussiama, Advisor for Administrative, Legal and Industrial Property • Mr Gabriel ITOUA, Economic Advisor (Delegation from the Embassy of Republic of Congo) • Ms Shavy Verma, Assistant to H.E. Ambassador (Delegation from the Embassy of Republic of Congo)	Republic of Congo
17 November 2021	Sh Anil Agrawal, Additional Secretary, DPIIT (Visited NCB Hyderabad Unit)	Ministry of Commerce & Industry, Government of India

18 November 2021	Visit of United Nations & NMDC officials to NCB Hyderabad Unit	United Nations and NMDC
22 November 2021	• Sh Pranav Desai, Head (R&D) • Dr Arunachala Sadangi, Asst. GM (Cement) • Ms Vinita Charles, Asst Vice President-HR	Nuvoco Vistas Corp. Ltd.
13 December 2021	• Sh J S Kamyotra, Ex-Member Secretary, Central Pollution Control Board (CPCB) • Dr M K Gupta, Director In-charge, Central Pulp & Paper Research Institute (CPPRI)	CPCB & CPPRI
10 February 2022	• Mr Prashant Senad, Building and Infrastructure Head (West and South)	Ambuja Cement Limited
17 March 2022	• Sh JS Kalra • Sh Vivek Negi • Sh Naveen Kumar	Bureau of Energy Efficiency (BEE)
20 March 2022	• Dr. S.S. Gupta, SDO (to NCB Bhubaneswar unit)	DPIIT, MoCI, Govt. of India
22 March 2022	• Dr. A.K. Singh, Sr. Vice President and Head- Product Assurance & Services (to NCB Bhubaneswar unit)	UltraTech Cement
23 March 2022	• Sh Pranav Desai, Vice President & Head CDIC	Nuvoco Vistas Corp.Ltd.

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.

MoUs signed by NCB during the year 2021-22 are:

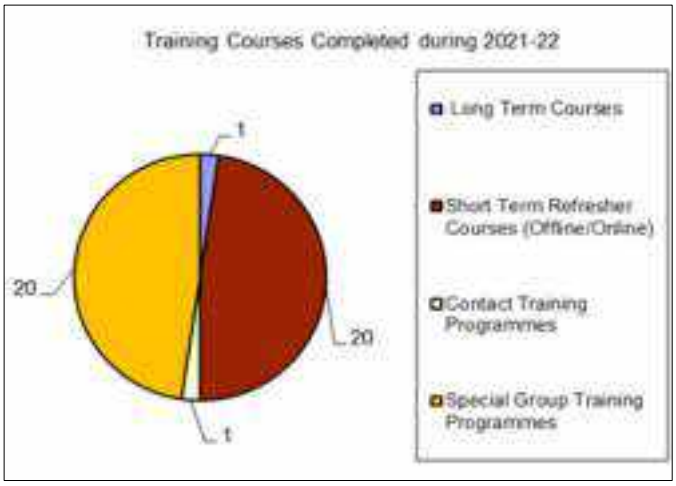
- Ravenshaw University, Cuttack
- Sambalpur University - Burla, Sambalpur
- Kalinga Institute of Industrial Technology (KIIT), Bhudaneswar
- Madhav Institute of Technology & Science, Gwalior
- GLA University, Mathura
- National Institute of Technology, Andhra Pradesh
- Birla Institute of Technology and Science, Pilani
- Quality Council of India, New Delhi

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 2021-22, 42 training programmes (online/offline) were successfully organized with a total of 1033 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	20
Contact Training Programmes	1
Special Group Training Programmes	20

Statistics of training programmes held at CCE

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. Total 17 self-sponsored participants admitted for 2021-22 session are going to successfully complete the course in September 2022.

Short Term Refresher Courses

During the year, 20 Short Term Refresher Online Training Courses were organized wherein 523 professionals from cement and construction industries participated. In Cement Technology related area, special emphasis was given to courses such as Advanced Pyroprocessing Techniques for Improved Productivity and Clinker Quality; Alternate Fuels and Raw Materials in Portland Cement Manufacture;

Sampling, Testing of Cement as per BIS Standards; Alternate Cementitious Materials; Consumer Complaint and handling Technique in Cement Marketing; Optimisation of Cooler Performance; Best Practices for Quality & Productivity in Cement Plants; Energy Efficiency in Cement Industry; Importance of CRMs for Quality Assurance & Quality Control in Cement and Building Material and Role of Proficiency Testing; Optimisation of Raw Mix to Improve Clinker and Cement Quality; Application of XRD & OM in Cement Industry; Optimisation of Pyroprocessing Systems in Cement Industry; Safety Practices in Cement Industry; Optimisation of Cement Grinding Systems to Improve Productivity and Energy Conservation; 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; Non-Destructive Testing and Evaluation of concrete structures; Corrosion in Reinforced Concrete Structures and its Remedial Measures; Concrete Mix Proportions and Acceptance Criteria; Quality Control and Quality Assurance in Concrete Construction were organized.

Lectures and Laboratory Demo Sessions during Training programmes

Contact Training Programmes

On the request of M/s Birla Corp. Ltd., Durgapur contact training programme was organized for their official on "**Optical Microscopy for Clinker & Slag**" at NCB's Hyderabad unit.

Special Group Training Courses

Twenty 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:

S.No.	Organization	Topics of the Courses Organized
1	M/s Oman Cement Company, Oman	➢ Special Group Training Programme for Officials of Oman Cement Company, Oman

2	M/s Dalmia Cement Bharat Ltd.	➢ Cement Manufacturing Technology for GETs – 2 batches
3	Nuvoco Vistas Corp. Ltd.	➢ Application of XRD & OM for Quality & Process Control in Cement Manufacture
4	M/s JK Lakshmi Cement Ltd.	➢ Special Group Training Programme on Pyroprocessing & Grinding Technology
5	Delhi Metro Rail Corporation Limited (DMRC), Delhi	➢ Quality Control and Quality Assurance in Concrete Construction
6	Power Grid Corp. of India Ltd. (PGCIL), Hyderabad, NCB-H	➢ Field Quality Assurance – 8 batches
7	Odisha Integrated Irrigation Project for Climate Resilient Agriculture (OIIPCRA), Bhubaneshwar	➢ Sound Construction Procedures and Workmanship Development of Minor Irrigation Works – 2 batches
8	M/s Hindustan Petroleum Corporation Ltd., Mumbai	➢ Quality Control and Quality Assurance in Concrete Construction
9	Syama Prasad Mukherjee Port, Kolkata	➢ Building Construction and maintenance with special emphasis on restoration and retrofitting of Old Buildings - 2 batches
10	Central Pulp & Paper Research Institute, (CPPRI) at NCB-Ballabgarh Training Facility	➢ Application of Advanced Bleaching Sequences in Indian Pulp & Paper Industry"

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 has also taken an initiative for translating the CEMENT TECHNOLOGY in local languages for reaching out to all level of employees which is under final stage.

GET's of M/s Dalmia Cement (Bharat) Ltd. during Special Group Training Programme on "Cement Manufacturing Technology" at NCB-Ballabgarh Unit

Visit of students from Rawal Institute of Technology, Faridabad at NCB- Ballabgarh

Training program of CPPRI officials at NCB- Ballabgarh

CCR Operators of M/s J K Lakshmi Cement Ltd., Sirohi (Raj) for Special group Training Programme on "Pyro-processing & Grinding Systems"at NCB-Ballabgarh Unit

Students of Post Graduate Diploma in Cement Technology Batch-2021-22

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	Sh S K Shaw Sh V Naga Kumar Sh Abhishek Agnihotri	5th PTP/RMP Conclave (Online)	National Accreditation Board for Testing and Calibration Laboratories (NABL), Gurgaon	2 Days 30 - 31 August 2021
1	Ms Meghna Verma	Annual Performance Appraisal (APAR) (Online)	Integrated Training & Policy Research (ITPR), New Delhi	2 Days 11-12 March 2022

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 centres 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 centre 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 1100 samples have been analysed.

Development of XRF Calibration Standards: Results from the XRF, predominantly depends on the quality of the standards used for the calibration of the equipment. Development of standards for calibration of XRF was taken up for plant laboratory. Various samples of raw materials, raw meal, kiln feed, clinker, cement etc. were collected from the plants and were analysed in the NCB laboratories for chemical composition. This high-quality data was used to calibrate the XRF of plant laboratories.

Utilization of industrial waste materials in the manufacture of cement: Use of industrial waste in the manufacture of cement is beneficial from environmental as well as economical point of view. Studies were successfully completed on utilization of chrome sludge from chemical industry in manufacture of clinker. Investigations were carried out on use of chrome sludge in development of other building products.

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 210 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, 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.

Contact Training Programmes for Cement Plant Officials

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. RCC 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, Power Grid Corporation of India in Andhra Pradesh, Telangana &Karnataka, NALCO in Odisha, NMDC, BDL 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, Andhra Pradesh, Tamil Nadu, Karnataka, Puduchchery, Kerala and Goa. 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.

Quality Checking being carried out at TNTPO Site, Chennai

Non-Destructive Testing being carried out on RCC Chimney of NALCO, Angul, Odisha

Water Permeability and Concrete Cube Testing being carried out at CDR Laboratory

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

Mandatory Energy Audits:

Mandatory Energy Audit was done for M/s Zuari Cement Ltd., of Heidelberg group Seethapuram Works, in Telangana. Various Process Measurement in Kiln, Preheater, Precalciner, Raw mill, coal mill, cement mill and packing plants were carried out. The audit comprises of Thermal & Electrical energy consumption and also compressor air audit carried out to evaluate the energy consumption and to identify the potential areas for energy conservation. The electrical energy comprises of major drives, lighting, pumps etc. Report prepared including above aspects and submitted to the plants.

Mandatory Energy Audit was done for M/s KCP Cement, Macherla, Andhra Pradesh. Various Process Measurement in cement plant Kiln, Preheater, Precalciner, Raw mill, coal mill, cement mill and packing plants were carried out. The WHR installed to recover the thermal energy loosing from the cooler vent gases was also evaluated for its energy recovery. The audit comprises of Thermal & Electrical energy consumption and also compressor air audit carried out to evaluate the energy

consumption and to identify the potential areas for energy conservation. The electrical energy comprises of major drives, lighting, pumps etc. Report prepared including above aspects and submitted to the plants.

Mandatory Energy Audits were carried out in association with NCB Ballabgarh team for One Line of M/s Awarpur Cement Works, Korpana, Maharashtra and Three Lines of M/s Vikram Cement Works, Khor, Madhya Pradesh of UltraTech Cements Ltd. Various Process Measurement in Kiln, Preheater, Precalciner, Raw mill, coal mill, cement mill and packing plants were carried out. The audit comprises of Thermal & Electrical energy consumption and also compressor air audit carried out to evaluate the energy consumption and to identify the potential areas for energy conservation. The electrical energy comprises of major drives, lighting, pumps etc. Report prepared including above aspects and submitted to the plants.

NCB-H was associated with NCB-B in Implementation of co processing of AFR materials (tyre chips) for Oman Cement Company, Muscat in evaluation of electrical drawings and other project management aspects.

Dust Load Assessment Studies

Monitoring of Dust load At Various Ducts in Pyrosystem, For M/S Saurashtra Cement Ltd., Wherein various process measurements were carried out to evaluate the total return dust preheaters and dust separation efficiency of the hurryclones of raw mill. Established the total load on the raw mill due to dust returning from the preheater and raw mill cyclones

Monitoring of Dust load at Various Ducts in Pyrosystem, For M/S Rajashree Cement Works of Ultratech Cements Ltd., Malkhed, Karnataka. The return dust concentration in the preheater down comer and dust load input to the coal mill through hot gas from the preheater outlet were measured at Line-2,3 & 4 to determine grain load increase due to the dust entering the coal mill through hot gas and preheater cyclone dust separation efficiency.

Heat Balance Studies:

Heat Balance Studies were carried out in association with NCB-Ballabgarh team for M/s JK Cement Works, Nimbahera and Mangrol. Various process measurements across Kiln, Preheater & Cooler were carried out at Two Lines of Mangrol Unit and one Line of Nimbahera Unit. Total thermal energy consumption from the fuel, heat loss and recovery from the WHR were evaluated for both the units.

Associated with NCB-Ballabgarh team, for Capacity Enhancement Assessment for Tanzania Portland Cement Company Limited (TWIGA), Dar-Es-Salaam, Tanzania. Various process measurements were carried out at Kiln, Raw mill and Cooler for heat balance study at Line-3 and Line-4.

Mandatory Energy audit at M/s. Vikram Cement Ltd, Zuari Cement Ltd, The KCP Cements Ltd & Awarpur Cement Works (UltraTech)

Heat Balance study & Dust Load Measurements at Tanzania Portland Cement Company Limited (TWIGA) & Rajashree Cement Works (Ultra Tech)

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 Convention& Exhibition centers, staff quarters and hostel buildings etc in Karnataka, Telangana and Tamil Nadu.

Inspection of different construction projects by TPQA electrical team.

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 attached to the training complex is available for providing residential facility to participants. NCB-H CCE is also equipped with CISCO webex platform for conducting virtual training programs.

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 has also taken an initiative for translating the CEMENT TECHNOLOGY in local languages for reaching out to all level of employees which is under final stage. As part of **"Digital India program"** CCE initiated virtual training programs during COVID-19 through CISCO Webex and 21 training Programs conducted for Cement and Construction industry.

CCE Hyderabad organised 5 short term refresher courses for Cement industry and 3 short term refresher courses for Construction industry through Virtual mode. Special Online Group Training Programmes were conducted for Power Grid Corp. of India Ltd., OIIPCRA-Odisha & Syama Prasad Mookerjee Port trust Officials. Hands on training was imparted through Contact Training Programme on Optical Microscopy for Clinker & Slag for Birla Cor. Ltd., Durgapur.

Around 157 participants benefited through NCB Training from Cement Industry representing Bharathi Cement Corp. Pvt ltd, Chettinad Cement Corp Pvt. Ltd, Dalmia Cement (B) Ltd, JK Cements Ltd, The Ramco Cements Ltd, Ultratech Cements Ltd, NU Vista Ltd., My Home Industries Pvt. Ltd, NCL Industries Ltd, The KCP Ltd, ACC Ltd, Orient Cements Ltd, Penna Cement Indstries Ltd, The India Cements Ltd, JSW Cements Ltd, Toshali Cements Ltd, Shree Digvijay Cement Ltd, TANCEM, Shiva Cement, Malabar cements, Bhavya Cements Ltd, Green Valliey Industries Ltd, etc.

DG-NCB sharing his remarks during training programme for Safety Practices in Cement Industry

Around 437 participants benefited through NCB Training from Civil & Construction Industry representing Rites Ltd, RBI, NTPC, BPCL, Oil India Ltd, NFL, IOCL, LIC, NSPCL, TS-I&CAD, Border Roads Organisation, Maharashtra State Power Corp. Ltd., South Eastern Coalfields Ltd., UPPTCL, Madras atomic Power Station, ISRO, Power Grid, OIIPCRA-Odisha, Syama Prasad Mookerjee Port trust etc.

Online Training Programme on Energy Efficiency Initiatives in Cement Industry

Special Training Programme for SMPK engineers

Special Training Programme for PGCIL engineers

Online training programme on Raw mix Design

Online Training Programme on Energy Efficiency in Grinding Systems

Contact Training Programme on Optical Microscopy for M/s Birla Corp. Ltd., Durgapur

Training Infrastructure:

Industry Interaction

- Meeting of "**Advisory Committee for NCB-Hyderabad & Bhubaneswar**" was conducted on 18th August 2021 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.

Meeting of "Advisory Committee for NCB-Hyderabad & NCB-Bhubaneswar" was conducted on 18th August 2021 through virtual mode

- Sh. Anil Agrawal, Additional Secretary, DPIIT visited NCB Hyderabad unit on 17th November 2021. Dr B N Mohapatra, DG-NCB was also present during the visit.

Sh. Anil Agrawal, Additional Secretary, DPIIT visited NCCBM, Hyderabad unit on 17th Nov 2021 and Interacted with Officials of NCB-H

- Sh. Anil Agrawal, Additional Secretary, DPIIT **inaugurated the Calibration Laboratory** that renders calibration services in the areas of Thermal, Dimensions, Mass, Force & RPM etc. He also visited the laboratories & training facilities of NCB Hyderabad.

- Sh. Anil Agrawal, Additional Secretary, DPIIT and Dr B N Mohapatra, DG-NCB interacted with Senior executives of Cement Plants in South India through virtual

conference for inputs to enhance the activities of NCB Hyderabad. The industry also sought the support from DPIIT.

- Sh. Anil Agrawal, Additional Secretary, DPIIT and Dr B N Mohapatra, DG-NCB planted saplings at NCB Hyderabad Campus.

- NCB-Hyderabad officials held discussions with Engineers of Kolkata port trust regarding to carry out condition assessment of SMPT guest house building

- Dr B N Mohapatra, DG-NCB, Dr S K Chaturvedi, HOC-CRT, Mrs K V Kalyani, UIC-NCBH and NCB-H officials interacted with officials of M/s. Srikalahashti Pipes Ltd., Chittoor, Andhra Pradesh through video conferencing on utilisation of Silica fume in cement and construction sectors on 19th November 2021.

- National Mineral Development Corporation (NMDC) and United Nations Association (UNA) officials visited NCB Hyderabad unit on 18-11-2021 for discussions on Feasibility studies for the Development of Building Material from Iron Ore Mines Waste project to collaborate with NCB. DG-NCB briefed NCB activities in line with National goals and 17 SDGs of UN. NCB team visited the NMDC laboratories on 18.11.2021, during the visit DG interacted with Scientists on avenues for utilization of minerals in cement industries

- NCB - Hyderabad celebrated National Energy Conservation Day on 14th December 2021

NCB - Hyderabad celebrated National Energy Conservation Day on 14th December 2021 and briefed about energy savings

- GHMC Officials visited NCB-Hyderabad laboratories and had discussions with NCB officials regarding various testing facilities available with us and providing Third Party Quality Assurance for their projects in Hyderabad on 18th January 2022

- NCB - Hyderabad celebrated National Science Day on 28th February 2022

- Virtual coordination meeting held between NCB & IIT-H Civil departments on 9th February 2022. The working areas and facilities available at NCB & IIT-Hyderabad are discussed in detail and agreed to work on Research & Development projects.

- A virtual coordination meeting held between NCB & NIT-AP Civil departments on 23rd February 2022. The working areas and facilities available at NCB & IIT-Hyderabad are discussed.

- National events: NCB-Hyderabad celebrated Independence Day & Republic day with due reverence and hoisted the National Flag.

NCB Ahmedabad

NCB Ahmedabad

NCB Ahmedabad Unit is situated at Smeet Bungalow, Bodakdev in Ahmedabad, Gujarat. Presently NCB-A unit is primarily working in the area of Centre for Construction Development and Research (CDR). Very soon, NCB-A will expand its activities in the area of 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.

DG-NCB Dr B N Mohapatra along with Unit In-Charge Sh P N Ojha visited NCB-A on 27th October 2021 for monitoring the ongoing activities and discussion on expansion plan of NCB-A

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, Ferroscan & Ultrasonic Pulse Velocity Test (UPV).

CONCRETE TECHNOLOGY (CON)

Evaluation of physical and 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 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.
- Carry out Condition Assessment using Non Destructive Evaluation Technique for Stability for High Level Bridge at Rakholi on Silvassa Khanvel Main Road in the District of UT of D & NH.
- Carry out Condition Assessment using Non Destructive Evaluation Technique for Stability for High Level Bridge at Athal on Silvassa Naroli Main Highway Road in the District of UT of D & NH.

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 the 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 programme

- 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- site office cum laboratory was established in 2016 in the State of Odisha and was set up on in a space provided by IDCO at Mancheswar Industrial Estate as per the MoU signed between NCB and IDCO. Accordingly NCB has established material testing laboratory in the above space 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 in final stage.

There are mainly two activities at NCB Bhubaneswar Unit viz.

1) Independent Testing Laboratory (ITL)

2) Third Party Quality Assurance (TPQA)

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, kota stone, marble, paver blocks, AAC blocks, etc. NABL Accreditation obtained during September 2020.

Testing services extended to customers including Odisha Industrial Infrastructure Development Corporation (IDCO). H&UD, OBCC, CPWD, NTPC, and Cement Manufacturing plants in Odisha and neighbouring states.

Mechanical & Chemical Laboratory Accreditation:

View of Cement Testing Laboratory

View of Aggregate Testing Laboratory

View of Soil Testing Area

View of Concrete Testing Laboratory

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 (Fly ash, Slag), construction water, etc.
NABL Accreditation obtained during March 2021.

Testing services to customers other than IDCO TPQA Projects commenced

View of Chemical Testing Laboratory at ITL NCB Bhubaneswar

Third Party Quality Assurance (TPQA):

NCB Bhubaneswar provided TPQA services to IDCO for construction of various multistoried structures for educational institutions, skill development center, hostel blocks, old age homes, sports complex, stadium, swimming pools, bituminous pavement, rigid pavement, and staff quarters in different districts of Odisha to assure that the quality of the work being carried out at site is as per the project specifications, CPWD specifications and IS standards. Successfully completed about 150 TPQA projects in IDCO during the last 5 years and 36 TPQA projects are in progress.

NCB Bhubaneswar was awarded during January 2022 with a 1month pilot project as the State Level Third Party Quality Assurance Team by H&UD, Odisha for monitoring various works like Concrete Paver Block Road works, CC Pavements, RCC Drains etc. taken up by 114 ULBs across the State of Odisha.

Meeting Photos with Chief Engineer cum Additional Secretary, Housing & Urban Development, Odisha

Services Provided to Housing & Urban Development, Odisha

- Site inspection and imparting awareness reg. latest revision and use of relevant IS standards for Municipal Works related to concrete pavement roads and concrete paver block roads
- Testing facility for concrete paver blocks
- Slump test at site for road projects
- Testing of hardened concrete

Site Inspection in various ULBs in Odisha

Core Extraction from ULB work sites

Building Material Samples submitted by representatives of ULBs at ITL NCB Bhubaneswar

Witness of Quality Tests on Building Materials by various ULB Representatives at ITL NCB Bhubaneswar

Visits of Clients at ITL, NCB Laboratory

DH Berhampur witnessed Testing of paver block samples in NCB Bhubaneswar Laboratory

XEN, BDA Bhubaneswar visit to NCB Bhubaneswar Laboratory

Cement plant representative visit to NCB Bhubaneswar Laboratory

Visit of Dr. S S Gupta, SDO, DPIIT, Govt. of India on 20th March 2022

Visit by various State Govt. Officials & Academia

NCB signed MoU with KIIT, Bhubaneswar on 1st February 2022 at Bhubaneswar

NCB signed MoU with Ravenshaw University on 25th March 2022 at Cuttack, Odisha

Skill Development Activities in Association with CCE Hyderabad

NCB Bhubaneswar in association with Centre for Continuing Education (CCE) NCB Hyderabad has organized various training courses to meet the needs of professionals from OIIPCRA, Power Grid Corporation of India Limited (PGCIL), cement, concrete & construction industry. The Unit has well established training facility for both onsite and online training. Proposals under active consideration for training engineers & technicians from Odisha Works Dept., Rural Development Department, Odisha, etc.

Interaction with Industry and Academia

An interactive meeting with cement plant Sr. Level officials was held on 23rd October 2021 at NCB Bhubaneswar and was attended by total 8 Nos participants from 6 major cement companies of Odisha, 4 Nos Eminent experts of academia in and around of Odisha and 10 Nos of NCB officials. All the participants shared their valuable views on challenges faced by Cement manufacturing Industries in Odisha region.

NCB interaction with Cement Industries spread across Odisha and neighboring states on 23rd October 2021 at NCB Bhubaneswar Office.

Interactions with various Academic Institutions for collaborative works.

Seminar on "Waste Utilization in Cement and Concrete Industry" organized by NCB in association with KIIT, Bhubaneswar on 21st March 2022 at KIIT Bhubaneswar: Participants: Representative of various Cement Industries, Officials from State Govt. & Central Govt. and Academia

Meeting with Senior Officials of Government of Odisha

DG met Sh. Suresh Chandra Mahapatra, IAS Chief Secretary & Chief Development Commissioner Govt. of Odisha on 21.10.2021

DG along with NCB Bhubaneswar Team Met Sh. Bijoy Chandra Tripathy, CGM (P&C), IDCO on 21.10.2021

Meeting with DH BCD-II IDCO on 21.10.2021

Meeting with Sh. Prashant Kumar Mohapatra Chief Engineer (Septage & Bhubaneswar Municipal Corporation) on 22.10.2021

Meeting with Sh. Manoranjan Mishra, Spl. Secretary Odisha Works Department on 22.10.2021

Visit of Sh. Kushdhar Mahanta, CGM (MSME) to NCB Bhubaneswar on 23.10.2021

NCB Bhubaneswar Lab visit by Cement Industry Officials during the Interactive Meeting with Cement Industry on 23.10.2021

NCB Bhubaneswar Lab visit by IIT-Bhubaneswar & KIIT (DU), Bhubaneswar Professors on 23.10.2021

NCB Bhubaneswar Lab visit by IIT-Bh & KIIT (DU) Professors and Dr. B. K. Panda, Ex Director DISIR on 23.10.2021

NCB Bhubaneswar visit by Sh. Bijoy Chandra Tripathy, CGM(P&C), IDCO on 23.10.2021

NCB Bhubaneswar Lab Visited by Sh. Bijoy Chandra Tripathy, CGM (P&C), IDCO on 22.10.2021

Examining the IDCO Space along with Sh. Kushdhar Mahanta, CGM (MSME) on 23.10.2021

Published Research Papers

Published Research Papers

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

Centre for Cement Research & Independent Testing – CRT

1. A review on Tertiary cementitious Systems: Limestone and Fly ash Based Composite Cements, Dr. Suresh Palla, Sh. Suresh Vanguri, Dr. Varsha Liju, Dr. S K Chaturvedi and Dr. B N Mohapatra, ZKG International, June Issue 4, 2021.
2. Chemico-mineralogical evaluation of clinker from four different zones of India: A comparative study towards development of Portland Limestone Cement (PLC) in Indian scenario, Sandeep Gupta, B.N. Mohapatra and Megha Bansal, Journal Name: Metallography, Microstructure, and Analysis, Springer, Scopus Journal, Aug 2021
3. Investigations of Calcined Clay cement based on marble dust with the comparission of limestone. Dr. B N Mohapatra Mr. S K Aggarwal Dr. Suresh Palla and Dr. S K Chaturvedi, ZKG International, Vol. 6, 50-56.
4. Study the Correlation of Clinker Quality, Reside, PSD on the Performance of Portland Cement, Dr. Suresh Palla, Sh. Suresh Vanguri, Dr. D Yadav, Dr. S K Chaturvedi and Dr. B N Mohapatra, International Journal of Advanced Research in Engineering and Technology (IJARET), Volume 12, Issue 11, (November 2021)
5. Development of fly ash and limestone based portland composite cements, Dr. B N Mohapatra, Dr. Varsha Liju Dr. Suresh Palla, Sh. Suresh Vanguri,, Dr. S K Chaturvedi, Cement international, Vol 6 2021 (Nov)
6. Estimation and Validation methodology of free in clinker by XRD, Dr. Suresh Palla, Sh. Suresh Vanguri, Dr. S K Chaturvedi and Dr. B N Mohapatra, Cement International-2021
7. BCSA raw mix design: Correlation between chemical and mineralogy, Dr. Suresh Palla, Sh. S Ramakrishna, Sh. Suresh Vanguri, Dr. S K Chaturvedi and Dr. B N Mohapatra, ***ASEN J of Sci &Tech for Development, vol. 38, no 3, 2021***
8. Impact of Liquid Content Percentage on the MgO Soundness, Dr. Suresh Palla[1], Dr. S K Chaturvedi[1] and Dr B N Mohapatra[1] Volume-22 Issue-11, NOVEMBER 2021.
9. Estimation and Validation of free lime analysis of clinker by Quantitative Phase analysis using XRD, Dr. Suresh Palla, Sh. Suresh Vanguri, Ms. Kalpana Sharma, Mr. Gourav Bhatnagar, Dr. Varsha Liju, Dr. S K Chaturvedi and Dr. B N Mohapatra, Proceedings of **ICCCC, Oct-2021)**
10. Estimation of OPC, fly ash and slag contents in blended and composite cements by selective dissolution method. Dr. Suresh Palla, Sh. Suresh Vanguri, Dr. D. Yadav, Mrs. Anitha, Dr. S K Chaturvedi and Dr. B N Mohapatra, **Proceedings of ICCCC Oct-2021**

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

1. Sh/s P. Sharma, B. Mohapatra, P. N. Sheth, **Leveraging emerging chemical engineering research for cement industry growth**, Cement International, 5/2021
2. Sh/s Prateek Sharma, M V Ramachandra Rao, B.N. Mohapatra, Ashutosh Saxena, **Development of suitable machine learning model for a cement plant calciner**, International Journal of Engineering Applied Sciences and Technology, 2021 Vol. 6, Issue 3, ISSN No. 2455-2143
3. Presented a paper titled "**Development of suitable machine learning model for calciner**" published in International journal for Engineering Applied sciences and Technology 2021.
4. Presented a paper titled "**VRM Audits and optimization**" in International Cement Review.
5. Presented a paper titled "**Solar Thermal Treatment of Phosphogypsum and its impact on Mineralogical modifications for effective utilization in cement production**" in Journal of Building Engineering.

Centre for Construction Development and Research - CDR

1. Vikas Patel, Brijesh Singh, P N Ojha & Sahara Adhikari: Mechanical Properties of Polypropylene Fiber Reinforced Concrete under Elevated Temperature, **Journal of Architectural Environment & Structural Engineering Research**, April 2021
2. P N Ojha, Suresh Kumar, Abhishek Singh, Brijesh Singh & B N Mohapatra: Alkali Aggregate Reactivity Evaluation of Aggregates for Application in Indian Concrete Dam. **Dam Engineering Journal, May 2021**
3. P N Ojha, Amit Trivedi, Brijesh Singh, Adarsh Kumar NS, Vikas Patel & R K Gupta: High Performance Steel Fiber Reinforced Concrete – for Repair in Spillways of Concrete Dams. **Research on Engineering Structures & Materials**, May 2021
4. P N Ojha, Brijesh Singh, Puneet Kaura & Abhishek Singh: Light Weight Geopolymer Flyash Sand; an Alternative to Fine Aggregate for Concrete Construction. **Research on Engineering Structures & Materials**, May 2021
5. P N Ojha, Abhishek Singh & Brijesh Singh: Experimental Investigations on Substitution of Natural Sand in Concrete with Copper Slag and Blast Furnace Slag, Asian Concrete **Federation Journal, Research on Engineering Structures & Materials**, May 2021
6. P N Ojha, Brijesh Singh, Adarsh Kumar NS, Abhishek Singh & Vikas Patel: A Case Study on Deterioration Assessment and Rehabilitation of Fire Damaged Reinforced Concrete Structure**. Journal of Building Materials & Structures**, May 2021

7. Satish Sharma, V V Arora, P N Ojha, Brijesh Singh, Vikas Patel, Adarsh Kumar NS: Use of Bottom ash as Part Replacement of Sand for making Concrete Blocks. **Journal of Building Materials & Structures**, June 2021

8. Arup Ghatak, P N Ojha, Brijesh Singh, Abhishek Singh, T V G Reddy & B N Mohapatra: Assessment of a Fire Damaged Reinforced Concrete Building, **Asian Concrete Federation Journal**, June 2021.

9. P N Ojha, Brijesh Singh & Ashok Kumar Behera: Sintered Fly Ash Light Weight Aggregate-its Properties and Performance in Structural Concrete. **Indian Concrete Journal**, June 2021

10. Rizwan Anwar, T V G Reddy, Sanjay Mundra, P N Ojha & Brijesh Singh: Condition Assessment in Induced Draught Cooling Towers Located in Different Climatic Regions of India. **Community Based Research and Innovations in Civil Engineering**, August 2021.

11. P N Ojha, Abhishek Singh, Vikas Patel, Brijesh Singh, Rahul Das, B N Mohapatra: Experimental Investigation on Thermal Properties of Mass Concrete for Dam Construction. **Dam Engineering Journal**, September 2021.

12. Amit Trivedi, P N Ojha, V V Arora, Brijesh Singh, Abhishek Singh, Shivang Bansal & Vaibhav Chawla: Design and Construction of Low Traffic Volume Concrete Roads using Construction and Demolition Aggregates. **Sustainable Structures and Materials,** November 2021

13. Vikas Patel, Brijesh Singh, P N Ojha & Amit Sagar: Case Study on Quality Assurance System in Construction. **Sustainable Structures and Materials, November** 2021.

14. P N Ojha, V V Arora, Amit Trivedi, Abhishek Singh, Brijesh Singh & Nikhil Kaushik: Experimental Investigations on Use of C&D Waste as an Alternative to Natural Aggregates in Concrete. **Sustainable Structures and Materials**, November 2021

15. Brijesh Singh, P N Ojha, Amit Trivedi, Vikas Patel and V V Arora: Development of Empirical Equations for Prediction of Flexural and Split Tensile Strength for Normal and High Strength Concrete with Granite and Calc-Granulite Aggregate. **Indian Concrete Journal,** November 2021

16. Brijesh Singh, P N Ojha, Vikas Patel, Amit Trivedi, & Abhishek Singh: Empirical equation and experimental validation of shear parameters for high strength concrete (HSC). **Journal of Asian Concrete Federation,** December 2021

17. P N Ojha, Puneet Kaura, Brijesh Singh, Y N Daniel & Nitesh Kumar: Evaluation of Polymer Modified Mortar and Bonding Agent for Structural Repair, **Journal of Asian Concrete Federation**, December 2021

18. P N Ojha, Suresh Kumar, Manish Mandre, Piyush Mittal, Brijesh Singh, V V Arora: Empirical Equation for Concrete Made With PPC or OPC with Fly Ash by Accelerated Mix Design Method. **Journal of Building Materials & Structures,** December 2021

19. Vikas Patel, Brijesh Singh, P N Ojha, B Pandu Ranga Rao and Amit Sagar: Impact of ISO: 17020 for Quality Assurance System in Construction Sector. **Journal of Building Materials & Structures**, December 2021

20. P N Ojha, Abhishek Singh, Brijesh Singh and Vikas Patel: Mechanical and durability properties of cement mortar and concrete reinforced with glass micro fibre. **Research on Engineering Structures & Materials,** December 2021

21. Brijesh Singh, Vikas Patel, P N Ojha, Amit Trivedi, VV Arora: Experimental Shear Study on Reinforced High Strength Concrete Beams Made Using Blended Cement. **Journal of Architectural Environment & Structural Engineering Research**, January 2022

22. P N Ojha, Pranay Singh, Brijesh Singh, Abhishek Singh & Piyush Mittal: Fracture behavior of plain and fiber-reinforced high strength concrete containing high strength steel fiber. **Research on Engineering Structures & Materials**, February 2022

23. P N Ojha, Brijesh Singh, Shivam Prakash, Pranay Singh, Manish K Mandre and Suresh Kumar: Effect of high ratio fly ash on roller compacted concrete for dam construction. **Research on Engineering Structures & Materials**, February 2022

24. P N Ojha, Amit Sagar, Brijesh Singh, Harish Sharma and Pranay Singh: Temperature Control and Monitoring For Mass Concrete in Raft under Hot Weather Condition – An Indian Case Study. **Sustainable Structures and Materials**, Published

B. Book Chapter

1. P N Ojha, Brijesh Singh, Puneet Kaura & Rajeev Satyakam (NTPC NETRA): As utilization strategy in India Away forward**. (Advances in Sustainable Materials and Resilient Infrastructure) Springer Transactions in Civil and Environmental Engineering**, PP-145-151, March 2022.

2. T V G Reddy, P N Ojha, Brijesh Singh, Rizwan Anwar & Vikas Patel: Condition Assessment and Repair Strategy for RCC Chimney of Thermal Power Plant Station located in Semi-Arid Region in India. **(Advances in Sustainable Materials and Resilient Infrastructure) Springer Transactions in Civil and Environmental Engineering,** PP-279-296, ISBN-978-981-16-9743-2, March 2022

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

1. Dr B N Mohapatra, Amit Trivedi, S K Shaw, V Naga Kumar, Abhishek Agnihotri, Gaurav Bhatnagar: **Development of CRM for Quality Assurance of Cement. Springer-MAPAN Journal of Metrology Society of** India, March 2022.

Paper Presented in Seminars and Workshops

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

1. Sh/s Prateek Sharma, Pratik N Sheth, B.N. Mohapatra, Rakshit Khandelwal, presented paper on "**Thermodynamic stoichiometric equilibrium model for RDF gasification in a fixed bed downdraft gasifier**", CHEMCON 2021, Bhubhneshwar, India
2. Sh/s Kapil Kukreja, M S Soni, B N Mohapatra, S R Patnaik presented paper on "**Challenges in RDF Characterization for Transfer Chute Design simulation and Analysis in DEM**", National Seminar on Research and Innovation for Sustainable Development of India, September 2021.
3. Sh/s Devmalya Biswas, Kapil Kukreja, Prateek Sharma, Vivek Sharma presented paper on "**Numerical Simulation of Multiphase Calcination Reaction with Coal Combustion in a Calciner**", National Seminar on Research and Innovation for Sustainable Development of India, September 2021.
4. Sh/s Prateek Sharma, Aditya Ranjan, M V Ramachandra Rao, Pratik N Sheth presented paper on "**Development of suitable machine learning model for a cement plant calciner**", National Seminar on Research and Innovation for Sustainable Development of India, September 2021.
5. Presented a paper titled "**Study on utilization of tyre chips and its impact on kiln operation in a gas fired cement plant**" in Cemtech Asia 2021

Centre for Construction Development and Research-CDR

1. C&D Waste Management and Circularity – Policy Framework and R&D integration in India by P N Ojha, Puneet Kaura, and B N Mohapatra, in **11th International Conference on Sustainable Waste Management & Circular Economy and IPLA Global Forum, December 2021**

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

1. S K Shaw, V Naga Kumar, Abhishek Agnihotri, Amit Trivedi, Dr B N Mohapatra presented a paper on "**Certified Reference Materials: Aiming Excellency in Testing and Calibration**", 5th PTP & RMP Conclave of NABL on 30th August 2021.

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

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

Sh. Ashutosh Saxena, Joint Director **(Retired on 31 March 2022)**

a) Member, Working Group on Technical Sector of Standard Promotion and Consumer Affairs Deptt. (SP & CAD), Bureau of Indian Standards, New Delhi.
b) Member, Environmental Services Sectional Committee: SSD 07, Bureau of Indian Standards, New Delhi.

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.

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.

Dr. D Yadav, Joint Director (Retired on October 2021)

a) Member, Panel for work relating to ISO/TC71 and ISO/TC74 (CED2/P1), Bureau of Indian Standards, New Delhi.
b) Member, Cement, Pozzolana and Cement additives Subcommittee (CED 2:1), Bureau of Indian Standards, New Delhi.
c) Member, Panel for Revision of Cement Standards (CED 2:1/P1), Bureau of Indian Standards, New Delhi.
d) Member, Methods of Analysis Sub Committee (PCD 7:4), Bureau of Indian Standards, New Delhi.

Sh. Amit Trivedi, General Manager

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.

Dr. D K Panda, Joint Director

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

Sh. Anupam, General Manager

a) Primary Member, Environment Protection Sectional Committee (CHD 32), Bureau of Indian Standards (BIS).
b) Primary Member, Environmental Management Sectional Committee (CHD34), Bureau of Indian Standards (BIS).
c) Member, Coal serving as member Beneficiation & Lignite Sub Committee (PCD 7.6 and PCD 7.9), Bureau of Indian Standards (BIS).
d) Member, Working Group on C&D waste, Ministry of Housing and Urban Affairs (MoHUA).

Sh. B P Ranga Rao, General Manager

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.

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.

Sh. B S Rao, General Manager

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

Sh. Brijesh Singh, Group Manager

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.
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, 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.
i) Member, Fibre Reinforced Cement Product Sub Committee (CED 53:1), Bureau of Indian Standards, New Delhi.
j) Member, Concrete Reinforcement Sectional Committee (CED 54), Bureau of Indian Standards, New Delhi.

Sh Amit Prakash, Group Manager

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

Sh Manish Kumar Mandre, Group Manager

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

Sh. P Anil Kumar, Group Manager

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

Sh. Kapil Kukreja, Group Manager

a) Member, Working Group on Technical Sector of Standard Promotion and Consumer Affairs Deptt. (SP & CAD), Bureau of Indian Standards (BIS)
b) Member, Construction Plant and Machinery Sectional Committee (MED 18), Bureau of Indian Standards, New Delhi.
c) Member, Bulk Handling Systems and Equipment Sectional Committee (MED 7), Bureau of Indian Standards, New Delhi.
d) Member, Solid Waste Management (CHD 33)

Sh. Ankur Mittal, Group Manager

a) Member, Solid Mineral Fuels Sectional Committee (PCD 07), Bureau of Indian Standards, New Delhi.

Sh. Suresh Kumar Shaw, Group Manager

a) Member, Coke Sub Committee (PCD 7:2), Bureau of Indian Standards, New Delhi.
b) Member - MSD 20-Reference Materials Sectional Committee, REMCO, Bureau of Indian Standards, New Delhi.

Dr. (Mrs) Pinky Pandey, Group Manager

a) Member, Building Limes Sectional Committee (CED 4), Bureau of Indian Standards, New Delhi.

Sh Suresh Kumar, Manager

a) Member, Panel for Revision of IS: 456 and IS: 1343 (CED 2:2/P5), Bureau of Indian Standards, New Delhi.
b) Convenor, Panel for Revision of IS 457 (CED 2:2/P6), Bureau of Indian Standards, New Delhi.
c) Member, Panel for Revision of IS 2386 (CED 2:2/P10), Bureau of Indian Standards, New Delhi.

d) Member, Concrete Pipes Sub Committee (CED 53:2), Bureau of Indian Standards, New Delhi.
e) Member Working group (WG-2) of IS:456-2000

Sh Puneet Kaura, Manager

a) Member, Concrete Sub Committee (CED 2:2), Bureau of Indian Standards, New Delhi.
b) Member, Panel for Revision of IS: 456 and IS: 1343 (CED 2:2/P5), Bureau of Indian Standards, New Delhi.
c) Member, Panel for Revision of Indian Standards on Test Methods for Concrete (CED 2:2/P7), Bureau of Indian Standards, New Delhi
d) Member Working group (WG-2) of IS:456-2000

Sh Amit Sagar, Manager

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

Sh Arup Ghatak, Manager

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

Sh Y N Daniel, Manager

a) Member, Fibre Reinforced Cement Product Sub Committee (CED 53:1), Bureau of Indian Standards, New Delhi.

Sh Rizwan Anwar, Manager

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

Sh Ajay Kumar, Manager

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

Dr. (Mrs) Varsha T Liju, Manager

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, Air Quality Sectional Committee (CHD 35), Bureau of Indian Standards, New Delhi.
c) Member, Environmental Services Sectional Committee: SSD 07, Bureau of Indian Standards, New Delhi
d) Member, Working Group on Phosphogypsum, DPIIT, Ministry of Commerce & Industry, Govt. of India
e) 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. M V Ramachandra Rao, Manager

a) Member, Environmental Management Sectional Committee (CHD 34), Bureau of Indian Standards, New Delhi.
b) Member, Working Group on Phosphogypsum, DPIIT, Ministry of Commerce & Industry, Govt. of India
c) Member, Working Group on FGD Gypsum, DPIIT, Ministry of Commerce & Industry, Govt. of India

Sh. Prateek Sharma, Manager

a) Member, Coal Beneficiation & Lignite Sub Committee (PCD 7:6 & PCD 7:9), 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. K P K Reddy, Manager

a) Member, Coal Sub Committee (PCD 7:3), 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. Munish Kumar, Assistant Manager

a) Member, Coke Sub Committee (PCD 7:2), 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, Coal Sub Committee (PCD 7:3), Bureau of Indian Standards, New Delhi.

FINANCE AND ACCOUNTS

FINANCE

CONTRIBUTIONS

Ministry of Commerce & Industry Grant

During the year 2021-22, Grant of Rs. 17.05 Crores received.

FOREIGN EXCHANGE

During the year 2021-22, the Council earned Foreign Exchange amounting to US$ 45772.91 towards Training Fee, Testing Charges, Sponsored R & D, Seminar, Delegate Fee, Technical Exhibition Etc.

AUDITORS

M/s K S Aiyar & Co, Chartered Accounts, Mumbai were the Auditors of the Council for the year 2021-22.

ACCOUNTS

The Accounts for the 2021-22 duly audited by the Auditors of the Council are given at Annexure (Balance Sheet as at 31st March 2022 and Income & Expenditure Accounts for the year ended 31st March 2022).

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, 2022 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, 2022, 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 K. S. Aiyar & Co.
Chartered Accountants
Firm Registration No. 100186W

Raghuvir M. Aiyar
Partner
Membership No. 038128

Place: Mumbai
Date: 29th September 2022
UDIN: 22038128AWQTVY8810

NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS
BALANCE SHEET AS AT MARCH 31, 2022

	Schedules		As at March 31, 2022		As at March 31, 2021
SOURCES OF FUNDS					
Capital Fund	A	6,80,76,146		6,80,76,146	
Reserves and Surplus	B	1,73,51,46,794		1,59,91,39,439	
Building Fund		45,00,000		45,00,000	
Gratuity Fund		9,08,43,144		9,54,57,624	
Provision For Leave Encashment		16,52,53,452		15,43,54,929	
Capital Grant from Govt of India	C	33,77,93,680		35,75,06,192	
Current Liabilities & Provisions	D	13,96,27,096	2,54,12,40,312	13,76,58,844	2,41,66,93,173
Total			**2,54,12,40,312**		**2,41,66,93,173**
APPLICATION OF FUNDS					
Fixed Assets					
Gross Block	E	92,87,30,929		89,71,10,965	
Less : Accumulated Depreciation		56,18,71,628	36,68,59,301	53,15,44,686	36,55,66,279
Lab Equipment Under Inspection			1,01,68,465		27,15,572
Gratuity Fund Investment					
(Fixed Deposit / Savings Bank / Interest Accrued)		23,12,30,074		20,96,35,639	
Leave Fund account		7,75,83,426		11,40,05,032	
Current Assets Loans & Advances					
R&D Contribution Outstanding		9,96,82,070		10,23,96,410	
Sundry Debtors	F	3,49,10,914		4,06,06,077	
Loans and Advances (unsecured and considered good)		12,26,85,593		14,12,07,099	
Cash and Bank Balances	G	1,55,81,96,077	2,12,42,88,154	1,36,70,14,292	1,97,48,64,549
FDR In lien			1,35,91,013		1,76,75,873
Interest Accrued on Bank Deposits			2,63,33,379		5,58,70,900
Total			**2,54,12,40,312**		**2,41,66,93,173**
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
K. S. Aiyar & Co.
Chartered Accountants

Dr S K Chaturvedi
Joint Director (Finance & Accounts)

Dr B N Mohapatra
Director General

Raghuvir M. Aiyar
Partner
M.No. 38128
Mumbai
Date:

Shri K C Jhanwar
Chairman -NCB

NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS
INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED MARCH 31, 2022

			For the Year ended March 31, 2022		For the Year ended March 31, 2021
INCOME					
Research & Development Contribution	H		23,85,45,149		23,15,93,983
Other Income	I		10,96,83,739		11,69,14,602
Grant-in-Aid (Revenue) from Ministry of Commerce & Industry	J		17,05,00,000		15,77,00,000
			51,87,28,887		**50,62,08,585**
EXPENDITURE					
Employee's Cost	K		32,12,00,356		29,69,93,910
Travelling & Conveyance (Including Overseas Travelling)			76,61,120		60,39,890
Lab. Stores Serv.& Comp.(S.W.)			70,70,841		78,31,552
Symposia & Seminars			4,307		6,77,294
Training Programm es			11,14,035		4,77,788
Repairs and Maintenance			97,78,092		66,64,863
Other Expenses	L		2,52,78,353		2,43,28,173
Depreciation		3,03,26,941		2,93,08,266	
Less : Transfer from Capital Grant from Govt of India		1,97,12,512	1,06,14,429	1,90,50,373	1,02,57,893
			38,27,21,532		**35,32,71,363**
Surplus for the year transferred to Reserve Fund			**13,60,07,355**		**15,29,37,222**
Significant Accounting Policies	M				
Notes on Accounts	N				

The Schedules referred to above form an integral part of the Income and Expenditure Account.
This is the Income and Expenditure Account referred to in our report of even date.

For and on behalf of
K. S. Aiyar & Co.
Chartered Accountants

Dr S K Chaturvedi
Joint Director(Finance & Accounts)

Dr B N Mohapatra
Director General

Raghuvir M. Aiyar
Partner
M.No. 38128
Mumbai
Date:

Shri K C Jhanwar
Chairman - NCB

NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS
SCHEDULES FORMING PART OF THE ACCOUNTS AS AT MARCH 31, 2022

Particulars	As at March 31, 2022 (Amount in Rs.)	As at March 31, 2021 (Amount in Rs.)
SCHEDULE - A		
Capital Fund		
As per the last Balance Sheet	6,80,76,146	6,80,76,146
Includes UNIDO Equipment valued at Rs 20,187,535 (Previous Year Rs 20,187,535) (Refer Note 3 (b) of Schedule M)		
TOTAL	**6,80,76,146**	**6,80,76,146**
SCHEDULE - B		
Reserves and Surplus		
As per the last Balance Sheet	1,59,91,39,439	1,44,62,02,217
Add: Surplus for the year	13,60,07,355	15,29,37,222
Less :Depreciation Transferred from Capital Grant from Govt of India for Financial year 2017-18 and 2018-19	-	-
TOTAL	**1,73,51,46,794**	**1,59,91,39,439**

NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS
SCHEDULES FORMING PART OF THE ACCOUNTS AS AT MARCH 31, 2022

Particulars	As at March 31, 2022 (Amount in Rs.)	As at March 31, 2021 (Amount in Rs.)
SCHEDULE - C		
Capital Grant from Govt of India		
As per the last Balance Sheet	35,75,06,192	37,65,56,565
Add : Plan Grant received during the year	-	-
	35,75,06,192	37,65,56,565
Less : Grant transferred to Income & Expenditure Account to the extent depreciation charged during the year on assets purchased out of capital grant	1,97,12,512	1,90,50,373
TOTAL	**33,77,93,680**	**35,75,06,192**
SCHEDULE - D		
Current Liabilities and Provisions		
Retention & Security Money	1,14,65,201	1,60,11,060
Other Liabilities	12,81,61,895	12,16,47,783
TOTAL	**13,96,27,096**	**13,76,58,843**

NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS
SCHEDULES FORMING PART OF THE ACCOUNTS AS AT MARCH 31, 2022

Particulars	As at March 31, 2022 (Amount in Rs.)	As at March 31, 2021 (Amount in Rs.)
SCHEDULE - F		
Sundry Debtors (Unsecured and Considered Good)		
Others	3,49,10,914	4,06,06,077
TOTAL	**3,49,10,914**	**4,06,06,077**
SCHEDULE - G		
Cash and Bank Balances		
In Fixed Deposits	1,45,98,37,496	1,28,24,60,868
In Saving Accounts	9,79,98,412	8,42,28,478
Cash in hand including postage imprest	3,59,032	3,23,809
UNESCO Coupons (US Dollar 132.10)	1,137	1,137
TOTAL	**1,55,81,96,077**	**1,36,70,14,292**

NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS
SCHEDULES FORMING PART OF THE ACCOUNTS AS AT MARCH 31, 2022

Particulars	As at March 31, 2022 (Amount in Rs.)	As at March 31, 2021 (Amount in Rs.)
SCHEDULE - H		
Research and Development		
Sponsored Research and Development Contribution	16,21,10,751	15,09,87,257
Standardisation and calibration	4,91,99,526	4,05,23,508
Symposia & Seminars	18,000	71,200
NCB Proficiency Testing Programme	2,72,16,872	4,00,12,018
TOTAL	**23,85,45,149**	**23,15,93,983**
SCHEDULE - I		
Other Income		
Interest	9,40,45,847	9,66,89,829
Sale of Publications	-	1,500
Training Programmes	1,00,35,489	66,04,758
Miscellaneous Receipts	10,37,884	12,47,100
Foreign Exchange Fluctuation	4,54,082	-
Licence Fee (Housing Colony)	10,83,672	13,12,959
Interest on Income Tax Refund	30,26,765	1,10,58,456
TOTAL	**10,96,83,739**	**11,69,14,602**
SCHEDULE - J		
Grant from Ministry of Commerce & Industry		
Towards Plan Grant	-	-
Less : Towards Capital Expenditure	-	-
	-	-
Towards Non-Plan Grant from Cement Cess	17,05,00,000	15,77,00,000
Grants from Ministry of Environment	-	-
TOTAL	**17,05,00,000**	**15,77,00,000**

NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS
SCHEDULES FORMING PART OF THE ACCOUNTS AS AT MARCH 31, 2022

Particulars	As at March 31, 2022 (Amount in Rs.)	As at March 31, 2021 (Amount in Rs.)
SCHEDULE - K		
Employee's Cost		
Establishment Charges	28,83,70,429	25,84,37,358
Contribution to Provident Fund & other Fund	2,15,91,395	2,05,50,520
Gratuity (Refer Note 4 of Schedule - M)	95,32,017	1,67,90,488
Social Security & Welfare	17,06,514	12,15,544
TOTAL	**32,12,00,356**	**29,69,93,910**
SCHEDULE - L		
Other Expenses		
Rent, Rates and Taxes	32,30,790	32,32,600
Electricity and Water Charges	77,79,793	71,95,097
Foreign Exchange Fluctuation	-	38,759
Postage, Telegrams & Telephones	25,05,016	18,52,251
Publications	2,11,294	97,205
Stationery & Miscellaneous Stores	18,23,222	14,99,204
Books, Periodicals and Membership Fee	21,03,135	23,12,291
Exhibition, Publicity and Advertisements	2,62,304	3,55,163
Legal Expenses	9,08,610	5,27,650
Patents	94,200	1,55,562
Audit Fees - Statutory Auditors	1,00,000	75,000
Bank Charges	69,275	79,341
Insurance of Assets	13,05,624	12,15,936
Sundry Expenses	27,93,250	23,90,914
Collaborative Assistance in R&D and	20,91,841	33,01,200
TOTAL	**2,52,78,353**	**2,43,28,173**

NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS
DEPRECIATION AS AT 31 MARCH 2022

Schedule -E

(Amount in RS.)

	GROSS BLOCK							DEPRECIATION										NET BLOCK	
PARTICULARS	Cost upto March 31, 2001	Cost from April 1, 2001 to March 31, 2021	Total cost as at April 1, 2021	Addition During the Year 2021-2022	Disposal/ Adjustment out of cost before 2001 2021-2022	Disposal/ Adjustment out of cost after 2001 2021-2022	Total cost as at March 31, 2022	On Old Assets Upto March 31, 2001	On Assets from April 1, 2001 to March 31, 2021	Op.Bal Depreciation as at April 1, 2021	Rate %	On Assets Prior to 01-Apr-01 during the year 2021-2022	Rate %	On Additions after 01-Apr-01 2021-2022	Depreciation/ Adjustment on cost before 2001 2021-2022	Dep. / Adj. on cost after 2001 2021-2022	Total Depreciation as at March 31, 2022	WDV As at March 31, 2022	WDV As at March 31, 2021
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
LAND (FREE HOLD)	39,24,748		39,24,748				39,24,748	-	-	-		-		-			-	39,24,748	39,24,748
VEHICLES	8,33,717	53,65,103	61,98,820	23,24,801			85,23,621	8,06,451	48,52,965	56,59,416	20.0	5,453	15	4,25,541			60,90,410	24,33,211	5,39,404
COMPUTER INCLUDING ACCESSORIES		5,39,98,809	5,39,98,809	12,02,129			5,52,00,938		5,25,21,425	5,25,21,425			40	10,71,805			5,35,93,230	16,07,708	14,77,384
FURNITURE AND OFFICE EQUIPMENTS	1,02,63,037	3,05,88,301	4,08,51,338	14,42,119			4,22,93,457	97,39,881	56,64,125	1,54,04,006	10.0	52,316	10	26,36,629			1,80,92,951	2,42,00,506	2,54,47,332
LABORATORY EQUIPMENT	8,05,59,050	34,59,55,905	42,65,14,955	2,64,84,273			45,29,99,228	7,61,15,538	27,42,13,514	35,03,29,052	10.0	4,44,351	15	1,47,34,000			36,55,07,403	8,74,91,825	7,61,85,903
MOBILE Quality Control Laboratory	-	52,68,489	52,68,489				52,68,489		52,11,765	52,11,765			15	8,509			52,20,274	48,215	56,724
CENTRE FOR CONTINUING EDUCATION																	-		
BUILDINGS	19,22,707	4,21,19,827	4,40,42,534				4,40,42,534	12,03,340	1,25,50,815	1,37,54,155	2.5	17,984	10	29,56,901			1,67,29,040	2,73,13,494	3,02,88,379
OTHER SERVICES	5,35,144	2,48,26,311	2,53,61,455				2,53,61,455	5,26,330	2,29,16,680	2,34,43,010	10.0	881	15	2,86,445			2,37,30,336	16,31,119	19,18,445
SOLAR PAWER PLANT		25,01,000	25,01,000				25,01,000		19,60,784	19,60,784			40	2,16,086			21,76,870	3,24,130	5,40,216
LABORATORY PROJECTS																	-		
BUILDINGS	2,79,73,919	9,53,89,269	12,33,63,188	1,66,642			12,35,29,830	1,76,04,796	2,52,11,063	4,28,15,859	2.5	2,59,228	10	70,34,485			5,01,09,572	7,34,20,258	8,05,47,329
CAPITAL WORK IN PROGRESS BULDG. (PG) UNDER CONST		14,08,02,902	14,08,02,902				14,08,02,902												
OTHER SERVICES	1,00,46,554	58,49,746	1,58,96,300				1,58,96,300	98,73,071	53,10,723	1,51,83,794	10.0	17,348	15	80,853			1,52,81,996	6,14,304	7,12,506
STAFF HOUSING	83,86,427		83,86,427				83,86,427	52,61,419		52,61,419	2.5	78,125	5				53,39,544	30,46,883	31,25,008
Total	14,44,45,303	75,26,65,662	89,71,10,965	3,16,19,964	-	-	92,87,30,929	12,11,30,826	41,04,13,859	53,15,44,685		8,75,687		2,94,51,254	-		56,18,71,626	22,60,56,400	22,47,63,378

NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS
Schedules forming part of the Accounts as at March 31, 2022

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	Rates as per Income Tax Act 1961
		% p.a.	% 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.

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, 2022

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. 23,12,30,074/- (Rs. 20,96,35,639/-). 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 2022.

5. The Council has got an actuarial valuation of the leave encashment for and upto the year ended 31st March 2022 and the liability computed is Rs. 16,52,53,452/- (Rs. 15,43,54,929/-).

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. 1,92,44,949/- (Rs. 1,69,52,801/-).

9. During the year 2021-22, the council earned foreign exchange amounting to Rs. 34,42,053/-

10. Expenditure in foreign currency:

Particulars	FY 20201-2022	FY 2020-2021
Expenditure in foreign currency	83,31,789	88,65,316

11. Previous year's figures have been regrouped and rearranged wherever necessary so as to conform to this year's classification.

Institutional Events

Institutional Events

World Environment Day

World environment Day is celebrated at NCB on 5th June every year. On the eve of World Environment Day 2021, Dr. Vandana Kumar, Joint Secretary-DPIIT, Govt. of India planted saplings at NCB Ballabgarh campus on 4th June 2021.

International Yoga Day

On the occasion of International Day of Yoga (IDY), NCB has organized yoga sessions virtually for NCB employees and their families on 21st June 2021. The International Day of Yoga is celebrated on 21st June to globally raise awareness about the benefits of the ancient practice.

Independence Day

NCB celebrated 75th Independence Day on 15th Aug 2021. Dr B N Mohapatra, Director General, National Council for Cement and Building Materials hoisted the National Flag on the occasion and addressed the scientists and staff of NCB. He also awarded the best performing housekeeping and gardening staff.

नराकास, फरीदाबाद, राजभाषा शील्ड प्रतियोगिता में प्रोत्साहन पुरस्कार

राष्ट्रीय सीमेंट एंव भवन सामग्री परिषद् ने नराकास, फरीदाबाद, राजभाषा शील्ड प्रतियोगिता (वर्ष 2019-20 एवं 2020-2021) में प्रोत्साहन पुरस्कार प्राप्त किया। नराकास राजभाषा शील्ड प्रतियोगिता मे पुरस्कार कोविड महामारी के कारण विगत दो वर्षो के पुरस्कार एक साथ दिये गए।

श्री अभय कुमार सिंह, अध्यक्ष एवं प्रबंध निदेशक एनएचपीसी एवं अध्यक्ष नराकास, डॉ राजबीर सिंह, समूह निबंधन (राजभाषा) एवं सदस्य सचिव नराकास, डॉ कुँवर पाल शर्मा, उपनिर्देशक कार्यान्वन, उत्तरी क्षेत्र कार्यालय, राजभाषा विभाग, गृह मंत्रालय एवं अन्य कार्यालय प्रमुख की उपस्थिति में ई-माध्यम के द्वारा 23 मई 2022 को कार्यालय को प्रदान किए गए।

हिन्दी पखवाड़ा का आयोजन

राष्ट्रीय सीमेंट एवं भवन सामग्री परिषद् के मुख्यालय में हिंदी पखवाड़े का आयोजन 14 सितम्बर 2020 से 28 सितम्बर 2021 के बीच बड़े हर्षोल्लास के साथ मनाया गया। पखवाड़े का शुभारंभ 14 सितंबर 2021 को माननीय डॉ. बीबेकानंद महापात्र , महानिदेशक के कर कमलों द्वारा किया गया। पखवाड़े का शुभारंभ करते हुये महानिदेशक ने सभी सदस्यों से अनुरोध किया की संस्थान में राष्ट्र भाषा के प्रचार प्रसार की लिये निरंतर प्रयास करते रहना चाहिये तथा अधिक से अधिक कार्य हिन्दी भाषा में करना चाहिये, तथा राष्ट्र भाषा में कार्य करते समय हमें गौरान्वित महसूस करना चाहिये। कोविड के केंद्र सरकार द्वारा जारी दिशा-निर्देशों का पालन करते हुये पखवाड़े के दौरान प्रतियोगिताओं का आयोजन किया गया। इस पखवाड़े में निम्नलिखित प्रतियोगितायें आयोजित की गई।

- हिन्दी आदर्श वाक्य (Slogan)प्रतियोगिता
- वाद विवाद-प्रतियोगिता
- शब्दावली प्रतियोगिता
- टिप्पणी लेखन प्रतियोगिता
- हिन्दी निबंध प्रतियोगिता
- कविता पाठस्वविचार प्रतियो

कार्यान्वयन समिति के अध्यक्ष श्री अभिषेक अग्निहोत्री ने भी प्रतियोगिताओं में भाग लेने के लिये सभी का धन्यवाद दिया तथा भविष्य में संस्थान, नराकास तथा मंत्रालय के अंतर्गत होने वाली सभी प्रतियोगिताओं में अधिक से अधिक संख्या में भाग लेने का आह्वान किया। इन प्रतियोगिताओं के प्रथम, द्वितीय व तृतीय पुरस्कार विजेताओं को कार्यालय के महानिदेशक एवं केंद्र प्रमुख के द्वारा समापन समारोह में सम्मानित किया गया।

राष्ट्रीय सीमेंट एवं भवन सामग्री परिषद् की वार्षिक हिंदी पत्रिका एन.सी.बी. दर्पण के द्वितीय अंक में लेख / कविता / कहानी लिखने वाले सभी रचनाकारों को कार्यालय के वार्षिक उत्सव, दिनांक 24.12.21 को श्री अनिल अग्रवाल, अपर सचिव, आन्तरिक व्यापार और उद्योग संवर्धन विभाग, वाणिज्य और उद्योग मंत्रालय, भारत सरकार के द्वारा सम्मानित किया गया।

राष्ट्रीय सीमेंट एवं भवन सामग्री परिषद् की वार्षिक हिंदी पत्रिका एन.सी.बी .दर्पण के द्वितीय अंक की प्रतिलिपि आन्तरिक व्यापार और उद्योग संवर्धन विभाग, वाणिज्य और उद्योग मंत्रालय, भारत सरकार एवं गृह मंत्रालय भारत सरकार को भेजी गई। नगर राजभाषा कार्यान्वयन समिति (का.), फरीदाबाद के तत्वावधान में अक्टूबर माह 2021 में आयोजित की गई विभिन्न हिन्दी प्रतियोगिताओं में भाग लेने वाले विजेताओं एवं प्रतिभागियों के नाम :-

क्र. स.	अधिकारी / कर्मचारी का नाम एवं पदनाम	प्रतियोगिता का नाम	पुरस्कार
1.	सुश्री चारू, कार्यालय सहायक	हिंदी निबन्ध प्रतियोगिता	द्वितीय पुरस्कार
2.	श्री सौरभ खरे, परियोजना अभियंता	हिंदी काव्य पाठ प्रतियोगिता	सांत्वना पुरस्कार
3.	श्री कपिल कुकरेजा समूह प्रबंधक	हिंदी काव्य पाठ प्रतियोगिता	प्रतिभागी पुरस्कार
4.	श्री प्रतीक शर्मा प्रबंधक	1. हिंदी शब्दावली एवं अनुवाद प्रतियोगिता 2. हिंदी प्रश्नोत्तरी प्रतियोगिता	प्रतिभागी पुरस्कार
5.	श्रीमती रूबी मालिक कार्यालय सहायक	1. हिंदी शब्दावली एवं अनुवाद प्रतियोगिता 2. हिंदी निबन्ध प्रतियोगिता	प्रतिभागी पुरस्कार

गृह मंत्रालय, भारत सरकार, द्वारा आयोजित प्रथम अखिल भारतीय सम्मेलन, वनारस (13-14 नवंबर 2021 में कार्यालय के प्रतिनिधित्व श्री अभिषेक अग्निहोत्री, अध्यक्ष हिंदी समिति द्वारा किया गया। नराकास फरीदाबाद द्वारा आयोजित सभी बैठकों में कार्यालय का प्रतिनिधित्व हिंदी समिति द्वारा किया गया।

Vigilance Awareness Week 2021

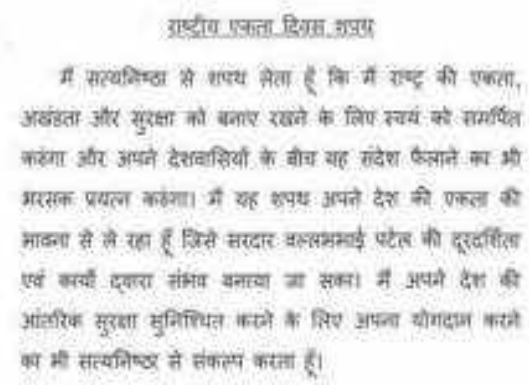
Vigilance Awareness Week was observed at NCB from 26th October to 1st November 2021

1. Banners were displayed at all NCB units to create awareness on Vigilance Awareness Week among officials/staff of NCB.

2. DG-NCB and officials / staff at all units / centres of NCB took Integrity Pledge on the inaugural day of Vigilance Awareness Week.

National Unity Day

NCB observed National Unity Day on 31st October 2021. NCB Officials took the Rashtriya Ekta Diwas Pledge.



राष्ट्रीय एकता दिवस शपथ

मैं सत्यनिष्ठा से शपथ लेता हूँ कि मैं राष्ट्र की एकता, अखंडता और सुरक्षा को बनाए रखने के लिए स्वयं को समर्पित करूंगा और अपने देशवासियों के बीच यह संदेश फैलाने का भी भरसक प्रयत्न करूंगा। मैं यह शपथ अपने देश की एकता की भावना से ले रहा हूँ जिसे सरदार वल्लभभाई पटेल की दूरदर्शिता एवं कार्यों द्वारा संभव बनाया जा सका। मैं अपने देश की आंतरिक सुरक्षा सुनिश्चित करने के लिए अपना योगदान करने का भी सत्यनिष्ठ से संकल्प करता हूँ।

Swachhata Pakhwada

NCB observed Swachhata Pledge from 1st- 15th November 2021. NCB officials took Swachhata pledge

स्वच्छता शपथ

महात्मा गांधी ने जिस भारत का सपना देखा था उसमें सिर्फ राजनैतिक आजादी ही नहीं थी, बल्कि एक स्वच्छ और विकसित देश की कल्पना भी थी।
महात्मा गांधी ने गुलामी की जंजीरो को तोड़कर माँ भारती को आज़ाद कराया।
अब हमारा कर्तव्य है कि गंदगी को दूर करके भारत माता की सेवा करे।
मैं शपत लेता हूं कि मैं स्वयं स्वच्छता के प्रति सजग रहूंगा और उसके लिए समय दूंगा।
हर वर्ष 100 घंटे, यानी हर सप्ताह 2 घंटे श्रमदान करके स्वच्छता के संकल्प को चरितार्थ करूंगा।
मैं न गंदगी करूंगा और न किसी और को करने दूंगा।
सबसे पहले मैं स्वयं से, मेरे परिवार से, मेरे मुहल्ले से, मेरे गांव से एवं मेरे कार्यस्थल से शुरुआत करुंगा।
मैं यह मानता हूँ कि दुनिया के जो भी देश स्वच्छ दिखते हैं उसका कारण यह हैं कि वहां के नागरिक गंदगी नहीं करते और न ही होने देते हैं।
इस विचार के साथ मैं गांव-गांव और गली-गली स्वच्छ भारत मिशन का प्रचार करुंगा।
मै आज जो शपथ ले रहा हूँ, वह अन्य 100 व्यक्तियों से भी करवाऊंगा।
मुझे मालूम हैं कि स्वच्छता की तरफ बढाया गया मेरा कदम पूरे भारत देश को स्वच्छ बनाने मैं मदद करेगा।

59th NCB Day

NCB celebrated its 59th NCB Day on 24th December 2021. Sh Anil Agrawal, Additional Secretary, DPIIT, Ministry of Commerce & Industry, Govt. of India was the Chief Guest on the occasion.

In his address, he appreciated NCB achievements in the field of cement, concrete & building materials". He inaugurated laboratory scale 3D concrete printer, Zeolite manufacture prototype and the working model of cement plant.

Sh K C Jhanwar, Chairman: NCB and Dr. Bibekananda Mohapatra, DG-NCB also addressed the gatherings and extended hearty congratulations to all the NCB employees & workers for their dedicated work.

73rd Republic Day

During celebration of 73rd Republic Day on 26th January, 2022 at NCB Ballabgarh unit, DG-NCB congratulated entire NCB staff and spoke about importance of the day.

He asked NCB's engineers and scientist to work towards making NCB Atmanirbhar. He told that NCB has to work towards becoming a leading organization in Research and Innovation in the field of cement and concrete and contribute towards the vision laid down by Hon'ble Prime Minister of India.

International Women's Day 2022

NCB celebrated International Women's Day on 8th March 2022. On the occasion, Dr B N Mohapatra, DG - NCB highlighted the social, political and economic achievements of women & their contribution in various fields.

Prof. Sasmitarani Samanta, Vice Chancellor, KIIT, Bhubaneswar as Chief Guest, Dr Usha Agrawal, Director, ICMR, New Delhi was invited as Guest of Honour, & Flt Lt Aparna Gautam Panda (Retd), Principal, St John's School, Faridabad as Special Guest on the occasion.

Visit of Dignitaries to NCB

Visit of Dignitaries to NCB

Visit of Joint Secretary, DPIIT

Dr. Vandana Kumar, Joint Secretary, DPIIT, Govt. of India visited along with Dr. S S Gupta, SDO, DPIIT in June 2021.

Dr. Kumar took a review of the current status of research work as well as key sponsored projects that are being carried out NCB. She also interacted with Head of Centres & Services to understand the working of various departments within NCB.

During the visit, Dr. Kumar and Dr. Gupta also visited various laboratories of NCB to understand research and testing work being carried out. She congratulated NCB for carrying out quality research work and for the vision of becoming financially self-sufficient. She also asked NCB to continually improve its activities in research field as all projects undertaken are all the more relevant in today's scenario. She also reassured the support and guidance of DPIIT in this venture.

Visit of officials from Nuvoco Vistas

Sh Pranav Desai, Head (R&D) & Dr Arunachala Sadangi, Asst. GM (Cement) from Nuvoco Vistas Corp. Ltd. visited NCB Ballabgarh on 23rd July 2021.

Visit of Ms Shalini Goyal Bhalla, MD, International Council for Circular Economy (ICCE) on 10 August 2021

Meeting with Ms Shalini Goyal Bhalla, MD, International Council for Circular Economy (ICCE) Presided by Hon'ble DG-NCB, Dr. Bibekananda Mohapatra. In the meeting, progressive discussions were held to build a resilient framework and providing expertise to design and strategize circular workflow for circular economy.

Visit of Bureau of Indian Standards (BIS)

Sh Anindya Chakrabarti, Scientist-E, Head, Management System Certification Department, BIS, New Delhi visited NCB Ballabgarh on 19 August 2021

Visit of Official from UltraTech Cement.

Sh Rahul Goel, Vice President-Technical Services, UltraTech Cement visited NCB Ballabgarh on 24 August 2021. Sh Rahul Goel appreciated the NABL accredited testing facilities available in the field of cement and building materials.

Visit of BIS Officials to NCB Ballabgarh

Shri Arun Kumar S, Scientist 'E', Head - Civil Engineering, Shri Sinam Hudson Singh, Scientist 'D', Civil Engineering, Shri Ashish Kumar Kanar, Scientist 'C', CMD-3 from BIS visited NCB-Ballabgarh on 21 Sep 2021

Visit of Dr. Mohammed Altaf Khan, Professor, Department of Commerce & Business Studies, Jamia Millia Islamia to NCB Ballabgarh on 1st October 2021

Visit of Dr. Prakhar Shrivastava, Assistant Vice President (QA) & Corporate Quality Head, JK Cement Ltd. to NCB Ballabgarh on 13th October 2021

Visit of Dr Abhishek Rai, General Manager, Corporate Quality Head, Dalmia Cement Bharat Ltd. to NCB-Ballabgarh on 14th Oct 2021

Visit of officials from UltraTech Cement to NCB Ballabgarh

Sh Raju Goyal, President & Chief Technical Officer, Dr V Ramachandra Joint Executive President, Dr Awadhesh Kumar Singh, Senior Vice President & Head QA & Product Development, Sh Ashwin Moghe, Senior Vice President & Head-Technical Services-Key Accounts, Sh Rahul Goel, Vice President, Technical Services & Sh Devendra Pandey, Assistant Vice President & Head-Technical Services-RMC visited NCB Ballabgarh on 2nd November 2021

Visit of Delegation from Ministry of Industrial Development and Promotion of Private Sector, Brazzaville, Republic of Congo

Delegation from Ministry of Industrial Development and Promotion of Private Sector, Brazzaville, Republic of Congo led by Mr Pierre Narcisse LOUFOUA, Chief of Staff and from Embassy of RoC, New Delhi led by Mr Gabriel ITOUA, Economic Advisor visited NCB on 11th Nov 2021.

The delegation had interaction and discussion on installation of cement factory at village Tao-Tao. The delegation appreciated the state of art testing & evaluation facilities available in the area of cement, building materials & concrete.

Visit of officials from Nuvoco Vistas Corp. Ltd.

Sh Pranav Desai, Head (R&D), Dr Arunachala Sadangi, Asst. GM (Cement) & Ms Vinita Charles, Asst Vice President-HR on 22nd November 2021.

Visit of officials from CPPRI & CPCB

Sh J S Kamyotra, Ex-Member Secretary, Central Pollution Control Board & Dr M K Gupta, Director In-charge, Central Pulp & Paper Research Institute visited NCB Ballabgarh for discussions on 13th December 2021

Visit of official from Ambuja Cement Limited

Mr Prashant Senad, Building and Infrastructure Head (West and South), Ambuja Cement Limited visited NCB Ballabgarh on 10th February 2021.Mr Prashant Senad appreciated the NABL accredited testing facilities available in the field of cement and building materials.

Visit of Bureau of Energy Efficiency (BEE) officials to NCB- Ballabgarh

Sh J S Kalra, Sh Vivek Negi & Sh Naveen Kumar visited NCB-Ballabgarh on 17th March 2022. The Agenda of the Visit was "Way forward discussion to work together to make Indian Cement Industry Energy Efficient & Low Carbon Emitter"

BEE officials visited CRT Laboratories & appreciated the state of Testing & Evaluation Facilities available in the area of Cement, Building Materials & Concrete.

Seminar Organised & Webinars, Conclave, Workshop & Meeting Attended

Seminars Organised

National Seminar on "Research and Innovation for Sustainable Development of India"

NCB organized a National Seminar On "Research and Innovation for Sustainable Development of India" in virtual mode, held on 6 -7 September, 2021 in collaboration with IIT-Roorkee, IIT-Hyderabad, IIT-Bhubaneswar, NIT Warangal, NIT Karnataka, NIT Meghalaya, NIT Silchar, National Productivity Council, CPPRI, BITS Pilani, NIT Andhra Pradesh & Manav Rachna University. The seminar was inaugurated by Dr. BN Mohapatra, DG-NCB along with Dr. S S Gupta, SDO, DPIIT, MoCI, Govt. of India as Guest of Honour & Sh Sanjay Pant, Deputy Director General (Standardization – II), Bureau of Indian Standards, Govt. of India as Chief Guest.

Highlights of the Seminar:

- The Seminar was attended by total 450 (Day 1: 247 & Day 2: 203) participants from Academia, Research Institutes, Students, Scholars and Experts from Cement and Construction Industries.
- In two days event there are 5 Keynote speakers and 13 technical paper presentations.
- Paper presentations from IIT Hyderabad, IIT Guwahati, AcSIR, CRRI, IIT Kharagpur, BITS Pilani, NPC, Datta Meghe College of Engineering, Manav Rachna University, IIT Roorkee, NIT Karnataka, BITS Pilani GOA, NIT Surathkal
- The main focus of two days Seminar was on "Sustainability and Innovation".

Webinar, Conclave, Workshop & Meetings Attended

Assocham Webinar on 18th November 2021 through virtual mode

Dr B N Mohapatra, DG-NCB participated in ASSOCHAM webinar on CemenTech "Road to net zero carbon cement" interacted with panelists and made presentation on "**ROAD TO NET ZERO CARBON CEMENT**"

ICR Jury Meeting on 18th November 2021 through virtual mode

Dr B N Mohapatra, DG-NCB participated in 5th Indian Cement Review Awards Jury Meeting on 18th November 2021

12th Cement Expo 2021-22

Dr B N Mohapatra, DG-NCB Participated in 12th Cement Expo & was invited as panelist on discussion on "Paving the way towards Energy and Sustainability" at the 12th Cement Expo 2021-2022 held on 17th December 2021 at Hotel The Lalit, Delhi

DCCI (Development Council for Cement Industry) Meeting held on 17th February 2022 through virtual mode

DG-NCB Participated in NICMAR, Pune Annual Academic Conclave 2022, held on 19th February 2021

1-Day International Workshop Organised by Dept. Of Chemistry, Manav Rachna University

Dr. Bibekananda Mohapatra, DG - NCB & Dr S K Chaturvedi attended 1-Day International Workshop Organised by Dept. Of Chemistry, Manav Rachna University, on 03rd March 2022.

National Workshop on Carbon Capture, Utilization & Storage (CCUS)

NITI Aayog organised a National Workshop on CCUS on 30th March 2022 at Vigyan Bhawan, New Delhi. The National Workshop brought together top government officials, industry leaders and the academia to discuss the role of CCUS in enabling a circular economy for India.

Dr B N Mohapatra, DG-NCB shared NCB's thoughts on "Decarbonization of Indian Cement Industry". Dr Mohapatra has also been facilitated by Dr V K Saraswat, Member, S&T and Energy, NITI Aayog.

Interaction with Stakeholders

Interaction with Stakeholders

Interaction with Industry

Visit of Dr B N Mohapatra, Director General, National Council for Cement and Building Materials to Mumbai from 6th to 10th September 2021.

DG-NCB's meeting with Shri K C Jhanwar, Chairman - NCB and MD, UltraTech Cement Ltd.

DG-NCB's meeting with Shri Neeraj Akhoury, Vice-Chairman - NCB, CEO, Holcim India and MD & CEO, Ambuja Cements Ltd.

DG-NCB's visit to Ambuja Cement Head Office, Mumbai

Had Meetings with Senior Officials:

- Shri Rama Rao, CMO
- Shri B C Pandey, Cluster Head
- Dr Jitendra Kar, VP-Corporate Quality
- Shri Gajendra Godhle-Technical Head
- Shri Vijay Chouhan

Had Meetings with Technical Services Team:

- Shri Gajendra Godhle
- Shri Jignesh Gandhi
- Shri Hitesh Barot
- Shri Hemant Shah

DG-NCB's visit to UltraTech Cement Ltd., Ahura Centre, Mumbai

Had Meeting with Senior Officials:

- Shri S V Patil
- Dr V Ramachandra
- Shri Raju Goyal
- Shri Sanjeev Shrivastava
- Dr A K Singh
- Shri Ashwin Moghe
- Shri Jayasankar Kentikara
- Shri Satyaki Sarkar
- Shri Amit Shah
- Shri Devendra Pandey
- Shri Shashi Gaggar
- Shri Shyamal Roy

DG-NCB's visit to Bhabha Atomic Research Centre (BARC)

Had Meetings with:

- Dr A K Mohanty, Director, BARC
- Dr D K Aswal, Director, Health, Safety and Environment Group
- Dr M S Kulkarni, Head, Health Physics Division

DG-NCB's visit to CDIC, Nuvoco Innovation Centre, Mumbai

DG-NCB's meeting with Shri Kaustabh Phadke, General Manager, GCCA India

DG-NCB's meeting with Leadership Team of JSW Cement Ltd.

- Shri Nilesh Narwekar, CEO
- Shri C. L. Sethunathan, Chief Marketing Officer
- Shri Manoj Kumar Rastogi, Head Business Strategy and Projects
- Dr J Kole, Vice President, R&D
- Ms Lopamudra Sengupta, VP (Technical Services)

Interaction with Government Organizations / Institutes / Dignitaries

Meeting with Vice Chancellor of Ravenshaw University Prof Sanjay Nayak Ex DG CIPET.

DG-NCB with Mr Hemant Sharma, Principal Secretary, Industries and Chairman IDCO, Chairman IPICOL

Interaction with Mr Subrato Bagchi, Chairman Odisha Skill Development

DG-NCB met Mr CV Raman, Global University

DG-NCB met Dr Achyutananda Samanta, Founder of KIITS

DG-NCB met with Mr Manoj Naik Chairman of ITER Sikhya and Anusandhan.

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 2021 – 2022

S. No.	Code	Project Title	Start Date	Completion Date
1	WAU-16	Development of Portland composite cement based on Flyash and limestone	April 2020	March 2022
2	WAU-17	Investigations on Utilization of Coarse Flyash (200-250 m2/kg) in Cement	August 2020	March 2022
3	CTM-05	Studies on Mechanical and Durability properties of High Strength Geopolymer Concrete	April 2020	March 2022
4	CTM-03	Use of Advanced Electronics in Construction and Condition Assessment of Concrete Structures	April 2017	March 2022
5	COB-13	Investigations on role of Particle size distribution (PSD) on performance of blended cements and concrete	April 2020	March 2022

Appendix – III

Sponsored Projects Completed During the Year 2021-22

National Council for Cement and Building Materials has completed 133 sponsored projects in the year 2021-22. Centre for Cement Research and Independent Testing (CRT) completed 30 nos. of projects, Centre for Centre for Mining, Environment, Plant Engineering & Operation -I (CME-I) have completed 14 nos. of sponsored projects, Centre for Centre for Mining, Environment, Plant Engineering & Operation -II (CME-II) have completed 04 nos. of sponsored projects, Centre for Construction Development and Research (CDR) have completed 85 nos. of sponsored projects.

Centre for Cement Research and Independent Testing (CRT)

Centre for Cement Research and Independent Testing (CRT) has completed 30 nos. sponsor projects during the year 2021-22, the distribution of 30 number sponsor projects as under: -

Project Title	Name of sponsor
Establishing limestone consumption factor	M/s Vikram Cement, Khor, M.P.
Burnability of Raw Mix samples and Bond Work Index of Limestone sample	M/s RCCPL, Maihar, Satna, M.P.
Burnability of Raw Mix samples	M/s Ultratech Cement bLtd., Manikgarh Cement Works, Gadchandur, Korpana, Chadrapur, M.H.
Investigation on coating and build-ups sample of cement rotary kiln	M/s Saurashtra Cement, Ranava, Gujarat
Burnability of Raw Mix samples	M/s Ultratech Cement bLtd., Rajshree Cement Works
Burnability of Raw Mix samples	M/s Birla Cement Works
Establishing Limestone Consumption Factor	M/s Prism Johnson Ltd, Satna, M.P
Testing of samples of coal and limestone bond index and burnability of kiln feed samples	M/s ACC Ltd Gagal
Development of raw meal standards for calibration of XRF	M/S Max cement, Jammu Kshmir.
Development of raw meal standards for calibration of XRF	M/s Prism Johnson Ltd, Satna, M.P
Establishing limestone consumption factor	M/s Heidelberg Cement India Ltd, Narsingarh, Damoh, M.P.
Establishing limestone consumption factor	M/s Udaipur Cement Works, Shripati Nagar, Udipur, Rajasthan- 313022.
Burnability of Raw Mix samples and testing of limestone and coal samples	M/s ACC ltd, Gagal, Bilaspur

Establishing limestone consumption factor	M/s KJS Cement (I) Limited, NH-7, Village Amilia, Distt-Satna (M.P)-485771
Establishing limestone consumption factor	M/s RCCPL Private Limited (Formerly Reliance Cement Company Pvt.Ltd), Village-Itahra, P.O-Bharauli, Maihar-485775, Satna, M.P.
Establishing limestone consumption factor	M/s Birla Corporation Limited, PO-Birla Vikas, Satna-485005, Madhya Pradesh.
Petrographic examination silt sediment samples inclu chemical analysis of water sample and Langmuir saturation index LSI, graanulamertry and sieve analysis of each collected silt sediments of river chenab at Ratle hydroelectric project	Ms Ratle Hydraoelectric project, J & K
Establishing limestone consumption factor	M/s ACC Kymore, M.P
Establishing limestone consumption factor	M/s Penna Cement Ltd, Tandur, Vikarabad, TS
Establishing limestone consumption factor	M/s Chettinad Cement, Dachepalli, Guntur Dist, AP
Establishing limestone consumption factor	M/s Karnataka Cement Ltd, Unit of Shree Cement Ltd , Kodka & Benkanhalli, Kalaburagi, KA
Burnability of Raw Mix samples	Birla Corporation Ltd, Satna, M.P
Development of standards for calibration of XRF	M/s ACC Ltd, Kymore Cement Works, Kymore, Katni, Kymore ,M.P
Establishing limestone consumption factor	M/s Karnatak Cement Ltd, Unit of shree cement ltd., kalaburgi, karnataka.
Development of Raw meal Standards for Calibration of X-Ray Fluorescence Analyzer (XRF)	M/s Dalmia DSp Ltd, Rohtas, Bihar
Establishing Limestone Consumption Factor	M/s Maihar Cement Work, Maihar, M.P.
Establishing limestone consumption factor	M/s Chettinad Cement Corporation Pvt Ltd, Pedagarlapadu Village, Dachapalle Mandal, Guntur Dist-522437
Raw Mix design for M/s Birla Coporation Ltd	M/s RCCPL, Mukutban, M.H.
NABL Assessment	M/s Rain Cement Ltd., Sreepuram Line, -2, Kurnoor, AP
NABL Assessment	M/s Rain Cement Ltd., Raramapuram, Suryapet, TS

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

Centre for Mining, Environment, Plant Engineering & Operation (CME) has completed 14 nos. of sponsor projects in the year 2021-22. Details of projects are given below:

Project Title
Construction of 100 bedded hospital at Tilak Nagar New Delhi under SDMC.
Procurement of ceiling fans for M.C.(P) schools under jurisdiction of Narela zone.
Annual Contract for operation of lift at 250 ward and Casualty block at Hindu Rao Hospital for the period 2019-2020
Improvement and modification of the existing crematorium for conversion of electric crematorium to CNG based crematorium at Green Park Extension
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
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)
Annual Comprehensive operation and maintenance contract of MEP equipments at Multilevel underground parking at J-8 Rajouri Garden under West Zone
Provision of Octagonal poles for lighting arrangement (with fitting) at various Parks in Ward No. 101S Sarita Vihar under Central Zone.
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
Comprehensive AMC (Annual Maintenance Contract) for Repair and Maintenance of Tubewells installed at various Mpl Parks under Rohini Zone
Construction of Bharat Darshan Park at Panjabi Bagh Ward no. 02-S in West Zone under Waste to Art. 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.
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
Construction of Community Hall at H-Block, Jahangirpuri in C-16N / CLZ. S.H:- SITC of Air Conditioning Plant.

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

Centre for Mining, Environment, Plant Engineering & Operation (CME) has completed 04 nos. of sponsor projects in the year 2021-22. Details of projects are given below:

Project Title	Sponsor
Capacity assessment study	M/s Meghalaya Cement Ltd
Heat Balance Study	M/s JK Cement, Mangrol
Heat Balance Study	M/s JK Cement Nimbahera
Monitoring of dust concentration at various ducts in pyro-system	M/s Saurashtra Cement Ltd

Centre for Construction Development and Research (CDR)

Centre for Construction Development and Research (CDR) has completed 85 nos. sponsored projects during the year 2020-21. The details are given below:

Concrete Technology (CON)

Title	Name of Sponsor
Testing of Concrete Carbonation and Microstructure Study	IIT Delhi, Hauz Khas, New Delhi
Concrete Mix Design and Third Party Quality Assurance (TPQA) for the Work "Special Repair of 4 Nos Spillway Bays (Bay No. 1, 2, 6 & 7) and Roller Buckets of Ichari Dam	UJVN Limited, Office of the Executive Engineer, Project Civil, Maintenance-Dakpathar, Uttrakhand
Durability studies on concrete prepared using coal based bottom ash as fine aggregate and preparation of mix design guidelines of PPC and PSC based cement concrete for NETRA-NTPC Limited"	NTPC Limited (NETRA), EOC Noida Office, Noida
Performance Evaluation of Water Proofing Compound to be used in Mortar & Concrete	Kaneka India Pvt. Limited, F-16, Salcon Ras Vilas, D-1, Distt. Center, Saket, New Delhi
Testing & Evaluation of Concreting Materials & Concrete Mix Proportions for M30A20 Grade of Concrete (2 no's) & M35A20 Grade of PQC Concrete (1 no) for Civil works of Flue Gas Desulphurization (FGD) System Package and Road/pavement works at NTPC Simhadri, Vishakhapatnam , Andra Pradesh	NTPC Simhadri, Simhadri Super Thermal Power Project, Distt: Vishakhapatnam, Andra Pradesh

Evaluation of Ambuja cement samples for water permeability testing	Ambuja cements ltd, 228 Udyog Vihar Phase 1, Gurgaon Haryana-122016
Durability Test to Ascertain the Suitability of Aggregate to be used in Concreting Work of Tunnel Lining	SJVN Limited, NMHEP, Mori
Evaluation of Materials & Concrete Mix Design for Construction of Helper Cell IDCT Package for 2X500MW Rihand STPP, Stage-III on M/s Paharpur Cooling Towers Limited	Paharpur Cooling Tower Limited, Industrial Area, Sahibabad
Performance Evaluation of Quartz Crystalline Admixture in Concrete	Asian Paints Limited, Ground Floor, Tower B, Lotus Business Park, Sector-127, Noida
Studies on Mechanical and Thermal Properties of Mass Concrete in Arun 3 HE Project Dam for M/s SJVN Limited	SJVN Limited, Civil Design Department, Shakti Sadan, Shimla
Evaluation of Material and Concrete Mix Design of Concrete for Switchyard Package at 2X660MW STPP, Khurja for THDC Super Thermal Power Plant near Aligarh	THDC India Limited, Khurja Super Thermal Power Plant, Aligarh
Performance Evaluation of Crystalline Waterproofing Admixture in Concrete	APAAR Infratech Pvt. Ltd., B-92, Sector-63, Noida, UP
Evaluation of Newly Proposed Cement Bag in Concrete	NUVOCO VISTAS CORP. Ltd., Eastern Operation Office, Tower–1, Rajarhat New Town, Kolkata
Evaluation of One Sample of Coarse Aggregate	Dalmia DSP Limited, (Formerly Kalyanpur Cement Limited), P.O. Banjari Distt. Rohtas, Bihar
Evaluation of Cement and Concrete Mix Design for Steam Generator and Associated Packages including site Levelling for Khurja Super Thermal Power Project (2X660MW)	Khurja Super Thermal Power Project, Village & Post–Dashera Kherli, Tehsil, Khurja, Distt. Bulandshahr
Evaluation of Material of Material and Concrete Mix Design for Work of Cooling Tower at 2X660MW Khurja STPP on M/s Paharpur Cooing Towers Limited	DGM (Mech.), THDC India Limited, Village & Post, Dashera, 2X660 MW Khurja STPP, Bulandshahr
Performance Evaluation Study of Integral Crystalline Waterproofing for Concrete Admix	Executive Engineer, HPD (East), Public Works Department, RGSS Hospital, Tahirpur, Delhi
Testing of Aggregate Samples of Chutti Behali Rock Quarry from Parbati HE Project, Stage-II	R&QA, NHPC Limited, Parbati HE Project, Stage-II, Parbati Complex, Nagwain, Distt. Mandi (HP)
Studies on Mechanical and Thermal Properties of Mass Concrete in Arun 3, HE Project Dam Part-II for M/s SJVN Limited	SJVN Limited, Civil Design Department, Shakti Sadan, Shanan, Shimla

Evaluation of Materials and Concrete Mix Designs for M35 Grade of Concrete for RCC Building (General) Work	Defence Research & Development Organization, Development Enclave, Rao Tula Ram Marg, Behind Army HQ Camp, Delhi Cantt. New Delhi
Evaluation of Material and Concrete Mix Design for the Construction of Pedestral and Culverts and Thrust Block for Ash Slurry Disposal Package Awarded to M/s Kumar Piyush Construction Pvt. Ltd	Kanti Bijlee Utpadan Nigam Limited P.O. Kanti Thermal, Distt. Muzaffarpur Bihar
Testing & Evaluation of Concreting Materials & Concrete Mix Proportions for M30A20 Grade of Concrete (total 2 no's) for Civil works of Flue Gas Desulphurisation (FGD) System Package at NTPC Simhadri, Visakhapatnam , Andhra Pradesh	NTPC Simhadri, Simhadri Super Thermal Power Project, Dist: Visakhapatnam, Andhra Pradesh
Testing of Cementitious Mortar sample "Xypex Megamix-II" as per EN 1504-3 (Class R4)	Dam safety Section, Kerala State Electricity Board Ltd, Sholayar, Kerala
Testing of Material Coarse Aggregate, Fine Aggregate, Water and Admixture	Northern Railway, Virbhadra
Evaluation of Concrete making Materials & Conducting Concrete Mix Proportions for M50A20 Grade of concrete using with Chemical Admixture	M/s Jaiprakash Associates Limited, Behind Babukhan's Millennium Centre, Rajbhavan Road Somajiguda, Hyderabad
Evaluation of Materials and Concrete Mix Design	THDC India Limited, Village & Post Dashera, 2x660 MW Khurja STPP, Bulandshahr
Testing of Construction Materials for Construction of 400 kv GIS Extension Work at Bhiwadi Sub-Station	Power Grid Corporation Limited, 4th Km Mile Stone, Alwar Bypass Road, Bhiwadi, Rajasthan
Evaluation of Materials and Concrete Mix design	NTPC Limited, Kahalgaon Super Thermal Power Project, Kahalgaon, Bhagalpur
Testing & Evaluation of Concreting Materials & Concrete Mix Proportions for M30A20 Grade of Concrete for Piling & M30 Grade Self Compacting Concrete of Flue Gas Desulphurization (FGD) System Package works at. NTPC Simhadri, Visakhapatnam, Andhra Pradesh	Aditya Engineering Services, C/o GE Power India Limited, NTPC Simhadri Simhadri Super Thermal Power Project, Dist: Visakhapatnam, Andhra Pradesh
Carrying out Condition Assessment using Non Destructive Evaluation Technique for various Structures (7 No's) at NID Campus, Ahmedabad.	National Institute of Design (NID)

Carry out Condition Assessment using Non-Destructive Evaluation Technique including preparation of Bill of Quantities (BOQ), Cost Estimate for RCC Chimney (120 mts.) at PP-II, NSPCL, Bhilai	NTPC SAIL Power Company Limited (NSPCL), PP-II, Bhilai-490 001, Dist: Durg, Chhattisgarh
Carrying out Condition Assessment and to provide suggestion for remedial measures for ESIC Establishments in Mumbai Region viz. (i) ESIC Regional Office Building at Lower Parel at Mumbai and (ii) 5nos. single Storey Independent Structures at ESIC Hospital Wagle Estate at Thane.	Employees State Insurance Corporation (ESIC)
Condition assessment of New Building of SSK Hospital (G+5) storied, New Delhi	Executive Engineer, SSK Hospital Division, CPWD, New Delhi
Execution of NDT and core testing at Khetri substation reg. at 765/400kV Khetri substation, Village Jasrapur, Tahsil Khetri	PGCIL, Khetri, 765/400kV Khetri substation, Village- Jasrapur, Tehsil- Khetri, Jhunjhunu-Rajasthan
Condition assessment of Residential Accommodation for NHAI staff at Pocket B-5 Sector-17, Dwarka, New Delhi	National Highway Authority of India, Dwarka, New Delhi
Core test, UPV and Rebound Hammer Test at 765/400 KV GIS substation, Orai Distt. Jalaun (Uttar Pradesh)	Power Grid Corporation India Limited. 765/400 KV GIS Substation, Distt. Jalaun, UP
Condition assessment of NDCT 1 & 2" at IGSPP Jharli	NTPC Limited, Aravali Power Capital Private Limited, Indira Gandhi Super Thermal Power Project, Jharli, Dist-Jhajjar, Haryana
Preliminary Site Inspection for Condition assessment of Chimney (5 No's) at NALCO CPP	Captive Power Plant(CPP), National Aluminium Company Limited (NALCO), Nalco Nagar, Angul, Odisha
Carry out Condition Assessment Studies of RCC Wagon Trippler and Under Ground Galleries at NTPC Kudgi STPP	Kudgi Super Thermal Power Station NTPC Limited, SH 124, Kudgi
1. Condition Assessment of TG Deck foundation of Unit#4 (500MW) at Ramagundam STPS-NTPC Ltd. 2. Preliminary Site Inspection for CHP RCC Structures at Ramagundam STPS-NTPC Ltd	DGM (O&M/CHP-MM), NTPC Ltd. NTPC Ramagundam, PO: Jyothinagar, Dist: Karimnagar, Telangana
Preliminary Site inspection for Condition Assessment of Residential Quarters and other buildings at POWERGRID Substations at Vijayawada and Kadapa.	POWERGRID Corporation of India, SR-1, Kavadiguda, Secunderabad –Telangana

Preliminary Site Inspection for Condition Assessment of Residential Quarters at POWERGRID Substations at Sriperumbadur, Udumalpet and Trissur	POWERGRID Corporation of India, SR-1, Kavadiguda, Secunderabad –Telangana
Preparation of BOQ/Specifications/Cost Estimate for Repair of NHAI Staff Quarters (covering Block A, B & C) at Sector-17, Dwarka, New Delhi	National Highway Authority of India G-5 H-6 Sector 10, Dwarka New Delhi
"Construction of High Level Bridge across Kalisindh River on K.M.13/8 of Nalkheda - Chhapiheda Road including approaches and protection work-Conducting Mix design for M-35 and M-45 grades of concrete"	Sr General Manager, Key Stone Infra, Hyderabad
Condition Assessment Study of Reclaimer-701 Foundation at Alumina Refinery, NALCO, Damanjodi.	M & R Complex, Nalco, Damajodi, Koraput, Odisha
Carry out Condition Assessment Study of RCC Structure of Banjara Petals at Banjara Hills, Hyderabad	Fr. Director General, NCB, Banjara Petals, Rd No 4, Green Valley, Banjara Hills, Hyderabad
Condition Assessment of Residential Quarters at Vijayawada Substation by third party using non-destructive evaluation.	Power Grid Corporation of India Ltd, Regional Head Quarters, SR-I, Secunderabad
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
Third Party Quality Assurance / Audit for Work of Construction of Dhalaos at various Locations nearby I and FC Drains in SSZ by Pdg. 0 from SH: 1. Adjoining Oration Bihari Colony LHS of Bank of Drain 2. Near Gate of Masjid Kabristan Jharkhand RD 5100 Bhola Nath Nagar 3. Near Metro Pillar No. 92 Pandav Road Bhola Nath Nagar RD 4400m 4. Opp. Satya Steel Furniture RD 4200m, 60 feet Road Vishwas Nagar 5. Near High Mast Electrical Pole Opp. Mahdev Gym RD-4100m Vishwas Nagar 6. Left Bank near Jhuggi B-31, Bhikam Singh Colony 7. Back of Bus Stand Radheypuri Opp. Red Light KKD Court Jagat Puri 8. Downstream on Right Bank Road No. 57 Side near KKD Flyover in Patparganj	Executive Engineer (Pr-II) Shahdara South, East Delhi Municipal Corporation, , Delhi
Third Party Quality Assurance and Audit (TPQA) for the work of Construction of OPD Block at Masjid Moth Campus at AIIMS	Executive Engineer (Civil)-III, All India Institute of Medical Sciences, Ansari Nagar, New Delhi

Third Party Quality Assurance and Audit (TPQA) for the work of Construction of Mother & Child Block at Masjid Moth Campus at AIIMS	Executive Engineer (Civil)-III, All India Institute of Medical Sciences, Ansari Nagar, New Delhi
Third Party Quality Assurance and Audit (TPQA) for the work of "Construction of Geriatric Block at Masjid Moth Campus of AIIMS"	Executive Engineer (Civil)-III, All India Institute of Medical Sciences, Ansari Nagar, New Delhi
Third Party Quality Assurance / Audit for Work of "Remodeling of drain at Karawal Nagar Road from Shiv Vihar Tiraha to near Govind Vihar main road in Shah(N) Zone".	Executive Engineer (Pr-II), Shah-N, East Delhi Municipal Corporation, New Usmanpur, Delhi
Third Party Quality Assurance / Audit for Work of "Construction of Centralized kitchen for central zone at M C Pry. School B-Block Kalkaji in ward no. 90, Central Zone"	Executive Engineer (Pr-I), Central, South Delhi Municipal Corporation, Under Lajpat Nagar, Delhi
(1) SITC of high mast pole work with LED light for Nadiad, Himmatnagar and Bhavnagar Sports Complex at Running Track. (2) Providing and fixing LED light in place of metal light in thirteen indoor hall and ground of sports complex. (3) LED street light work in sport complex at Godhara, Rajpipla & Saputara. (4) Light fitting working Sama Sports Complex.	Sports Authority of Gujarat (SAG), Gandhinagar, Gujarat
(1) Providing and Fixing Acoustic work in Indoor Hall at High Performance Centre SAMA Vadodara) at Sports Complex. (2) Providing and Fixing H.V.A.C. work in Indoor Hall at High Performance Centre SAMA (Vadodara) at Sports Complex.	Sports Authority of Gujarat (SAG), Gandhinagar, Gujarat
Third Party Quality Assurance / Audit for work of "Construction of Additional Class rooms at M C Pry. School, Dayalpur Ward no. 62E Shahdara (North) Zone".	Executive Engineer (Pr-I), Shah-N, East Delhi Municipal Corporation, Shahdara, Delhi
Third Party Quality Assurance / Audit for work of "Construction of M C Pry. School at West Azad Nagar in ward no. 26E AC-61, Shahdara South Zone".	Executive Engineer (Pr-II), Shah-N, East Delhi Municipal Corporation, Krishna Nagar, Delhi
Third Party Quality Assurance / Audit for work of "Construction of M C Pry. School at Block-13 Geeta Colony in ward no. 24E, AC-60 Shahdara South Zone"	Executive Engineer (Pr-II), Shah-N, East Delhi Municipal Corporation, Krishna Nagar, Delhi
Third Party Quality Assurance / Audit for work of "Construction of Bharat Darshan Park	Deputy Director (Hort.) HQ, South Delhi Municipal Corporation, JL Nehru Marg, New Delhi

at Punjabi Bagh Ward No. 2-S West Zone under "Waste to art"	
TPQA for work of "Improvement Development of road side berm, backyard and raising of Drain PDG by recycled CC Paver Block, Plaster etc. in CRPF Apartment pocket-2, Sector-16B, Dwarka, Ward NO. Kakroal, NGZ".	Executive Engineer (M-IV), NGZ, South Delhi Municipal Corporation, Dhansa Stand, Delhi
TPQA for work of "Improvement Development of road side berm, backyard and raising of Drain PDG by recycled CC paver block, brick work, plaster etc. in Om Apartment pkt-2, Sec-14, Dwarka, Ward no. 35S, Kakrola, NGZ"	Executive Engineer (M-IV), NGZ, South Delhi Municipal Corporation, Dhansa Stand, Delhi
TPQA for work of "Improvement Development of road side berm of road by PDG CC Paver Block from M C Pry. School to Phirni Road in Village Jaffarpur in C-45S, NGZ	Executive Engineer (M-IV), NGZ, South Delhi Municipal Corporation, Dhansa Stand, Delhi
TPQA for work of "Construction of Hostel Block for Boys and Girls in Medical College at Hindu Rao Hospital in C-280/CLZ". SH: Providing and fixing of the fire check doors.	Executive Engineer (Pr), CLZ, North Delhi Municipal Corporation, Shakti Nagar, New Delhi
TPQA for work of "C/o two story CTC Block at Ekta Camp in RK Puram Sector-7 Ward no. 65-S/SZ RK Puram" SH: balance work of toilet at first floor, Doors and grit wash of the whole building.	Executive Engineer (M-I), South, South Delhi Municipal Corporation, Gulmohar Park, New Delhi
TPQA for work of "Improvement Development side berm of road by PDG CC Paver block from main road to Phirni road in Village Malikpur in C-45S, NGZ"	Executive Engineer (M-IV), NGZ, South Delhi Municipal Corporation, Dhansa Stand, Delhi
TPQA for work of "Construction of outfall drain (L=200 mtr) and sumpwell in village Dariyapur Khurd in ward no. 40-S/NGZ"	Executive Engineer (Pr.), NGZ, South Delhi Municipal Corporation, , Delhi
TPQA for work of"Imp. Dev. Of lane and drain by pdg. RMC M-30, B/W, 12 mm cement plaster, near cement punning, CC 1:2:4. Precast RCC slab from DDA Park to 1 and FC Najafgarh drain road at Col. Bhatia Marg in ward no. 21-S/AC-31"	Executive Engineer (M-IV), West Zone, South Delhi Municipal Corporation, Rajouri Garden, Delhi
TPQA for work of "Imp. Dev. Of lane by pdg RMC interlocking tiles from H. No 285 to 263 and side lane of H No. 155 at Kangra Niketan Society in Vikas Puri in Ward No.20-S/AC-31"	Executive Engineer (M-IV), West Zone, South Delhi Municipal Corporation, Rajouri Garden, Delhi

TPQA for work of "Providing and laying green paying cover to curb the air pollution in AC-63-AC-62 in Shahdara (North) Zone at various location under the jurisdiction of EE(Pr-1) Shahdara North".	Executive Engineer (Pr.-I), Shah-N, East Delhi Municipal Corporation, Opp. Shyam Lal College, Delhi
TPQA for work of "Construction of CNG based crematorium at Dwarka Sector-24 ward no. 47-S Dwarka-C Najafgarh Zone"	Executive Engineer (Pr.-I), South Zone, South Delhi Municipal Corporation, Sewa Nagar, New Delhi
TPQA for work of "Construction of Pucca School Building at M C Pry. School Tahirpur School No. 1 Ward No.34E in Shahdara (North)"	Executive Engineer (Pr-I), Shah-S, East Delhi Municipal Corporation, Opp, Shyam Lal College, Delhi
TPQA for Improvement Development of Road by Providing and Laying RMC from H. No. 745 to RZ 8666 and H. No. 825 to Gali No. 1 Railway Road and Gali NO. 1 to Gali No. 10 Railway Road and H. NO. C-22/15 Durga Mata Mandir in Gali No. 8 in Sadh Nagarin Ward No. 53S Sadh Nagar/NGZ	Executive Engineer (M-IV), NGZ, South Delhi Municipal Corporation, Dhansa Stand, Delhi
TPQA for Construction of FCTS at the Existing Site of Dhalao near Mahila Mangal, Raja Ram Marg, Madangir in Ward No. 74-S South Zone	Executive Engineer (Pr.-I), South Zone, South Delhi Municipal Corporation, New Delhi
Third Party Quality Assurance / Audit for work of "Construction of RCC box drain across GT Road connecting SSBL with PWD drain on south side in shahdara (North) Zone".	Executive Engineer (Pr-I), Shah-N, East Delhi Municipal Corporation, Shyam Lal College, Delhi
Third Party Quality Assurance / Audit for work of "Setting up one "Swachhta Kendra by United Nations Dev. Programme (UNDP) India through implementation partner Hindustan Coca Cola Beverage Pvt Ltd. SH: C/o shed, office, toile approach road etc. for setting up of at Dwarka Sec-29, NGZ	Executive Engineer (DEMS), HQ, South Delhi Municipal Corporation, SPM Civil Centre, New Delhi
Third Party Quality Assurance / Audit for work of "Improvement of Dashrath Vatika Park Boundary by modification of existing M S Grills and Entry Gates in Janakpuri C-2 Block in ward no. 16-S"	Executive Engineer (Pr-II)/WZ, South Delhi Municipal Corporation, Under Dabri Flyover, New Delhi
Third Party Quality Assurance / Audit for work of "Development of Haritage Park, Parade Ground, Opposite Lal Quila, Chandni Chowk, Delhi"	Executive Engineer (Project), SPZ, North Delhi Municipal Corporation, Kashmere Gate, Delhi
Third Party Quality Assurance / Audit for work of "Civil work construction of	Executive Engineer (M-I)/NGZ, South Delhi Municipal

Panchkarma Ayurvedic treatment Centre at SDMC Community centre, Sector-22 Dwarka by pdg and laying partition walls for reception, Doctors rooms, meditation rooms and stories of panchkarma Ayurvedic treatment centre of Community Hall Sector-22 Dwarka under NGZ". SH: Providing EI, Fans and provision of AC Facility	Corporation, Near DDA Market, New Delhi
Third Party Quality Assurance/Audit for work of "Providing and laying Interlocking Paver Block and tree Guard from Govind Vihar Main road to Gutta Factory at Karawal Nagar Road in Shahdara (N) Zone, (2.) Providing and laying Interlocking Paver Block and tree Guard from Harsh Trading Co. to Govind Vihar at Karawal Nagar Road in Shahdara (N) Zone. (3) Providing and laying Interlocking Paver Block and tree Guard from Shiv Vihar Pulia to MLA office at Karawal Nagar Road in Shahdara (N) Zone. (4) Providing and laying Interlocking Paver Block and tree Guard from MLA office to Hariom Timber shop at Karawal Nagar road in Shahdara (N) Zone, (5) Providing and laying Interlocking Paver Block and tree Guard from Shyam sweets to Harsh Trading CO. at Karawal Nagar Road in Shahdara (N) Zone ".	Executive Engineer (Pr-II), Shah-N, East Delhi Municipal Corporation, Shyam Lal College, Delhi
Third Party Quality Assurance / Audit for the Work of "Restoration of road by providing RMC in Rajokari Village Vasant Kunj in Ward no. 69-S/SZ 1) from Old Panchyat Ghar to Shiv Mandir near UGR Rajokari Village".	Executive Engineer (M-IV), South Zone, South Delhi Municipal Corporation, Pushp Vihar New Delhi
Third Party Quality Assurance / Audit for work of "Improvement of lane by pdg. CC interlocking tiles from H No. WZ-54/2 WZ-56 in Gali NO. 8 Prithvi Park and from H.No. WZ-60 to WZ-60A in Gali No. 9-----and from H.No.WZ-412 to H.No. WZ-418 (Kali Mata Mandir) in Gali No. 18 in Sant Garh in Ward no. 013-S/WZ".	Executive Engineer (M-III)/WZ, South Delhi Municipal Corporation, Vishal Enclave, New Delhi
Third Party Quality Assurance / Audit for work of "Construction of Building for Central Malaria Store and malaria Circle at Saidulajab in Ward no. 71-S South Zone"	Executive Engineer (Pr-II), South Zone, South Delhi Municipal Corporation, Sewa Nagar, New Delhi
Third Party Quality Assurance / Audit for work of "Providing shed for Yoga Hall and	Executive Engineer (M-II), NGZ, South Delhi Municipal

Senior Citizen Shed at J-Block Park, West Sagarpur in W. No. 31-S in NGZ".	Corporation, Manglapuri, New Delhi
Third Party Quality Assurance / Audit for work of "Development of Park by providing boundary wall at Aman Vihar Ward No. 41N in Rohini Zone".	Executive Engineer (Project), RZ, North Delhi Municipal Corporation, Sector-17, Rohini, Delhi

Appendix – IV

Research and Development Programme 2021–2022 : In Progress

S. No.	Code	Project Title	Date of commencement	Target Date of Completion
PROJECTS UNDER DCCI				
1.	WAU-17	Investigations on Utilization of Coarse Flyash (200-250 m2/kg) in Cement	April 2020	March 2022
2.	COB-12	Development of new clinker system using industrial by products and low limestone content	April 2020	March 2023
3.	COB-13	Investigations on role of Particle size distribution (PSD) on performance of blended cements and concrete	April 2020	March 2022
4.	WAU-14	Improvement of Fly Ash Quality, Through Chemical / Mineral Doping In Coal During Its Generation In Thermal Power Plant, and Study Its Effects In Cement And Concrete	April 2017	March 2022 (on hold)
5.	WAU-16	Development of Portland composite cement based on flyash and limestone	April 2019	March 2022
6.	EMG-01	Process design and integration of RDF Gasification in cement manufacturing process	April 2020	March 2022
7.	EMG-02	Solar thermal calcination of phosphogypsum for cement manufacture	April 2020	December - 2021
8.	PSD-02	Design and Development of Transfer Chute to Handle Alternate Fuels and Their Mix in Indian Cement Plants	April 2020	March 2022
9.	WAU-18	Technical feasibility of using FGD gypsums in cement manufacturing	Aug 2021	July 2023
10.	WAU-19	Investigations on Utilization of Phospho- gypsum in Cement Manufacturing	Aug 2021	July 2024
11.	WAU-20	Utilization of lime sludge generated from paper industry in the manufacture of Cement	Aug 2021	July 2023

12.	FBR-16	Formulation of chemical admixture using by product lignosulfonate from paper industry for improved performance in mortar and concrete	Aug 2021	July 2023
13.	FBR-17	Development of Zeolite for Oxygen Concentrator by using Raw materials of Cement Industry	Aug 2021	July 2022
14.	PRP-07	Enhancement of plastic waste utilization as Alternative Fuel in Indian Cement Industry and its impact assessment	Aug 2021	January 2023
PROJECTS UNDER: PROJECT BASED SUPPORT FOR AUTONOMOUS INSTITUTES				
1.	CTM-05	Studies on Mechanical and Durability properties of High Strength Geopolymer Concrete	April 2020	March 2022
2.	CON-17	Study of Carbonation and Carbonation induced reinforcement corrosion in new cementitious system	April 2020	March 2023
3.	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
4.	CON-18	Utilization of Coarser Flyash (having fineness between 250 m2/kg to 320 m2/kg) in Concrete as a cementitious material	April 2020	September 2022
5.	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)	October 2020	September 2023
6.	CTM- 03	Use of Advanced Electronics in Construction and Condition Assessment of Concrete Structures	April 2017	March 2022

Appendix –V

NCB Patents Granted/ Filed During 2011-2021

Patents Granted:

Sl. No.	Patent No	Title	Names of Inventors
1.	248230	A Ceramic Composition for Preparing Scientific Pottery ware and Process of Preparation thereof	Sh. S Raina Dr. K Mohan Dr. K M Sharma Dr. M M Ali Sh. S K Chaturvedi Dr. D Yadav Sh. S K Agarwal
2.	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
3.	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
4.	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
5.	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
6.	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
7.	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

Sl. No.	Patent No	Title	Names of Inventors
8.	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
9.	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
10.	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 Ahemad

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