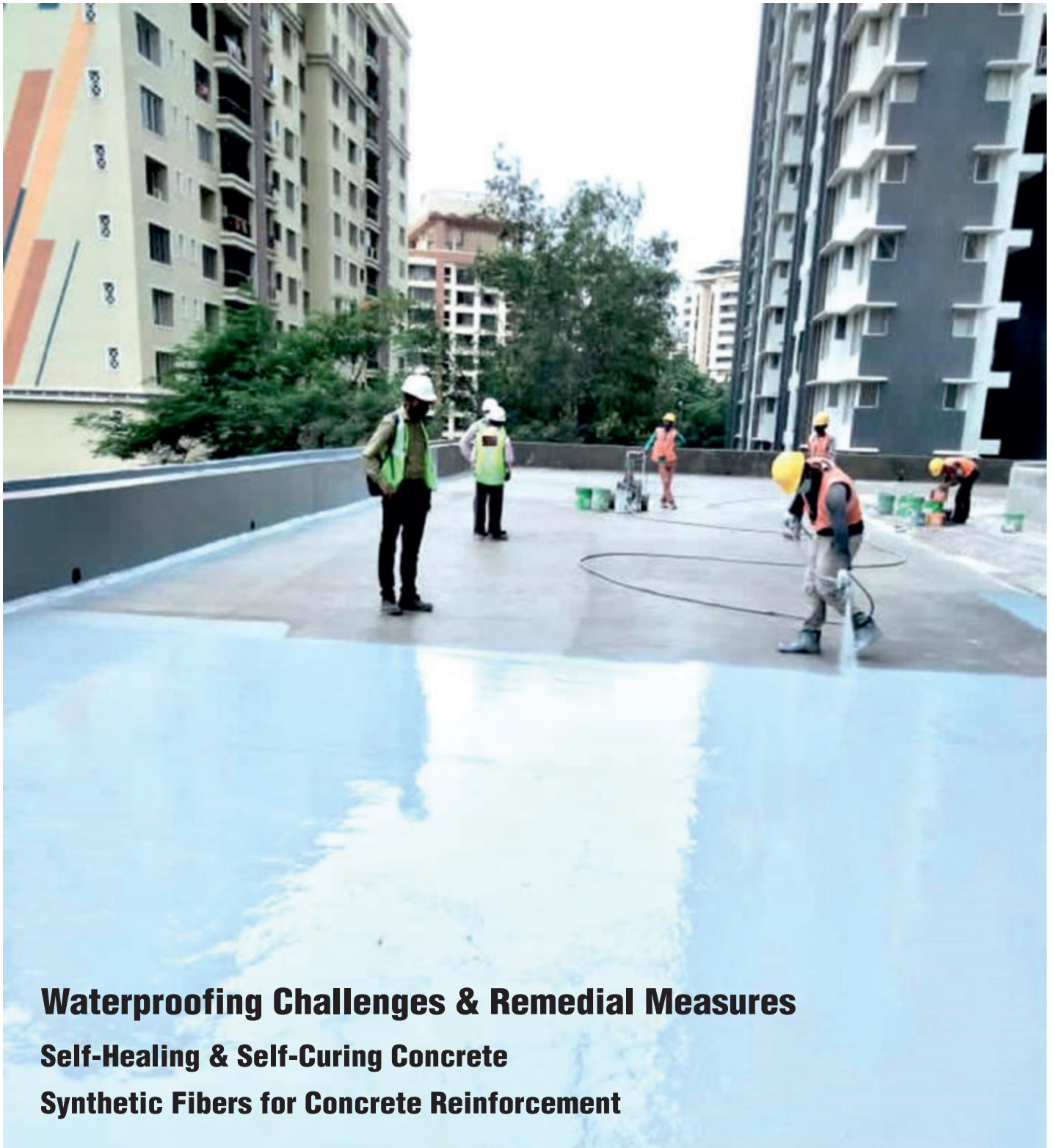


NBM&CW
Special Supplement

concrete construction



Waterproofing Challenges & Remedial Measures

Self-Healing & Self-Curing Concrete

Synthetic Fibers for Concrete Reinforcement

the sand experts

struggling to find a reputed **Pan-India sand supplier**

Source all your sand from a
single vendor anywhere in the country

Call the experts: **93300 80000**

support@doctorsand.com | www.doctorsand.com

doctorsand



doctorsand

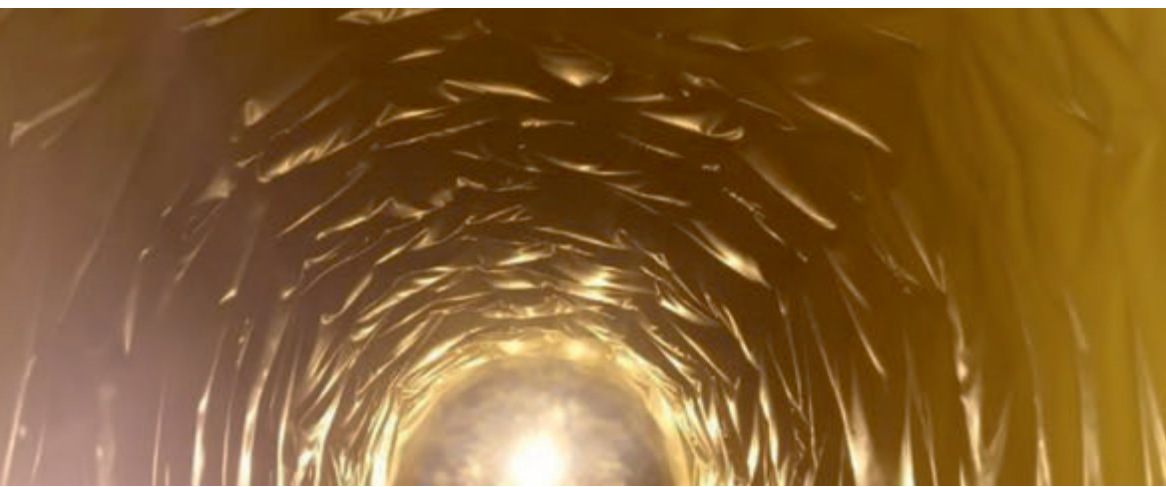
Experts in Construction Chemicals

Structural Strengthening, Retrofitting, Repairs, Waterproofing, Corporate Interiors

Agrani Infra Intech Private Limited

(Formerly Known as Agrani Enterprises)

Agrani known for its commitment & quality work.
It provides supply & apply warranty with tripartite agreement



Specialized Construction Company Presence in PAN India

- Tunnel/ Dam Waterproofing & Repair
- Structural Strengthening/
Retrofitting/Repairing/ Rehabilitation
- Epoxy/ PU Flooring
- Waterproofing
- Metallic Expansion Joint
- Corporate Interiors

Prestigious projects

- Mumbai Metro
- Jammu & Kashmir T-48 Tunnel
- Tata Realty – Eureka parks, Tata Serein.
- Tata Projects – Tata Power, Mumbai
- ITPO, Pragati Maidan
- IIT Bhubaneswar, by NBCC
- Godrej properties – Golf Link Greater Noida, Nirvaan Mumbai



Office-Delhi-NCR & Mumbai
www.agranimilestone.com
info@agranienterprises.in
+91-120-4168824

SHEAR COMPACTION TECHNOLOGY

4TH GENERATION OF PROFITABLE PRECAST

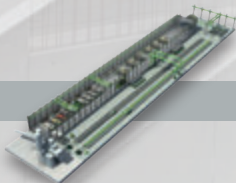
SMART
SOLUTIONS FOR
PRECAST CONCRETE
PRODUCTION



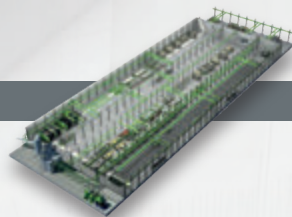
30 Years have passed since shear compaction technology first saw the light of day on the drawing boards of Elematic's engineers. Smart Evolution for Your benefit is at our very heart. Thus, four generations later,

the technology has been finetuned down to the last detail to give the best possible compaction result and the highest quality of precast products. Not to mention the clear savings in cement and concrete consumption.

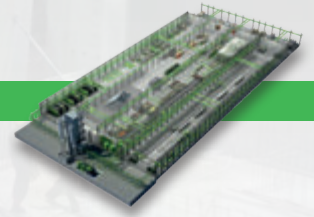
SEMI



PRO



EDGE



Elematic offers precast plants, lines, and machinery, as well as maintenance, optimization, and renewal.

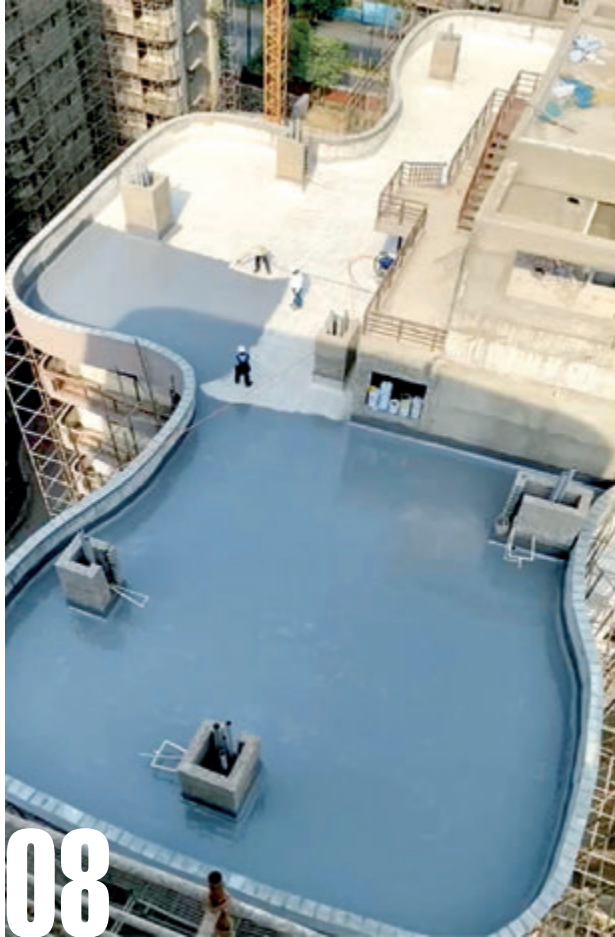
Mr. Shridhar Rao, Mob : +91 9591847722
E-Mail : shridhar.rao@elematic.com

Find out more on shear compaction at
www.elematic.com

ELEMATIC

SMART EVOLUTION

Contents



Interviews

28



Anil Banchhor, RDC Concrete, explains how ultrafine materials improve the hydration of cement particles and also the strength and are a way forward towards sustainability

30



V R Kowshika, Amazecrete, shares insights on the properties of Icrete that help reduce shrinkage and permeability while increasing the durability of concrete

Cover Story

08 **Waterproofing Challenges & Remedial Measures in High Rise Buildings**

Inputs by:

- Aarti Harbhajanka, Primus Partners
- Ramendra Bahadur Sinha, Agrani Group
- Kunjan Popat, Trifix Technologies & WAI
- Sameer Karkhanis, Odd Jobs Waterproofing
- Anil Banchhor, RDC Concrete
- Harsha Kavi, Fosroc

Terrace Waterproofing

18 Terrace waterproofing is considered a priority as the roof is always exposed to harsh climatic conditions and weather changes: **Rajeev Gupta, ECMAS Construction Chemicals**

Importance of Waterproofing Structures

22 Water leakage not only reduces the durability but also hampers the serviceability or usability of the structure; hence, a good waterproofing system will address the issues of long-term and usability aspects: **M N Ramesh, Talrak Construction Chemicals**

Synthetic Fibers for Concrete Reinforcement

25 **Kalyani Polymers** is offering made-in-India Synthetic Micro & Macro Concrete Fiber Products for the Construction Industry under the brand name FIBERCRETE®

Climate Control Concrete

32 **Sridhar Balakrishnan, ACC Limited,** discusses the attributes, applications, and benefits of thermal insulating climate control concrete system for home builders, architects, engineers, and developers

Bacterial Concrete

40 **Dr. Manjunatha L R,** and **Raghavendra, JSW Cement,** discuss bacterial concrete that can meet the requirements for strength, durability, and self-healing of cracks

Self-Curing Concrete

- 34 **Prof Dada S. Patil, Dr. S. B. Anadinni, and Dr. A. V. Shivapur,** give insights on the importance of curing for controlling the moisture movement from concrete mass during the process of cement hydration

Precast

- 44 **C. A. Prasad, Metey Engineering & Consultancy,** guides entrepreneurs on the various aspects of precast construction business

Autoclaved Aerated Concrete Blocks

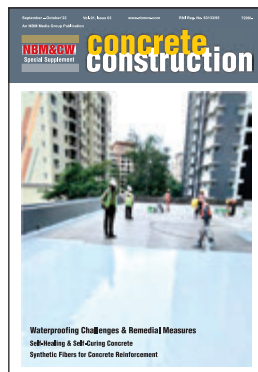
- 46 AAC block is finding preference over the red brick and emerging as the future of building construction informs **Mohit Saboo, BigBloc Construction**

Construction Cost

- 50 **Nidhi Aggarwal, SpaceMantra,** offers tips to save costs while constructing a house

News

- 52 **CRISIL:** Profitability of cement companies to fall for second straight fiscal
- 54 **Progress Group:** 3D printed concrete chair wins 'Best of the Best' Red Dot Award
- 56 **FCN's** new technology can reduce CO² emissions of concrete paving blocks and products by up to 80% by using Betolar's Geoprime®
- 58 **Dalmia Bharat** accelerates drive for net-zero emissions
- 58 **Adani** acquires Ambuja Cements and ACC
- 58 **Ahmedabad Municipal Corporation** to build roads using 'white top' technique
- 59 **IITD** organizes Technical Training Program on Waterproofing & Maintenance of Structures



Cover courtesy: Agrani Group

Head Office: NBM Media Pvt. Ltd.

B-27, 11nd Floor, Nizamuddin West, New Delhi-110 013

Ph: +91-11-26832424, +91-98181 65648, 79829 31374

E-mail: info@nbmcw.com, www.nbmcw.com

Group Managing Editor

S. A. Faridi

Editorial

Maria R – *Executive Editor*

P. C. Sharma – *Chief Editor*

Seema Gupta – *Associate Editor*

Jeet Singh* – *Associate Editor*

Partha Pratim Basistha – *Associate Editor*

Vinod Behl – *Contributing Editor - Real Estate*

Zainab Faridi – *Assistant Editor*

Meghana Raut – *Assistant Editor*

Honorary Adviser

Dr. N. Subramanian | Mr. C.A. Prasad

Marketing

S.K. Rizvi – *Business Head*

M. +91-98109-19797

E-mail: marketing@nbmcw.com

Mumbai

Neelkanth Menon, M. +91-98202-45763

E-mail: nkm@nbmcw.com

Gujarat

Krishnakant Panchal, M. +91-98982-22244

E-mail: panchal@nbmcw.com

Circulation

Geetika – *Manager Circulation*

Shaifar K.

Production

S. Sheikh – *Publishing Manager*

Rajesh Mishra – *Manager Production*

Najam Khan – *Studio Head*

Azhar Abbas Abbasi – *Head - IT*

Managing Director & Publisher

M. A. Faridi

Subscription

India ₹1200 / Int. US\$ 100

All payments in favor of **NBM Media Pvt. Ltd.** Delhi.

No Part of this publication may be reproduced by any means without prior written permission from Editor.

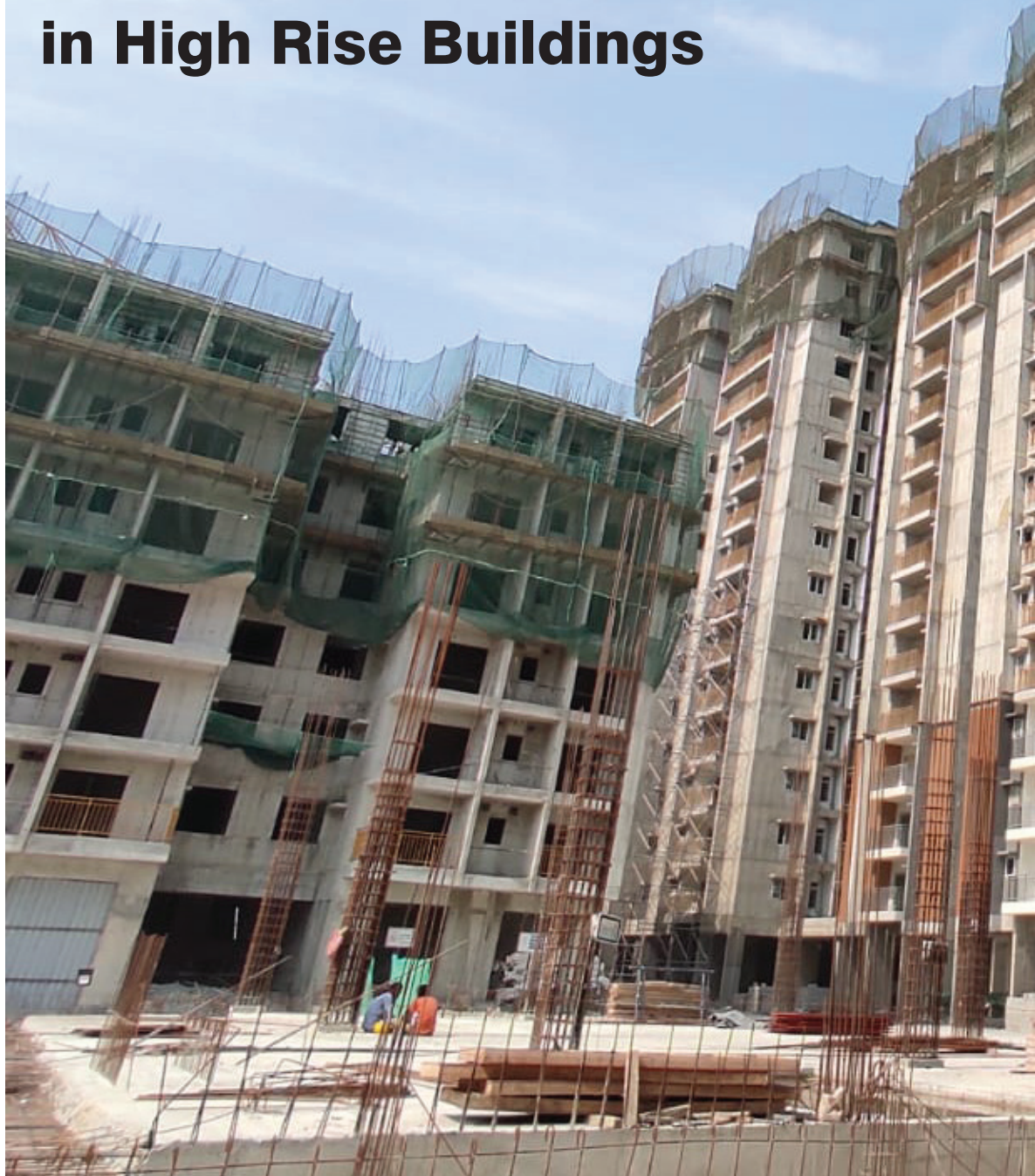
* Responsible for selection of news under the PRB Act.

Concrete Construction is not responsible for statements made, or for opinions expressed, in the articles published in this volume and publisher accepts no responsibility for accuracy of information, errors or omissions and rejects any claims arising out of any action which a company or individual may take on the basis of information contained herein.

Concrete Construction is printed & published by Shakeel Ahmed Faridi, on behalf of NBM Media Pvt. Ltd., and printed at Samrat Offset Pvt. Ltd., B-88, Okhla Ind. Area, Phase-II, New Delhi-110020 and published at B-27, Nizamuddin (West) New Delhi-110013, editor S. A. Faridi.

All Rights Reserved. Copyright © 2022 NBM Media Pvt. Ltd.

Waterproofing Challenges & Remedial Measures in High Rise Buildings



*High-rise buildings need special attention when it comes to waterproofing as the challenges inherent in them are peculiar in nature. Unfortunately, there is a lack of knowledge on the remedies and products available in the market as water-proofers continue to rely on age-old methods. In this article, experts from leading waterproofing companies share with **Meghana Raut**, their knowledge and experience in waterproofing concrete structures and suggest some of the latest solutions.*





“Despite the training by numerous institutions, there still seems to be a shortage of labour; as a result, it is difficult to control the quality of craftsmanship and the developer is to blame.”

Aarti Harbhajanka, Primus Partners

Waterproofing Challenges

“One of the most important aspects of a structure’s design and construction is the waterproofing membrane that covers it. External structures are often severely damaged by intense heat and humidity followed by frequent heavy rainfall. Due to this, in many structures, cracks, water leakage, and seepage are typical issues,” says **Aarti Harbhajanka, Co-Founder, Primus Partners**.

“Even if one pipe leaks, there will be multiple seepages going into different buildings. Building damage and faults can have detrimental implications for all parties, whether they do so directly or indirectly. In addition to endangering the safety of the residents, it could also degrade the building’s visual appeal. There is no reason why the residents of a building should avoid taking the necessary precautions to maintain their outside walls, even while the cause of this issue may be the builders’ lack of foresight or the contractors’ adoption of a quick repair,” she adds.

“An issue faced by high rises is the tilting they experience due to wind pressure. Tilting demands use of waterproofing compounds with good elongation index and flexibility,” explains **Kunjan Popat, Founder, Trifix Technologies and General Secretary, WAI**. “Another serious concern is the basement because as buildings go higher, basements go deeper. When basements go deeper, a lot of construction joints appear, and the building will undergo uplift pressure, settlements, hydrostatic pressure, seismic movements, etc.”

He adds, “In coastal cities like Mumbai, basements are also subjected to sea water ingress. There have been many cases where basements of some buildings have been closed to public access because of water seepage. Also, if there is no space between the sheet piles and the retaining wall, waterproofing becomes necessary so that the water does not fill the space.”



According to **Harsha Kavi, Regional Product Segment Manager - Waterproofing/Sealants, Fosroc**, exposure to ground water pressure combined with quality of urban soil contamination by surrounding effluent release necessitates high quality waterproofing. “So, one cannot afford to apply underperforming material for waterproofing or be negligent in the application quality.”

Harsha Kavi informs that the quality of construction of high-rise buildings has to be extremely good in terms of specifications, materials etc. What’s more, specifiers need to have full information on the merits and demerits of waterproofing systems, accessories, and appurtenant systems that augment high-end waterproofing materials. “Since high-rise buildings have a lot of inhabitants, to reduce the carbon footprint, one must provide vegetated landscaping; this, in turn, needs the right waterproofing sealing system that can bear the brunt of the water laden soils and the fertilizers used for growing the vegetations.”

“Waterproofing for such situations demands very durable systems which come with a higher cost. Waterbodies may be at the podium level or on the roof and thereby contained within the building. Waterproofing thus becomes a challenge in terms of the durability of the waterproofing system. Wind-driven rain experienced in high-rises necessitates waterproofing and sealing of window perimeters and service areas. The exterior walls of high-rise buildings are also inaccessible for re-coating and maintenance, which can be problematic,” he adds.

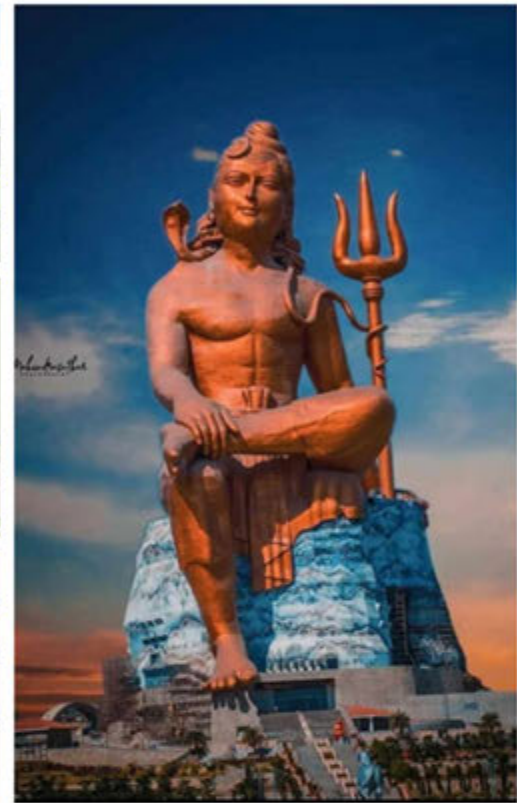


Skeleton Consultants Pvt. Ltd.
Integrated Project Consultants &
Structural Engineering Service Providers

Delhi- NCR : ☎ 0120-4222642 | ✉ skeletondelhi@skeleton.in

Indore: ☎ 0731-2551267 | ✉ skeletonindore@skeleton.in

Bengaluru: ☎ 099580 03108 | ✉ Babu.pj@skeleton.in



Sectors Served

Industries | Residential and Commercial | Hospitals | Institutional Complexes | Schools | Sports Facilities | Commercial & High Rise Group Housing | IT Buildings | Data Centre Mix use development | Auditoriums | Canal Top & other Solar Farm Structures | Engineering of Gigantic Statues | Domical Roof Structures | Pre-cast and Post Tentioned Structures Infrastructure | FOB & ROB.

Services Offered

Industrial Sector

Master Planning, Architecture, Interiors, Structure, Landscape, MEP + Fire Fighting Consultancy Services, QS/ Tender Services

Residential & Commercial

Architecture, Structure Interior and Landscaping

Building & Structures

RCC & Steel Structural Design & Detailing, Pre Engineered Buildings, Proof Consultancy, Wind Engineering Consultants, Wind Tunnel Design Consultants

Project Management Consultancy

Complete Coordination & Execution Management for all services in Industrial Sector & for Civil Construction work in Building Sector

Structural Diagnostic Services

Strength Assessment & Rehabilitation of Distressed Buildings, Repair & Retrofitting Consultancy and Execution, third party construction audit for quality & quantity

Structural Detailing Services

Shop drawings for Steel Fabrication, BBS for RCC work, Revit & TEKLA Applications.

Contact Us:

Er. Arun Sodani (Indore)

arun.sodani@skeleton.in

☎ :09752531945

Er. Jayes K. Jain (Indore)

jk.jain@skeleton.in

☎ :09329548742

Er.(Dr) Abhay Gupta (Noida)


abay.gupta@skeleton.in

☎ :09871844932

Ar. Kartik Sodani (Indore)

kartik.sodhani@skeleton.in

☎ :08888216172



Qualified Waterproofing Experts or Professional Agencies should be appointed to find the root cause and Propose tailormade waterproofing system suitable for the job. Waterproofing is not a Product Application alone, it's a system with lot of steps involved.

Ramendra Bahadur Sinha, Agrani Group

“One peculiar issue for undertaking waterproofing in high-rises is the Lifting of materials to top floors. A single lift is used by multiple agencies due to which time slot given to one agency is very limited each day which increases the Labour cost as well as delays the material shifting. Also, waterproofing work has to be done perfectly, and any pause in the work can lead to faulty waterproofing,” says **Ramendra Bahadur Sinha, Founder & MD, Agrani Group.**

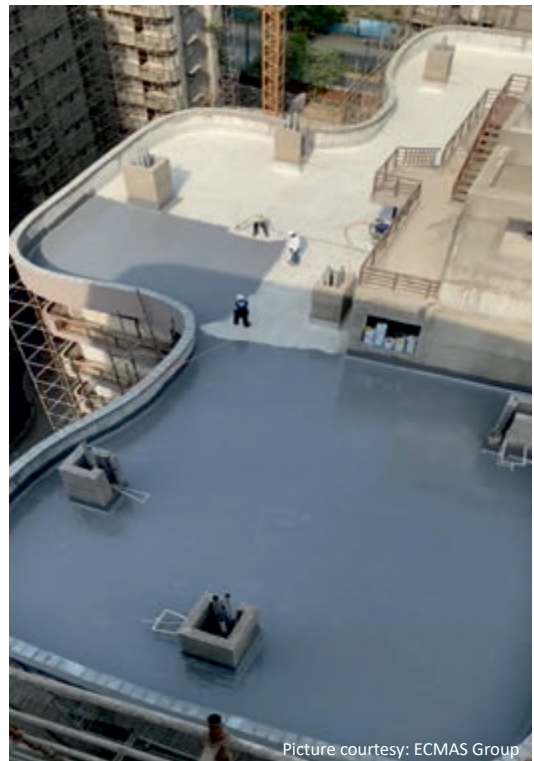
Sameer Karkhanis, Founder, Odd Jobs Waterproofing, enumerates the many operational challenges in high-rise buildings:

- Elevation/projections of the building are such that it is not feasible to install scaffolding, material lifts, etc.
- Working while retaining the exterior look of the building.

- The cost factor is higher hence service societies and maintenance departments don't sanction the amount needed for quality work, and look for cheaper options, with the result that cracks, and seepages reoccur.
- Property buyers have already paid many other charges and are reluctant to pay for any extra work.

Factors leading to failure in waterproofing

“The first mistake an owner makes is in not hiring a waterproofing consultant. Waterproofing is a full-time specialized profession and should never be carried out by an unprofessional. You might end up using inappropriate products for the waterproofing job,” warns Sameer Karkhanis.





“Waterproofers are reluctant to adopt new technologies since, according to them, the age-old techniques are working just fine.”

Kunjan Popat, Trifix Technologies & WAI

“Other cause are additives and admixtures not used, or, if used, then added to concrete without proper know-how. Wrong diagnostics by pseudo contractors leads to wrong remedies and subsequently failure in stopping the leakages. Professional water-proofers not only undertake full responsibility for the work done, but also give warranties/guaranties for an x-number of years. Another issue is the lack of importance given to surface preparation, which is equally important. It is said that a good beginning is half the work done!” he adds.

According to him, use of old, stereotype practices to solve concrete leakage will not help in solving the current issues that come up due to modern, complex designs. “Architects want their projects to look the best with unique designs and elevations. The beautification of a building’s exterior can only be retained for a long time if a waterproofer is hired at the planning and designing stage; however, this

does not happen due to the lack of attention given to waterproofing.”

“Another issue is of water ponding on concrete surfaces that are not flat enough or where there is an inadequate slope. Even if concrete is freshly laid, preventing water ponding is very important before waterproofing work begins by checking if there are any structural defects, shrinkage, cracks etc. When it comes to basements and retaining walls, using cheap chemicals can put the entire building in danger. In case of landscaping, swimming pools, and fountains, unethical waterproofing practices and use of low elongation chemicals and membranes can create trouble in the long run.” he warns.

“An add-on factor impacting waterproofing is the reluctance in adopting newer technologies. Waterproofers like to stay with the age-old techniques since according to them, they are working just fine,” says Kunjan Popat.



Picture courtesy: Odd Jobs Waterproofing



“The first mistake an owner makes is in not hiring a waterproofing consultant. Waterproofing should never be carried out by an unprofessional as you might end up using inappropriate products.”

Sameer Karkhanis, Odd Jobs Waterproofing

“For the common man, waterproofing is simply applying a solution with a brush and the work is done! He is influenced by TV advertisements on the readily available products in hardware shops. But the fact is that a qualified Waterproofing Experts / Professional should be appointed to find the root cause and solve it because Waterproofing is a term used for system application not a Product, adds Ramendra Bahadur Sinha.

Joints: the vulnerable places

Kunjan Popat emphasizes proper joining of HDPE membranes used in basement waterproofing as an essential measure. This has to be done using heat treatment. If EPDM membranes are used, then good solvents have to be used to ensure waterproof joints. Wherever construction joints are present, water stoppers have to be compulsorily used, since the joints are the most vulnerable places where seepage can penetrate from.

Agrees Harsha Kavi, “Almost 99% of the failures in waterproofing happen due to the 1% of openings in transitions and poor detailing that are not sealed effectively. Before taking up waterproofing, a thorough understanding of the structural and architectural detailing are a must. Lack of proper detailing is one of the major factors for waterproofing failures. Proposing ‘fit to purpose’ waterproofing is the only way. For instance, the tensile strength of waterproofing membrane should be high.”

Says Aarti Harbhajanka, “Building flaws are a natural result of poor craftsmanship. The weakest link in every structure’s combination is its joints. When leaks occur, their sources are frequently close to where the building fabric first failed. Structural instabilities can be one of the major reasons for water seepage if waterproofing is not done properly. Cracks, a deteriorating waterproofing system, concrete honeycombs, and construction joint failure are the main causes of waterproofing failures in concrete buildings and structures.”

“Improper plumbing is a common issue of seepage in high-rises. To ensure good joint sealing, firstly, the core cutting for the pipe slots has to be sufficient all around the Pipes to accommodate the sealing compound and the cutting has to be uniform. Sometimes bores are cut with the help of chisel hammer in improper shape and pipes cannot be properly sealed and above that waterproofing cannot be done adequately. Another issue is that sometimes two to three pipes touching each other and passes through a single bore which is actually a wrong practice and causes a major reason of leakage. This also hinders the application of waterproofing to the entire circumference of the joints,” says Ramendra Bahadur Sinha.

Who bears the responsibility?

The experts attribute the cause of failure to improper selection of waterproofing system, not carrying out proper preparatory work, use of incompatible materials, design flaws, and co-ordination issues. According to them, the applicator and the product owner are responsible for waterproofing execution, incorrect diagnosis of leakage problems, faulty external plastering, and lack of effective monitoring post the application.

Says Aarti Harbhajanka, “In most cases, waterproofing is inexpensive compared to other project costs. Many contractors are attempting to reduce the cost of waterproofing membranes. Plus, there is a short supply of workers in the industry due to the building industry’s explosive rise. Despite the training initiatives run by numerous institutions, there still seems to be a general shortage of labour, both skilled and unskilled. As a result, it is now difficult to control the quality of craftsmanship, and the developer is to blame.”

“However, post the advent of RERA, in cases of any structural defect or any other defect in workmanship, quality, or provision of services, the governing body will hold the promoter or the developer responsible to make amends within five years of handing over possession,” she adds.



OUR FORMULATIONS[®]
BUILDTech PRODUCTS
 YOUR SOLUTIONS

Serving Construction Industry for over 25 years

Concrete Admixtures / Superplasticisers

- BUILDPLAST SUPER 3000**
Hyper superplasticiser for high performance concrete
- BUILDPLAST SUPER 3000 (SC)**
Superplasticiser for self compacting concrete
- BUILDPLAST SUPER 2000 (M)**
- BUILDPLAST SUPER 1000 (M)**
- BUILDPLAST SUPER**
- BUILDPLAST SUPER-HR**
- BUILDPLAST SUPER-RP**
- BUILDPLAST SUPER-RP (HR)**



Rishikesh - Karnaprayag Railway Project

Accelerators for Shotcrete

- BUILDSHOT-AFL**
- BUILDSHOT-AFL (60)**
- BUILDSHOT-AFL (65)**
- BUILDSHOT-AFP**

Anchoring Systems

- ROCKFIX (R)**
- ROCKFIX (C)**



Range of Products

- Concrete Additives & Aids
- Resin & Cement Capsules
- Epoxy & Polyurethane
- Waterproofing & Thermal Insulating Systems
- Engineering Grouts
- Synthetic (PP) & Steel Fibres
- Silicafume / Microsilica
- Floor Hardeners
- Coatings



Larji HE Project



**BUILDTech PRODUCTS
 INDIA PVT. LTD.**

Regd. & Corporate Office
 47-B/2, 1st floor, Corner Market
 Malviya Nagar, New Delhi : 110017

Factory
 G1/273, RIICO Industrial Area, Khushkhera
 Distt. Alwar : 301707

Email
 info@buildtechproducts.com
 factory@buildtechproducts.com

Contact Nos.
 +91 98101-10442
 +91 98101-16126

www.buildtechproducts.com

CIN: U74899DL1995PTC073661





“The quality of construction of high-rise buildings has to be extremely good in terms of specifications, materials etc, and specifiers need to have full information on the merits and demerits of waterproofing systems, accessories, and appurtenant systems.”

Harsha Kavi, Fosroc

“When it comes to the governing body, no such Codal regulations are in force which focus on waterproofing. Architecture fraternity focusses only on building design, but not on the waterproofing aspect. Ideally, the rainfall facing side of buildings should have least number of openings,” says Kunjan Popat.

Types of waterproofing solutions in the market

According to Harsha Kavi, in every structure, depending on the exposure conditions and serviceability requirements, and in every part of the building, different kinds of waterproofing systems are specified, as shown in the table below:

Areas	Type / Category (Exposure)	Area of application	Product / System suggested	
SUBGROUND	PILES / PILE CAPS	WET & DRY	Pile Top	Epoxy grout
		WET & DRY	Reprofiling of pile	Factory Controlled Repair Mortars
	FOOTINGS, FOUNDATIONS in RCC	WET	Below footings	Pressure sensitive HDPE membrane
			Footings perimeters	Self adhesive HDPE / SBS membranes / PU coatings protected with boards from backfills
	RAFT	WET	Below RAFT	Pressure sensitive HDPE membrane
	Confined Retaining wall	WET	On shore piles	Sacrificial shuttering and cell mesh bonded to a blended polyethylene membrane (mechanically bonded)
Sacrificial shuttering and Pressure sensitive HDPE membrane				
Un Confined Retaining wall	WET	Membrane	Self adhesive HDPE/SBS membranes	
		Liquid applied	Pure Polyurea/Polyurethane coating	
Podiums	Driveways	Wet & Dry	Liquid applied	PU coating
	Land scape areas	Wet	Liquid applied	Hybrid PU/ Polyurea
Swimming pool	Floors and walls	Wet	Liquid applied	Cementitious with negative pressure resistance / PU coating overlaid with Glass tiles or ceramic tiles and gaps filled with UV resistant resinous tile grout
Roofs	Dry		Liquid applied/membrane	Hybrid polyurea / TPO membranes
	Landscaped		Liquid applied	Hybrid polyurea
Bathrooms	All types	Always wet	Liquid – Brush applied	Cementitious coating with good tensile and elongation

Sameer Karkhanis elaborates, “Epoxy-based waterproofing is done by using the injection method for concrete waterbodies and basement retaining walls. Hot air bitumen membrane sheet and tarfelt should be used on the exposed areas. Unfortunately, these are wrongly used on concrete surfaces where materials fall over it. In polymer coating, cement may or may not be added. These cementitious coatings are diluted with either polymer or polyethylene. What matters here is the quality of the product, its viscosity and elongation properties, and knowing how to apply the product. PVC membranes used for installing in water bodies, basements, and retaining walls, should be installed correctly and by using the right methodology.”

Explains Aarti Harbhajanka, “There are different types of waterproofing solutions: cementitious waterproofing is inexpensive and simple to install, but it lacks flexibility and cannot withstand joint or crack movement. Thermoset and thermoplastic polymers are used in sheet membrane waterproofing. Thermoset membranes are sheets of rubberized performance material that can be vulcanized, non-vulcanized, or both. It is necessary to apply for a damp proof course. The appropriate corrective measure is to replace the damp-proof materials.”

“In order to accomplish a totally effective treatment, drilling should be used. Epoxies can close gaps while maintaining load-bearing capacity. It has numerous strong compressive points. Expansion and control joints must be added if the crack is likely to expand or move in the future; otherwise, the treated crack might permit movement. Preventing moisture from penetrating beneath concrete pads and causing them to heave or sink will keep the junction waterproof. Prevention is always better than cure, and timely waterproofing measures will prevent a great deal of trouble in the future,” she adds.

“There are a lot of options available in the market, Majorly double component acrylic systems for wet areas are recommended. The choice of either depends on the budget of the client. Polyurea/ Polyurethane-based coating are the best for Podiums & Terraces. For the raft areas, these days good HDPE

membranes are available with thickness varying from 1.2mm to 1.5mm,” explains Ramendra Bahadur Sinha.

Treatments recommended

Anil Banchhor, MD & CEO, RDC Concrete:

“Waterproofcrete is a specially designed concrete which has reduced water permeability for the same grade of concrete generally used. It has specially tested admixtures, which have been tested to give the highest performance in terms of reduction in water permeability. Most of the integral waterproofing solutions available for concrete have their own unique properties, which, however, are not meant for Indian conditions, besides which, they are costly too. Our R&D has rigorously tested most of the methods, both on lab models and prototypes. Since we don't have a tie-up model with any manufacturer of these chemicals, we have the liberty to choose the best performing solutions for waterproofing. In my view, the solutions offered by Waterproofcrete are the most efficient.”

Sameer Karkhanis, Odd Jobs Waterproofing:

“Crystalline waterproofing comes in single component or 2 components and is applied mostly on poured concrete surfaces to protect them from dampness. It can be applied on concrete slabs of a terrace, bathroom sunk, water bodies, places below the ground surface, etc.

Alkaline admixtures and glass fiber or liquid admixtures should be used strictly under a waterproofing consultant's or an applicator's supervisor's guidance and while pouring concrete by RMC or a hand mixer machine. This will protect the areas from voids, porosity honeycombing, concrete shrinkage, crack formations, and also give excellent protection to the reinforcement.

Water stoppers or swelling bars are used to break the flow of water seepage and are placed in position during the construction phase. These should be used in areas where concrete joints are present and particularly on steel bars before pouring concrete, or after an earlier poured concrete has got set. Its main utilization is in basement walls, retaining walls, shear walls, and in water bodies. Flashing tapes can also be used similarly on horizontal and vertical joints.

Injection grouting whether it's cementitious, epoxy or PU Foams should be used from positive sides in construction rather than from negative sides. Silicon coatings, PU, high elongation polymers, and bore packing methods ensure good waterproofing in a building.”

Ramendra Bahadur Sinha, Founder & M.D, Agrani Group: “For rainwater related dampening, I would suggest injection grouting. For retaining walls, Podiums & other heavy concrete structures, where positive side waterproofing cannot be done, negative

side waterproofing methods can be adopted, especially in places like basements and underground car parking areas.”

Harsha Kavi, Fosroc: “Remedial waterproofing in roofs is by far the most complicated. Roofs are usually crowded due to installed units for air conditioning, plumbing pipes fixed onto the roof surface and parapet walls, etc. Sometimes, steel fabricated over-bridges are erected over roof areas, where large sized pipes run over the roof surface. All these need to be relocated and lifted well above the roofing surface or parapet before one can start surface preparations. In domestic situations, the relocation may be far easier, which the waterproofing contractor can take up as a part of his remedial job.

Loose plasters and cracks in surface of the roof need to be exposed with mechanical means along with high pressure water jetting, etc. Once the bare surfaces of the walls and roofing surface are exposed, there could be signs of corrosion seen. Generally re-roofing requires quite a bit of civil work and good technical understanding, which sometimes may be outside the scope of the waterproofing job, that requires to fix the substrate issues. In short, there is no straight answer for recommendation of the waterproofing materials, as it is always subjective. A tailored solution needs to be worked out to see that the remedial waterproofing is effective and long lasting.

In wet areas like bathrooms, a superficial remedy must never be adopted. It is essential to remove tiles. The basic waterproofing must be done by way of brush applied cementitious coatings after repair of plumbing and sanitary fittings. In most situations, old, corroded GI plumbing has to be replaced and relocated in the bathroom. Bathroom renovation and its interiors will dictate the waterproofing and tile fixing specifications with more modern fittings. In case a bathroom's base is leaking into the neighbour's bathroom below, PU Injections may be most effective solution for drip leakage.

For basement walls, good materials are available to arrest mild dampness in the interior side of concrete basement walls. Once a dry surface is achieved, it will be safe to coat these walls with decorative paints. When it comes to leaking podiums, it is ideal to strip the entire area on top of a leaking podium and after surface preparation and repair of the deteriorated area. Depending on hard scaping or wet scaping design, appropriate membranes such as polyurea treatment is suggested. The existing expansion joint profiles need to be repaired and treated, and then filled with a low modulus, high MAF sealant. The sealant all along the podium surface will need to be covered with an aluminum channel cover, riveted over, to protect the sealant from the landscaping and soil overburdens. ●

Terrace Waterproofing Solutions for Energy Efficient Buildings



With the increasing emphasis on sustainability and sturdiness and the introduction of recent ECBC codes, the concept of terrace waterproofing and thermal insulation in commercial and high-end residential buildings is becoming popular; in fact, terrace waterproofing is considered a priority as the roof is always exposed to harsh climatic conditions and weather changes.

Rajeev Gupta, ECMAS Construction Chemicals

An effective waterproofing solution ensures the durability of the structure by controlling water seepages. Eco-friendly and high-performance proofing solutions are essential for multi-level applications in a building where terrace waterproofing is particularly important as the roof is always exposed to harsh climatic conditions and weather changes. Waterproofing of flat terraces is extremely challenging as the water cannot run off the structure quickly, and will move slowly or pool above the surface, leading to leakages.

In India, traditional materials and techniques like brickbat Coba, Lime terracing, or the Mud Fuska are still in use though they offer a limited degree of waterproofing along with some insulation against heat. But these systems have some major limitations as outlined below:

- Heavy loading on the slab
- Cracks on the surface, especially in the case of brickbat-coba
- Very labor intensive and application expertise required for lime terracing/mud fuska not as good as in the earlier days
- Rely more on the slope than a leakproof or a water-tight system
- Breaking them and re-doing the same system is risky for the slab; cracks caused in the slab increase the problem of leakage.

Nowadays, a wide range of products is available in the market, ranging from the basic to the more

premium and advanced materials, each of which cater to a specific requirement.

Key selection criteria for an effective waterproofing system for terraces & green roofs:

- Complete water tightness
- Capability to accommodate the structural movements & thermal stresses
- Ability to carry heavy intense built-ups such as landscaping, gardens, pavers, etc.
- Robustness to take pedestrian/vehicular traffic
- Capability to sustain climatic conditions and UV exposure
- Resistance to root penetration, chemicals (pesticides), etc.
- Long-life expectancy along with minimal maintenance.

Alongside waterproofing, managing the thermal comfort of the occupants should be considered keeping in mind the well-being of the people and also cutting down on energy requirements. Constructing energy-efficient buildings will ensure a reduction in power bills, contributing to the saving of fossil fuels. High levels of comfort are obtained through use of sunlight, ventilation, and other modern methods of construction. Thermal comfort can be provided to occupants at diminished levels of power usage by adopting strategic planning of building design and use of heat insulation construction materials.

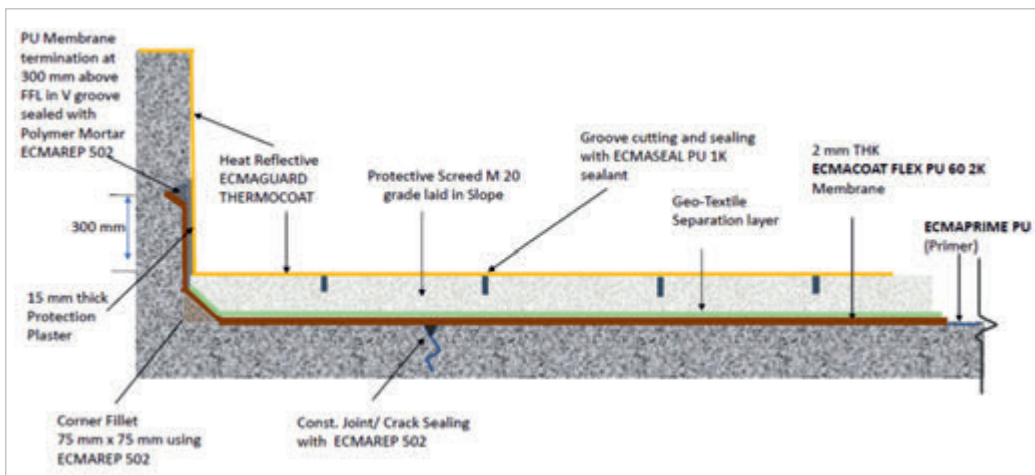


Figure 1

Importance of Thermal Insulation in Buildings

In countries with extreme climatic conditions, more than 65% of the energy consumption goes into air conditioning to maintain soothing indoor temperatures. This poses a great challenge to architects and designers to conduct major analytical studies, to make maximum use of natural resources like lighting, ventilation, along with performance-oriented thermal insulation materials limiting the U-value for roofs and external walls in the buildings. The use of high-quality insulation materials has resulted in controlling the heat transfer through the walls. A premium quality insulation material reduces the heat transfer rate from outside to inside during summers and the reverse during winters.

The quantum of heat transfer through roofs and walls ranges between 60-70%. This heat is removed by air-conditioning. Therefore, the use of insulation materials for roofs and walls is very essential for energy conservation as it helps in the following:

- Reducing the energy required for cooling and heating.
- Reducing the capacity of air-conditioning equipment and hence reducing capital cost.
- Reducing thermal stresses (thermal expansion & contraction with temperature changes).
- Maintaining a comfortable indoor thermal environment.

With the increasing emphasis on sustainability and sturdiness and the introduction of recent ECBC codes, the concept of terrace waterproofing and thermal insulation is becoming a replacement trend, especially in commercial and high-end residential buildings. Although it may require higher initial costs, the overall life cycle costs are much lower because

the payback is achieved within a few years of (generally) 5-7 years.

Key selection criteria for good thermal insulation material for roofs:

- Low thermal conductivity
- Dimensional stability
- Higher compressive strength
- Negligible water absorption & low vapor permeability
- Good fire resistance

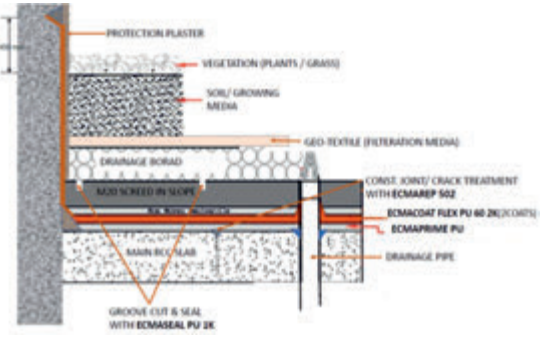
Recent Trends in Roof Waterproofing

Roof waterproofing along with thermal insulation:

A high-performance roofing system is achieved by combining waterproofing alongside thermal insulation. It includes a highly impermeable and sturdy waterproofing membrane that guards against extreme climatic conditions, irregular temperature variations, rain, and suitable thermal insulation material.

Generally, insulating materials like spray applied PUF insulation, XPS, or EPS insulation boards are applied in a controlled thickness (as recommended by consultants) on a well-prepared, clean substrate, followed by liquid applied waterproofing membrane like spray-applied Polyurethane or Polyurea membrane or sheet membrane-like TPO or vice-versa and with or without protection screed. A typical system that is being employed at a prestigious project site is shown in Figure 1.

Green roof solutions: Garden roof systems are specialized roofing solutions designed to support roof gardening. Green roofs provide a variety of benefits in an urban context, starting with giving an aesthetic appeal to the unused roof. The plants and soil protect the roofing membrane from being exposed to harmful ultraviolet rays, extreme climatic conditions, and



physical damage, thereby increasing the durability and lifespan of the roof and roofing material. Green roofs contribute to lowering greenhouse gas emissions, using direct shading of the roof, evapotranspiration, and improved insulation values.

A typical Green Roof System includes the following:

- Durable Waterproof Membrane (ECMACOAT FLEX PU 60 2K or ECMACOAT FLEX PUR 10)
- Root Barrier
- Drainage Layer
- Filtration Media (Geotextile Mat)
- Growing Media or Soil (50-100 mm in depth)
- Vegetation layer: Low-growing, stress-tolerant alpine and herb species.

The components act together to provide a suitable environment that supports plant growth while not compromising the waterproofing function of the roofing membrane.

Cool Roof Solutions: Dark-colored roofs absorb the sun's energy and get hotter as the day progresses. The roof surface can become superheated up to 80°C on a 35°C normal day, as a result of which, the temperature of rooms below becomes unbearable, leading to an increase in air-conditioning costs. Hot buildings also increase the Urban Heat Island effect.

The best method is to stop the roof space from heating up in the first place by reflecting heat away from the roof surface. A cool roof is designed to reflect more sunlight and absorb less solar energy than a

typical roof. Cool roofs are often made from a highly reflective sort of paint or a sheet membrane.

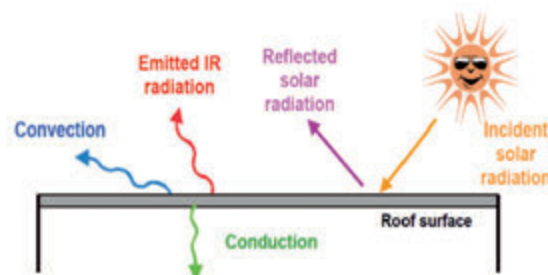
ECMAGUARD THERMOCOAT is a Cool Roof coating with high SRI (roof's ability to reject solar heat) and low thermal conductivity. It is capable of reflecting a large portion of ultraviolet, infrared and visible light, and offers a list of benefits to the building occupants, as mentioned below:

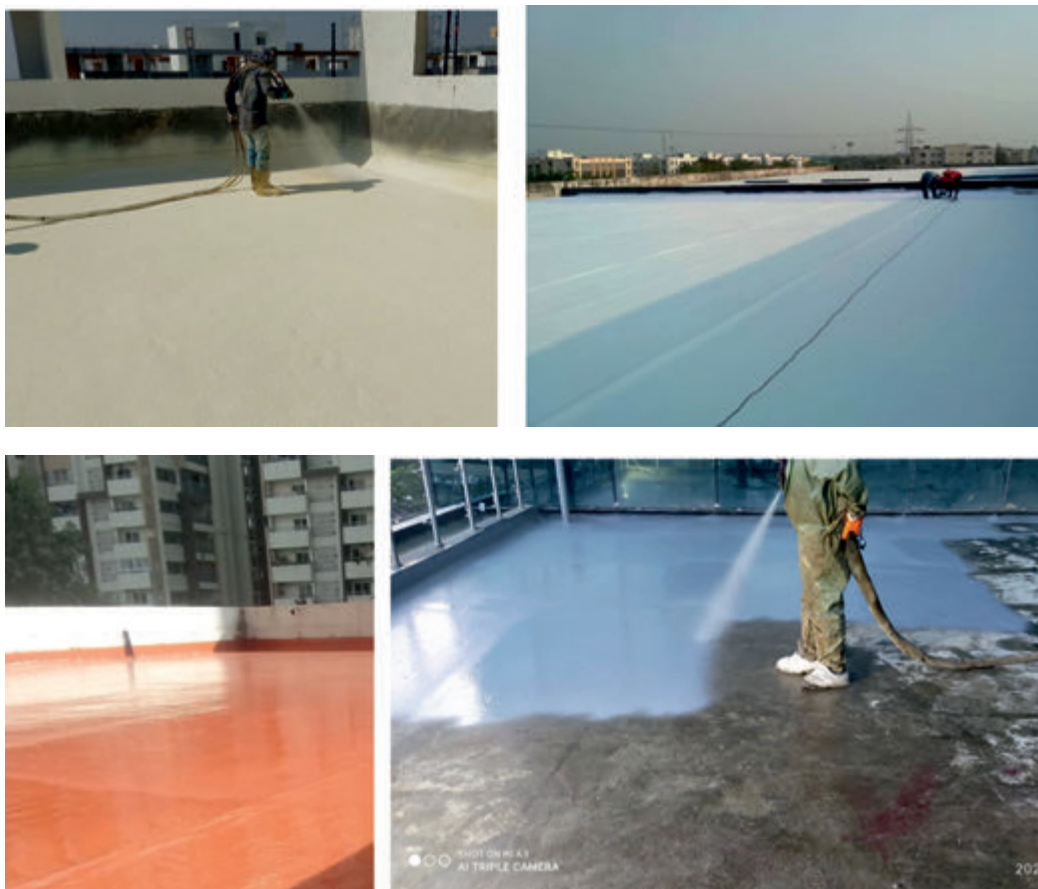
- Reduces indoor temperature by 3-10°C (improved thermal comfort)
- Reduces roof surface temperature by 10 to 30°C
- Reduces air-conditioning costs
- Helps reduce heat islands
- Can be applied over a variety of roof surfaces

Insulation Materials

Roofs are often insulated either over the deck or under the deck. Generally, over-deck insulation is preferred, to avoid the absorption and retention of warmth by the concrete surfaces. Commonly used roof insulation materials include Expanded Polystyrene boards, Extruded Polystyrene boards, Spray applied PUF Insulation, Foam Concrete, Exposure grade liquid membranes with high SRI; etc.

ECMAS is a leading player offering high-performance thermal insulation products like ECMAFLEX PUF 40 which is a two-component, polyurethane resin (PUR) based, seamless, fully bonded, closed-cell rigid foam to be applied with a specially designed spraying machine. It provides high-performance thermal insulation for terraces, green roofs, walls, etc.





High-performance waterproofing

Although, multiple choices are available to the building owners and designers fitting into their technical requirements, and budgets. Some common solutions are cementitious coatings, liquid-applied acrylic coatings, polyurethane and polyurea membranes, bituminous sheet membranes, TPO membranes, etc.

Liquid-applied pure Polyurethane and Polyurea membranes from ECMAS have become increasingly popular thanks to their long-term heavy-duty performance and optimal costs. ECMAS offers a multiple choice of high-performance PU and Polyurea membranes which are ideal for waterproofing huge terraces, green roofs, and podiums.

Non-exposure grade pure Polyurethane membrane (ECMACOAT FLEX PU 40); Exposure and trafficable grade pure Polyurethane membrane (ECMACOAT FLEX PU 60 2K); and Hybrid Polyurea membranes (ECMACOAT FLEX PUR 10 & PUR 20) are popular high-performance, liquid-applied waterproofing solutions offered by ECMAS.

Ec Mashield TPO

The eco-friendly sheet membrane system is a perfect solution for both heat shielding and waterproofing roofs. Thanks to its high SRI values with high emissivity — it reflects over 90% of the sun's heat, thus insulating the roof below. This exceptionally durable and versatile membrane does not allow water to percolate below, thereby waterproofing at the same time. ECMASHIELD TPO membrane is efficient, eco-friendly, and straightforward as a solution for both old and new constructions, and for terraces of residential, commercial, and industrial buildings.

Conclusion

Demand for high-performance waterproofing and insulation systems has grown exponentially. Green roof and cool roof solutions are providing quantitative benefits to building owners and greater comfort to the occupants. This is accelerating the demand for better insulation products such as spray-applied PUF insulation, XPS boards, high albedo solar reflective coatings, and high-performance waterproofing solutions. ●

Importance of Waterproofing Structures

The longevity of structures depends on how much resistance the building element will offer to water ingress. Water leakage not only reduces the durability but also hampers the serviceability or usability of the structure; hence, a good waterproofing system will address the issues of long-term and usability aspects.

M N Ramesh, Managing Director, Talrak Construction Chemicals

Waterproofing is a key activity of the building process. However, sometimes waterproofing problems require individual solutions. That is why a skilled technical team should work together with designers to analyse each situation in order to develop a customised solution which meets the individual requirements of a given project. In other words, waterproofing should commence from the drawing board stage.

Why is waterproofing so important? Each year, around the world, massive amounts of money are invested into infrastructure, public, and private building projects. According to a report on distress in building structures, 80% of damages ultimately relate to waterproofing issues. Investing in high quality waterproofing not only protects construction elements against water ingress but also ensures resource efficiency, low maintenance costs, and high return on investment in the long run.

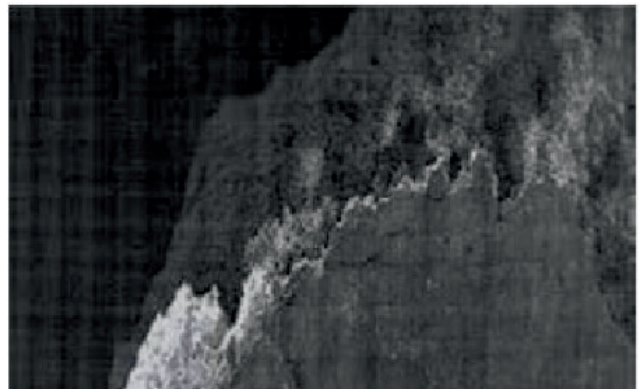
New Construction Projects

In new constructions, external basement waterproofing and waterproofing under the foundation plate protect against water ingress from surrounding soil. TPO roofing membranes protect flat roofs that can last for 50 years in any climatic region around the world. Liquid applied polymer coatings protect balconies and terraces against weathering. Cementitious materials with drinking water certification safeguard drinking water on the inside of potable water storages.

In commercial building projects, decorative flooring combines design with easy cleaning. In industrial facilities, highly resistant floor coatings protect concrete floors from traffic or contamination by oils, acids as well as provide slip resistance. Joint sealants and injection gels help to successfully build underground infrastructures such as new metro lines and tunnels. Water repellents protect buildings and infrastructure from water ingress while special coatings protect façades in coastal areas against the aggressive and salty air.

Remedial Waterproofing Systems

In restoration projects, cementitious crystallizing waterproofing materials provide waterproofing from the negative side such as in basements or tunnels. Special fast setting blitz mortars can even stop



Electron microscope scan: White areas: latent hydraulic compounds which penetrated into the pore structure of the substrate – and reacted to form a pore blocking crystal.



Sealants

STP Limited
Enhancing Structures' Life



ShaliSeal PS PG

Two Component Pouring Grade
UV Resistant Polysulphide Sealant

ShaliSeal PS GG

Two Component Gun Grade
UV Resistant Polysulphide Sealant

ShaliSeal PU PG 2K

Two component Polyurethane Sealant

ShaliSeal PU GG

Single component Polyurethane
joint Sealant

ShaliJet® Sealing Compound

Coal Tar Sealing Compound

ShaliTex Sealing Compound

Bituminous Sealing Compound



Corporate Office:

707 Chiranjiv Tower, 43 Nehru Place, New Delhi – 110 019

Customer Care: +91 81302 81114 Tel: +91 11 46561359

E-mail: info@stpltd.com

Regional Office:

Delhi: +91 11 46561359 Kolkata: +91 33 22821262

Mumbai: +91 22 42530100 Secunderabad: +91 40 2789 6397



www.stpltd.com

flowing water. Curtain injection or area injection are special solutions that are able to waterproof the external side of a construction without direct access. Horizontal barriers stop rising damp (capillary action) in walls while restoration plasters support the drying process by preventing salts from damaging the building substance. Moisture control systems protect against vapor migration through the concrete slab and prevent flooring failure.

Infrastructure forms the heart of trade and commerce in a modern world. Its reinforced concrete structures need to be maintained for secure transportation today and tomorrow. Crack injection technology is capable of repairing cracked concrete structures, whether against active water pressure or just for restoring structural strength.

Key Parameters of a Negative Side Waterproofing System

For successful waterproofing of a structure from the negative side, the ideal product should have the following properties:

- The waterproofing product should be mineral based, just like the brick or concrete substrate and it has to become one with the substrate.
- It should ideally penetrate a little into the substrate; that way it cannot be pushed off by the water pressure.
- It has to be open to vapor diffusion so that water vapor can penetrate the cured coating.

- It should be free of chlorides so that it does not harm the steel reinforcement.
- It should resist high water pressure from the negative side.
- The product should be easy to apply.
- It should have self-healing properties to avoid leakages from minor cracks.

The mineral substrate has to be sound and solid as well as free of grease, oil and loose particles. Prior to application, the substrate has to be wetted and standing water has to be avoided. Dusty or salt-contaminated substrates are primed with a crystalline stabilizing penetrating primer.

Salt Laden Substrates

When sufficient crystallization has taken place, the pressure in the capillaries will get so high that the building material is destroyed. The material loses its mechanical strength and becomes brittle, resulting in a damaged surface.

A typical sign of salt contamination is salt efflorescence, mostly seen as a whitish substance on the surface of masonry or concrete. Often the salts are transported from the surrounding soil through the capillary system of the building materials by rising damp. After a while, paints or conventional plasters are simply pushed off by the pressure of salt crystallization.

For restoring salt contaminated substrates, products that can be used should be flow viscous and products



Salt Efflorescence

based on a combination of polymers and silicates. When it is sprayed onto the surface of the substrate, it penetrates into the capillaries. It reduces the pore volume, lowering the danger of renewed salt efflorescence, and also increases the chemical and mechanical resistance of mineral building materials. The polymers ingredient encapsules the salt molecules and reduces their mobility, preventing the leaching out of efflorescence. ●

FIBERCRETE®: Synthetic Fibers for Concrete Reinforcement

Kalyani Polymers is offering world-class made-in-India Synthetic Micro & Macro Concrete Fiber Products for the Construction Industry under the brand name FIBERCRETE®.

Concrete is an integral part of any construction project, it can be roads, tall structures, irrigation canals, reservoir dams, tunnels, industrial floorings, precast segments etc. This is because concrete is more durable than any other material. Even though concrete is more durable, it is naturally subjected to cracking due to the effect of change in temperature, humidity, wind, and corrosion of steel bars. The cracks can give a way to repair and maintenance or the structure may collapse at service load conditions.

Synthetic Fiber Reinforced Concrete (SFRC) is a type of concrete which contains short discrete synthetic fibers that are uniformly distributed and randomly oriented in the concrete matrix and provides 3-Dimensional Reinforcement for concrete structures.

Role of Synthetic Fibers in Concrete

The two forces, one in top layer and other in bottom layer of freshly laid concrete, develops tensile stresses in the top layer. This leads to the development of early tensile strength in top layer of concrete and creates cracks. The fibers intercept the cracks and act like internal band-aids. Fibers will 'elongate' or 'stretch' before they are able to transfer significant amounts

of stress across the cracks and allow it to carry more load. It's an interlocking mechanism.

Synthetic Fiber Reinforced Concrete projects have proven that synthetic fibers do increase the longevity of constructed projects and have been found to contribute to a number of durability properties, which translates into longer concrete life at a reasonable additional cost.

These Synthetic Fibers have the potential to enhance specific properties of the fresh and hardened concrete such as workability, segregation, bleeding, plastic shrinkage, compressive strength, flexural strength, impact resistance, toughness or energy absorption, abrasion resistance, durability etc.

Based on the cross-sectional size, shape, and intended applications, Synthetic Fibers are categorized into 2 groups:

Micro Fibers: These fibers are used in concrete to reduce Plastic Shrinkage Cracks. These shrinkage cracks occur mainly due to moisture loss in concrete within first 24 hours after placing. During this plastic state, Young's Modulus of Micro Fibers is greater than Young's Modulus of Fresh Concrete. Thus, Polymer Micro Fibers act as a Plastic Shrinkage Reinforcement during the first 24 hours and later

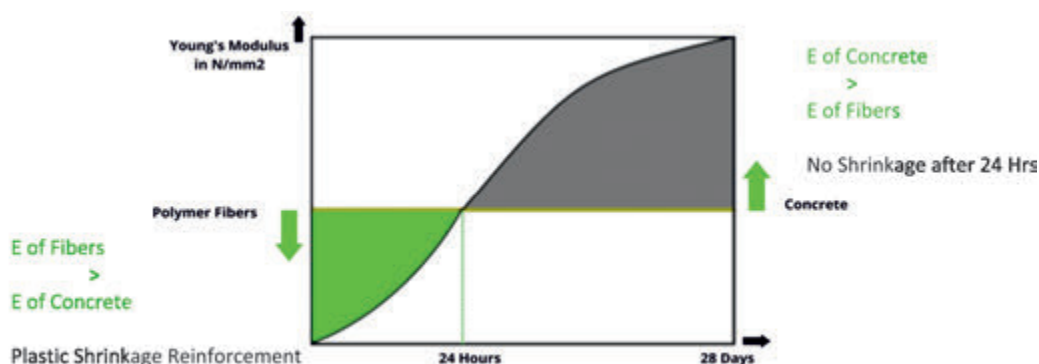


Figure 1: Young's Modulus (E) of Polymer Fibers at an early age of Concrete



mechanical properties of the concrete will add up and result in no shrinkage cracks at a dry state.

“Greater the Young’s Modulus of Fiber, better will be the crack control in terms of crack length and width. The Young’s Modulus of Fiber is the only key parameter to resolve crack issues by bridging the cracks by millions of dense network of Synthetic Fibers.”

In case of any fire accidents, these micro fibers act as capillaries or ducts. Fibers get liquefied and create pores in the concrete to ventilate the accumulated smoke/steam from the inner area to the outer atmosphere, which, in turn, reduces the internal pressure of the building and offers high resistance to spalling of concrete.

Macro Fibers: These fibers are designed to infuse the concrete with high added levels of energy absorption, flexural toughness, durability and increase the post-cracking residual strength of concrete, without the risk of corrosion associated with steel. They also help to mitigate the formation of shrinkage cracking in concrete. These macro fibers play a vital role in transferring

structural loads and are a 100% substitute for steel fibers and steel reinforcements in some areas of applications such as tunnel lining, shotcrete, industrial floorings, mezzanine deck slabs, and many more.

The responses of the macro fibers in the concrete panels indicate a significant load recovery after the cracking. The bridging provided by the fibers contributes to significant energy absorption as shown in the graph.

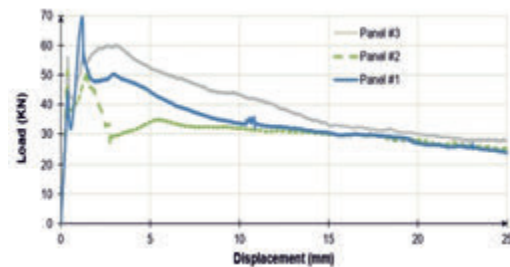
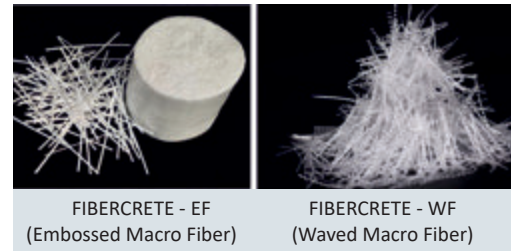


Figure 2: Load Deflection behaviour of Concrete Slabs with Synthetic Macro Fibers

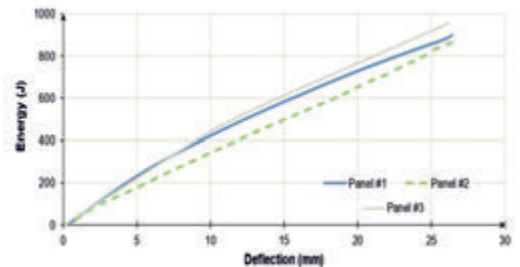


Figure 3: Absorbed Energy as the function of Slab Deflection

Table1: Peak Loads, Crack Loads & Energy absorbed values recorded from panels			
	Panel #1 5 Kgs Dosage	Panel #2 6 Kgs Dosage	Panel #3 7 Kgs Dosage
Energy Absorption up to 25 mm (Joules)	855	883	928
First Crack Load (KN)	56.1	44.8	51.5
Peak Load (KN)	60.2	69.8	59.7



FIBERCRETE® offers world-class made-in-India Synthetic Micro & Macro Concrete Fiber Products for the Construction Industry; they carry a valid CE (European conformity) mark.

Shotcrete, Plastering Mortar, Refractory Bricks, Paver Blocks, Thermal Power Plants, Soil Stabilization, Paints, Waterproofing, Cement Boards and many other applications.

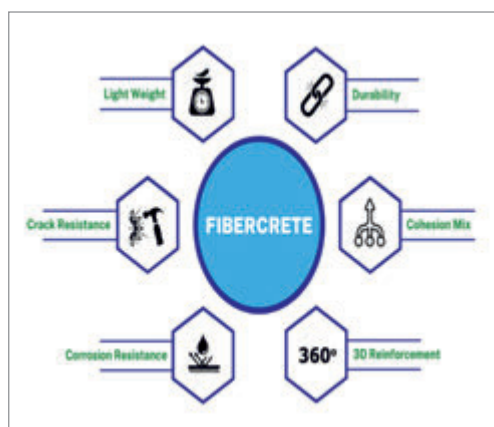
Kalyani Polymers is a leading manufacturer and supplier of Synthetic Micro & Macro Concrete Fibers to the Indian and International Markets under the brand name FIBERCRETE®. These Fibers are Tri-Component Polymeric-based engineered fibers produced by state-of-the-art European machineries from the pellets to fibers and they comply with the standard specifications of Fiber Reinforced Concrete such as EFNARC, ASTM, IRC, MORTH, RVNL, MES, IS standards.

FIBERCRETE® Fibers are Certified and Approved by the following Organizations:

- Indian Institute of Technology Madras, Chennai
- Indian Institute of Technology, Hyderabad
- SKG Project and Engineering, Mumbai
- Kalinda Technical Services & Consultancy, Pune
- Stedrant Technoclinic, Bangalore
- Academy of Concrete Technology, Bangalore
- CIPET, Mysore and Hyderabad
- SHRIRAM Institute for Industrial Research, New Delhi
- The Bombay Textile Research Association, Mumbai

Why FIBERCRETE®:

- High Tensile Strength
- Greater Elastic Modulus



- Non-Corrosive
- Acid & Alkali Resistance
- Chemically Inert
- Hydrophobic (do not absorb water)
- High fiber count
- Reduces the dead weight of concrete element
- Uniform Dispersion in concrete

Fiber Compliance

1. EN 14889-2, 2006
2. ASTM C 1116-03
3. ASTM C 1116M – 06
4. IRC SP 46, 2013
5. IRC SP 76, 2016

For more details visit: www.fibercrete.in

Ultrafine Materials: Changing the Dynamics of Concrete



Anil Banchhor, Managing Director & CEO, RDC Concrete, explains how ultrafine materials improve the hydration of cement particles and also the strength properties and are a way forward towards sustainability.

Would shifting to environment-friendly concrete be financially sustainable?

All products and services have two major inbuilt costs: the cost of energy required to process it, and the cost of energy to transport it to the market. Apart from this, there are many by-products produced during the manufacturing process, which are mostly pollutants, and incur cost for their disposal, and find their utility in the manufacture of concrete. These by-products incur no cost for the energy used in production, but only the cost of energy needed for their transportation. Thus, the correct indicator for environmentally friendly concrete is basically concrete, which is financially sustainable.

The acceptance of the recent trend of using eco-friendly concrete is still very low; it has not picked up the way it should have. This is because the

construction industry is rule-book driven, which means that unless specified and documented, concrete specifications will not be changed.

Also, the specifications are not performance-based, but are prescriptive, wherein the minimum cement, maximum replacement etc. are specified along with just the performance for strength, but there is no mention of durability or sustainability parameters. These documents do not warrant against usage of more environmentally friendly concrete, but it is also the interpretation of these specifications that leads to slow acceptance.

To change this situation, educating the specifiers and the designers will be required. Manufacturers and customers still haven't understood the importance of environment friendly concrete, and what profits and benefits are in store for them by using this





concrete. Manufacturers are driven by customers and customers by the prescriptive specifications, which do not change so easily.

Why is Greencrete by RDC Concrete so popular amongst the designers?

Greencrete is made using selected cementitious materials judiciously such that the cost of concrete is minimum for the specifications of strength. The choice of materials for Greencrete are driven by local conditions, as the closest available material which can give the highest performance per unit cost. As said earlier, the cost of concrete is the best indicator of its environmental friendliness or sustainability. Not many designers are yet aware of such concrete, unfortunately, but few of them have started specifying this concrete for their projects - the reason could be the cost or its sustainability factor. Though green concrete may not find its optimum use everywhere, today almost 50% of conventional concrete can be replaced by Greencrete.

What R&D is being conducted in India for developing sustainable solutions for environment friendly construction?

R&D is being done in national institutes for developing sustainable solutions in construction. These include developing materials and new techniques of construction which would demand fewer resources. Construction creates pressure on resources in many ways. For example, a lower life of structures requires constant construction or reconstruction of existing structures, greater requirement of building materials due to their low strength to weight ratio, inability to optimally use certain materials and their properties relevant for structure and their loading condition. I am

happy to say that the new materials and construction techniques are closing these gaps.

Reducing cement content and replacing it with fly ash or GGBFS reduces carbon dioxide emission and water consumption. What is your view of this practice?

Yes, replacing more cement with either fly ash or GGBFS are common strategies to reduce the carbon footprint. Reduction of cement is now also being done through particle packing at the microscopic level. The reason why we have finer cement today as compared to cement of almost 20 years ago, is because fine cement is being used more and more. The strength we achieve at 28 days with a low cost of grinding, is not more than the strength that we get for higher cost of grinding with significant reduced cement content. This is due to the rising cost of transportation w.r.t. the cost of grinding the clinker at the mills.

Reduction in cement content is also possible with ultrafine mineral additives to a significant level from M25 grade onwards. These materials have proven that they can reduce the cost of concrete not just for high grades but also for normal high volume grades. This is essentially due to the proximity of the manufacturing units (which save transportation costs) compared to the imported microfine materials that we got earlier.

We are seeing more and more new ultrafine materials which improve the hydration of cement particles and also the strength properties due to their surface characteristics. In other words, optimum fineness and distribution of particle sizes through supplementary cementitious materials is the way forward towards sustainability. ●

Icrete: A New Age Material for Concrete Construction



V. R. Kowshika, Executive Director, Amazecrete, shares insights on the properties of Icrete that help reduce shrinkage and permeability, while increasing the durability of concrete.

What are the properties of Icrete?

Icrete is a new concrete additive made from industrial by-products. It is a carefully selected blend of micro minerals available in powder form and conforms to ASTM C 1797. It chemically reacts with intermediate phases of cement to increase its strength and durability. Though not a super-plasticizer, it helps to maximize profitability, durability, and use of supplementary cementitious materials. It helps to make low cement content systems with increased durability and sustainability. The dosage of Icrete is between 0.7 to 2.25%.

Benefits:

- Stronger and denser than conventionally produced concrete, partially due to the filling on concrete pores by the reaction products of Icrete.
- High ultimate strength, reduced shrinkage.
- Decreased permeability to water and other corrosive chemicals.
- Better economics when compared with similar materials.
- Reduces cementitious materials needed to achieve a specific strength.
- Lowers cement and increases SCM loading.
- Because of the ability of Icrete reaction to hold extra water, the concrete produced by adding Icrete undergoes lesser problems associated with shrinkage and bleed water.

How does Icrete induce reduction in cement requirement?

- It works by promoting the dissolution of alumina and iron present in the supplementary cementitious materials and cement.
- It accelerates the hydration of intermediate phases present in cement and hence increases the rate of silicate reaction, forming additional binding phases other than C-S-H.
- It aids in the formation of additional binding phases, thereby reducing the pore size. By this unique action, Icrete increases the strength even at reduced cement /cementitious content.

What are the application areas of Icrete as a waterproofing compound?

The unique reactions triggered by Icrete in the concrete system reduce capillary pore size which means good enhancement in permeability. Many test results by Dr. Ramkumar (inventor of the product) and an independent third party have conclusively proved the permeability reduction capability of the product, which is to the tune of 50% or even more in many tests.

The product therefore can be utilized as an integral waterproofing compound to enhance impermeability of concrete, mortars, or any cement based systems. In fact, tests have shown that Icrete complies with IS 2645 as an integral waterproofing compound.

How does Icrete help in increasing the content of Flyash and GGBS in concrete?

The specially formulated invention works on Alumina and Iron present in the cementitious products like Flyash and GGBS and makes compounds which fill up capillary pores and also makes concrete more denser and stronger. Hence, we have seen many possibilities in the usage of SCMs - both in lab trials and field applications.

Observations:

- We can get increased strengths when we use OPC+GGBS or OPC+PFA incorporated with Icrete.
- We can reduce total cementitious content or we can increase use of SCMs with use of Icrete with same cementitious content.
- In fact, Icrete allows very high loading of GGBS & PFA in conventional concrete mixtures.

How does Icrete influence the strength characteristics of traditional concrete mix?

Icrete modifies the micro-structure of concrete by interacting with cementitious products. We have seen in numerous trials the increase in strength compared to reference concrete. Icrete, by its unique action, gives comparable strengths and durability even when the cement reductions are in the order of 50 to 100 kgs per cubic meter at different dosage levels, and with different mix designs.

How has the market accepted such additives?

The concrete industry of India traditionally has embraced many technologies and innovations in the past 3 decades; we have seen many customers accepting the product easily after trials. We see a great future for innovative products which make a disruptive impact in the way concreting is done. The benefits of Icrete are appreciated by many concrete producers. In fact, Amazecrete has been successful in introducing Icrete to many customers across India, who have shared their experiences on the benefits of the product and value additions brought by Icrete.

In a recent plant trial in a ready-mix company where a popular product was used at 6%, Icrete was tried at 2% and the results were found to be encouraging. The customer has already started using the same for M60 grade concrete.

We are confident that the product will find its place in all concrete manufacturing units. We have plans to introduce many other such beneficial products for the concrete industry.

Icrete Mix	1Cum
Cement	400 Kgs
Flyash	160 Kgs
Icrete	11.2 Kgs
Water	147 Kgs
20 mm	583 Kgs
10 mm	472 Kgs
Sand	689 Kgs
Admixture	5.139 Kgs
Initial flow	680 mm
1 Hour Flow	650 mm
2 Hour Flow	630mm
3 Hour Flow	575 mm
7 Days Average compressive Strength	59.16 Mpa
28 Days Average Compressive Strength	82.13 Mpa

Please tell us about Amazecrete and its manufacturing facilities.

Amazecrete strives to provide Green Concrete solutions to the construction industry through its flagship product Icrete. The product is the brainchild of Dr. Ramkumar, who has worked for almost 2 decades to bring this product to the market. As Director of Navodaya Sciences, he has been helping the company introduce Icrete to the concrete world. Our R&D facilities involve huge investments as we need to do both basic testing of concrete and a lot of work on hardened properties of concrete, especially related to durability.

The company focusses on providing readymix concrete, precast concrete and ready-to-use plasters which can be pumped. Icrete can provide 20 - 30% reduction in cement content in concrete thereby reducing CO₂ emissions and thus being an alternative for an ecofriendly solution like GGBS and Flyash.

Icrete is produced by carefully planned proprietary processes (invented by Dr. Ramkumar) at a state-of-the-art the production facility in Trichy. The processes are closely monitored by modern QA/QC systems. There is constant evaluation of raw materials and the processes till the finished product is ready, followed by tests both at our in-house laboratory and at third party labs like the Bureau Veritas. More than 6000 trials have been done to tailor make the product to reach the current efficiency level. ●

Climate Control Concrete

Leading cement and concrete maker ACC has unveiled a revolutionary thermal insulating climate control concrete system in India. **Sridhar Balakrishnan, MD & CEO, ACC Limited**, discusses its attributes, applications, and benefits for home builders, architects, engineers, and developers.

The latest innovation by ACC is the ACC Airium, a mineral foam-based insulating technology, which as a unique concrete system, offers a long-lasting roofing solution that insulates the surface at the time of construction itself.

ACC Airium is available in low densities starting from 300 kg/m³ and above. The product with its superior thermal insulation properties provides an ideal solution for homes, offices, and buildings across India. Furthermore, it is sustainable, fire-resistant, energy-efficient, healthier, safer, and simpler to work with. With ACC Airium on top, its insulation technology reduces the inside temperature of buildings by up to 5 degrees in peak summer and makes them warmer up to 5 degrees in peak winter. It can be used in a simple way from insulating roof terraces to sub-screed floor insulation to filling of concrete blocks and attics.

Airium is an essential component of ACC's strategy to advance the transition towards low-carbon and circular construction, deliver energy savings with healthy and sustainable construction solutions, lower cost



“The super lightweight technology behind Airium provides insulation at the construction stage itself; it will provide thermal comfort and improve energy efficiency for buildings, from roof to floor, and is seen as a solution with low CO₂ footprint

Sridhar Balakrishnan

of construction and reduce environmental footprint. The product once again demonstrates our ability to rethink construction practices with sustainable, high-performance products and solutions that significantly reduce the carbon footprint of the entire building. While ACC Airium is being launched in two markets: Delhi NCR and Hyderabad, we plan to roll it out in all key markets.



WATERPROOFING FOR BELOW-GROUND STRUCTURES THAT STAY LEAK FREE



HIGH PERFORMANCE CRYSTALLINE SYSTEMS

THE ULTIMATE WATERPROOFING PROTECTION FOR YOUR
UNDERGROUND STRUCTURES, TANKS & WET AREAS

Durable Waterproofing is a combination of materials, application methodologies, detailing and experience. We at **Assess Build Chem**, provide materials and engineered solutions to keep your basements, tanks, UG structures leak free. Our technical expertise helps you design a system, install it and confidently **mitigate risks** to keep structures dry and water-tight.

We engineer basement waterproofing with a combination of Crystalline Additives, Coatings, Grouting, Hydrophobic Mortars, Joint Treatment and other ancillaries. With many **basements larger than 10000 sqm, successfully completed**, we have solutions for you.

CRYSTALLINE ADDITIVES
SS - ConProof CR

CRYSTALLINE COATINGS
SS - CryptoSeal Range

GROUTING SYSTEMS
RASCOflex Range

HYDROPHOBIC MORTAR
SS - HydroNil PM

CURTAIN GROUTING
WILLGel Range

JOINT TREATMENTS
SS - JointSeal Range

RESIN BASED COATINGS
SS - FlexProof Range

SPECIALTIES
SS - WaterStop Range

BASEMENTS, UG TANKS, BATHROOMS, SWIMMING POOLS, ROOFS

WE HAVE YOUR REPAIRS / WATERPROOFING COVERED

WATERPROOFING ISSUES? CONTACT US NOW!



ASSESS BUILD CHEM PRIVATE LIMITED



AN ISO 9001: 2015 COMPANY

+91 22 41272323 | info@ssbuildchem.com | www.ssbuildchem.com

Sustainable Development Through Use of Self-Curing Concrete

***Dada S. Patil**, Assistant Professor, Civil Engineering Department, AIKTC, Panvel, Navi Mumbai, Maharashtra; **Dr. S. B. Anadinni**, Professor & Associate Dean (Core Branches), School of Engineering, Presidency University, Bengaluru; and **Dr. A. V. Shivapur**, Professor, Department of Civil Engineering, Centre for PG studies, Visvesvaraya Technological University, Belagavi, Karnataka, give insights on the importance of curing for controlling the moisture movement from concrete mass during the process of cement hydration.*

Concrete requires sufficient curing to attain the desired strength as well as durability properties. If the concrete is not cured adequately, cement will not undergo full hydration. It is a well-known fact that more fraction of cement particles attaining hydration leads to formation of desirable compounds in the concrete. Moreover, it results in an improved performance of the concrete on site. The sufficient cement hydration ensures that the concrete porosity is decreased to such an extent that the required strength and durability are achieved; moreover, volume changes in the concrete due to shrinkages are also reduced [1].

Initial drying shrinkage is because of quick drying of concrete. It results in the formation of powdery surfaces with low resistance against abrasion. An improper curing increases concrete absorptivity as well as permeability. These two vital factors are a function of concrete porosity. The durability depends upon whether the pores and capillaries are interconnected or discrete. The size and quantity of pores and capillaries prevailing in the cement paste are a function of water curing and water-cement ratio. The capillaries and pores are partly or fully filled by the hydration products. Hence, proper curing is very essential for concrete to attain the desired properties [1, 2 and 3].

It is a well-known fact that the water-cement ratio of at least 0.38 is desired for concrete, of which 0.23 is needed for hydrating all the cement particles and 0.15 for filling the voids in the gel pores. However, practically, water-cement ratio of 0.5 is necessary for full hydration in a sealed container for attaining the required relative humidity (RH) level. However,

in the field it's entirely a different story. Even though higher water-cement ratio is used, concrete is open to atmosphere leading to evaporation and insufficient hydration.

Need for Self-Curing (Internal Curing) of Concrete

Lack of sufficient moisture conditions results in virtually slowing down the rate of cement hydration. Hydration process practically stops when the RH within the pores falls below 80% and it becomes negligible when the internal RH drops to 30% [4]. The conventional curing is done by external application of water to the hardened concrete. Self-Curing or internal curing is a mechanism of preserving sufficient moisture in concrete for an effective cement hydration and reduction of self-desiccation [5]. Self-desiccation is a localized drying because of decreasing RH which may be due to cement demanding additional water for hydration. It is the reduction in the internal RH of a sealed system when empty pores are formed.

Initial period evaporation leads to plastic shrinkage cracking and during final setting; it results in to drying shrinkage cracking. Therefore, curing time and temperature are vital factors that govern the rate of strength development [6]. At high temperatures, ordinary concrete loses its strength due to formation of cracks between two thermally incompatible ingredients, i.e., cement paste and aggregates. Continuous evaporation of moisture occurs from an exposed concrete surface due to difference in chemical potentials between vapor and liquid phases.

Self-Curing facilitates in preserving water inside the concrete mass so that no additional water is required for an external curing. As a thumb rule, 1 m³ of

Contracts for Infrastructure Works

15th October 2022, 9am to 6pm
at Vivanta by Taj President, Cuffe Parade, Mumbai

OBJECTIVE OF THE SEMINAR

The pace is now right to analyse and examine the changes that the two years and more of the pandemic thrust upon the judicial thinking, processes and procedures for contracts especially those related to the extensive Infrastructure development in the country.

The term 'Infrastructure' is used here to imply all sectors - Roads & Highways, Railways & Metros, Shipping & Water transport, Airports, Water, Wastewater & Solid Waste, Power, Irrigation & Flood Control, Townships, Smart Cities, Buildings, Hospitals & HealthCare, Industrial, etc.

The Consulting Engineers Association of India, based on similar successful interactions and the feedbacks received, brings yet another opportunity for discussion on current topical issues in the legal eco-system.

Chief Guest: Vice Admiral Rajaram Swaminathan, AVSM, NM
Director General Naval Projects (Mumbai)

Distinguished Guest: Dr. Ramnath Sonawane, Secretary,
Maharashtra Water Resource Regulatory Authority

Topics & Faculty

1. **Current Judicial trend and issues in Limitation of Interest clauses in Contracts - Mr. Rajat Taimni & Mr. Aditya Gupte, Tuli & Co**
2. **What the Future outlook would be vis-à-vis Operation and Interpretation of Force Majeure clauses in Covid-19 – Mr. Ashutosh M Kulkarni, Advocate**
3. **Recent Judicial Pronouncements on Liquidated Damages – Mr. Suwigya Awasthy, PSL Advocates & Solicitors**
4. **Right to Claim variations and acceleration/ damages and time extension in Contract Execution – Mr. Vikas Kumar Sinha, IRAS, DFCCIL**
5. **Design Liability in Design and Build contracts- Mr. Kirindeep Singh, Dentons Rodyk & Davidson LLP**
6. **Final & Binding- Engineers Determination Clause- With reference to Indian Contract- How can this be Challenged? - Mr. Sachin Mishra, TATA Consulting Engineers Limited**

Panellists – Dr. Vandana Bhatt, Mr. Uttam Sengupta, Mr. Chetan Kavdia, and Dr. Milind Wankhede

Two sessions for interaction with the attendees.

People from the legal sector, construction and engineering who have their finger on the pulse will share their views, experience and the recent pronouncements on legal matters and their impact on the Works. They will be **eminent persons from their fields to break bread together and exchange experiences, notes and views** with Corporate Legal Heads, VP/ GM Contracts, Commercial Managers, Project Managers, Engineers & Quantity Surveyors, Construction Professionals, Consultants, Lawyers & Arbitrators, Insurance Professionals and Others who have a professional interest in the handling of contracts and the resolution of divergent views that arise on the Works.

WHO SHOULD ATTEND?

- Corporate Legal Heads
- VP/ GM Contracts
- Commercial Managers
- Project Managers
- Engineers & Quantity Surveyors
- Construction Professionals/ Consultants
- Lawyers & Arbitrators
- Insurance Professionals
- Others who have a professional interest in the handling of contracts

finished concrete needs about 3 m³ of water, most of which goes into curing [7]. Making water available for external curing has certain limitations such as non-availability of potable water, lack of accessibility of the structure, and low water-cement ratio of High Performance Concrete. In Indian construction industry, external curing techniques are tedious, labor intensive and unsustainable. On the contrary, sometimes, there may be lot of water wastage through evaporation and run-off. To cope up with these issues, Self-Curing is a sustainable solution.

Mechanism of Internal Curing

Concrete curing methods can be broadly categorized into water adding method and water retaining method. Self-Curing is a water retaining method. There are two major ways of internal curing of concrete. The first method utilizes the prewetted porous lightweight aggregates (LWAs) to provide an internal water source in order to replenish the water consumed by chemical shrinkage during cement hydration. The second approach uses hydrophilic additives to reduce water evaporation from concrete surface and bring about water retention. These additives reduce the water loss and create an affinity for the moisture from the atmosphere, as well. This leads to an uninterrupted concrete curing. In recent years, the idea of Self-Curing concrete has been proving its worth and is gradually making impact in the field applications from the laboratory studies.

As per ACI 308 committee [8], "Internal curing is a mechanism by virtue of which cement hydration takes place due to additional water available which is not the part of mixing water". The driving mechanism for internal curing is chemical shrinkage. Chemical shrinkage is a process in which the products of a reaction occupy a smaller volume than the reactants [9, 10]. It refers to decrease in volume which occurs during hydration due to chemical reaction. Before setting of concrete mass, this volume change is not a problem, because as chemical shrinkage occurs, concrete is still in fluid form and particles have an ability to re-adjust themselves to fill the voids created by chemical shrinkage. However, once the concrete sets, rigid nature of concrete does not allow the particles to re-adjust which leads to formation of vapor-filled voids in concrete [11].

Self-Curing is particularly beneficial in concretes with low water-cement ratio because of the chemical shrinkage which is associated with Portland cement hydration and low permeability of these materials. As the water incorporated into and absorbed by the cement hydration products has a specific volume less

than that of bulk water, a hydrating cement paste will imbibe water, about 0.07 g water/g cement, from the available sources [12]. In greater water-cement ratio concretes, this water is supplied by surface curing. However, in low water-cement concretes, concrete permeability becomes too low in first 2 to 3 days and hence does not allow an efficient transfer of water from external surface to the interior of concrete [13]. If additional water can be distributed somewhat uniformly throughout the concrete through internal curing, it will be readily available to migrate to the nearby cement paste and participate in hydration process.

Self-Curing is an efficient way to decrease self-desiccation and autogenous shrinkage [11, 14]. Autogenous shrinkage is a volume change in concrete taking place without moisture transfer from the environment into concrete. It is because of internal chemical and structural reactions of the concrete. It is significant in High Performance Concretes because of low quantity of water and increased amount of various binders used. During initial few hours, before concrete becomes a hardened skeleton, autogenous shrinkage is often due to only chemical shrinkage. However, after one day, it can also result from self-desiccation since the hardened skeleton resists the chemical shrinkage. Along with thermal strains, it can be a considerable contributor to early-age cracking.

Apart from reducing shrinkage, Self-Curing facilitates in reducing shrinkage cracking [15], plastic shrinkage cracking [16] and water absorption [17]. The basic difference between the conventional curing and internal curing is shown in fig. 1 [18]. In external curing, water is applied on the surface. The water penetration depth is affected by the factors such as quality of concrete and age. The advantage of Self-Curing is that the water gets distributed throughout the concrete mix.

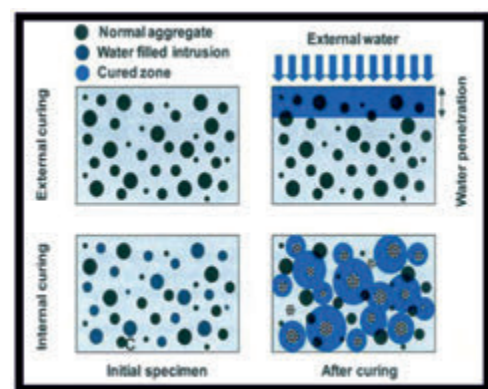


Figure 1: Difference between External Curing and Internal Curing [18]



Figure 2(a): Super Absorbent Polymer [4]

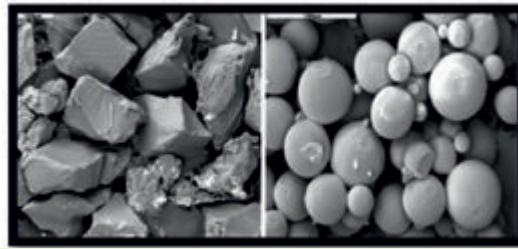


Figure 2 (b): Microscopic View of SAP [4]

Super Absorbent Polymer (SAP) is a hydrophilic material. It is added in to concrete by mass of cement. It can absorb and retain extremely large amounts of a liquid relative to its own mass. Fig. 2(a) and (b) [4] show SAP and its microscopic view.

These water absorbing polymers, classified as hydro gels, when cross-linked, absorb aqueous solutions through hydrogen bonding with water molecules. The other hydrophilic materials acting as Self-Curing agents are Shrinkage Reducing Admixtures (SRA) such as polyethylene glycol, propylene glycol, polyvinyl alcohol, paraffin wax, acrylic acid, etc. These agents are added by mass of cement to reduce the surface tension of the mixing water. These chemical polymers added into concrete mix have a tendency of forming hydrogen bonds with water molecules and reduce chemical potential of water molecules. This reduces the vapor pressure, thereby decreasing the evaporation rate from the concrete surface and enhancing cement hydration.

Rate of hydration increases quantity of solid phase of the paste owing to the fact that water is consumed by chemical reactions of hydration. In addition, water adsorbed onto the surfaces of the solids in the hydration products keeps them saturated, maintaining the RH in the paste to evade the phenomenon of self-desiccation.

The various LWAs used in prewetted condition for the internal curing are expanded shale, expanded clay, pumice, perlite, sintered fly ash aggregates, etc. These are added as partial replacement of fine aggregates or coarse aggregates by volume. Part replacement of fine aggregates with fine LWAs is preferred due to their uniform distribution throughout the concrete mass. Efficiency of LWA as an internal curing additive primarily depends on amount of absorbed water which it can hold, it's particle size and distribution and it's pore structure. The optimum quantity of LWA used to attain Self-Curing is a function of type of LWAs, their size, degree of their moisture preconditioning, water-cement ratio of mix and type and amount of binders used in the concrete mix. LWAs should hold sufficient

water until needed and should not affect water-cement ratio. They should give up water at high RH, through good desorption behaviour. The water leaves pores of LWAs provided that enough suction pressure exists. However, this favorable desorption behaviour is not characteristic of all LWAs [19]. The distance of water travelled from the surfaces of internal reservoirs was estimated by Bentz et. al. [20] in terms of hydration age. Early age (< 1 day): 20 mm, middle age (1day to 3 days): 5 mm, late (3 to 7 days): 1mm, worst case (> 28 days): 0.25 mm.

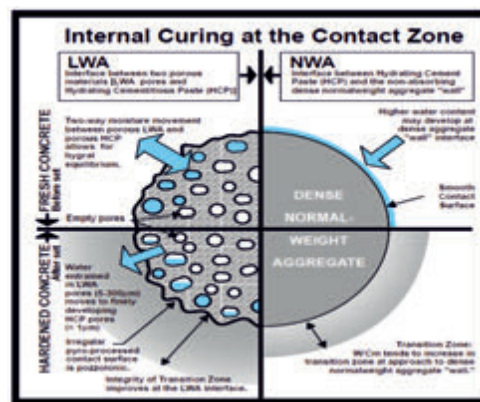


Figure 3: Difference in moisture movement between Porous LWAs and NWAs [20]

The microstructure of Interfacial Transition Zones (ITZ) around LWAs and normal weight aggregates (NWAs) are different (Fig. 3). In NWAs, a wall effect exists because of inherent size differences between cement particles and aggregates. There is a deficiency of cement particles and a surplus of water (porosity) near the aggregate surface; so, a higher water-cement ratio within the ITZ.

Field Applications of Internally Cured Concrete

There are many cases of practical use of Self-Curing concrete on construction sites, especially for highway projects in advanced countries. Prewetted LWAs were utilized as internal curing additives. Photographs of two such cases are shown in Figure 4 and 5.



Figure 4: Internally Cured Concrete being Cast at Bartell Road in New York (Wolfe, 2010)



Figure 5: Internally Cured Concrete Bridge Deck being Cast Near Bloomington, IN (Di Bella, Schlitter, & Weiss, 2010)

Scope for Internally Cured Concrete for Sustainable Development in India

After agricultural sector, construction industry sector is second largest contributor to Indian economy. So, it needs to be taken on priority basis in terms of providing world class infrastructure as well as delivering time-bound projects. Success of Indian construction sector largely depends upon the availability of raw materials, skilled manpower, construction equipment and state of the art technologies.

Availability of required quality as well as quantity of water is an issue. The unskilled workers don't realize the importance of sufficient curing, thereby producing a low-quality concrete. On the contrary, sometimes, a huge amount of water is wasted for the curing purpose. There is a dire need of producing the concrete with judicious and optimum use of constituent materials, including water, to cope up with the field requirement of workability, strength and durability. India has a complex physical diversity in the form of temperatures and humidities. These factors are important for concrete performance in its life cycle. If internal curing is practiced in India, it would lead to a sustainable development.

References

- [1] S. Mindess, J.F.Young, and D. Darwin, Concrete, (2nd edition, Prentice-Hall, 2003. p. 287).
- [2] P.K. Mehta, P. K. and P.J.M Monteriro, Concrete – Microstructure, Properties and Materials, (Third Edition, Tata McGraw Hill, 2009).
- [3] A.M. Neville, Properties of concrete, (Fourth Impression, Pearson Education, 2009).
- [4] K Vedhsakthi, M Saravanan- (2014), "Development of normal and high strength self-curing Concrete using SAP and comparison of strength characteristics", International Journal of Engineering Research & Technology (IJERT) volume: 03 Issue 10 Oct 2014.
- [5] Dhir R K, Hewlett P C, Lota, J S, and Dyer T D(1996), "Influence of Microstructure on the Physical properties of Self-Curing Concrete", ACI Materials Journal, Vol.93 (5), pp. 465-471.
- [6] J. Wang, R.K. Dhir, M. Levitt, Membrane curing of concrete: moisture loss, Cem. Concr. Res. 24 (1994) 1463–1474.

- [7] Castro, L Keiser, M Golias, J Weiss, (2011), "Absorption and desorption properties of lightweight aggregate for application to internally cured concrete mixtures", Cement Concrete Composites (33), pp.1001–1008.
- [8] ACI Committee 308. Guide to curing concrete (ACI 308R–01, Re-approved 2008). American Concrete Institute, Farmington Hills, Mich, 2001, p. 31.
- [9] L'Hermite, R.G., Volume changes of concrete, in 4th International Symposium on the Chemistry of Cement. 1960: Washington D.C.
- [10] Lura, P., D. Bentz, D. Lange, K. Kovler, A. Bentur, and K. van Breugel, Measurement of water transport from saturated pumice aggregates to hardening cement paste, Materials and Structures, 2006. 39(9): pp. 861-868.
- [11] M. Geiker, Studies of Portland cement hydration: measurement of chemical shrinkage and a systematic evaluation of hydration curves by means of the dispersion model, PhD thesis, Technical University of Denmark, 1983.
- [12] D.P. Bentz, K.A. Snyder, Protected paste volume in concrete –extension of internal curing using saturated light weight fine aggregate, Cem. Concr. Res. 29 (1999) 1863–1867.
- [13] Lura, P., O. Jensen, and S.-I. Igarashi, Experimental observation of internal water curing of concrete, Materials and Structures, 2007. 40(2): pp. 211-220.
- [14] Henkensiefken, R., P. Briatka, D. Bentz, T. Nantung, and J. Weiss, Plastic shrinkage cracking in internally cured mixtures made with pre-wetted lightweight aggregate, Concrete International, 2009.
- [15] R. Henkensiefken, D. Bentz, T. Nantung, J. Weiss, Volume change and cracking in internally cured mixtures made with saturated lightweight aggregate under sealed and unsealed conditions, Cem. Concr. Compos. 31 (7) (2009) 427–437.
- [16] Henkensiefken, R., J. Castro, D. Bentz, T. Nantung, and J. Weiss, Water absorption in internally cured mortar made with water-filled lightweight aggregate, Cement and Concrete Research, 2009.
- [17] A Francis, J John, (2013), "Experimental Investigation On Mechanical Properties Of Self-Curing Concrete", International Journal of Emerging Trends, Vol.2, Issue3, pp. 641-647.
- [18] Igor De la Varga , Javier Castro, Dale Bentz and Jason Weiss, Application of internalcuring for mixtures containing high volumes of fly ash, Cement and Concrete Composites , Volume 34, Issue 9, October 2012, Pages 1001–1008.
- [19] Pietro Lura, Dale P. Bentz, David A. Lange, Konstantin Kovler and Arnon Bentur, Pumice Aggregates for Internal Water Curing, Concrete Science and Engineering Proceedings. International RILEM Symposium, Evanston, IL, March 22-24, 2004, 137-151 pp., 2004.
- [20] D.P. Bentz, E.A.B. Koenders, S. Mönnig, H.W. Reinhardt, K. van Breugel, G. Ye, Materials science-based models in support of internal water curing RILEM report 41, 29-43. ●



REDECON

2022

National Seminar and Exhibition

SUSTAINABLE DEVELOPMENT - THE FUTURE

17th - 18th November 2022 at NIMHANS Convention Centre, Bangalore

www.redecon-acceibl.com



Organised by



Association of Consulting Civil Engineers (India) Bangalore Centre

DELEGATE FEES

ACCE (I) & Associate Partners Members ₹ 4000/-
DELEGATES ₹ 5000/-
STUDENT DELEGATES ₹ 2000/-

Plus 18% GST

(Registration fee for two days includes Delegate Kit, Conference Proceedings (CD), Souvenir, Lunch/ Coffee/Tea & Certificate of Participation.

SOUVENIR ADVERTISEMENTS

A Souvenir will be published on this occasion. Advertisements will be included in the Souvenir. The tariffs for the advertisements are as follows (which includes 18% GST as per Government directives)

Full Page Colour
Half Page Colour

Rs: 20,000
Rs: 10,000

EXHIBITION

Concurrently with the Conference, an Exhibition is also being planned on the themes of the Conference with many exhibitors displaying the latest equipment, techniques, services and software.

SPONSORSHIP AND ENTITLEMENTS (Exclusive of GST@ 18%)

Features	Principal Patron	Patron	Gold Sponsor	Silver Sponsor	Bronze Sponsor	Supporting Org.	Exhibition Stalls	
							Indoor	Outdoor
Amount in Rs.	7,50,000	5,00,000	3,00,000	2,00,000	1,00,000	25,000	50,000	35,000
Complimentary Delegates	15	10	8	6	4	2	2	1
Product Presentation time	12 Min	9 Min	7 Min	5 Min	-	-	-	-
Exhibition Space (Stalls)	2	1	1	1	-	-	-	-
Advertisement in the Souvenir	Front Inner Page	Back Inner Page	Inside Full Page	Inside Full Page	Inside Full Page	Inside Half Page	Inside Full Page	
Company Logo will appear in the all brochures	Free	Free	Free	Free	Free	Free	Free	Free
Welcome Banner at Venue	Free	Free	Free	Free	Free	Free	Free	Free
Backdrop/Side Wings	Free	Free	Free	Free	Free	Free	Free	Free
Distribution of Product Literatures to Delegates	Free	Free	Free	Free	Free	-	Free	Free

Note: All payments should be made in full, Cheque/DD to be drawn in favour of '**ASSOCIATION OF CONSULTING CIVIL ENGINEERS (INDIA) - BANGALORE CENTRE**' payable at **Bangalore**. Payments can also be made by electronic transfer. (Details given in Registration Form).

Innovations in Crack Bridging with Self-Healing Bacteria in Concrete



Dr. Manjunatha L R, Vice President - Direct Sales & Sustainability Initiatives, and Raghavendra, Senior officer, JSW Cement Limited, discuss bacterial concrete that can meet the requirements for strength, durability, and self-healing of cracks.

The strength and durability of concrete are the major aspects while designing and during construction of any concrete structure. While strength of the structure can be achieved through a mixed design, its durability remains a concern. Cracks in concrete can be observed due to plastic shrinkage, differential settlement, creep, overload, design failure, fatigue, freeze and thaw. These minor and major cracks lead to corrosion of steel that result in spalling and failure of concrete structures.

These cracks can be remediated by conventional methods, polymer impregnation, epoxy injections, and chemicals. But these methods lead to higher repair cost and the inaccessibility of the position of cracks is also a drawback. So, concrete has to be produced such that it should have higher compressive strength and durability, and the capacity to repair its cracks autogeneously.

Crack remediation in concrete

Concrete is the most used construction material; its durability demands regular vigilance so that the structure can endure all kinds of stresses. In fact, durability in concrete is the direct measure of its quality. A rough estimation shows that around 50% of the total budget of construction is further used for repair of structures.

The major spoilsport for durability is cracking of concrete due to tension. Micro-cracks affect concrete's durability and need to be repaired. This leads to a tremendous increase in the lifecycle cost of the structure due to its repair and maintenance. While

care is being taken to prevent cracking, on the other hand, crack remediation is posing a new challenge.

To overcome the set of drawbacks thrown by the synthetic materials available for crack remediation, a special concrete known as Self-healing/bio-concrete has been developed since the 90s that has the ability to heal itself.

The crack remediation materials and techniques available in market such as, epoxy injection, routing and sealing, grouting etc. have various drawbacks. These techniques depend on type and extent of cracking. The treatments only aid the present intended remediation, and should be applied repeatedly if further cracking happens. Also, the durability of the available repair systems itself is questionable. The biggest threat is that the synthetic materials do not prove to be environment friendly. Hence, there is a need to develop an eco-friendly method to remediate cracks in concrete by utilizing locally available materials and considering the factors of the required environment. Therefore, developing bio-concrete by employing bacteria as healing agents demands intense research for the Indian scenario.

What Is Self-Healing Concrete?

Self-healing concrete or bacterial concrete is its ability to produce lime/calcite (CaCO_3) and fill the cracks when exposed to air and water. The lime produced fills the pores and increases the strength and durability of concrete.

Concrete has an autogenous capacity to heal itself through secondary hydration of existing and hydrated

cement when in contact with air and water. But this might not become possible always as the extent of an hydrated cement left is unreliable and the duration is questionable. Also, increasing the cement content is not feasible. That is when the demand for fast, long lasting, efficient, and environment friendly method of healing led to the invention of self-healing concrete through microbial induction. There are various methods to bring about self-healing in concrete. These methods are weighed against each other and a set of desirable parameters to choose the best method applicable is made available.

History of Self-Healing of Concrete

Carolyn Dry, architect professor at the University of Illinois first considered the idea of incorporating mineral admixture and making concrete self-healing. Carolyn used glass capsules which contained methyl methacrylate glue, which would be released when the capsules were broken. However, the higher viscous glue didn't have enough velocity to fill the cracks and glass capsules, being sensitive, would not survive in the concrete environment, which made this approach unyielding.

Others have tried polymers, gels, clay and waxes as a self-healing agent, which resulted in varying degrees of success. In the mid-2000's Jonkers and Schlangen did a research on bacteria as a medium in concrete and found success in the laboratory results. The world's first structure with bacterial concrete at Delft University of Technology was constructed in the Netherlands. The building provides data on its strength and durability based on the performance of the bacterial concrete.

Self-Healing or Bacterial Concrete was invented by Dutch scientist H M Jonkers, with his vast research on bacterial concrete - a product that, despite its higher initial cost, could save money and work in the long run.

Why Bacteria in Self-Healing of Concrete

- Bacteria are unicellular micro-organisms found in several habitats.
- They are the most common amongst the micro-organisms.
- They can easily multiply by binary fission.
- Species that are alkaliphilic and thermophilic are suitable for the concrete environment.
- They are viable for 200 years which far exceeds the service life of any structure.
- They have spore forming ability and the aerobic bacteria becomes dormant during non-availability of water and oxygen.

Selection of Bacteria for Self-Healing Concrete

- The bacteria should be easily available in accessible habitats.
- Owing to concrete environment, they should be alkaliphilic, thermophilic, and aerobic.
- They should be able to sustain the environmental conditions.
- They should be viable for long duration i.e. have spore forming ability. The endospores shall become active when in need to remediate and stay dormant otherwise.
- They should be harmless to the ecosystem, hence non-pathogenic.

There are quite a few mechanisms identified in nature through which calcite precipitation occurs by bacteria. To name a few, urea hydrolysis, sulphate reduction, denitrification etc. The bacteria also act as catalysts to initiate calcite. The bacteria, as healing agents, are used to catalyze the precipitation of calcite through their metabolism.

Mechanism of Calcite Precipitation in Self-Healing Concrete

The reactions for calcite precipitation are as follows:

1 mole of urea is hydrolyzed intracellular to 1 mole of ammonia. Carbamate spontaneously hydrolyses to form additionally 1mole of ammonia and carbonic acid. These products subsequently form 1 mole of bicarbonate and 2 moles of ammonium and hydroxide ions. The last 2 reactions give rise to a pH increase. This in turn shifts the bicarbonate equilibrium resulting in the formation of carbonate ions.

Urea is hydrolyzed to carbamate and ammonia in the presence of urease.

$\text{CO}(\text{NH}_2)_2 + \text{H}_2\text{O} \longrightarrow \text{NH}_2\text{COOH} + \text{NH}_3$
Carbamate is spontaneously hydrolyzed to form ammonia and carbonic acid.

$\text{NH}_2\text{COOH} + \text{H}_2\text{O} \rightleftharpoons \text{NH}_3 + \text{H}_2\text{CO}_3$

Carbonic acid is hydrolyzed to form carbonate ion and hydrogen ion.

$\text{H}_2\text{CO}_3 \rightleftharpoons \text{HCO}_3^- + \text{H}^+$

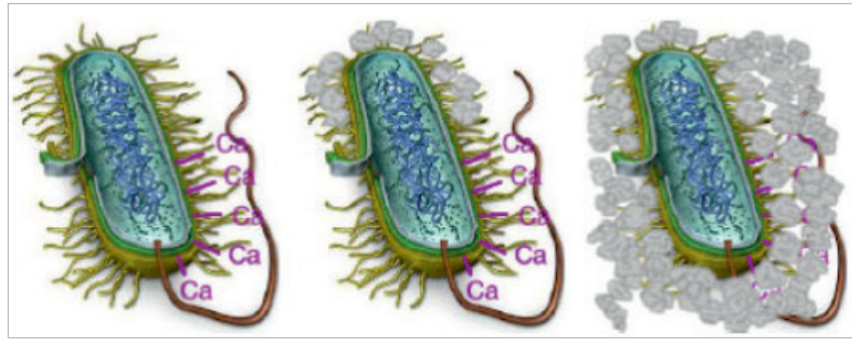
Ammonia spontaneously hydrolyzes to form ammonium and hydroxide ion.

$2\text{NH}_3 + 2\text{H}_2\text{O} \rightleftharpoons 2\text{NH}_4^+ + 2\text{OH}^-$

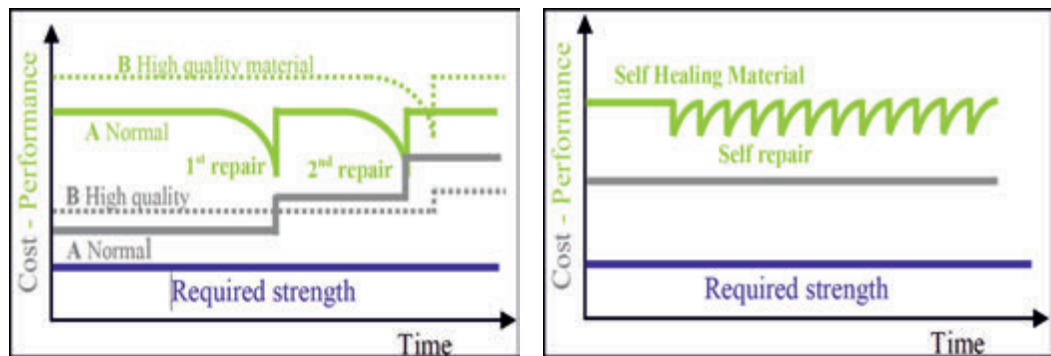
There is a rise in pH due to hydroxide ions which shifts the overall equilibrium of bicarbonate ion towards the formation of carbonate ions.

Calcium Carbonate crystals are formed.

$\text{Ca}^{2+} + \text{CO}_3^{2-} \rightleftharpoons \text{CaCO}_3$



Comparison Between Normal Repair Material Concrete & Self Healing Material Concrete



From the above two graphs, it is assumed that self-healing concrete performs better compared to high quality repair material in repair and rehabilitation works. For the estimated required strength, the cost of repair doesn't change in bacterial concrete and performance is also up to the required standards, whereas in other concrete with high quality repair material, it increases during the course of time and performance is below standards sometimes.

Types of Bacteria for Self-Healing of Concrete

Following are the different types bacteria that have the capability of calcite precipitation

- Bacillus Subtilis
- Bacillus Balodurais
- Bacillus Megatarium
- Lysinibacillus sphaeracus
- Bacillus Pasteurii
- Escherichia colli
- Bacillus Cohnii

Advantages of Self-Healing Bacteria

- Enhances the compressive strength of concrete with calcite precipitation
- Improves the secondary hydration in concrete which result in dense and impermeable concrete

- Increases the tensile & flexural strength in concrete by bridging minor cracks through calcite precipitation
- Reduction in the repair and maintenance cost
- Reduced carbon emission as we are not using additional cement in the repair works.

Disadvantages of Self-Healing Bacteria

- Inappropriate usage of bacteria in concrete may affect the structure's lifespan
- Improper knowledge about bacteria can cause health hazard to human beings
- Higher initial cost in concrete production
- Not suitable for higher grade concrete due to lack of elaborate research on the subject
- Skilled labor required.

Conclusion

Civil engineering and concrete research scientists are keen to develop sustainable technologies that enable a low carbon footprint, while satisfying the strength and durability aspects. Self-healing bacteria is a leading invention in this context. Using bacterial concrete, we are minimizing the repair and rehabilitation cost of concrete structures and thereby reducing the building material usage which results in reduced carbon footprint.

The above study shows a strong possibility of using commonly available non-pathogenic bacterial species as an ingredient of self-healing concrete. It also emphasizes the healing capacity of each bacterium selected. The ingredients have to be chosen precisely to develop bio-concrete/self-healing concrete, as the microorganisms in it will portray higher sensitivity than normal concrete.

References

- 1) Victor C Li and Emily Herbert, "Robust Self-healing Concrete for Sustainable Infrastructure", *Journal of Advanced Concrete Technology*, vol 10, pp 207-218, 2012
- 2) Ali Amiri, Mahzad Azima and Zeynep Basaran Bundur, "Crack remediation in mortar via biomineralization: Effects of chemical admixtures on biogenic calcium carbonate", *Construction and Building materials (Elsevier)*, pp 317-325, 2018.
- 3) Christine Farrugia, Ruben Paul Borg, Joseph Buhagiar and Liberato Ferrara, "Application of *Lysinibacillus sphaericus* for concrete healing using different calcium sources", *SynerCrete 18: International Conference on Interdisciplinary Approaches for Cement based Materials and Structural Concrete*, pp 1053-1058, 2018.
- 4) E Schlagen, H Jonkers, S Qain and A Gareia, "Recent advances on self-healing of concrete", *Proceedings FRAMCOS7*, 2010.
- 5) Erini Triviloglou, Virginie Wiktor, Henk M. Jonkers and Erik Schlagen, "Selection of Nutrient Used in Biogenic Healing Agent for Cementitious Materials", *Frontiers in Materials*, vol.4, pp 1-7, 2017.
- 6) Victor C. Li and Emily Herbert, "Robust Self-healing Concrete for Sustainable Infrastructure", *Journal of Advanced Concrete Technology*, vol.10, pp 207-218, 2012.
- 7) M. G Sierra Beltran and H M Jonkers, "Crack self-healing based on bacteria", *Journal of Ceramic Processing Research*, vol.16, pp 33-39, 2015.
- 8) K. Paine, I. Horne, L. Tan, T. Sharma, A. Heath and R. Cooper, "Microencapsulated spores and growth media for self-healing mortars", *Life-Cycle Analysis and Assessment in Civil Engineering: Towards an integrated vision (Taylor & Francis Group)*, pp 2247-2253, 2019.
- 9) Mohamed Alazhari, Trupti Sharma, Andrew Heath, Richard Cooper and Kevin Paine, "Application of expanded perlite encapsulated bacteria and growth media for self-healing concrete", *Construction and Building materials (Elsevier)*, pp 610-619, 2018.
- 10) N De Belie and W De Muynck, "Crack Repair in Concrete using Bio-deposition", *Concrete Repair, Rehabilitation and Retrofitting (Taylor and Francis Group)*, vol.3, pp 777-781, 2009.
- 11) N De Belie and W De Muynck, "Remediation of Concrete using Microorganisms", *ACI Material Journal*, vol.98, pp 3-9, 2001.
- 12) Nidhi Nain, R. Surabhi, Yathish N. Y, V. Krishnamurthy, T. Deepa and Seema Tharannum, "Enhancement in strength parameters of concrete by application of *Bacillus bacteria*", *Construction and Building materials (Elsevier)*, pp 904-908, 2019.
- 13) P. Jagannathan, K. S Satyanarayanan, Kantha devi Arunachalam and Sathish Kumar Annamalai, "Studies on mechanical properties of Bacterial concrete with two bacterial species", *Materials Today: Proceedings 5 (Science Direct)*, pp 8875-8879, 2018.
- 14) Henk M Jonkers and Erik Schlagen, "A two-component Bacteria based Self-healing concrete", *Concrete Repair, Rehabilitation and Retrofitting (Taylor and Francis Group)*, vol.3, pp 215-220, 2009.
- 15) Sookle S Bang, Johnna K Galinat and V Ramakrishnan, "Calcite Precipitation involved by Polyurethane Immobilized *Bacillus pasteurii*," *Enzyme and Microbial Technology (Elsevier)*, vol.98, pp 404-409, 2000.

Codal reference:

- IS 12269:1987, "Specifications for 53 Grade Ordinary Portland Cement", BIS, New Delhi.
- IS 2386 (Part 1 and Part 3), "Methods of Test for Aggregates for Concrete- particle size and shape", BIS, New Delhi.
- IS 383: 1970, "Specifications for Coarse and Fine Aggregates from Natural Sources for Concrete", BIS, New Delhi.

For more details, please contact:
 manjunatha.ramachandra@jsw.in
 raghavendra@jsw.in ●

Precast & PEB Construction Opportunities for Entrepreneurs



C. A. Prasad, Director, Metey Engineering & Consultancy and President, PSI, Hyderabad, guides entrepreneurs on the various aspects of Precast and PEB construction business.

Quality assurance and timely construction using Precast and PEB produced elements are the reasons behind their increasing demand. These elements are cast by the industry at a centralised location where all facilities for production, testing, and curing are available. Elements produced in precast are:

- Precast prestressed Hollow core slabs
- Precast solid elements like slabs, columns, walls, beams, stairs, and (occasionally) precast footings.

Similarly, in the PEB industry, elements produced include:

- Structural steel columns
- Structural steel rafters, portal frames, trusses, and beams
- Purlins, roofing sheets

All these are prefabricated as per the required size.

How to meet increasing demand for Precast & PEB structures

Demand for Precast and PEB structures is coming from the far interior regions, including tribal areas, so much so that the Indian Government is planning construction of high-quality, sustainable buildings for tribal people in the interiors and at sectors located far away from the cities.

However, precast industries are located near cities and towns, so how will the industry provide the prefabricated structures to the interior areas and to faraway places?

Option1: Produce the precast elements in the industry located in the city and transport them to the faraway areas.

Option 2: Set up a temporary precast facility in a nearby, centrally located area to reduce cost of transportation of the elements. There should be a sufficient number of precast productions for the temporary set up to make the project cost-effective.

In both the options, the precast production of elements should be done by a company experience in this field of work as it will have all the facilities for production, QA&QC assurance, testing, and automated curing system to make the elements produced robust and durable.

Challenges & Opportunities in Transportation and Erection

One of the challenges experienced by the Precast/ PEB industry is the transportation and erection of the precast elements. Many





precast producing companies are looking for external agencies to offload this work.

If transportation of the elements is taken up by an entrepreneur, it will reduce the burden on the Precast/PEB industry, which is looking forward for entrepreneurs to come forward to undertake this activity.

However, entrepreneurs need to be trained on the Transportation and Erection systems such that they will get employment or business opportunities from the precast companies.

Certified Course for budding entrepreneurs

PSI (Pre-Engineered Structures Society of India www.pessi.in) is looking forward to running a certified course in Transportation and Erection of Precast and PEB elements with the help of the Precast Industry. Its aim is to impart knowledge to qualified engineers on how to transport and erect the elements safely at sites. (Details on the certified course will be announced shortly through this magazine).

Cost economics of transportation of elements

Precast elements are heavier while PEB elements are lighter. Usually, a distance of 60 to 80 km is considered as cost effective and is very competitive compared to conventional construction.

However, the Precast Industry is also transferring elements to faraway places of 300 to 400 km distances as per the demand of clients and project sites. Transporting long distances and setting up a

facility to cater to faraway places poses the following challenges:

- Non availability of labour in a remote place.
- Providing labour accommodation is uneconomical and not viable.
- Non availability of materials in the vicinity.
- Time required to complete the structure is less.

Considering the above constraints, companies like Precast India Infrastructure in Pune and Inventaa Industries in Vijayawada are catering to clients requesting the precast industry to deliver the precast structures to faraway/remote places. The two companies have successfully delivered precast elements to far off distances of 250 to 300 kms and thereby set a trend for constructing precast structures in any part of the country.

Cost of Transportation & Erection

The prevailing market rates for transportation and erection rates are as follows:

Up to 25km: ₹500/ton

Up to 60km: ₹750/ton

Up to 80 km: ₹900/ton

Installation/Erection rate: ₹1500/ton

CPWD SSR (DSR/DAR) gives the desired information on costing of precast elements, transportation, erection, grouting, stressing strands, sims, etc.

Acknowledgement: The author expresses his gratitude to Inventaa Industry and to Kirby for providing the required information.

Autoclaved Aerated Concrete Blocks



A sunrise segment in India's building materials industry, the AAC block is finding preference over the red brick and emerging as the future of building construction.

***Mohit Saboo, Director & CFO
BigBloc Construction***

Technology has changed the way we think, work, and live our lives. It is instigating a fresh approach towards better, more innovative, new-age solutions that are future ready. One such product is the Autoclaved Aerated Concrete Blocks (AAC Blocks). Over the last decade, this green and non-toxic building construction material has emerged as a preferred choice over the red brick due to its unique combination and superior build properties like strength, low weight, thermal insulation, sound absorption, unrivalled fire resistance, and economical pricing – reasons why the AAC block has emerged as the future of building construction.

India Opportunity

With around 150-180 plants for making AAC blocks, India is the second largest block manufacturer in the world after China. India's block Industry is almost entirely unorganized, and is characterized by a large number of small players competing at the regional level.

Despite the high growth of AAC blocks in building application during the last decade, it comprises only 7-8% of the industry, while 85-90% of the industry is still dominated by Red Bricks. This presents a huge potential for AAC blocks in the years to come.

The global autoclaved aerated concrete (AAC) market size is expected to reach USD 28.41 billion at a steady CAGR of 5.3% in 2028, according to Emergen Research. A recent report says that the Indian AAC

blocks market is anticipated to register a CAGR of 14.3% during 2020-27 to reach Rs. 11,000 crore.

With increasing regional government projects and expanding real-estate industry, demand for autoclaved aerated concrete is expected to see an upsurge. The Indian government's 'Housing for All by 2024' is also a major game changer for the industry. Projects such as Pradhan Mantri Awas Yojana, Police Housing, Kanya Shiksha Parishar, etc. where the Government has made mandatory to use AAC Blocks.

India is likely to witness an investment of around USD 1.3 trillion in housing over the next seven years, during which it is likely to witness the construction of 60 million new homes. The union cabinet has also extended the validity of the PMAY-Gramin programme till March 31, 2024, to achieve the target of constructing 2.95 crore houses.

Growth Drivers

AAC block manufacturing is gaining prominence and a large number of plants are being set up across the country, especially in Western India. A large number of Integrated Townships, Mass Housings (for Urban Poor, Slum Rehabilitation etc), IT/ITES Parks, High Rise buildings, and SEZs' are commonly seen these days with AAC blocks. Growth in this segment will increase exponentially in the years to come due to increased awareness amongst builders

and architects about the beneficial attributes of AAC blocks over red clay and fly ash bricks.

Shortage of urban labor and high interest costs have forced developers and construction companies to look for faster and more efficient building materials. Projects constructed using AAC blocks complement

the project management in terms of speed, consistency, and quality of construction.

In the domestic market, factors such as pent-up demand and the Indian government's impetus through numerous infrastructure and housing projects, and regulations to use eco-friendly construction materials under its net-zero carbon emission mission, are the primary factors to steer the AAC market growth.

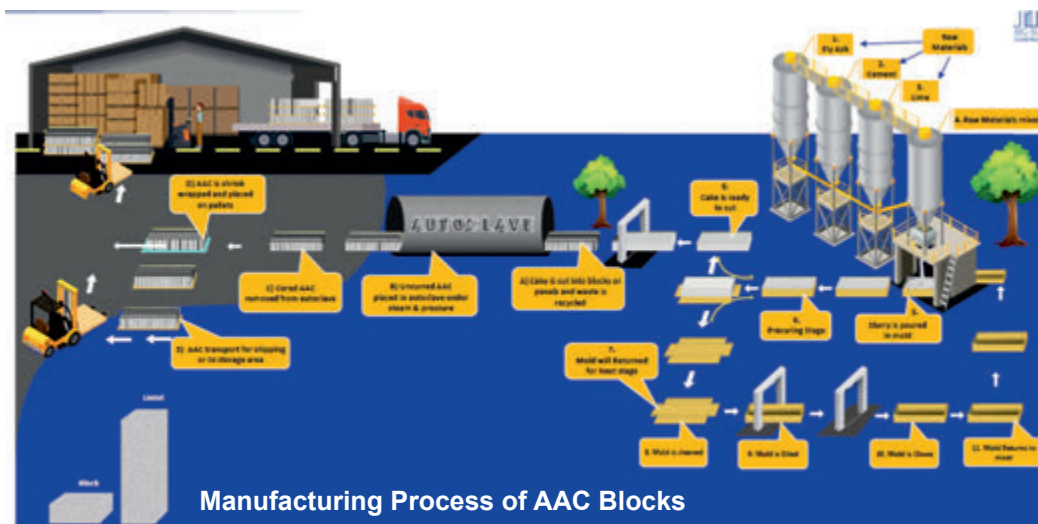
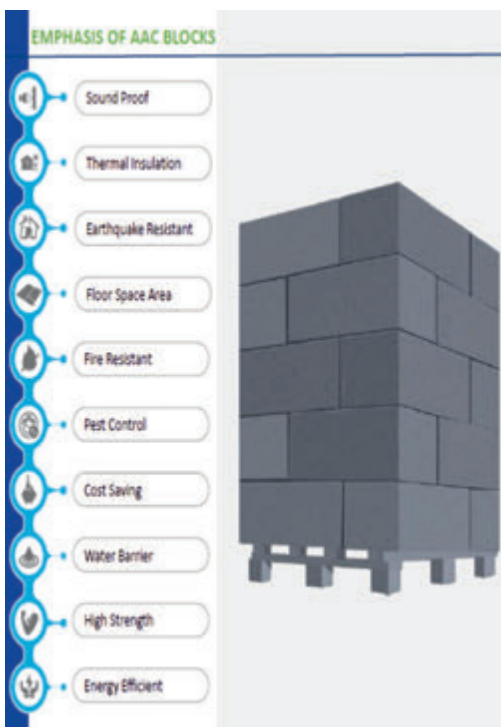
Green Solutions

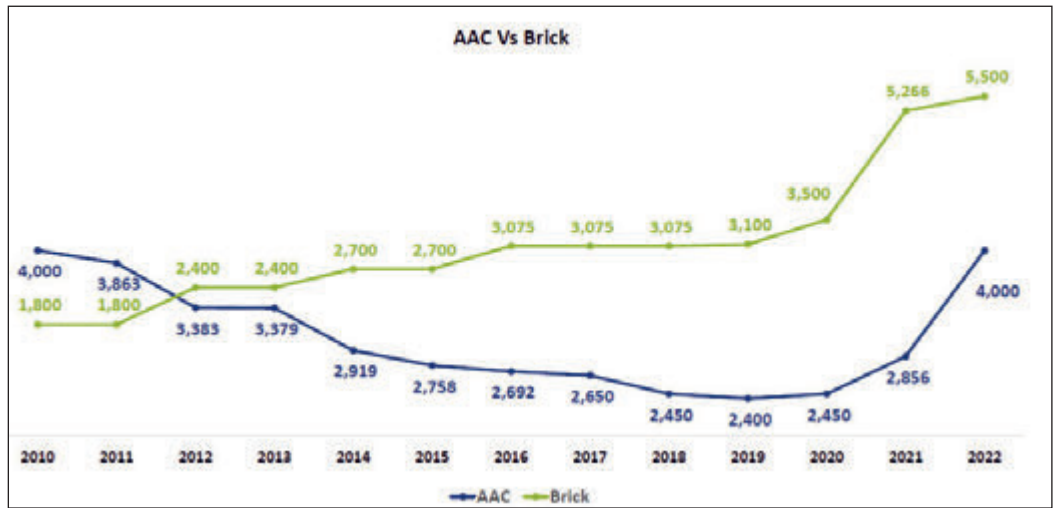
Growth in the infrastructure sector, growing preferences for low-cost houses, and an ever-increasing focus on green and soundproof buildings, are driving the AAC market.

AAC blocks, owing to its energy efficient properties along with being fire resistant, termite or pest resistant, seismic resistant, lightweight, sustainable, quick and easy in application, have emerged as a preferred choice.

The construction industry for the longest time has used red clay bricks. Fundamental issue, however, is that it used red soil for mass production, which is cultivable soil that reduces the forest area.

AAC is a natural and non-toxic construction material that saves energy and is eco-friendly for the environment. Additionally, thermal insulation properties of AAC blocks reduces the energy consumption and helps fight global warming, resulting in the savings during the life of the building.





Economical and Faster Execution

AAC Blocks help by building the home better, faster, and cheaper by use of innovative construction technologies – the reason why they have emerged as a suitable replacement of clay bricks.

Fly ash is one of the key raw materials used in AAC blocks. In India, there are many thermal power plants which generate coal waste (fly ash), which are used in the AAC blocks as a raw material, and also provides a green solution to India’s brick industry.

The current pricing of raw materials like lime, cement, petcoke, and aluminum powder is also in favor of AAC blocks compared to clay bricks. Over the last decade or so, the prices of bricks have risen considerably as compared to AAC Blocks, which further gives AAC a competitive advantage. AAC Blocks are priced at ~Rs. 4000 per cbm, while the price of bricks has crossed Rs. 5500 per cbm.

Upcoming Products & Plans of BigBloc

BigBloc is the only listed company in the AAC Block space in India and the largest in Western India. The

company has plans to launch ALC Panels, Tile Adhesives, Gypsum Plaster, and other construction chemicals. It aims to become the largest manufacturer of AAC Blocks and Panels in India in the next 2-3 years.











It is also the only company in this segment to generate carbon credits. The company is committed towards producing green building products and solutions to help the Construction and Infrastructure Industry to build green and sustainable habitats.

With the vision to Conserve Soil, the company has launched NXTBLOC - a green product. The carbon footprints of NXTBLOC AAC blocks are considerably less compared to traditional walling materials (per sq ft carbon levels: AAC blocks 2.13 kg of CO₂, clay bricks 17.6 kg of CO₂, concrete walls 14 kg of CO₂).

Furthermore, the light weight of NXTBLOC AAC blocks reduces the carbon emission as more cubic meter can be transported per truck load as compared to traditional walling material (3 trucks traditional material in cu m equates 1 truck AAC blocks in cu m).

WORLD'S NO#1 CONCRETE SHOW NOW IN INDIA

PRODUCT SEGMENTS

 <p>Concrete, Building Materials & Precast</p>	 <p>Construction Chemicals</p>	 <p>Commercial & Industrial Flooring</p>	 <p>Construction Equipment</p>	 <p>Formwork & Scaffolding</p>
 <p>Construction Safety Equipment</p>	 <p>AI & IT Solutions</p>	 <p>3D Printing Solutions</p>	 <p>BIMs</p>	 <p>Dry Mortar</p>

IMPORTANT ATTRACTIONS



**WATERPROOFING
PAVILION**



**DRYCOTEC
PAVILION**



BAI SEMINAR

STATE OUTREACH PARTNER



SUPPORTING ASSOCIATIONS



BOOK YOUR STALL NOW

Iyer Narayanan | E: iyer.narayanan@informa.com | M: +91 99673 53437
Saiprasad Terde I | E: saiprasad.terde@informa.com | M: +91 99200 50415
Amitava Sarkar | E: Amitava.Sarkar@informa.com | M: +91 93792 29397

Follow us on:



How to Save Construction Cost



*If the homebuilding exercise is carried out with proper planning and smart execution, it would lead to a significant reduction in cost. **Nidhi Aggarwal, Founder, SpaceMantra**, offers 7 tips to save costs while constructing a house.*

Homebuilding is not only an emotionally intensive exercise but also a financially demanding one. Anyone who wishes to make the home of his dreams has some specifications and preferences in mind. However, the rising cost of construction materials and cement, and steel is leading to an exponential rise in construction costs. However, if you plan a little and employ smart construction techniques, you can save up to 30-40 percent of the usual construction cost. The following tips would come in handy to save on construction expenditure.

A simple plan is the best plan

Although you might have your own specifications and preferences, a complex building plan with curves and turns will add to the cost of the building. A simple plan would be easy to build and will save a significant part of the total cost. If you have hired an architect, you must discuss all the complexities beforehand including the cost. Unnecessary structures would also hinder the free flow of air and will give rise to ventilation issues.

Choice of Construction Material

The choice of construction material makes all the difference to the cost quotient. When you are about to initiate the construction, you must take quotes from different dealers and compare the cost as well as quality. It must be noted that while you are trying to reduce the cost, you must not compromise on the quality as poor quality would be a cost forever. Eco-friendly porotherm bricks or fly ash bricks reduce construction cost significantly.

Prefer a Load-bearing Structure

While building a home, go for a load-bearing structure over a frame structure. A load-bearing structure is known for its economic output. Moreover, in the case of a low-rise building, it reduces the cost significantly

as it uses a reduced amount of steel and cement. In addition to this, the load-bearing structures are easy to construct and require lesser time, leading to reduced consumption of energy and cost.

Soil Testing

A significant amount of building cost is covered by the foundation of the building. In general, the foundation is 3-4 feet deep. However, if you go for soil testing and the soil is normal, you can reduce the depth of the foundation by up to 2 feet. It will reduce the cost of construction significantly. However, the advice of a structural engineer is warranted in this regard.

Prefabricated Components

The prefabricated components market is contributing significantly to modern constructions. Prefabricated materials are predesigned and precast and can be fixed as they are. If not for the entire structure, you can use it for a part of it such as an outhouse, animal shade/shelter etc. Moreover, prefabricated doors and windows are significantly cheaper than hardwood doors while providing the same strength and security.

Precast Staircase System

Contrary to the traditional staircase system, a precast staircase mechanism helps in cost reduction. As compared to the In-situ staircase system, the precast staircase mechanism is efficient and affordable. It also utilizes lesser labour and requires lesser time to get installed.

Right Plot Selection

If you are on the lookout for a new residential plot, you must bear in mind that the level of the plot should not be very high or very low from the road level. If the level difference is too much, then it will require greater efforts in releveling and would add to the overall cost.

International Trade Fair for Construction Machinery, Building Material
Machines, Mining Machines and Construction Vehicles.

bauma CONEXPO INDIA

31 Jan. - 03 Feb. 2023

India Expo Centre, Greater Noida / Delhi NCR

Partner Association

ICEMA

Indian Construction Equipment Manufacturers' Association

Joint Organizer



Facts and figures*

39,173

Participants from 61 countries

668

exhibitors from 26 countries

195,000 m²

of exhibition space

* Figures from 2018

Who must visit?



Contractors



Developers
/Builders



Government
/PSUs



Financial
Companies



Manufacturers



Rental
Companies



Channel
Partners

to name few...

Products on display



All around
construction
sites



Mining, extraction
and processing of
raw materials



Production
of building
materials



Component
and service
suppliers

TO EXHIBIT



➔ bit.ly/bCI_application



Profitability of cement companies to fall for second straight fiscal

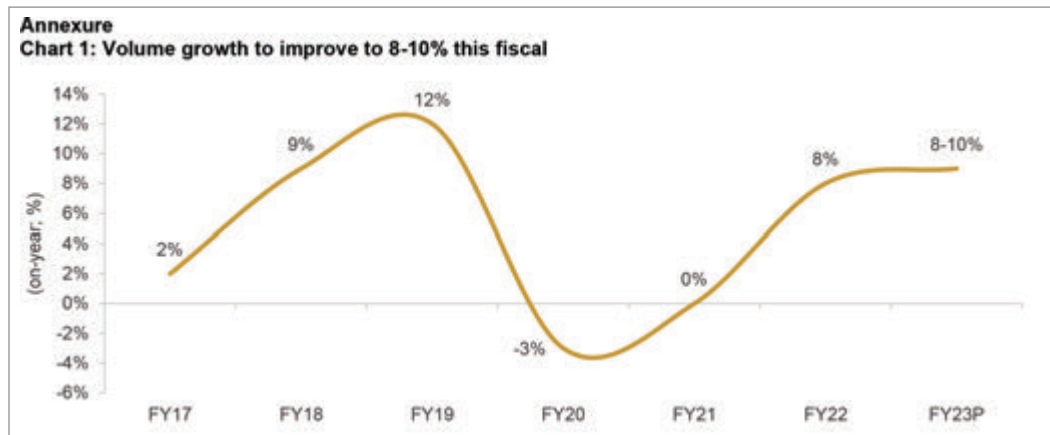
Price hikes to lag increase in production cost, but higher demand to cushion credit outlook: **CRISIL**

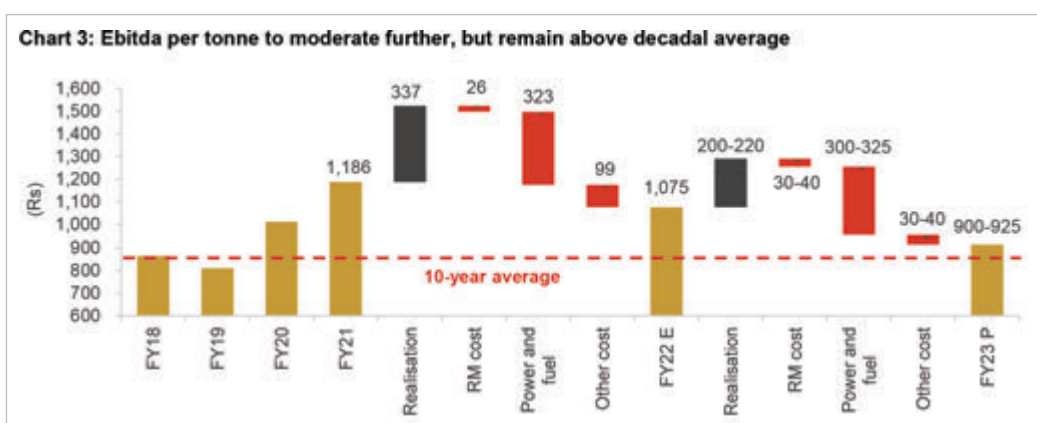
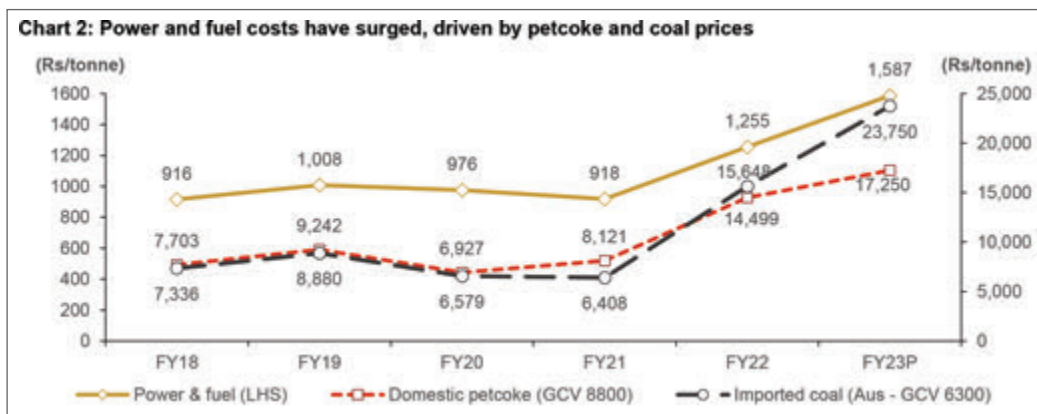
Operating profitability¹ of cement makers will decline ~15% on-year to Rs 900-925 per ton in fiscal 2023, adding to the pain of a 9% decline last fiscal, as increase in realisations will not be enough to offset the increase in prices of coal, petcoke, and diesel that has pushed the average cost of production higher.

However, the 17% growth in cement demand during the first quarter of the fiscal, albeit on the low base of the previous fiscal (which was hit by the second wave of Covid-19), offers a silver lining. Though growth may taper in subsequent quarters, and print at 8-10% for the full fiscal, it would still be the highest since fiscal 2019. The higher demand will mitigate the impact of lower profitability on absolute operating profits

and cash accruals of cement makers, cushioning their credit profiles. A CRISIL Ratings analysis of 22 cement companies, accounting for 85% of the market volume in India, indicates as much.

Says **Koustav Mazumdar, Associate Director, CRISIL Research**, "Cement volume growth this fiscal will be driven by non-housing² segments, wherein offtake is expected to rise more than 15%. Demand from the infrastructure segment will be aided by government spend, while industrial/ commercial demand will be driven by growing investment in data centres and warehousing, and the low base of the previous fiscal. Offtake from housing segment is expected to grow ~5%, taking overall cement volume growth to 8-10%."





Eastern India (including the north-east) will lead the demand growth, at 13-14%, largely on a lower base. The central and southern regions may see ~10% growth, given demand from key infrastructure projects. The northern and western regions, which are relatively more developed in terms of rural-urban mix as well as infrastructure, may see mid-single-digit demand growth.

As for production cost, petcoke prices remain higher than last year's average despite softening in recent months. The same goes for imported coal. Power and fuel costs, which account for up to 30% of the production cost of cement manufacturers, may rise ~Rs 300 per ton this fiscal. Similarly, freight costs will be Rs 10-15 per ton higher, tracking diesel prices that remain high despite some stability of late.

Says **Ankit Kedia, Associate Director, CRISIL Ratings**, "Cement production cost may rise 8-9% this fiscal, given that the benefit of softening petcoke and coal prices will be visible only towards the end of the fiscal as the high-cost inventory depletes. Cement

prices, on the other hand, may go up by just 3-4%, bringing down the operating profitability of cement makers (Ebitda per ton) by Rs 150-175 to Rs 900-925 this fiscal. This will still be a tad higher than the decadal average."

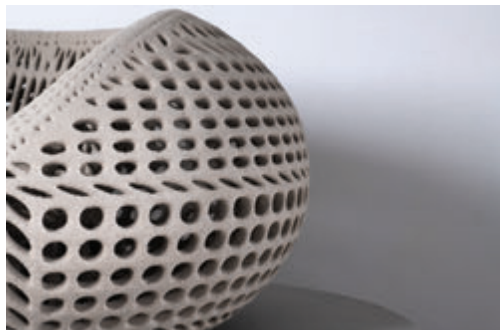
The sector has seen significant consolidation over the past several years, resulting in strengthening of business profiles. Acquired assets have been turned around even as companies have scaled up, leading to reduction in financial leverage of the sector to less than 1 time (measured as the ratio of net debt to Ebitda). This will keep the debt protection metrics stable despite moderation in profitability, thereby sustaining the credit profiles of cement makers.

Further, a significant spurt in capex to more than Rs 27,000 crore this fiscal from less than Rs 19,000 crore in the last will not make a dent as most of this capex would be funded largely from internal accruals. That said, any significant delay in softening of petcoke and coal prices or inability of companies to increase cement prices will bear watching. ●

¹ Earnings before interest, tax, depreciation and amortisation (Ebitda)

² Non-housing includes infra and industrial/commercial segments and constitutes 40% of overall demand. The housing sector accounts for the rest.

3D printed concrete chair wins 'Best of the Best' Red Dot Award



A co-production between Progress Group 3D Innovation and studiooberhauser was awarded Best of the Best at the renowned international design award Red Dot "In search of good design". The project impressed with its innovative design and absolute freedom of form at one of the largest design competitions in the world. Out of approx. 4,000 international submissions, only 38 were awarded the Red Dot: Best of the Best, which is awarded for groundbreaking design and is the highest award in the Red Dot Award: Design Concept.

The CHAIR N°ONE design project is not just a piece of furniture but a piece of art, conceived in absolute freedom of form by studiooberhauser, created in sculptural design, with an extremely dynamic effect, and realised in the 3D printing process by Progress 3D Innovation. Dynamism, durability, and sustainability confer concrete an unmistakable beauty that can only be achieved using the 3D printing process. The chairs are printed in one piece, which provides structural stability and a continuous surface. The selective cement activation process gives the material concrete its own language, immediately connects the user with the object, and radiates simplicity, purity, and essentiality.

Interior design, statues, figures, or entire façades can be realised by Progress 3D Innovation (a company of the Progress Group based in Brixen) using the innovative 3D printing process. The new technology of selective cement activation creates absolute freedom of form.

At studiooberhauser, the focus is on researching and using new and innovative production methods. The latest project is based on selective cement activation, a newly developed 3D printing process for concrete and cement material.

For further details, please contact:

PROGRESS GROUP

Progress 3D Innovation

Schrambach 34, I-39040 Feldthurns
3di@progress-m.com, +39 0472 979 936, Italy

studiooberhauser

studiooberhauser

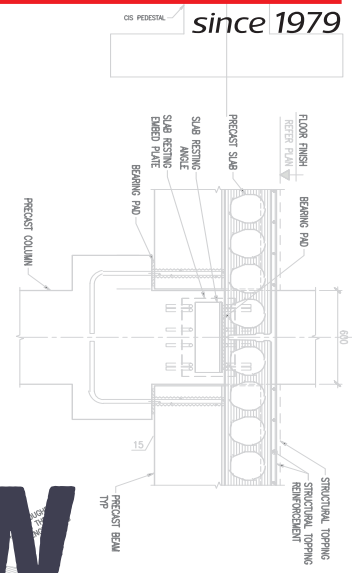
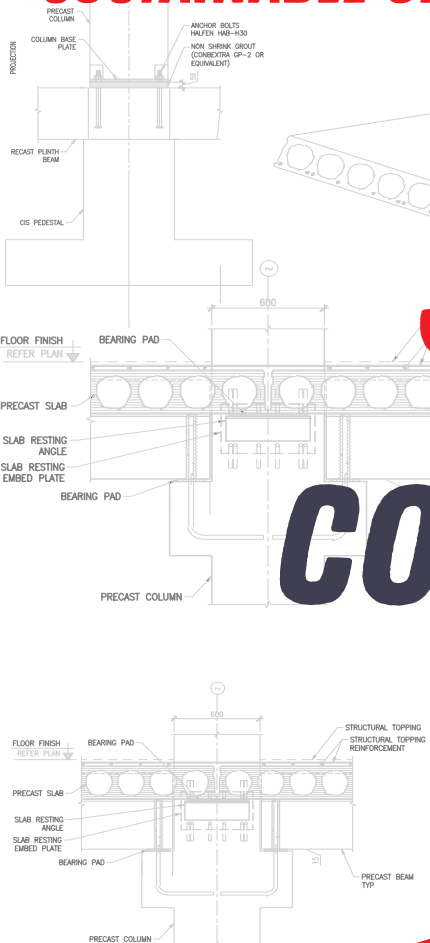
Via Max Plancks. 33, I-39100 Bozen/Bolzano
office@studio-oberhauser.com
www.studio-oberhauser.com
+39 349 400 5583, Italy

**TRANSPARENT
ACCOUNTABLE
SUSTAINABLE GROWTH**

inventaa
Industries Pvt. Ltd

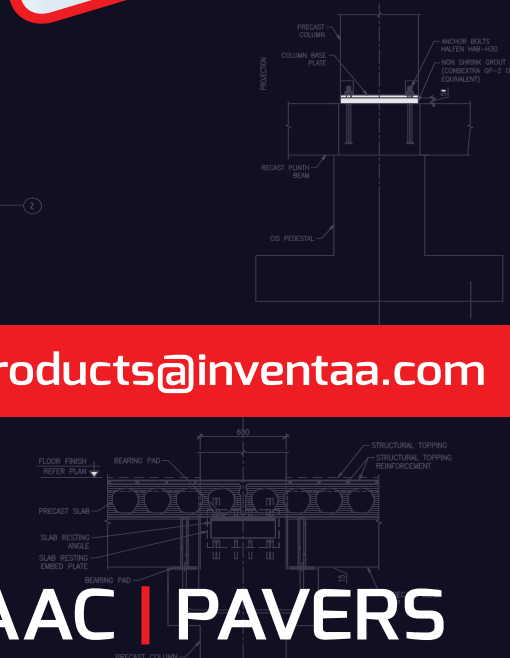
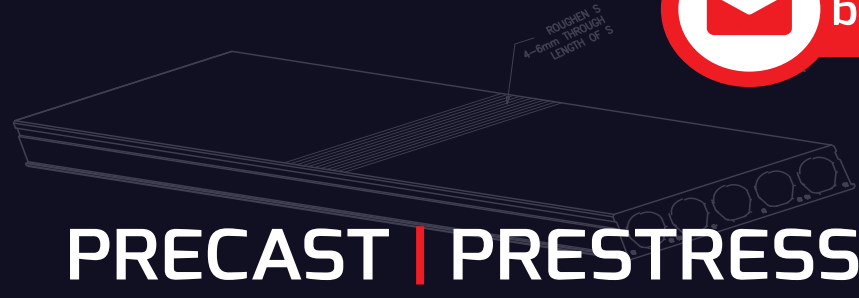
since 1979

ONE STOP SOLUTION FOR ALL YOUR CONSTRUCTION NEEDS



building.products@inventaa.com

PRECAST | PRESTRESSED | AAC | PAVERS



FCN's new technology can reduce CO₂ emissions of concrete paving blocks and products by up to 80% by using Betolar's Geoprime®



Betolar Oyj customer FCN has launched new low carbon paving stones with significantly reduced CO₂ footprint using Betolar's Geoprime® solution. FCN, supplier of concrete block products for gardening and landscaping, has been producing in a CO₂-neutral manner since 2021. It has now introduced a new innovative technology in its production that can reduce the CO₂ emissions of concrete paving blocks and products by up to 80%.

In the 'classic' production method of concrete paving blocks, cement has been used as a binder up to now. The disadvantage of this raw material is that a lot of CO₂ emissions are released during its production. The current composition of a concrete block paving with a stone height of 8 cm emits around 20 kg of CO₂ per square meter. With Geoprime® solution and FCN's innovative manufacturing technology, this figure can be significantly reduced to less than 5 kg of CO₂ per square meter. That is 75% less compared to the previous value.

With its new production technology, FCN is using a development from the Finnish start-up company Betolar: a so-called geopolymer binder. This combines industrial by-products, such as granulated blast furnace slag produced during steelmaking, with special alkaline liquids.

"We are very satisfied with our cooperation with Betolar. We have received great technical support from them in taking Geoprime in use in our production. In the concrete industry everyone talks about reducing CO₂ now and we are happy to be able to respond to this demand," says Bernhard Klöppner, CEO, F.C. Nüdling Betonelemente.

"We are happy to see that FCN has moved into production phase after extensive testing. Our cooperation with FCN has been close during the testing period and we have reached very good results together," says Janne Rauramo, Head - EMEA, Betolar Plc.

The low carbon pavers under the brand Geoprime® were presented for the first time at the Galabau exhibition held in September 2022.

Betolar Plc is a Finnish materials technology company that offers the production of sustainable and low-carbon concrete with the Geoprime® solution. The solution converts several previously unused high-volume industrial side streams into a substitute for cement. Betolar's innovation can significantly reduce CO₂ emissions at a competitive cost compared to conventional cement-based concrete manufacturing, leveraging the existing manufacturing processes.

Betolar signs commercial agreements with three Indian concrete manufacturers to utilize the Geoprime® solution; customers to produce 250,000t/yr of Geoprime concrete by 2023

Three Indian concrete manufacturing companies have separately secured agreements for the use of Finland-based Betolar's Geoprime alkali-activated slag and fly ash additive. The companies are Balajji Cement Products, Shiv Tiles, and SNEH Precast. Engineering company, Godrej & Boyce has also signed a letter of intent with the supplier for pilot production of concrete blocks, paving slabs, and other elements. The companies' product offering focuses on various concrete products for infrastructure and environmental construction, such as pipes and paving materials. The three commercial agreements aim for a total annual Geoprime-based concrete production volume level of 250,000 tons by the end of 2023.

The contract partners have the right to use the Geoprime product family of solutions developed by Betolar in the manufacture of concrete products, combined with continuous product development and expert services, and, in the future, also data support. The contractors also have the right to use the Geoprime trademark in their products manufactured in accordance with the concept.

The Indian government is pushing hard for the country's construction industry to shift to more environmentally friendly building materials. Replacing cement with industrial side streams in concrete production is one of the key means. The government aims to reduce CO₂ emissions by 45% by 2030 and to strive for carbon neutrality by 2070.

“ CONCRETE results you’ll see all year”

Other shows may talk a big game, but only World of Concrete speaks concrete and masonry. We know that a solid foundation isn't just part of the structures you build — it's also the key to a more profitable business. That's why you'll find everything you need to strengthen your operation here, from new products, innovative solutions, and new technologies to help you capitalize on emerging opportunities.

We Speak Your Language: worldofconcrete.com



 **informa**markets

EXHIBITS: JANUARY 17-19, 2023
EDUCATION: JANUARY 16-19
LAS VEGAS CONVENTION CENTER



Get the latest industry news at WOC360.com



Dalmia Bharat accelerates drive for net-zero emissions

Dalmia Bharat Limited (DBL) is accelerating its commitment towards becoming carbon negative by 2040 through its transformative and collaborative strategy roadmap. The company has revealed its larger purpose that emphasized innovation, growth and sustainability through shared synergies with multiple organizations, social entities and governing bodies. These include Asian Development Bank as well as 50 local governments across the nation.

The company has already begun taking steps to replace fossil fuels through its nation-wide circular economy approach such as partnering with local governments to help in non-recyclable waste disposal. For this, DBL commissioned two chlorine dust bypass systems in its cement manufacturing units, a first-of-its-kind project in India. Additionally, the cement major set-up solar and waste heat recovery power generation for clean energy transition.

Today, more than 40% of the power generation capacity at DBL is fossil free. The company is also working on access to clean water by reducing its water footprint. This has made it 13 times water positive. By partnering with Asian Development Bank for feasibility assessment of Carbon Capture and Utilisation (CCU), the company is using CO2 emissions from cement plants in collaborative ways with fertilizer, soda ash and construction sector.

Dr. Arvind Bodhankar, Executive Director, ESG & CRO, Dalmia Bharat Limited informed, "As a cement producer, we are attached to people's happiness by



gluing thousands of dreams into reality. We therefore strive to give our customers only the best building materials with the lowest environmental impact. In addition, we also intend to drive a net-zero emissions reality with a strategy that's aligned with our business philosophy, Clean and Green is Profitable and Sustainable."

Adani acquires Ambuja Cements and ACC

Adani has become India's second largest cement player by acquiring Ambuja Cements & ACC Ltd. Adani family, through their special purpose vehicle Endeavour Trade and Investment Ltd, completed the acquisition after completing the transaction with Swiss firm Holcim and an open offer.

The value of the Holcim stake and open offer consideration for Ambuja Cements and ACC is USD 6.50 billion, which made this the largest ever acquisition by Adani, and India's largest ever M&A transaction in the infrastructure and materials space.

Karan Adani, the elder son of Gautam Adani, is set to oversee the family's scaled up cement business.

Ahmedabad Municipal Corporation to build roads using 'white top' technique

After failing to repair pothole-ridden roads in the city, the Ahmedabad Municipal Corporation has decided to build three roads of around 5.5km using the 'white topping' road construction method. These roads will be in Gurukul near Tirthnagar Society; north zone near Trikamlal crossroads; and Isanpur near Alok Society. It will spend Rs. 20.39 crores on these projects.

White topping is a Portland Cement Concrete (PCC) overlay that is constructed on top of an existing bitumen road. This overlay acts as a long-term alternative for the rehabilitation or structural strengthening of roads.

Bitumen roads last for about three years after which they require maintenance and RCC roads last longer but are expensive. Therefore, AMC chose building white topping roads which are expected to last for eight to ten years.

IITD Organizes Technical Training Program on Waterproofing & Maintenance of Structures

The Institute for International Talent Development (IITD) launched its inaugural Training and Certification Course in 'Waterproofing, Structural Repair and Maintenance of Structures'. The program was held from 22nd to 24th August 2022, at IITD's Training Facility at Kundaim, Goa. The course trained and certified supervisors and budding entrepreneurs in practical understanding of construction chemicals, and helped participants advance their professional practice or launch startups in the field of Waterproofing and Maintenance of Civil Engineering Assets.



Inauguration of Training Program
[L-R: Robert D'Souza
Dr. P. R. Swarup
Er. Samir Surlaker
Sujay Surlaker
Er. Sunny Surlaker]



Sunny Surlaker conducting the theory portion of the course



Group Photo Trainers and Participants at the course

The program covered modern construction chemicals and techniques for waterproofing, concrete repairs, concrete protection, injection grouting and concrete technology, with theoretical as well as practical demonstrations. Over 30 skilled supervisors and budding entrepreneurs from across India attended the program. IITD, led by its Director, Er. Sunny Surlaker conceptualized and conducted the program for Assess Build Chem Private Limited.

The course offered a nationally recognized Certification of Competency, conferred by the Construction Industry Development Council (CIDC) - an apex body in the construction industry set up by the Planning Commission / Niti Aayog. One of CIDC's main initiatives is Training Manpower across various levels in the construction industry.

The program was inaugurated by Dr. P. R. Swarup, Director General, CIDC, Robert D'Souza (from Int-Electra), a leading technical expert in the field of Injection Grouting, and Samir Surlaker, Director, IITD. The program commenced with a prayer and lighting of the lamp, following which, the dignitaries shared their vast experience and reiterated the importance of training and skill development, in waterproofing and maintenance of structures, and motivated the attendees to become a part of a new and Skilled India.

The various segments in the training program were covered by field experts in concrete, waterproofing and repairs and maintenance of structures. Sunny Surlaker covered concrete technology, waterproofing, repairs, and detailing. Robert D'Souza discussed practical issues and challenging case studies in Injection Grouting. Prasad Bhohe and Shounak Vaigankar gave practical demonstrations on using admixtures, repair systems, waterproofing and injection grouting, while Sujay Surlaker covered costing and estimation of various product systems.

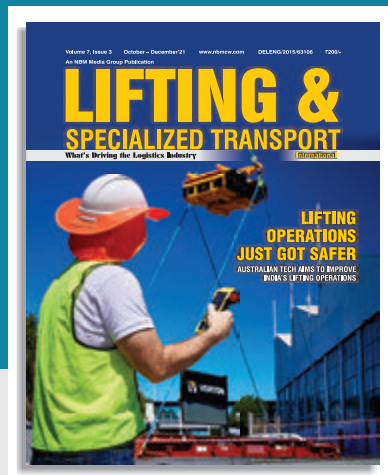
The highlight of the program was a joint CIDC-IITD certification provided to the participants. This nationally recognized certificate of competency was awarded based on the level of participation in the course, demonstrations, and a written test. This Certification places the attendees in CIDC's national database, recognizes their qualifications, improves their skills, and most importantly, their employability. CIDC and IITD aim to expand the program across India.

For more information please contact:
iitd.edu@gmail.com

NBM Media

Most Reliable, Promising and Effective Trade Publication House in the Indian Subcontinent to Advertise with.

Spend your advertising budget wisely with the magazines your customers actually read!



Print & Digital Media

NBM&CW

LIFTING &
SPECIALIZED TRANSPORT

concrete
construction

MGS Modern Green Structures & Architecture

e-Newsletters

Indian Infrastructure & Tenders Week

IndiaConstructionWeek

Modern Green Structures & Architecture
MGS +Design
A fortnightly e-newsletter
ISSN: 0988-0000

Websites

www.nbmcmw.com

www.mgsarchitecture.in

E-mail: info@nbmcmw.com

www.torsa.com

TORSA
VALUE CRUSHING SOLUTIONS

Maximum Up Time Maximum Smiles

Delivering performance excellence since 1999



TORSA SC25 – 250 Tph Crushing and Screening Plant

Torsa SC25 in action at Perficient India Stone Crusher, Siddhi, Madhya Pradesh

Email: info@torsa.com | Toll Free: 1800 121 5696

Scan for more



JAPANESE
PRECISION

INDIAN
ADVANTAGE

KYB
conmat

10,000+
Machines
Sold Globally



- ARAI Approved
- With BS-IV Engine

Self Loading Mixer
2.8,4,4.3,4.8 cu.mtr./hr

CSLM 4800

Salient Features

- ♻ Specially designed blades for better mixing & faster discharge
- ♻ Powered Shovel gate for spillage free charging
- ♻ Loading arms mechanism designed for better pushing force & ease of operation while loading
- ♻ Low centre of gravity
- ♻ Electronic weigh batching system with printer
- ♻ Reversible operator post for better visibility
- ♻ Three way steering systems, ideal for working in confined spaces
- ♻ Live tracking & monitoring system (optional)



CSLM 2800

Product Range



Stationary Concrete Batching Plant



Mobile Concrete Batching Plant



Stationary Concrete Pump



Canal Paver



Road Paver



Concrete Mixer



Self Loading Mixer



Compact Deep Bucket Plant



Tower Batching Plant

KYB-CONMAT PVT. LTD. | 702-703, National Highway No. 8, Por, Vadodara-391243, Gujarat, India

☎ 0265-6132900, 3000300 ✉ sales@conmatindia.com, info@conmatindia.com 🌐 www.conmatindia.com

Follow us on :     