CONCRETE ADMIXTURES & WATERPROOFING SYSTEMS

– Best practices for durable structures.

SEMINAR DOCUMENT

Organised by :

Indian Concrete Institute
Bangalore Centre

7th EDITION

CONCRETE PANORAMA & DEMINAR 2016
ICI - KBC

Two Day National Seminar,
Live Product Demonstration
and Exhibition

25th & 26th February 2016, Bangalore

In association with :

Ready Mixed Concrete Manufacturers' Association

Dr. Aswath M.U.
Chairman, ICI, Bangalore Centre

Er. Kaushik Hajra
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Two Day National Seminar Cum Deminar,

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on

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PREFACE

Construction Industry plays a vital role in the economic development of the country. India's construction industry hasa market size worth about Rs.25 Billion. It is the second largest contributor to the GDP after the agricultural sector. A vital constituent of the construction industry is attributed to concrete. In the present day scenario concrete is rarely being used in its original form.Use of admixtures in the modern concrete is inevitable.

Indian construction chemicals industry stands at over Rs.6000cr and shows growth of approximately 17% over the last 5 years. Concrete admixtures constitute a major portion of this construction chemicals industry with 42% of the share and waterproofingcontributing to about 18% of total construction chemicals volume.

Therefore Indian Concrete Institute has precisely chosen concrete admixtures and waterproofing as prime theme of Concrete Panorama & Deminar – 2016.This is not only because of the size of the market of the above segments but also because of the importance of concrete being the largest consumed material in construction, and in modern day concrete cannot be thought without admixtures and waterproofing is also as an important part of the industry as the construction itself.

Concrete Panorama & Deminar 2016 has attracted very good response from the industry. As of now, four key note addresses, four Technical Presentations, ten Demonstrations are scheduled to take place during the event.

This souvenir consists of all the lead lectures and a few of important topics of relevance are compiled herein.

The organizations supporting the event are to be duly recognized. Keeping this in view, the advertorials of these organizations are also included in this compendium.

We hope that this Deminar document will be a good takeaway to all the participants.

Happy reading

Mr. M N Ramesh

Editor-in-Chief.

Message by President - ICI

Indian Concrete Institute has been in the forefront of espousing the cause of strong and durable structures made with concrete, the most versatile and sustainable material. The judicious use of admixtures in concrete, both mineral and chemical, have made it possible to get most of the desirable properties including durability. Although a well-made concrete element is naturally dense and impermeable, a lack of 'systems approach,' sometimes makes the waterproofing of buildings and other structures a real challenge.

The ICI Bangalore Center has been organizing a unique blend of Demonstration cum Seminar called "Deminar" for several years now. ICI-BC has chosen the subjects of Concrete Admixtures and Waterproofing Systems for the 7th Edition of Concrete Panorama (Deminar). An exhibition is also being organized concurrently. The Organising Committee led by Dr. Aswath has taken pains to ensure that this two day event being held on the 25th and 26th February 2016 is a real technical feast for the delegates.

I wish the program a great success and I am sure that ICI Bangalore Center will raise the bar still higher this time again.

Dr. M. R. Kalgal

President,

Indian Concrete Institute

Message by Vice President (South) - ICI

Deminar is a unique event of ICI Bangalore centre, where in live demonstrations of usage and applications of the products are exhibited . ICI Bangalore centre is organizing these deminars every year on specialized themes. This year the theme selected is "Concrete admixtures and water proofing systems".

Admixture has become an integral part of Concrete construction. With high strength, high performance and special concretes getting widely used, we cannot think about a concrete without admixtures. A good waterproofing system has become a part of all construction activities as a preventive measure to avoid leakages. Also water proofing has become a critical function in all repair and rehabilitation work.

I am sure the contents of the two day deminar, will benefit the participants to a great extent. The organizing committee of this event has put their best foot forward to make this deminar a grand success.

Best wishes

K Jayashankar

Vice President (South)

Indian Concrete Institute

Message by President (Elect) - ICI

Dear ICI Members,

It is my pleasure to see that Indian Concrete Institute, Karnataka-Bangalore Centre is organizing "7th Edition of National Seminar-cum-Deminar". Concrete Admixtures and Waterproofing Systems can be best explained by live demonstration.

The subject of this event is very important for Infrastructure and Construction Industry, which is growing fast. I am quite sure the event will help all the delegates to upgrade the knowledge and information about concrete admixtures and waterproofing systems.

I also wish that the tecno-commercial presentations will benefit the participants, product developers and manufacturers to understand the challenges. They will come-up with improvements and innovations to give best of the technologies for the benefit of Construction Industry.

I extend my best wishes to the organizers, participants and all stake holders and wish them a great success.

Er. Vivek Naik

President (Elect)

Indian Concrete Institute

Message by Secretary General - ICI

Concrete Parorama and Deminar is the Branded Event of ICI-Bengaluru Centre. Concrete lovers eagerly look forward for this event every year. The uniqueness in combining the Seminar and Product Demonstration is being well appreciated by the participants.

This year, organizers have chosen "Concrete Admixtures & Water Proofing Systems" as the topic, which is of paramount importance.

The mounting complexity in design, integrating MEP, HVAC, etc., throws the challenge to Designers and Executors to ensure that there is no compromise on safety and comfort of the occupants due to leak in the structure. I am sure, at the end of the two-days programme, the delegates will carry home a lot to practice.

Bengaluru Centre is known for the grandeur in its events. I Wish the Programme All Success.

Er. R.Radhakrishnan

Secretary General

Indian Concrete Institute

Message by Chairman, ICI - Bangalore Centre

The Civil Engineers for the present and future should have special skills and specific competencies. The engineering colleges are trying to reduce the gap existing between industry and academia by offering trainings and special courses. In spite of all these efforts the employability of the graduates coming out of the institutions is not up to the expectations of the industry. The reasons quality faculty, lack of Infrastructure and there are many such. With systematic training of faculty and students from the beginning of the professional course and regular interactions with the industry and professional associations, the problem of employability may be addressed. Motivation, practical oriented teaching-learning methodologies, original project works, proper mentoring and good salaries will make some difference in the present status of employability.

In the present context of fast track constructions and high grade concretes, production of quality concrete is becoming more complex. In view of this Quality council of India and RMCMA are educating all the stake holders to use concrete from the QCI certified plants having 'RMC Capability Certification'

Indian Concrete Institute, Bangalore Centre** is striving to enhance the knowledge of all the professionals by organizing various activities and facilitating interactions with the industry experts. Focus on quality in all the areas is the need of the day. **Realizing the importance of admixtures and waterproofing, we are organizing this 7th Edition of Concrete Panorama & Deminar 2016.

I am sure all the participants will have some value addition and learn the best practices for durable structures. As a team, keeping the objectives of the ICI in focus, ICI-BC will continue to make a difference and contribute for the betterment of the profession.

I thank all the advisors and the members of the organizing committee for their guidance and support in making this event.

Dr. Aswath M U
Chairman, ICI-BC
Bengaluru

Message by Secretary, ICI - Bangalore Centre

Welcome to all the Civil Engineering Professionals!!!

Indian Concrete Institute, Bangalore Centre presents 7th Edition of "Concrete Panorama & Deminar 2016 on Concrete Admixtures and Waterproofing Systems".

Fast track construction being the order of the day the field and practicing engineers must not to lose focus on the Quality Aspects. Hence, it is been our constant endeavorto enhance the knowledge of all the professionals by organizing various activities and facilitating interactions with the industry experts round the year.

One such effort has been made to Emphasize on the importance of Admixtures and Waterproofing in Constructionand its recent developments in this episode of Concrete Panorama & Deminar 2016.

Knowledge enhances by sharing and hence creating awareness (Demonstration and Seminar) only makes our "Construction Practices Better for making more Durable Structures". I am sure all the delegates will have a lot of value addition by the end of the program.

I personally wish to thank the Chief Patron, Patron, Sponsors, Exhibitors, Supporting Organisations and all the Advisors and the Members of the Organizing Committeefor their support and guidance in making this event.

"There is no wealth like knowledge, and no poverty like ignorance – Buddha"

Looking forward to meet you all at Deminar 2016!!!

Kaushik Hajra

Secretary,

ICI-BC
Bengaluru

ABOUT ICI and ICI - Bangalore Centre

Indian Concrete Institute - Bangalore Centre
www.icikbc.org Email: icikbc@gmail.com

- ICI was born on 7th September 1982, with Head Quarter in Chennai.
- It has 34 centers with more than 10000 members spread across the country.
- ICI is having more than 140 ICI-Student chapters across the country.
- ICI- Bangalore center was started in the year 1984 and it is successfully being run by an able adoptive and progressive managing committees since then.
- ICI - Bangalore Centre is one of the active centres,which conducts several programs every year.
- ICI-KBC has a membership of over 740 with over members in Bangalore city and membership is growing progressively day by day.
- ICI-KBC is having 25 student chapters affiliated to it.

1	Christ University Faculty of Engineering (CU-FE)	Bengaluru
2	J.S.S. Academy of Technical Education (JSS-ATE)	Bengaluru
3	R.V College of Engineering (RVCE)	Bangalore
4	Siddaganga Institute of Technology (SIT)	Tumkur
5	UVCE Bangalore University (UVCE-BU)	Bangalore
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11	SJB Institute of Technology (SJBIT)	Bengaluru
12	PES Institute of Technology (PESIT)	Bengaluru
13	Sri Jagadguru Chandrashekarnatha Institute of Technology (SJCIT)	Chickballapur
14	BMS Institute of Technology and Management (BMSIT & M)	Bengaluru
15	Sir. M. Visvesvaraya Institute of Technology (Sir. MVIT)	Bengaluru
16	Sri Jayachamarajendra College of Engineering (SJCE) CT&M	Mysuru
17	BANGALORE INSTITUTE OF TECHNOLOGY (BIT)	Bengaluru
18	East West Institute of Technology (EWIT)	Bengaluru
19	MALNAD COLLEGE OF ENGINEERING	Hassan
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21	JAIN UNIVERSITY - SCHOOL OF ENGINEERING & TECHNOLOGY	Bengaluru
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23	SRI VENKATESHWARA COLLEGE OF ENGINEERING	Bengaluru
24	EAST POINT COLLEGE OF ENGINEERING & TECHNOLOGY	Bengaluru
25	ACS COLLEGE OF ENGINEERING	Bengaluru

Objectives:

- Promote growth of concrete construction and its sub-specialization
- To disseminate information and train personnel by organizing seminars/Conferences/workshops.
- Training programs for fellow members/students and corporate.
- Collaborate with national / international agencies.
- Identify R & D problems of practical relevance.,
- Arrange National and International Workshops, Conferences, Seminars, Deminars and Exhibitions.
- Arrange annual lecture series on selected topics of relevance to Concrete Constructions.
- To identify and recognize outstanding construction and outstanding performers in the field of concrete technology/construction.

Important Events and Programs from ICI - Bangalore Centre.

- Monthly technical lectures, Endowment Lectures, National Workshops and Conferences.
- ICI- BC was the first to organize ICI-IWC (Innovative World of Concrete) in 1993,ICI ACECON in 2000.
- ICI- BC is the first centre among all the centres of ICI in India to start Concrete Panorama and Deminars at Bangalore in the year 2009.
- Training Modules on Concrete and Concrete Technology for various organizations and Institutions, These programs are conducted throughout the year to cater for the specific needs of the organizations concerned.

Concrete Days Celebrations:

- Indian Concrete Institute- Bangalore centre celebrates concrete Day on 7th September every year. This event is celebrated in a grand and befitting manner.
- Every year during the Concrete Day Celebrations ICI- BC in association with Ultratech Cements Ltd recognizes outstanding and innovative structures built using concrete as main construction material and also identify and honour an individual who has worked for the cause of Concrete and rendered significant contributions to the research, development and application of concrete.
- The two prestigious awards instituted and given away during the Concrete Day Celebrations are:

  ICI-BC –Ultratech Endowment Award for outstanding Concrete Engineer of Karnataka.

  ICI-BC Birla Super Endowment Award for Outstanding Concrete Structure of Karnataka.

The following Managing Committees are instrumental
in keeping the flag of ICI-BC fly very high since its inception in 1984

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Technical Articles

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Advanced Techniques and Instruments for Water Leakage Detection in Buildings

Edited and compiled by: **M N Ramesh**

Introduction

One of the most common problems faced by users of buildings is dampness, seepages, leakages and consequential damages. Often, difficulties in finding the source of the leakages and seepages lead to unsuccessful remedial measures, mental agonies and eventually even financial losses. With the advent of advanced non-destructive testing methods it is possible to pinpoint the exact location of a leakage, and the same technique can be used during the installation of a waterproofing system or during any remedial treatment.

Leakage Tracing

The most vital aspect of inspection will be the detection of moisture penetration or its possible sources. One can more readily trace a leak with water itself so one can simulate a leak by applying water to the suspected leak source. It is important to verify that the leak is indeed coming from the roof and not from another source. Inevitably, any moisture that enters a building from overhead is immediately considered a roof leak, but it might be something entirely different: condensation from piping, poorly insulated roof decks, uninsulated equipment or leaks in overhead sprinkler and drain lines, failed window seals, etc. Uncovering a moisture source not associated with the integrity of the roof membrane or flashings can save an owner valuable time and money as well as improve the credibility of the contractor, manufacturer or consultant involved. Material discolorations and deformations also aid in leak tracing.

Once the leak's location inside the building has been determined, the job of hunting down the water's point of entry on the roof's surface begins. Roof leaks won't always be found directly above the point where water is dripping from the ceiling. The water may be traveling some distance within the roof system or along the deck flutes or other components before it finds an opening into the building. It is possible, however, to backtrack from the inside leak to the point of entry on the roof's surface by following the route the water is most likely to take. If the leak's source can't be found close to the leak on the inside, the investigator should begin examining roof surfaces that are higher than the area directly above the leak. Possible sources include curbs, walls, drains, gravel stops, scuppers or air handling units near the interior leak. New base flashings on retrofit roofs should be examined to see that they have not been carried up beyond the old counter flashing and secured to the wall with a termination bar. Metal copings, especiallyflat copings, deserve special attention. Rusting may be a problem if the joints are exposed to wind-driven water. Sagging, open flashings are frequently found to be the leak's point of entry. Base flashings are also common sources of problems such as punctures, especially where there is heavy foot traffic. Opened or separated laps in the base flashing or diagonal wrinkles that have cracked may also allow water to enter. Vertical penetrations such as sill vents could also be suspects. Expansion joints, particularly those that intersect each other or a vertical surface, should also be checked.

Common sources of leakage from external walls

The common sources of leakage in external walls are:

- Deep cracks/crevices penetrating the finishes and the body of the wall.
- Defective masonry or concrete in the wall.
- Defective or delaminated finishes that protect the wall from the direct attack of rain.

Sources of leakage from bathrooms and kitchens

In bathrooms or kitchens, the source of the leakage must be identified before any repair works can be considered. If it is the loosening of components in the drainage system such as traps under the sink, basin or bathtub, simple fixing can stop the leakage. The usual remedial treatment would be wrapping a seal tape around the pipes and grouting the gaps with non-shrink grouts. However, if defective water supply pipes are identified as the main problems, expert plumbers should be engaged to replace the defective parts or overhaul the entire system.

A common cause is defective sealant around the bathtubs, basins, sinks, if provided or a defective waterproofing system on the floor. This problem can be easily dealt with by replacement / provision of a sealant. However, if there is a "wet floor" the waterproofing system of the floor is put to test. Should the cause be identified as water spilled on to the floor, it is always advisable to reconstruct the entire waterproofing layer instead of patch repair. In balconies where ponding may be frequent due to heavy rain or blockage of drain outlets by rubbish, the waterproofing system has to be sound in order avoid a nuisance to the floor below.

Leakage Testing:
The following testing methods are used as part of water leak investigations in buildings. They are also used with new constructions to verify waterproofing. The different types of leak tests are:

Flood Testing: It is performed on new low-slope horizontal waterproofing installations such as parking garages and large floors. As part of a leak investigation, flood testing is performed on low-slope building roofs. Proper binds are sometimes constructed around the horizontal regions to be tested.

ASTM Method of Leakage Testing at Window: ASTM E 1105-08: "Standard Test Method for Field Determination of Water Penetration of installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference."However ASTM E331 test is by Uniform Static Air Pressure Difference. Whereas, ASTM E547 test is by Cyclic Static Air Pressure Difference. The air-pressure differences acting across a building envelope vary greatly. These factors should be considered fully prior to specifying the test pressure difference to be used. The field test may be made at the time the window, skylight, curtain-wall, or door assemblies are initially installed and before the interior of the building is finished. At this time, it is generally easier to check the interior surfaces of the assemblies for water penetration and to identify the points of penetration. The major advantage of testing when assemblies are initially installed is that errors in fabrication or installation can be readily discovered and corrections made before the entire wall with its component assemblies is completed at which time the expense of corrective work may be increased many times.

The field test may also be made after the building is completed and in service to determine whether or not reported leakage problems are due to the failure of the installed assemblies to resist water penetration at the specified static air pressure difference. Weather conditions can affect the static air pressure difference measurements. If wind gusting causes pressure fluctuation to exceed ±10 % from the specified test pressure, the test should not be conducted.


Fig. 1: A field leakage test by pipe rack system at window frame

Generally it is more convenient to use an interior mounted pressure chamber from which air is exhausted to obtain a lower pressure on the interior surface of the specimen. A calibrated rack of nozzles is then used to spray water at the proper rate on the exterior surface (Fig. 1). Under circumstances where it is desirable to use an exterior-mounted pressure chamber, the spray rack must be located in the pressure chamber and air supplied tomaintain a higher pressure on the exterior surface.

Exterior chambers are difficult to attach readily and seal to exterior surfaces. This test method addresses water penetration through a manufactured assembly. Water that penetrates the assembly, but does not result in a failure as defined herein, may have adverse effects on the performance of contained materials such as sealants and insulating or laminated glass.

ASTM Method of Leakage Testing on External Wall: STM E2128: "Standard Guide for Evaluating Water Leakage of Building Walls"This standard describes multiple methods for determining and evaluating causes of water leakage of exterior walls. It is an investigative guide to determine if a buildings drainage capacity of the wall is causing or is likely to cause premature deterioration of a building or its contents. A field leakage test by pipe spray system at external wall is shown in Fig. 2


Fig.2 Leakage test by pipe spray system at external wall

The other related standards are ASTM E2556: "Standard specification for vapour permeable flexible sheet water resistive barriers intended for mechanical attachment" and ASTM E783: "Standard Test Method for Field Measurement of Air"

Leakage Testing by Non-Destructive Testing Methods
Leak testing is the branch of non-destructive testing that concerns the escape or entry of liquids or gases from pressurized or into evacuated components or systems intended to hold these liquids. Leaking fluids (liquid or gas) can penetrate from inside a component or assembly to the outside, or vice versa, as a result of a pressure differential between the two regions or as a result of permeation through a somewhat extended barrier. Leak testing encompasses procedures for one or a combination of the following.

- Locating (detecting and pinpointing) leaks
- Determining the rate of leakage from one leak or from a system
- Monitoring for leakage

Leakage investigation is increasing in importance because of the rising value of, and warranties on, manufactured products and because of the constantly increasing sensitivity of components and systems to external contaminants. Environmental concerns are causing additional emphasis on leak testing and its conduct.

Equipment/Methods used for leakage detection

The water leak detection system helps to find leaks on pipe work and building envelopes. Some of the major equipment used to locate leaks on building envelopes include Thermal Imaging, Electronic Vector Mapping, Vac Box testing and Trace Gas Injection & sensing etc. Combining these techniques with more traditional techniques such as dye testing, smoke testing, and pressure testing can give an ideal solution for all leak location processes. These techniques for water leak detection can be combined or used in isolation depending on what is constructed over the service or how deep the service lies.

Acoustic Leak Detection

Acoustic leak detecting instruments (Fig. 3) allow the localization of the lowest consistent noise. It offers automatic noise reduction from intermittent interfering noises, like passing vehicles, people talking, and pedestrian footsteps. This means the source of leaks can be identified a lot quicker.

Correlator Leak Detection

Leak correlators (Fig. 4) identify the acoustic frequency made by water escaping from a pipe. The correlator uses two sensors placed over the pipe length which detect the noise of the water escaping from the leak and calculates the leak's location by comparing the delay in the signal reaching each sensor.

There are some other equipment/methods by which leakage detection can be made, such as:

- Acoustic data loggers
- Combined acoustic logger & correlator
- Ground penetrating radar
- Salts/Chemistry analysis
- Drain cameras
- Humidity sensors
- Dew point alarms
- Pipe tracing equipment

Fig.3 Leakage detection by advanced Ground Microphones

Fig.4 Leakage detection by Digital leakage correlator

Inference

With new construction, verification is achieved if no water leaks into the interior of the structure. With leak investigations, where there may be signs of interior water damage but no actual leaks, infrared (IR) thermography and electrical capacitance (EC) testing such electronic field vector mapping (EVFM) are most suitable in addition to visual inspection to determine whether water penetration is occurring. These two methods have been discussed in detail in subsequent sections.

Infrared Thermography for Detecting Water Leakages – Case

The speed of using infrared, and the larger areas covered rapidly by an IR camera, can save time and money by providing a faster, more efficient and more reliable survey. An IR camera can detect moisture located behind interior walls under the right conditions. The temperature difference created by the presence of moisture on the inside surface of a wall will appear differently than the surrounding areas. These techniques for water leak detection can be combined or used in isolation depending on what is constructed over the service or how deep the service lies. Infrared Thermography inspection is a powerful and non-invasive means of monitoring and diagnosing the conditions of buildings and detecting water leakages (Fig. 5).

Fundamental Principles

Fig. 5: Display on LCD screen of thermal camera

According to the Fundamental Law of Planck, all objects above absolute zero emit infrared radiation. This radiation only becomes visible to the human eye when the temperature is above 5000C. Infrared monitoring equipment has been developed which can detect infrared emission and visualize it as a visible image. The sensitive range of the detector lies between 2 and 14 microns. The 2–5.6 micron range is generally used to visualize temperatures between 400C and 20000C and the 8-14 micron range is used for temperatures between –200C and ambient temperatures. The thermograms taken with an infrared camera measure the temperature distribution at the surface of the object at the time of the test. It is important to take into consideration that this temperature distribution is the result of a dynamic process. Taking a thermogram of this object at an earlier or later time may result in a very different temperature distribution. This is especially true when the object has been heated orcooled. The detectability of any internal structure such as voids, delamination or layer thicknesses depends on the physical properties (heat capacity, heat conductivity, density, and emissivity) of the materials of the test object. Naturally any interior 'structure' has an effect on the temperature distribution on the surface. If the temperature changes on the surface there is a delay before the effect of this change occurs below, where a defect such as a void occurs. The longer the time delays before the temperature changes, the greater the depth of the defect below the surface. Generally anything deeper than 10 cm will only show after a long period of time (>1 hr) after the temperature change has occurred. Since the infrared system measures surface temperatures only, the temperatures measured are influenced by three factors: (1) subsurface configuration, (2) surface condition; and (3) environment. As an NDT technique for inspecting concrete, the effect of the subsurface configuration is usually most interesting. All the information revealed by the infrared system relies on the principle that heat cannot be stopped from flowing from warmer to cooler areas, it can only be slowed down by the insulating effects of the material through which it is flowing. Various types of construction materials have different insulating abilities or thermal conductivities. In addition, differing types of concrete defects have different thermal conductivity values. For example, an air void has a lower thermal conductivity than compared to the surrounding concrete. Hence the surface of a section of concrete containing an air void could be expected to have a slightly different temperature from a section of concrete without an air void.

There are three ways of transferring thermal energy from a warmer to a cooler region: (1) conduction; (2) convection; and (3) radiation. Sound concrete should have the least resistance to conduction of heat, and the convection effects should be negligible. The surface appearance, as revealed by the infrared system, should show a uniform temperature over the whole surface examined. However, poor quality concrete contains anomalies such as voids and low density areas which decrease the thermal conductivity of the concrete by reducing the energy conduction properties without substantially increasing the convection effects. In order to have heat energy flow, there must be a heat source. Since concrete testing can involve large areas, the heat source should be both low cost and able to give the concrete surface an even distribution of heat. The sun fulfils both these requirements. Allowing the sun to warm the surface of the concrete areas under test will normally supply the required energy. During night-time hours, the process may be reversed with the warm ground acting as the heat source. For concrete areas not accessible to sunlight, an alternative is to use the heat storage ability of the earth to draw heat from the concrete under test.

Factors Affecting Temperature Measurement

The first important point to remember is that in order to use infrared thermography, heat must be flowing through the concrete. It does not matter in which direction it flows.

The second important factor to consider when using infrared thermography to measure temperature differentials due to anomalies is the surface condition of the test area. The surface condition has a profound effect upon the ability of the surface to transfer energy by radiation. This ability of a material to radiate energy is measured by the emissivity of the material, which is defined as the ability of the material to radiate energy compared with a perfect blackbody radiator. A blackbody is a hypothetical radiation source, which radiates the maximum energy theoretically possible at a given temperature. The emissivity of a blackbody equals 1.0. The emissivity of a material is strictly a surface property. The emissivity value is higher for rough surfaces and lower for smooth surfaces. For example, rough concrete may have an emissivity of 0.95 while shiny metal may have an emissivity of only 0.05. In practical terms, this means that when using thermographic methods to scan large areas of concrete, the engineer must be aware of differing surface textures caused by such things as broom textured spots, rubber tire tracks, oil spots, or loose sand and dirt on the surface.

The final factor affecting temperature measurement of a concrete surface is the environmental system that surrounds that surface.Some of the factors that affect surface temperature measurements are:

Solar Radiation

Testing should be performed during times of the day or night when the solar radiation or lack of solar radiation would produce the most rapid heating or cooling of the concrete surface.

Cloud Cover
Clouds will reflect infrared radiation, thereby slowing the heat transfer process to the sky. Therefore, night-time testing should be performed during times of little or no cloud cover in order to allow the most efficient transfer of energy out of the concrete.

Ambient Temperature
This should have a negligible effect on the accuracy of the testing since one important consideration is the rapid heating or cooling of the concrete surface. This parameter will affect the length of time (i.e. the window) during which high contrast temperature measurements can be made. It is also important to consider if water is present. Testing while ground temperatures are less that 0OC should be avoided since ice can form, thereby filling subsurface voids.

Wind Speed
High gusts of wind have a definite cooling effect and reduce surface temperatures. Measurements should be taken at wind speeds of less than 25 km/h.

Surface Moisture
Moisture tends to disperse the surface heat and mask the temperature differences and thus the subsurface anomalies. Tests should not be performed while the concrete surface is covered with standing water or snow. Once the proper conditions are established for examination, a relatively large area should be selected for calibration purposes. This should encompass both good and bad concrete areas (i.e. areas with voids, delaminations, cracks, or powdery concrete). Each type of anomaly will display a unique temperature pattern depending on the conditions present. If, for example, the examination is performed at night, most anomalies will be between 0.1° and 5°C cooler than the surrounding solid concrete depending on configuration. A daylight survey will show reversed results, i.e. damaged areas will be warmer than the surrounding sound concrete.

Test Methodology
The leakages and dampness in buildings can quickly and thoroughly be scanned using an infrared camera, identifying problem areas that cannot be seen by the naked eye. Infrared thermography (also called "thermal imaging" or "infrared imaging") is a process by which infrared radiation from an object can be measured or imaged using a special type of digital camera which translates the infrared image of the object (which is not visible to the human eye) into an image on an LCD display (Fig. 1). In many cases the infrared radiation received by the camera corresponds in a fairly straightforward way with the temperature of the surface(s) being imaged. Thermal imaging of building structures and components is useful because it allows a thermographer to visualize temperature differences up to 0.10C between two different materials or between two different areas of the same material. The area having moisture penetration, dampness, leakages are shown with blue colour images (Fig. 5). The temperature difference of the image establishes the damp areas. Taking digital images of the same spot either by a separate camera or by the same thermal imaging camera with a provision to take digital images will help to identify the spot. Once the source of the leakage is identified, the remedial treatment becomes more successful.

Case studies

1. Bath Room Water Leakage Detection
Survey of one of a villa's bathrooms at Santacruz, Mumbai was conducted to detect water leakages. Accordingly, a thorough thermal image investigation of the bathroomarea was also carried out in April 2012. The visual inspection as well as thermal image inspection was carried out internally as well as externally to ascertain the extent of damage and methodology for proposed repair work. The thermograph photos were also taken where more attention was required in respect of identifying the leakage spots for remedial work. The temperature difference of affected areas were noted and analysed to locate the leakages. The following leakage locations were identified as follows:

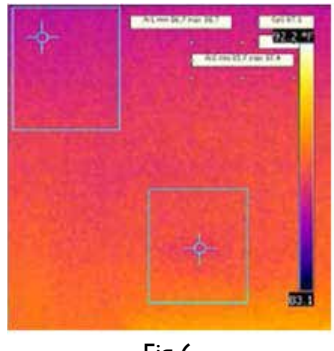
Fig 6.

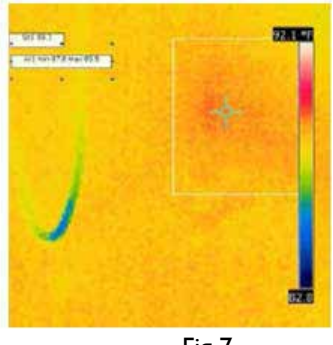
Fig 7.

- Dampness in the ground floor bathroom slab area coming from 1st floor bathroom (Fig. 6).
- Concealed Nahani trap (Fig. 7) and pipe line have deteriorated which need replacement.

After locating the leakage spots the remedial treatment was successfully carried out, after which no leakage was observed.

Leakage Detection of a Roof Ceiling
In a 27-storey posh residential tower in south Mumbai, leakage was occurring at the 12th floor roof slab. It was observed that water was dripping from one point at continuous intervals (Fig. 8). Some drillings were carried out on ceiling surfaces (Fig.8) to release the water pressure. The water drop variedbetween 30 to 50 drops in each 10 minutes interval and increased with

heavy rain but decreased without rain. The same water was being accumulated in a larger area and was dripping slowly when there was no rain. At the 13th floor, all the water spread areas such as the deck slab, water fountain, artificial water pond, back side of the fountain, were tested by visual observation, water ponding test and thermal imaging. Except for the deck slab, the other locations were ruled out as causes of the leakage. The deck slab of the 13th floor was double height of 8.4 m, without any facade protection. During the monsoons the rain water was splashing on the deck floor. Though the deck had a provision of water proofing, a leakage occurred due to a failure of the waterproofing at one transition zone of a pillar. After conducting thermal imaging, the exact location point was identified. The digital image and thermal imaging of the same spot is given in Fig. 9 & Fig. 10 respectively. The remedial waterproofing treatment was carried out after which no leakage has been observed.

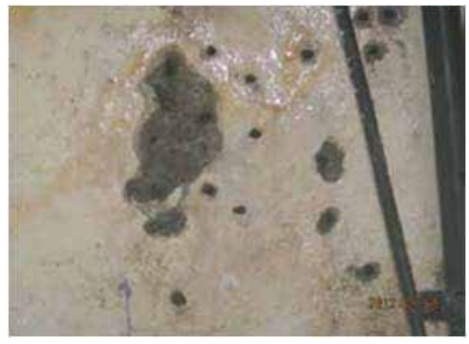

Fig.8. Water dripping point and accumulation of water of 12th floor roof ceiling

Fig 9. View of 13th Floor deck slab floor near pillar

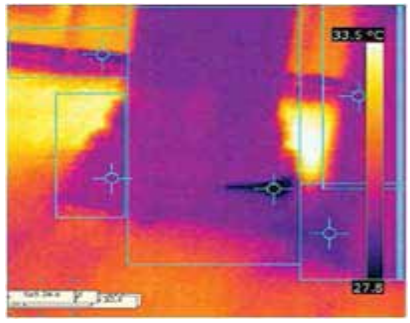

Fig.10. Infrared thermal imaging showing gap at joints of pillar where water was penetrating

Leakage Detection of a Jacuzzi

A RCC framed bungalow of plinth area of 25000 sqft having all ultra-modern facilities covered with lawns and landscaped gardens in Revas Road, Chondi, Alibaug had some leakage issues. It had a Jacuzzi where water leakage was occurring for which thermal imaging was carried out. After filling the Jacuzzi with full of water it was observed that the level of water was receding slowly. Wet spots were observed at few locations after making empty of Jacuzzi. There were cracks in few locations on the surface of Jacuzzi, which was identified by thermal imaging analysis. The digital and thermal images are shown in Fig. 11 to 14. The leakages spots were identified in all the thermal images and accordingly remedial treatment was carried out after which no leakage was observed.

Non Invasive Roof Leak Detection

A leakage occurred at the ceiling-wall joint of a residence in year 2003. Water entered the home at the supply duct register and the windows at the front wall of the living room. Water testing indicated the intrusion might have been the transition between the wall and roof. Corrective measures were performed that included replacing the roof flashing as well as the stucco siding of this area. After one year a rainstorm again caused water intrusion within the same area previously noted before flashing and wall stucco replacement. In the absence of infrared thermography the ceiling would have been removed to inspect the roof sheathing for the water intrusion point(s). With infrared thermography it was not necessary to remove contents, wallboard, or erect scaffolding, nor was floor protection necessary.

Fig. 11. Digital Image of leakage spot

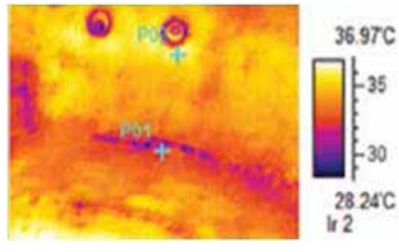

Fig.12 Temperature: P01- 30.80C Min.; P02- 36.40C (Max.)

Fig. 11. Digital Image of leakage spot

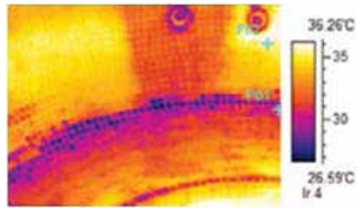

Fig.12 Temperature: P01- 30.80C Min.; P02- 36.40C (Max.)

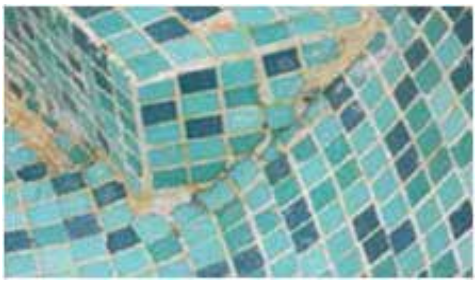

Fig.14 Digital Image of leakage spot

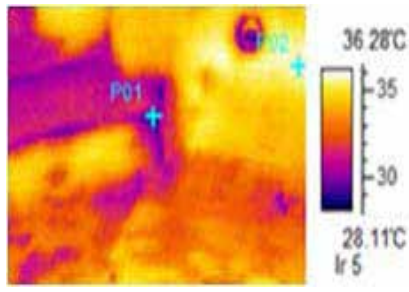

Fig.15Temperature: P01- 28.20C Min.; P02- 36.10C (Max.)

Visual inspection of the roof exposed two potential water intrusion points, the gutter and chimney areas. The gutter had foam installed at the upper slope of the gutter. Since this was an unusual use of foam, it may have hidden imperfections or water entry points behind the gutter. Water testing was directed at the gutter area to determine if it was a leak site.

Baseline Determination

Following the visual inspection a complete infrared thermographic inspection of the interior of the affected area was performed. This was to provide a reference pointof the thermal characteristics of the walls and ceiling of the affected area. Areas that were cooler or showed temperature abnormalities were examined closer with moisture survey equipment that consisted of conductive and dielectric meters. No moisture differences were found in the cooler areas visible in the infrared thermograms.

Water Testing

Water was applied to the roof from a spray rack system for 30 minutes at each location or 15 minutes using the hand held spray applicator (Fig. 16). Fig. 17 shows the positions of the rack system for each 30-minute test. Entire roof surface was divided into number of panels for the spray followed by thermal imaging at ceiling surface of the same location and testing was conducted in each panel. Soon after the spray rack system was moved into another position, water intrusion was found in the ceiling of the residence. During this test no water intrusion was found, indicating no water intrusion points for this area of the roof. Moisture Detection

Fig. 16 Images of the spray rack system used to apply water to the roof

Fig. 17. Image of the hand held applicator and its position during the water test of the gutter area as well as the positioning of the spray rack system

During the water application process infrared thermography was used to scan the ceiling surface of the living room. No moisture was detected until the spray rack system reached a particular position. Figure 18 shows the beginnings of the water intrusion as indicated by the cool spot noted by the arrow.

Intrusion Discovery

Once it was determined through water testing where the approximate location of the roof leak was, roof tiles were removed to examine the underlayment and roof sheathing. By following the water visible below the underlayment, the source of the intrusion was found. Two nails were discovered that had been dropped onto the roof sheathing, then covered by the underlayment and having punctured the underlayment. Since the roofing tiles prevent water from entering the underlayment it was important to determine how the water got under the roofing tiles to begin with. Further exploration of the roof revealed a debris dam at the valley of the roof. Roofing codes in the area required the tiles to be installed without a gap at the roof valley. This allowed debris to accumulate in the valley eventually damming the valley causing water to spill over onto the underlayment.

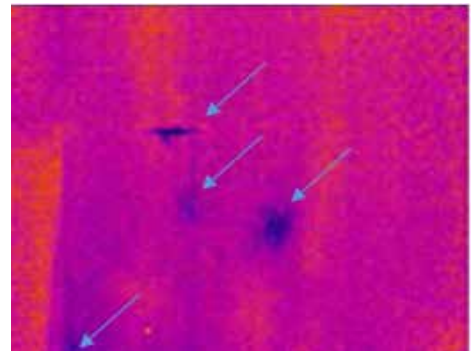

Fig: 18. Thermogram showing the beginnings of the water intrusion

As the roof water test continued, the water intrusion increased, moving to the

front wall of the living room. Fig. 18 above, indicates the location of the water within the wall as it moves behind the wall, surfacing at the top and bottom of the window. At this point of the test water was dripping from the window header on to the floor of the living room. Water testing continued with the spray rack positions at different locations. As the rack moved away from the valley of the roof the water intrusion decreased, finally stopping with the completion of the water testing.

Membrane Integrity Testing& Electronic Leak Detectionby Vector Mapping and CaseStudies

Electronic Field Vector Mapping (EFVM) is a cutting edge technology that is redefining the art of leak detection and quality assurance in low-slope roofing and waterproofing systems. Vector mapping pinpoints breaches in the roof membrane by tracing the flow of an electric current across the membrane surface. One can get virtually 100% testing on roofing and waterproofing membranes with ELD Fusion®, with an advanced combination of High and Low Voltage Electronic Leak Detection methodologies.

Importance of Integrity Testing

Small punctures, membrane splits or mechanical damage to a waterproofing membrane will result in wet insulation, mold, and costly interior damage. Leaks can go unnoticed and the water exit location might not correspond with the point of entry. Previously, lengthy and costly leak investigations were necessary to locate a membrane breach, especially in protected roof membrane assemblies, garden roofs, or parking and plaza decks. Vector mapping eliminates the dangers and potential damage inherent in traditional flood testing. Unlike the interpretive process of water, flood, infrared, or nuclear testing, vector mapping detects membrane faults directly.

How Does EFVM Work?

An electric field is created by applying water on the surface of the membrane and using the water as a conductive medium. The EFVM equipment delivers a low voltage pulsating electrical charge between the non-conductive waterproofing membrane and the conductive structural deck. A watertight membrane will isolate the potential difference, while breaches in the membrane will cause an electrical connection to occur. The directional flow of the current is read with a potentiometer to locate the point of entry with pinpoint accuracy.

The vector mapping conductive mediums are created to test non-conductive substrates. Three different conductive mediums allow for accurate EFVM testing results.

Vector mapping grid (VMG): A welded stainless steel mesh which can be utilized on the fully-adhered systems. This mesh is a non-corrosive material that prevents aging deterioration within the roofing system.

Summary

Leak detection in the building is an important prerequisite of water-proofing. The scientific methods and techniques of leak detection have been commercialised in the recent years. Employing these techniques will not only make the waterproofing carried more durable, but also help to achieve high performance.

Acknowledgement:

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2. http://www.ndtwiki.com/index.php/Leak_Testing

3. http://leak-detection.com/about-ild/case-studies/case-study

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Product Benefits: Technical Application and Support and NO water ingress into the Structures

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Innovation in Building Chemicals

Solution for Podium slab Waterproofing

B.S Nagaraj

For the past 70 years Fosroc being world leader in construction chemical industry, recognised has an effective solution provider in all areas of construction. Fosroc quality product can be found in nearly every major project around the globe. Every day, as the demand increases for enhanced structural integrity obsolete maintenance is the future mantra of construction industry, Fosroc products are being specified more often because they offer more long-term value. The reason goes beyond innovation and superior product performance. Fosroc customers credit the association of our sales engineers as the single most important service the company offers, providing support throughout all phases of a project. Additionally, Fosroc offers highly skilled technical service personnel around the world to assist customers in the use of products. Furthermore, Fosroc dedication to the industry, through ongoing R&D, has resulted in many product improvements and a number of innovative products and systems with a heritage of proven performance backed by state-of-the-art technology. As a result, the world's most important structures stand protected from the ravages of water, fire, erosion, corrosion and time.

Podium Slab Waterproofing-Risk involved

An effective and durable waterproofing system is absolutely critical to ensure the long-term durability of the structure and to keep maintenance costs obsolete by avoiding possible repair. In sensitive buildings areas like Podium slabs where you plan for water bodies, landscape, children play area sports facilities car parking & drive ways etc proper waterproofing system helps to keep out water and pollutants thereby preventing leakages & also protecting structural elements and embedded steel reinforcement from corrosion damage, A good waterproofing system has to ensure that it keeps performing at optimum level for a very long period of time, even beyond the warranty period to provide maximum value & comfort to the end user

Podium Slab Waterproofing-Requirements

- Large open areas-Excellent tensile & elongation properties to accommodate thermal movements
- Water bodies- Excellent barrier to water ingress and continuous exposure to water
- Landscaping- Resistant to root penetration even for intensive roots
- Sand Filling-Enable sand filling directly on the membrane without protection screed
- Chemical Resistance- Resistance to pesticides
- Medium duty traffic-Resistance to dynamic & Impact load
- Very high impact & puncture resistance-Able to sustain mechanical abuse during construction
- Zero VOC-Environmental friendly, meet the norms of green products for waterproofing

Fosroc Innovative Solution for Podium Slab Waterproofing

Fosroc Polyurea WPE system provides an effective solution for podium slab waterproofing. Fosroc Polyurea WPE is a spray-applied, 100% solids, flexible, two-component, rapid curing pure Polyurea system, designed as a waterproofing and protective coating. It combines the advantages of seamless and fully bonded system with very long life cycles and high durability

Fosroc Polyurea WPE system:

Features	Benefits
Fast curing (fully cured within hours)	Immediate return to service, waterproofing runs parallel with construction activity
Very high physical properties	Durability & longer life of the system
Chemical & Abrasion resistance	Ideal system for land scaping on podium/roof slab (protection screed is not mandatory)
Very high puncture & Tear resistance	Resistance to roots
High elongation & tensile strength	System can be taken across expansion joints seamlessly
Fully bonded to substrate	Prevent water tracking between the membrane & the substrate
Spray application	Enable faster application of larger area in less time
Zero VOC	Environmental friendly, Complies with LEED Norms for LEED certification
High thermal stability	withstand service temperature from -30°C to 135°C

Fosroc Polyurea WPE-Product Properties

Fosroc Polyurea WPE	Properties	Advantages
Membrane thickness,	1. 5mm	
Tensile strength (Peak) ASTM D412	19 N/mm2	Accommodate movements, able to continue over expansion joints
Elongation (Peak) ASTM D412	300%	Excellent crack bridging capability
Tear resistance ASTM D624C	90N/mm	Very good Resistant to wear and tare
High Abrasión Resistant – DIN EN ISO 5470	< 0.02 mg/1000	Withstand abuse of construction process
Spray Application	Facilitate Rapid Application	Provides seamless coating-Ensures Water tightness
Fast curing	Cure within seconds	Save overall project time for installation of waterproofing system
Chemical resistance	Very Good	Resistance to ground salts & chemicals
Zero VOC	Green Product	Environmental Friendly
Adhesion to substrate	Very High	Prevent lateral migration of water

Podium Slab

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Smart Admixtures to address Modern Concrete Challenges and Construction Needs

Shivram B Bagade

ABSTRACT:
While the civil constructions may be as old as human civilization, yet in present day context, it is rather difficult to imagine any construction which does not use or does not require concrete. As per the latest statistics one cubic meter of concrete is consumed per person per annum. In Construction Concrete plays a vital role and in Concrete, it's Admixture. Modern Concrete challenges need high performance concrete admixtures. Only products providing excellent resistance to cracking, shrinkage and steel corrosion should be considered. Ever increasing concrete making ingredients makes modern concrete even more challenging. Choosing the right grade of concrete and admixture is of paramount importance. In today's construction practices, many extra properties are demanded of the concrete in terms of speed of construction, workability characteristics, early strength gain, durability, resistance to aggressive media and a long service life. Durable concrete is the order of the day. Modern construction needs comprehensive and proven system solutions to facilitate highest reliability. The complexity of mega-structures requires appropriate materials to ensure state-of-the-art construction. The construction of modern infrastructure is a painstaking process which requires sophisticated architectural design, precise engineering, solid craftsmanship and the best quality building materials. Increasingly sophisticated designs and the need for faster construction create challenges for entire construction fraternity. In this paper the authors will set out to explain the value addition of smart and innovative admixture technologies to address the modern construction and Infrastructure challenges, and is being presented using a case study of Penang Second Bridge.

Key words: Modern Concrete challenges, Modern construction needs, Infrastructure challenges, Durability, Smart and Innovative Admixture technologies and Penang Second Bridge.

1. INTRODUCTION.

Infrastructure, in all its guises, binds together our prosperity and our day to day quality of life. Without it, we cannot bring clean water to communities, build new homes, schools and hospitals, create the transport links vital to global travel and trade or deliver cleaner forms of renewable energies.

Major infrastructure failures quickly and radically reduce communities' quality of life and productivity. Conversely, improving infrastructure services enhances welfare and fosters economic growth. Providing infrastructure services to meet the demands of businesses, households, and other users is one of the major challenges of economic development.

Construction is the second largest industry, next only to agriculture in most of the developing countries. In India, approximately, 16-18 percent of the nation's working population is reportedly dependent on construction for its livelihood. Nearly 32-35 million workers and professionals are directly employed in construction activities. Of, those, 24-27 million are Unskilled. Thus, the construction industry in India has, by and large, been a labour-intensive industry, although change in favour of modernization and automation is now discernible in certain fields. Ready-mixed concrete is one such field. Cement is an intermediate product in construction, as it requires further processing to get the end product - that is concrete.

2. INFRASTRUCTURE CHALLENGES FOR READY MIX INDUSTRY

The ready-mix business is a diverse and demanding sector with its own requirements and challenges. Ready-mix operations are always local, with key factors such as financial resources and transportation playing a central role in decision making.

In a nut shell we can classify the challenges into 3 categories:

A. Operational challenges.
B. Supply Chain challenges.
C. Technical Challenges.

Strength, durability and placeability are at the forefront of challenges faced by ready mixed concrete producers .One of the wish from the wish list of ready-mix producers is to have RIGHT Admixture partner with broad-based product solutions which can provide added value, that increase the service life of concrete, speed of construction, environmental efficiency and liquid coloring products for aesthetically pleasing architectural concrete.

3. INNOVATIVE ADMIXTURES TECHNOLGIES TO MEET MODERN CONCRETE CHALLENGES AND CONSTRUCTION NEEDS

Today in the field of Concrete Technology, there is a revolutionary shift, any properties of Concrete (Green or Grey) can be achieved without much difficulty. This has been aided due to the developments in the field of Construction Chemicals

especially in Admixtures.

What was mentioned by Mr. V.M. Malhotra 37 years ago, ("There have been very few major developments in concrete technology in recent years? The concept of air entrainment in the 1940s was one; it revolutionized concrete technology in North America. It is believed that the development of superplasticizers is another major breakthrough which will have a significant effect on the production and use of concrete in years to come") has been proven correct.

Ready-mix concrete is characterized by a great number and variety of different mix designs. Utilizing different types of fillers, cements and binders together with the increasing trend towards more performance, and durability based concrete specifications. At the same time, ready-mix producers must maintain their profitability in the face of rising materials, labour and equipment costs. As a result, producers are optimising their production and logistic costs. The Innovative admixture systems form Master Builders Solutions of BASF, supports these goals by providing the capability of delivering high-quality concrete at any time to the job site. This new concepts facilitates the production of concrete with both extended workability and a low water/cement ratio. Cost savings in production may be realized through mix design optimizations for cement types and aggregate composition. As a result, these technologies enable ready-mix producers to optimize inventory, to facilitate logistics and to reduce investments in tanks and dispenser equipment and thus also, decreases maintenance costs.

Table 1 challenges addressed using smart and innovative admixture

Process Step	Admixture Solutions for:
Materials	Higher Usage of Manufactured Sand
	More Sustainable Concrete Mixtures
Mixing	Faster Mixing Times
	Production of Ultra High Strength
Transit	Improved Slump Retention
Placing	Reduction of Concrete Stickiness
	Easier & Faster Placement of Concrete
Hardening	Faster Early Strength Development
Hardened Properties	Reduction in Shrinkage and Cracking
	Replacement of Steel Reinforcing

Figures: Building blocks used in PCE Technology

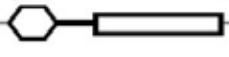
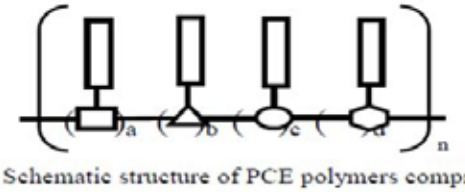
	Description	Effect
Block A		Slump retention
Block B		Early strength
Block C		Final strength
Block D		Water reduction

Figure 1a): PCE building blocks (schematic) and their function in polymer



b) Schematic structure of PCE polymers comprising building blocks A-D

	Block A	Block B	Block C	Block D	Connector
ADX-1	<75%	100%	100%	100%	50%
ADX-2	100%	<75%	100%	100%	100%
ADX-3	none	none	none	100%	50%
ADX-4	none	none	none	75%	75%

c) Admixture compositions, percentage of blocks relative to connector amount

4. Case Study: Penang Second Bridge, Malaysia.

4.1 Admixture tailored for extended workability retention

As shown in Figure 1c), Super Plasticizer-Super Retaining Polymer (SP-SRP) contains a large amount of building block A, responsible for workability retention. Hence, the composition should qualify this admixture for RMC application where long transportation times are typically encountered, under severe conditions like hot weather or difficult aggregate or cement conditions. We decided to apply SP-SRP in a 30 MPa strength class concrete, where the designed slump upon delivery to site is 10-14 cm.

In this case, SP-SRP enables the RMC station to adjust initial slump at the batching station to the designed slump at delivery. The perfectly flat performance of SP-SRP ensures that, no matter when the concrete arrives at the site (as long as it is within 2 hours), the specification is matched. Retarded Naphthalene based, however, cannot be treated that way. Due to the severe slump loss, the batching plant would have to adjust to a slump higher than the specification requires, with consequences for the mix proportion. Furthermore, due to the slope of the slump loss curve, the actual slump delivered on site is dependent on the actual transportation time, which makes it challenging to hit a tight specification like in the example given, and re-tempering at the jobsite eventually has to occur.

4.2 Admixture tailored for precast applications

Super Plasticiser-High Early Strength (SP-HES) molecules are rapidly adsorbed on the surface of the cement grains and act through electrostatic and steric repulsion to powerfully disperse the individual particles of cement.

The molecular structure of polycarboxylate ether polymers is essential for the early development of strength. With conventional PCE super plasticisers, the molecules cover the entire surface of the cement grain and build a barrier against contact with water. Therefore, the hydration process takes place slowly. The unique, proprietary molecular structure of SP-HES exposes increased surface of the cement grains to react with water. As a result of this effect, it is possible to obtain earlier development of the heat of hydration, faster development of the hydration products and, as a consequence, higher strengths at very early age. This advantage can even be utilized at low temperatures.

The unique mechanism of this new polymer technology allows it to be adsorbed into the cement without inhibiting the hydration of the cement. Thanks to this technology, SP-HES exhibits 10-20% higher early strength development than traditional technology while providing good slump retention.

With the slump life extended, one would anticipate early strength is inferior in case of SP-HES. However, SP-HES shows not only equal early strength compared with conventional PCE, but after 28 days at standard curing conditions the strength exceeds the benchmark by 12%.

It is noteworthy, that due to the chemical nature of the mechanism of the new admixtures, its effect is quite dependent on the cement composition.

4.3 Project Challenges and Customer Requirements

BASF got involved in the project when completion schedule was already a topic.

In addition to the time constraint, BASF had to meet with so many other construction challenges such as high productivity and superior finish in segment construction, very high slump retention for in situ concrete for bridge piers construction and segment adhesive which could meet with the challenge of varying application conditions. Underwater concreting for sub-structure construction in the middle of the sea imposed further challenge requiring solution for anti-wash out property.

4.4 Solution

In order to shorten the construction time for precast bridge segments, BASF introduced a new admixture technology – Master Glenium series admixtures added to the precast concrete for high early strength and superior finish. Master Glenium ACE 8589 (formerly known as Glenium ACE 389) offers high early strength to the concrete that increases productivity within tight production timeframes. As a result, the segmental casting period was reduced by two months, much needed for timely completion of the project.

The concrete produced onshore and poured in-situ for substructure construction posed a major challenge – workability retention!! Concrete was produced on shore and needed as long as eight hours in selected cases to transport and place. Master Glenium SKY 8705 (formerly known as Glenium 105 SureTec) was recommended to China Habour Engineering Company, the ready-mix supplier to meet with the demand.

The segmental bridge construction requires a structural grade epoxy adhesive for binding the segments prior to post tensioning of cables. With proven track record in projects such as the Metro Bridge in Dubai, MasterBrace AHD 1441(formerly known as Concresive 1441) was chosen by United Engineers Malaysia for this application. BASF's innovative approach in formulation and onsite storage solution ensured smooth application in varying temperature and wind conditions.

Table 2 Mix design details: Substructure concrete and Pre-cast concrete mixes.

- Concrete grade 40 MPa
- Typical slump retention 6 – 8 hours
- Typical mix design :

OPC	288kg
GGBS	129kg
Silica Fume	13kg
Water	158kg
MasterGlenium SKY 8705	1000ml/100kg
Slump	175 +/- 25mm

- Concrete grades: 55 MPa & 80 MPa (22 MPa @ 10 hours)
- Typical mix design for 55 Mpa

PFA Cement	420kg
Silica Fume	27kg
Water	145kg
s/a	0.45 - 0.47
MasterGlenium ACE 8589 @ 800-900ml/100kg	
Flow Table	600 +/- 50mm (after 15 Drops)

5 CONCLUDING REMARKS

Cost and time savings remain the twin objectives of the project owners, developers, contractors and ready-mix companies. Today the construction industry awaits a breakthrough solution that addresses the escalating need for speed and sustainable development. Modern architecture, large scale and high-rise constructions demand building materials that provide durability and energy efficiency.

The importance of concrete as modern day construction material cannot be denied. In fact the innovative use of concrete can only add to its importance in coming time. For Infrastructure business to increase its commercial viability and its relevance the contractors and builders in market need to look beyond the traditional boundaries defined by existing construction practices, market segments and structures built.

At the outset the growth of Infrastructure is unstoppable. The Smart and Innovative Admixture technologies will be the driving force for the development and growth of Infrastructure. The Master Builder solutions from BASF meet most of challenges and requirements of concrete that has a major share in the Infrastructure investment.

New and rapid developments in nano chemistry can certainly aid in the progress of concrete technology. Hence, this in turn can help in the construction processes by making them more efficient, faster and economical. The admixtures described in the paper have the potential to minimize the cost related to wastage and energy. More importantly these factors contribute towards achieving construction practices with lower carbon foot prints.

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Reliable Waterproofing Systems for Drywalls in Wet areas

Neha Murthy

Drywall (also known as plasterboard, wallboard, gypsum board) is a panel made of gypsum plaster pressed between two thick sheets of paper. Drywall construction has become prevalent as a speedier alternative to traditional blockwork and plaster. However, Drywall is highly vulnerable to moisture due to the inherent properties of the materials that comprise it: gypsum, paper, and organic additives and binders. It is for these reasons that greenboard and ideally cement board are used for rooms expected to have high humidity, primarily kitchens, bathrooms and laundry rooms.

While greenboard drywall's paper covering is water-resistant, it is not waterproof. Not only that, but the brittle gypsum core is not suitable for wet applications. A cement-based backerboard is suitable for tile-covered wet applications like showers and tub surrounds.

The great value of cement board is does not rot, warp, grow mould, or deteriorate, when subjected to water. Wood obviously is not a great material to use in wet applications, and even green board, a more hardy type of drywall, is not recommended for places with constant water usage, such as showers. Cement backer board is mainly used as a sub-surface for tiling.

Areas that are constantly subject to moisture, such as bathrooms, showers, sanitary areas etc. that have been built with dry wall material must be waterproofed, since these materials are easily ruined by moisture and also in order to avoid water leakages (in the form of moisture) to neighbouring areas.

Such waterproofing is normally applied underneath tiles that usually cover the surfaces of humid areas. The waterproofing layer must provide complete water tightness but also sufficient elasticity, since it is applied on substrates that are dimensionally unstable or suffer from vibrations.

Furthermore, it must be resistant and durable because any future intervention to repair the waterproofing layer would be difficult and expensive.

Waterproofing system failures in dry wall construction can generally be attributed to:

1. The use of an inappropriate waterproofing system
2. Use of waterproofing membrane not compiling with class III
3. Use of rigid corner treatment
4. Use of rigid reinforcing mat which hinders the elongation and flexibility of the membrane
5. Incompatible waterproofing membrane with respect to the tile fixing adhesive

IMPORTANCE OF CHOOSING THE RIGHT WATERPROOFING SYSTEMS FOR DRY WALL SYSTEMS

The proposed waterproofing over dry wall system should meet class III classification is given in Table 1.

Table 1. Waterproofing over dry wall system

Membrane Class*	Description	Elongation at break**
Class I	Rigid	<60
Class II	Flexible (but not elastomeric)	60% to 300%
Class III	Elastomeric and highly flexible	>300%

*As per membrane classification AS 4858; ** Elongation at break is the ability of a waterproofing membrane to stretch before breaking or tearing, also referred to as the Movement Accommodation Factor (MAF)

The corner treatment tape shall comprise of thermoplastic elastomer to accommodate the substantial movements in the corners to release the stress to the waterproofing membrane. The tape shall be flexible width wise and rigid length wise. Polyethylene as corner treatment is not as flexible as thermoplastic elastomer corner sealing tapes. And fixing it with high strength adhesive will also lead to brittle corners by not allowing any movement.

Solution: Keeping all the above mentioned parameters the designed waterproofing system which comprises all the vital needs for waterproofing and the compatibility with other building materials that they will be in contact with.

All corners are first treated with a Self-AdhesiveButanol Tape, and waterproofing is done out with suitable system.

It should meet the **Class III classification as per AS 4858** and is a tough, fast drying two component waterproofing membrane specifically designed for use under tiles. The product has been uniquely formulated with synthetic microfibers to increase its strength and eliminate the need for a separate reinforcement mat. It is based on the most advanced acrylic polymer technology, and is totally resistant to re-emulsification. It is flexible, low in odour, and is fully compatible with polymer modified tile adhesives.

Tiling can be done with a suitable polymer modified tile adhesive like and the joints grouted with Epoxy Grout

Progress in technology:
With the advancement in technology and increased challenges on site, the trend has shifted from polymer modified cement based waterproofing systems to PU based under-tile waterproofing systems which is a single component, tough, flexible, hybrid polyurethane based under-tile waterproofing with early drying time and higher tensile retention values. It has excellent adhesion to a wide range of substrates and complies with the requirements of Class III Classification of AS 4858 Wet Area Membranes.

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Spray Applied, Two Component PU WP System

S. Seshadri

Introduction

Innovations in chemical technology solutionsfor civil engineering and construction are meeting demands placed by increasing complexity in structures. One such is in waterproofing, driven both by the increasing realisation thatwater tightnessis essential for durability of structure and by the frequent failures of installed waterproofing.

Developments right from the cheap and simple bituminous coatings, through a slew of waterproofing materials, to the latest two component spray applied materials have continued though their adaptation has been hampered occasionally due to 'copy-paste specifications' and over emphasis on initial costs.

One suchinnovative technology, the spray applied, two component polyurethane waterproofing systems has been a late bloomer in Indian context, despite it's over a quarter century of flawless performance – without ever needing re-application – in a variety of structures.

This paper discusses thekey features of the system that has made this technology so sustainable.

Waterproofing for durability

Water tightness of concrete structures is essential for its durability and its need cannot be overstated. Neville, asserts that '… all the adverse influences on the durability involve transport of fluids through the concrete'. The ease with which fluids (liquids and gases) enter and move through concrete is referred to as permeability (Neville, 1981).

In fact, water and air permeation properties of cover-zone concrete have been used to index durability (McCarter and Chrisp, 2000).

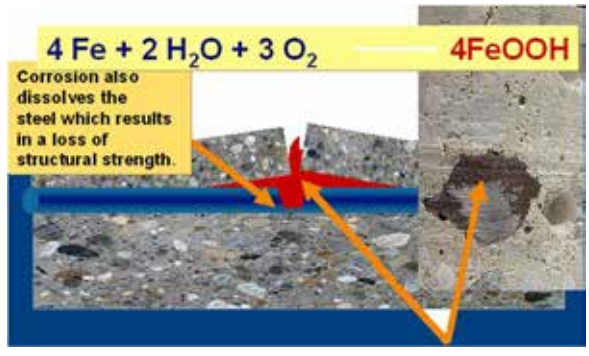
Role of water in deterioration mechanisms

Studies have established the principal triple role of water in almost every major deterioration process - it transports aggressive chemicals into concrete; provides conducive environment for their destructive attacks; and directly partakes in destructive chemical reactions such as, reinforcement corrosion, carbonation, chloride attack, sulphate attack, alkali-aggregate reaction, etc.

Development of waterproofing technologies

Waterproofing technologies have been continually developing both to overcome the drawbacks in the onesin use, and to meet stiffer challenges from increasing complexities of structures.

Broadly, waterproofing systems can be divided into 'un-bonded systems' and 'Bonded systems'. While bonded system needs excellent adhesion with the substrate for long-term performance, the un-bonded systemsare designed to perform as loosely laid with just mechanical fastenings at regular intervals.



Un-bonded systems

Un-bonded membraneis typically a pre-formed thermoplastic membrane that is laid loosely and welded at the overlaps. The membrane obviously must be,weldable (for watertight joints at overlaps), elastomeric (to accommodate movements) and UV resistant (on terraces). Membranes made of specific grades of PVC (polyvinyl chloride) and TPO (thermoplastic polyolefin, especially for UV exposed areas) are the most popular choice for their sustainable performance.

The key advantages are, substantial project time saving (no need for bone-dry and cleanconcrete substrate), and the ability to ascertain water tightness before moving ahead with construction (a thankless benefit in basement waterproofing). The key disadvantages are the difficulty and sometimes impossibility of installation on profiled substratesand substrate with too many upstands (for chiller unit, AHU fixtures, pipelines, etc), its unsuitability for traffic (even occasional maintenance traffic) without protection.

Bonded system technologies

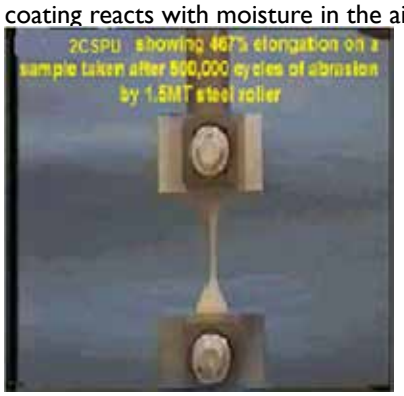
Effective adhesion is a key criterion for water tightness in bonded systems.Chemical solutions continually developed to overcome deficiencies or meet new challenging demand.

Perhaps, the first adoption of chemical technology in bonded waterproofing is bitumen, as a brush / roller applied solventedpaint. Its inadequate flexibility was enhancedin early 90's by modifying with rubber in rubberised bitumen. The film's flimsiness was compensated by pre-forminginto thick sheets, and furtherreinforcing / modifying with different types of polymers.In its final versions, pre-formed bituminous membranes are adhered to substrate either by controlled melting of membrane's underside through skilled torchingin APP (Atecticpolypropylene) modified bitumen or,in case of SBS modification, adhered to bitumen hot-melt priming before primer cools to below 200°C. However, the inherent properties of bitumen such as,rapid weathering, vapour impermeability(that cause ballooning and punctures), weak puncture resistance and related root penetrationand, its proven carcinogenic effect remain unresolved.Chemists had to look into different chemistries to overcome them.

For example, acrylic coatings were developedfor a more weathering resistant coating than bitumen but its ready re-emulsification restricted it to sloped roofs and walls; acrylic modified cementitious coating overcameemulsification issues but, use was limited to areas with minimal movements as in bathrooms. One component polyurethane spray / roller applied coating was a great improvement but suffered oversensitivity to the humidity and application thickness. Two component polyurethane spray applied system is formulated to overcome all the known deficiencies and currently the more sustainable amongst such high performance systems.

Two component,spray applied polyurethanewaterproofing system (2C SPU)

In this system, the two components react to polymerise and form a tough film instantly, while the one component polyurethane coating reacts with moisture in the air and on the substrate to polymerise with emission of carbon dioxide gas.

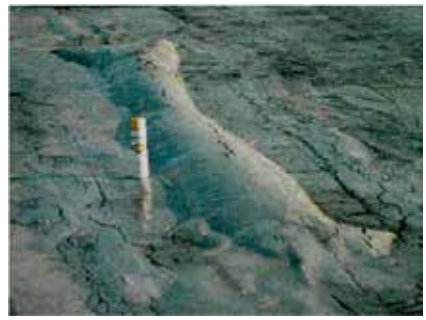


Experience and research has taught us that an effective bonded waterproofing system must exhibit several key performance properties such as, adhesion to common building materials; adequate elongation even after exposure to prolonged heating in summer or cooling in winter;water vapour permeability; toughness;resistance to - weathering and UV, abrasion, puncture, tear, root penetration and impact. It should also exhibit key application properties such as easy sprayability, fast setting to prevent damage during application, joint-free adhesion with overlaps and insensitivity to atmospheric humidity.

We can see that the two component spray applied polyurethane waterproofing system meets all of them and much more, making it the most versatile and durable waterproofing.

Essential performance properties:

Adhesion: The waterproofing membrane must exhibit a tensile adhesion strength of minimum 1.5MPa with concrete – i.e. when tested for adhesion according to ASTM 7234 using an elcometer, and the failure should occur in the substrate. Two component polyurethane system inherently is a 'fully bonded' system; its excellent wetting of substrate further enhances it.



Elongation: The membrane should repeatedly stretch and contract with the cyclic substrate movements to bridge cracks and joints without itself rupturing; should be greater than 400%. i.e., much before the elongation must be adequate to bridge cracks subjected to normal loads in service – abrasion, typically, elongation at break reaching the breaking point, and be reversible, even when temperature cycles, etc.

Good water vapour permeability: Impermeability to water vapour is the most common cause of filmrupture from vapour pressure build-up at the bond-line and the consequent ballooning. Whether retained moisture in concrete, or penetrated through any defect in membrane, the membrane should allow its expulsion.

Toughness: The membrane should not be easy to damage and withstand the various mechanical loads typical of construction sites. Damage to membrane either during installation or during service will fail it.

Excellent weathering resistance: Must retain flexibility and toughness over a wide temperature range; and even after prolonged heating in summer or cooling in winter. Bituminous membrane, even when covered with screed, is known to deteriorate from weathering.

Resistance to abrasion: Modern roofs have many equipment such as, pumps, motors, chiller units, AHU equipment, etc. Theyare transported on trolleys for maintenance; some dragging and impacts cannot be rules out! Waterproofing membrane should withstand these.

Plant root penetration resistance: The seeds dropped by birds germinate and plants could grow. Penetration of roots through the waterproofing membrane could bea root cause of leakage damage to the membrane!A screed cannot stop this problem, and membrane must be plant root resistant.

High puncture resistance: A membrane can invisibly puncture when civil works are in progress or later during maintenance traffic. Pebbles pressed by traffic tend to puncture membranes. Two component sprayed polyurethane membrane is resistant to such loads.

Essential application properties:
However good a waterproofing system is, its effective application is equally important for success. More the skill requirement in the installer, clearly, more the risk. Modern solutions try to build the skill in the product through application properties – i.e. minimal chance of wrong application.

Sprayability: Most bonded waterproofing systems are applied by brush or roller with their inherent drawbacks –impossibility of avoiding coating holidayson rough concrete, time and dependence on installer's skill.

Spray ability eliminates chances of coating holidays, continuity and thickness. Further, with about 600m2 completion per shift, it substantially saves project time. Though spraying too is a skill, it is an easier one to master.

Spray applied two component polyurethane system eliminates the limitation presented by profiles, contours, upstands, etc. Even a simple upstand needs several joints and bond-lines with pre-formed membrane and each joint is a potential ingress point.

Sensitivity to humidity: Two component polyurethane systems are free from solvents and are catalysed; the reaction preferentially occurs between the two components and not with the moisture in air making it insensitive to relative humidity and enabling the required 1.5 – 2mm in one coat without blisters.

In comparison, one component polyurethane system can also be spray applied; but its typically high solvent (20 to 40%) and sensitivity to atmospheric humidity (with which it reacts) limit the sprayed thickness in a coat to a few hundred microns. To achieve the required 2mm dry film, it needs considerable care to avoid blistering, to ensure good inter-coat adhesion and thickness.

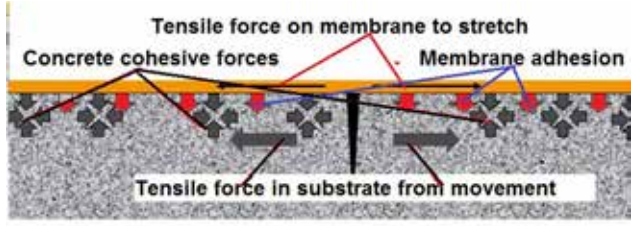
Two component spray applied polyurea system

Anobjective appraisal of the polyurea system, which also is a two component spray applied system can help educated choice for waterproofing applications.

Both polyurethane and polyurea have one common component –diisocyanate. Polyurethane has a polyol with a hydroxyl group (OH-) as the other component whereas,polyurea has an amine (NH2) as the second component. Because of the similarity in reactive chemistry, bothfigured under polyurethane in the past until polyurea deserved to be treated as different due to its few superior properties.

Almost all the properties discussed for the two component polyurethanes are also applicable to polyurea.But,polyurea is much more tough, has a very high tensile strength, sets more rapidly (in 10 - 15 seconds), more resistant to abrasion, puncture, impact, temperature and chemicals.

While superiority in a couple of properties needs objective consideration for waterproofing applications, the higher values of all these properties are not essential for waterproofing of slabs.



Key forces in the concrete and membrane build-up

Consideration 1 -Toughness: Polyurea's higher toughnessand its typically high tensile strength of 18-20MPa (against typically 7-8MPa of two component spray applied polyurethane)mean that polyurea membrane needsproportionately higher force to stretch it across cracks and joints. Amongst the forces holding the system together (tensile strength of membrane, adhesion of membrane to concrete and cohesion of concrete),around 1MPa cohesive strength of typical concrete (in M20-M40 concrete) is the weakest,making it susceptible should the force acting to stretch the membrane is inadequate. i.e., while the substrate moves, the membrane cannot stretch and the system has to fail where it is the weakest – concrete cohesion. On slabs longer than 50m the movement can be substantial and this factor needs to be objectively considered. In case of short slabs,or where variation in temperature is low, the movements would be small and the impact of this factor could be negligible.

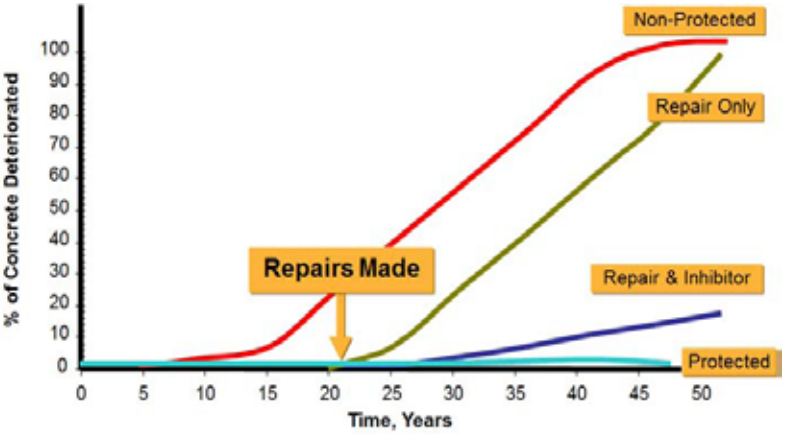
Consideration 2 –rapid setting: Polyurea's rapid setting within about 10-15 seconds leaves no time for it to wet the surface, essential for optimal adhesion.

Consideration 3 - High chemical and abrasion resistance –these fantastic propertiesare not needed for waterproofing but makes polyureaideal for both industrial and urban effluent treatment tanks (where the typical length of concrete slab wouldalso be short).

A perusal of the above factors and of the demonstrable decades of maintenance free performance of the two component spray applied polyurethane waterproofing installations on a variety of substrates – brick, limestone, steel, concrete, glazed tiles or even old bituminous waterproofing – could help in the choice of the waterproofing system on roof slabs and podiums.

Summary:

Water's triple modes of deteriorating actions makewater tightness essential for a structure's durability. Development in waterproofing technologies has kept pace with the increasing complexities in structures and, need for reducing dependence on installer's skill. Experience and research has established certain non-negotiable properties for sustainable waterproofing of structures. The inability of the past chemical technologies in meeting them fuelled the development of two component spray applied polyurethane system.



Importnace Of Concrete Protection

A close cousin is the two component spray applied polyuria system, which exhibits superior degree of some of those properties. While improved values

of many properties are not needed for waterproofing application and a couple of them could be cause for concern, this technology is ideally suited for chemically aggressive structures such as, effluent and wastewater structures.

Effective waterproofing is also a powerful protection to structures. Installation of these systems during construction tremendously improves the durability.

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Review of State of the Art - Construction
Chemicals for Concrete and Waterproofing Systems

Sunny Surlaker

1.0 Introduction

Concrete is the most versatile man-made construction material of our times on account of its flowability in most complicated forms while wet and its strength and durability characteristics when set or hardened. Concrete construction is economical considering the longevity of the structures. Durability of concrete is therefore a function of the performance of concrete with respect to time. The concrete is said to be durable when it can withstand the conditions, for which it is designed, over a period of time without getting damaged or deteriorated. For a durable concrete, more stress should be laid on the four 'C' as commonly called viz. Cover, Compaction, Curing and Cement to water ratio (inverse of water cement ratio). This 4C concept addresses to mitigate the effects of Corrosion, Carbonation, Chlorides, and Chemical attack (for e.g. sulphates). Concrete Technology addresses the concept of a good base concrete to improve structural durability and waterproofing systems address this concept by providing concrete with dense impermeable protective cover. In tandem, these systems help achieve long lasting structural durability.

In today's construction scenario, due to extreme requirements we put on speed, economy and construction practices, the durability of concrete is severely affected. In Indian conditions, Waterproofing is a very important and more often than not, not executed in a technically correct manner. Due to these construction and/or material problems, structures both above and belowground are susceptible to waterproofing problems. Dampness entering the living space (especially through ceilings and walls) is an indication that the structure has failed and that structural elements have already begun deteriorating.

Waterproofing is important in protecting the structure and ensuring that it is usable over its service life. The forces exerted by water are enormous and its effects are unpredictable. Water enters the structure through the weakest route. Therefore the best possible way to ensure waterproofing is to place "multiple barriers" between water and the living space. A good concrete followed by a reliable waterproofing system installed by professionals is essential to achieve lasting protection from water damage. Much is demanded here from both the material and its applicators.

2.0 Concrete Technology and its role in Durability

Over the past decade, the use of concrete admixtures, especially plasticizers and superplasticizers, is showing upward trend in India. The advent of concrete pumps and transit mixers has also contributed to this, as the use of superplasticizers enables trouble-free pumping operations and minimizes pipe blockages. In addition, the use of superplasticizers results in a wide choice in mix design for such operations.

As the infrastructure projects are more specific and need dependent, specific concretes will have to be designed to suit individual requirements. The durability would be the prime consideration as these structures cannot be easily replaced or repaired. Depending upon the appropriate selection of exposure classes, specialized specifications for concrete mix designs would need to evolve. The mix designs are getting relatively complex on account of interaction of several materials and mix design calls for expertise in concrete technology and materials. High Performance Concretes will have to be adopted considering special properties as well as low cost maintenance strategies. High performance waterproof concrete is highlighted in the section below.

2.1 High Performance Waterproof Concrete

For any kind of structure and especially for structural elements like foundations, slabs and shear walls it becomes imperative to protect concrete from ingress of water. Quite simply this can be achieved by blocking the pores and capillaries in concrete using one or a combination of the following methods.

- Using high performance PCE polymers to reduce water cement ratio of concrete
- Use of materials like Silica-fume or Aluminosilicate slurries in concrete
- Use of highly specialized latest generation Integral waterproofing compounds that work on process of Dynamic SynCrystallization (DySC) technology

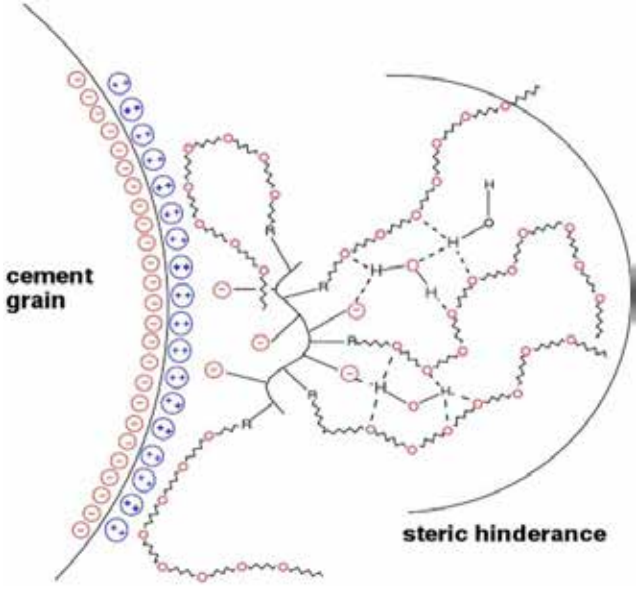


Figure 1: Structure and Functioning (Stearic Hindrance) of Latest Generation PCE Molecules

2.1.1 Using PCE Polymers to improve water-tightness

Using PCE polymers, give excellent water reduction as compared to normal plasticizers. This helps to reduce the w/c ratios and cement contents, even in normal concretes. Lower the w/c ratio, lower are the number of capillaries in concrete. Unlike conventional superplasticizers, PCEs work on the principle of Stearic Hindrance. What this means, is that PCEs can be designed to provide the required workability time, following which; the strength gain in concrete is not hindered by retardation. This is also a well documented fact that PCE based admixtures do not have the side effects of retardation often seen with normal retarding super-plasticizers. This is beneficial as workability time of concrete can be controlled but the hydration and setting of concrete will proceed unhindered.

This ensures that any subsequent vibration to concrete after initial set will not open up capillaries, as is the case if concrete is retarded for a very long period of time, thereby rendering concrete relatively waterproof / chemically resistant. Figure 1 shows the structure and functioning of the latest PCE Polymer molecules.

2.1.2 Use of Condensed Silica Fume or Aluminosilicates to improve watertightness

Again it well known that Condensed Silica Fume or Aluminosilicates are extremely fine materials that function both as micro-fillers as well as pozzolanic materials that hydrate in the presence of the Calcium Hydroxide in Concrete. The combined effect of these materials, as micro-fillers and hydrating materials, close capillaries in concrete, thereby rendering it waterproof / Chemical Resistant.

2.1.3 Using Integral Waterproofing Compounds working by Dynamic SynCrystallization

Special additives in Integral Waterproofing Additives make the concrete moreworkable (increases slump) at the same w/c ratio or provide a reduction in w/c at the same workability levels. This property helps concrete achieve excellent compactability thereby reducing capillary pores. Less capillary pores means less transport of water through the cement matrix, giving your concrete an excellent first line of defense against water ingress.

These materials also use advanced microfine latent hydraulic and pozzolanic Nanoparticles to effect a structure of densest packing in the cement matrix on a nano-scale. The cement matrix is densified by a complex process called Dynamic SynCrystallization®(DySC).

The strength and permeability of a cement-based material is based on hydration of the clinker components, to form C-S-H gel and Ca(OH)2. Our special nano-particles use this Ca(OH)2, in presence of water, to recrystallise and form new more stable C-S-H and C-A-S-H phases. One gram of our crystallizing nano-pozzolan can react with more than 1000gm of free lime in the concrete, which means its reactivity is much higher than most normal pozzolans. Therefore the most porous part of the cementitious matrix, (Ca(OH)2), is converted to very stable C-S-H and C-A-S-H type crystals. This crystalline mineralization process continues over time in presence of water, and the structure of the matrix becomes more refined, overall porosity decreases, micro-cracks are sealed and pore volumeis minimized. This DySC® process thus makes concrete watertight.

The result of these mechanisms has been verified in accordance with DIN 1048:Part 5: Testing water penetration into the concrete at varying pressure upto 5 bars. Results indicate that depending upon the concrete mix-design the water penetration under pressure is reduced by up to 60%. In addition, similar tests for co-efficient of permeability for concrete was reduced by up to 67% as compared to control concrete.

In addition to reduction of capillary pores and the Dynamic SynCrystallization, the high performance Integral Waterproofing Admixture has special hydrophobic pore blocking additives, which converts the water-absorbing capillary forces into water repellant capillary forces. Thus water is pushed out of the capillary pores and the concrete is kept dry. Figure 2 shows the combined action of an Integral Waterproofing Additive based on Dynamic SynCrystallization Technology. Figure 3 shows the crystalline structure developed by the DySC Process.

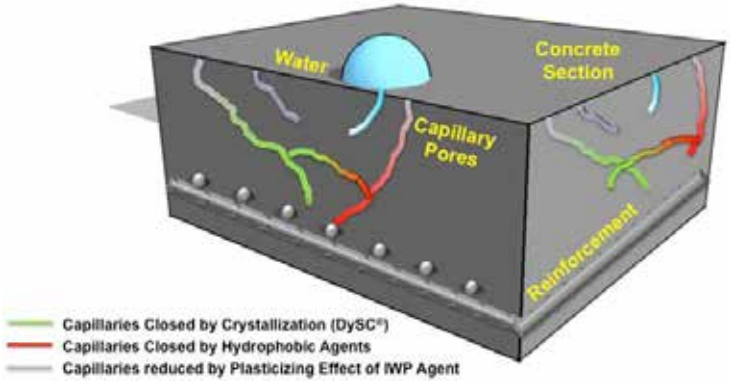


Figure 2: Combined Working Mechanism of Specialty Integral Waterproofing Additives incorporating DySC and Hydrophobic Pore Blocking Technology

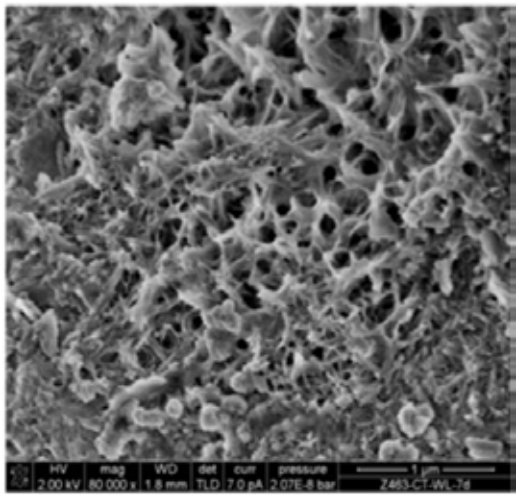


Figure 3: Crystalline Structure developed by the DySCCrystallization Process

Precautions While Using Integral Waterproofing Compounds

1. Requires adequate quality control
2. In case of integral waterproofing or any other waterproofing treatment for underground structures, joints become the weakest link in entry of water and should be adequately treated.
3. Also the material to be added to concrete should be characterized with respect to the waterproofing they provide and not merely marketing stories.

Advantages of using DySC based Integral Waterproofing Compounds in Concrete

- Provides an efficient and durable barrier against rainwater, moisture and ground water and makes concrete waterproof
- No external application, simply mix it into your existing concrete
- Save costs on material and application costs for external membranes
- Speed up your construction, no waiting for external membrane application
- Permanent protection from water penetration and absorption
- Makes the mix more workable (improves the slump) at lower w/c
- Does not change setting time nor adversely effect the reinforcement.
- Disperses rapidly and makes a homogenous mix.
- Free from chlorides
- Certified for use in contact with water intended for Human Consumption
- The use of prevention as a means to waterproof structures can be a cost effective measure, especially for structural elements as it prevents future deterioration and repair cycles.

3.0 Why do we need Waterproofing?

Once a good quality concrete is made as per guidelines in Section 2.0 above, we still need to remember that concrete is a wettable material and has affinity to water. Water enters the body of concrete through hydrostatic pressure or capillary action or both. The capillary suction of dry or partially dry concrete can be equivalent to a hydrostatic pressure through cracks and crevices. Water passes end to end through concrete, either in the liquid or vapor phase, through interconnected voids. In the concrete, there are gel pores, capillary pores and entrapped air. Permeability is a function of capillary porosity and water-cement ratio. Permeability of concrete to liquids, ions and gases is of direct relevance to both its durability and to its leak-resistance. The basis of waterproofing is thus, to minimize permeability and / or wettable characteristics of concrete.

Concrete by and large offers good resistance to moisture penetration if recommended procedures are followed in mix design, workmanship, mixing, transporting, placing, vibration, and curing. However, conditions may nevertheless, develop where concrete may further need protection against water ingress. Efficient waterproofing systems can help.

There are several harmful or undesirable effects of leakage in a building. When water penetrates the structure, corrosion begins in the reinforcement and cracks develop in the concrete. This may cause structural failure later in the life of the structure. Dampness in floors also leads to health and safety problems. Unsightly marks appear on the walls due to dampness and seepage causing discoloration, shedding of plasters and efflorescence. Dampness attracts and breeds termites or other biological organisms. With deterioration of concrete and the reinforcement, the durability of the structure is endangered. Dampness causes short circuits from electrical installations, which may act as possible fire hazards. Dampness in laboratories or technical workshop may cause failures or damage sophisticated equipment.

4.0 Waterproofing Principles

Waterproofing is the treatment of a surface or structure to prevent passage of water into it or out of it. There are various forces that can act alone or in combination, to force water into concrete. These forces include hydrostatic pressure, capillary action, wind-driven rain, difference between vapor pressure between two sides of concrete or some combination of these. Waterproofing differs from damp proofing in that the former consists in the positive prevention of movement of water under pressure. Water enters the concrete structure through interconnected voids and pores, cracks, structural defects or through faulty joints.

Here it is important to consider, in many projects damp proofing is expected of the waterproofing system. There is a clear difference between the two. As per ACI Committee 515 report, waterproofing is a treatment of a surface or structure to prevent the passage of water under hydrostatic pressure while damp proofing is a treatment of surface or structure to resist the passage of water in the absence of hydrostatic pressure. While designing the waterproofing system, actual service conditions are to be borne in mind and the material to be selected accordingly.

5.0 Conventional Waterproofing Methodologies

Waterproofing has been a part of construction in India for a long time. However, these conventional systems had a lot of limitations and often did not / do not perform as needed. This gave rise to the concept of waterproofing guarantees, which was more psychological as opposed to providing a real safeguard against water ingress into structures. The success of waterproofing system depends not only on the materials alone, but also more on application and understanding limitations of the materials in question. Rather than asking for Guarantees from applicators, which has not stopped failures, the adherence to Quality Assurance systems should be reverted to. Guarantees can only be asked from bonafide, qualified and authorized applicators.

Some of the conventional waterproofing systems include:

- Brickbat Coba
- Bituminous membranes – APP/SBS
- Acrylic modified cement coatings
- Metal deck
- Asbestos sheets
- China Mosaic Tiled roof

Some of the shortcomings of these systems are:

- High Dead Load on structure
- No engineered detailing
- Shorter durability under critical exposure
- Fire issues (mainly with bitumen)
- Leaking through Joints (tiles, metal deck)
- Lack of additional benefits like energy smart
- Very costly maintenance and repair
- No insulation
- Not a green / sustainable system

6.0 Requirements of a good Waterproofing System

The latest trend in waterproofing will be "Prevention is better than cure". With high demands on durability, the thought process should turn to preventing water ingress through the concrete, either by provision of an external membrane or by manipulating the properties of concrete itself. This approach also follows the logic that "Waterproofing can only be as good as the Base Concrete". Therefore, for new constructions, this entails making good watertight concrete and for restoration projects, the substrate should be brought back to its initial state. This methodology also follows the Diktat "Put Multiple Barriers" between the water and the living space / structural elements for best protection against water.

Though waterproofing problems are serious and at times look unsolvable, it has never been a difficult task to ascertain the reasons for waterproofing failures. Once the investigation is complete and after proper diagnosis, the waterproofing treatment passes through three distinct phases:

1. Selection of waterproofing systems and materials
2. Repairs to the existing structure and surface and surface preparations
3. Application of specified waterproofing systems or treatments

The steps are intentionally formulated to include repairs and surface preparation as independent operations, as it has been observed that this very important step does not receive the attention it deserves. Many systems involving proper specifications and proper selection of materials have failed only on account of improper pretreatment repairs and negligence of proper surface preparation. It is unlikely any waterproofing system properly applied under efficient supervision cannot guarantee the desired performance.

The dampness and water seepages are mostly from the following weak spots and zones:

a. Concrete or masonry constructions of high permeability.
b. Weak spots on account of honeycombing and segregation in concrete.
c. Cold joints and construction joints.
d. Improper pointing of brickwork or block work.
e. Not providing waterstops, waterbars etc., wherever necessary
f. Not providing or improper sealing of expansion joints.
g. Cracks during construction due to faculty concreting, faulty design or natural settlements.
h. Improper bonding at the interface of two different materials of construction.
i. Non-provision or failure of Damp proofing courses.
j. Improper surface treatment and wrong selection of coating materials.
k. Improper provisions of slopes and drainage.
l. Improper sealing of plumbing and sanitary joints.

To address these weak spots, waterproofing materials should possess following basic requirements:

a. The material should provide water tightness (a combination of hydrophobicity and impermeability) to the system.
b. The material should have flexibility and elasticity to combat thermal and other stresses.
c. The material should have excellent bonding and adhesion properties both to the substrate as well as to ensuing treatments.
d. The material, as far as possible, should retain the breathing properties of concrete.
e. The material should have abrasion resistance if used as a topcoat.
f. The material should be easy to apply, preferably free from solvents, etc.
g. The material should be cost effective.
h. The material should be resistant to algae, fungus and other microbial attacks.

However, in the actual practice it is quite difficult to locate a material possessing all above requirements. The fact therefore becomes quite evident that there can be no universal material to solve all the problems and only a combination of materials can be fruitful. Judicial compromises are necessary but the problems become simpler when the waterproofing treatment is viewed as system and not as a material.

7.0 Modern Waterproofing Systems

Modern waterproofing systems are designed as a combination of materials to address the concept of impermeability of the structure as a whole. Waterproofing can never be designed as a single material. It is a system of different materials, working in tandem to keep water away from the RCC structure, ensuring dry living spaces and channeling away water effectively in wet areas. The aim of an efficient waterproofing system is to "Keep Outside Water Out [Roofs, Basements, Walls, etc.] and Inside Water In [Swimming Pools, wet areas, water tanks, etc.]". The design of a highly effective waterproofing system includes:

7.1 High Performance Waterproof Concrete
7.2 Well designed and watertight Construction and Expansion Joints
7.3 Provision of a waterproofing coating system to have a seamless barrier on concrete

7.1 High Performance Waterproof Concrete

This has been covered in Section 2.4.3

7.2 Joint Treatment

Cracks occur in a structure when tensile forces accumulate and the structure cannot yield to accommodate them. There are many reasons for this. Crack formation can be prevented by a suitable arrangement of joints. A joint is a planned break in a structure or elements of a structure, and as such is part of the structure, but its detail depends on the demands of the structure. Permanent joint sealing depends largely on three factors:

- Joint design
- Choice and quality of sealant
- Execution in workmanlike manner in accordance with specification and standards

Cracks develop in concrete not only because of poor quality of concrete, improper curing, improper strength design, etc., but also due to improper joint design. Joints are most important and should be properly planned to counteract the expansion of concrete elements due to thermal and other stresses. Two major sub-divisions are:

- Construction joints
- Expansion joints

Construction joints are left due to construction purposes at connections etc., and they should be sealed to avoid water, dust, etc., from entering the inside of the structures. Expansion joints are designed to take care of expansions of the concrete elements and thereby avoid the formation of cracks. They should be carefully sealed with materials having expansion capacities more than the expected expansion.

A well designed and sealed joint is an asset. A little care at the time of construction and waterproofing can be key to total success of waterproofing. In fact waterproofing passes through two stages, the first being filling of joints and the second application of surface barrier. Usually a good waterproof concrete is less permeable if there are no cavities or honeycombs and it is relatively easy to waterproof the surface. The success of waterproofing depends fully on adequate joint filling, which is usually neglected. Wrong materials are filled in joints without giving a second thought to the movements expected. Wrong boards and fillers are used which deteriorate over a period causing irritation to the house owner. Once water leakages start through the joints, repairs are difficult as source of water is on the other side.

A major impediment to water tightness of concrete is the drying shrinkage cracks developed if control joints are not provided. Also there would be random cracking in concrete due to temperature contractions. If waterproofing is done at very early stages the cracks will be transferred to rigid surface barriers and would be major conduits for leakage. Therefore control joints should be well designed in addition to the unavoidable construction and expansion joints. Principally each joint is to be sealed by suitable joint sealants in addition to providing the waterstops or waterbars. Passage of water through joints can only be arrested by preventing migration or by forming water seals.

The joints should be properly prepared and the opposite faces should be parallel. Joint sealing material should be able to resist the joint movement. Joint covers are usually neoprene or silicone and should be installed giving due weightage to intersections. It should be remembered that in case of negative side waterproofing, the waterstops and joint sealants are primary defenses to water tightness.

Some of the Systems Available to treat joints includes:

- Water-stops
- Hydro-swelling Systems
- Injection hoses
- Adhesive tapes
- Suitable Joint Sealants based on Polysulphides, PU, Butyl / Acrylate or silicone to be incorporated with suitable backer rods for expansion joints
- Acrylic or PU Injection Systems to address leaking joints [these can also be used in negative waterproofing systems]

Improper joints construction whether in design; detailing or sealing is one of the main causes for waterproofing failures. Joints are to be provided to avoid cracking of concrete due to thermal variations. Other types of joints are cold construction joints and both if left unfilled or wrongly filled waterproofing fails. Decision for a proper joint sealant depends on several considerations from structural as well as architectural angle. Several guides are available to the engineering and Architect fraternity for use of sealants. After selection of proper sealant, it is also imperative that joint is prepared properly and sealant applied by expert applicators. This is a specialist job and needs understanding of material properties, adhesion parameters, curing characteristics and exposure conditions.

Joint sealing therefore is most important step in waterproofing. The first responsibility is of the designer to provide adequate Joint design and thereafter of the construction to provide it. Once joint is provided the movement capacity and Joint Sealant should be selected. Here comes in responsibility of the manufacture. The manufacturer should provide long-term data about movement capacity after exposure conditions. The next step is selection of authorized applicator and generation of quality assurance system. A shared responsibility of all parties concerned must guarantee proper joint sealing. The field of Joint Sealing is too vast and these note only cover some basic information with respect to sealants in waterproofing and restoration of damaged joint. Figure 4 shows some of these systems.

7.3 Provision of a waterproofing coating system to have a seamless barrier on concrete

7.3.1 Surface Preparation

Prior to coating the concrete, surface preparation becomes very important as the final waterproofing treatment can only be as good as the base concrete. The surface to be coated must comply with the principles of building construction and should fulfill the structural requirements, including properly designed slopes and drainage system to avoid stagnation of water. Before carrying out any repairs the basic principles of civil and structural engineering should be thoroughly adhered to.

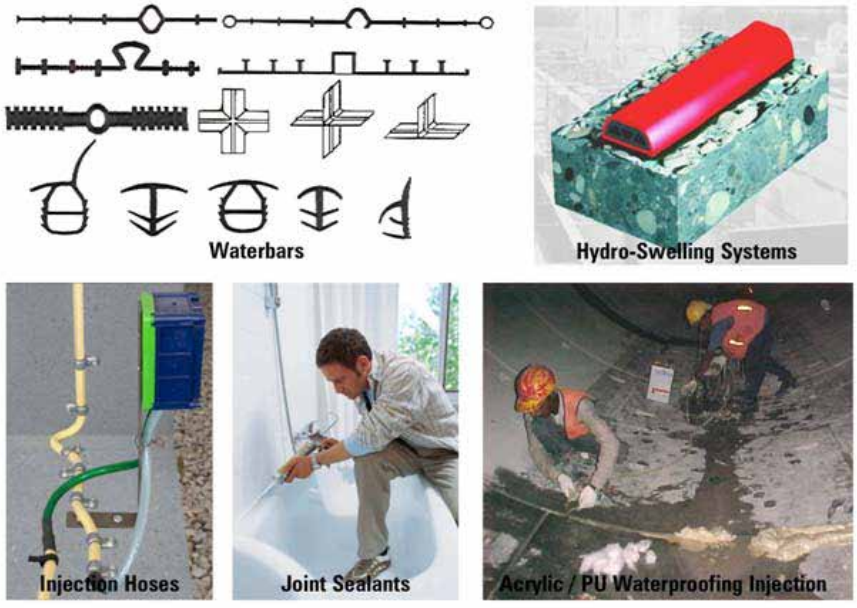


Figure 4: Joint Treatment Systems

Cracks: First it should be ascertained whether the cracks are structural or non structural. Secondly it should be established whether there is moisture ingress through the cracks and whether the cracks are moving or non-moving type. The width and depth of the crack plays a major role in deciding the material for repairing the cracks. Wider cracks can be cut open and filled with non-shrink materials having bonding properties. For finer cracks, injecting and grouting techniques with epoxies, polyurethanes and ready to use polymer grouts can be used. For leaking cracks, the Primary injection is carried out with foaming polyurethane resins and the secondary injection is carried out by low viscosity and flexible polyurethane resin. Figure 5 shows addressing Cracks by Injections (cementitious or resin-based)

Figure 5: Addressing Leaking Cracks by Injections

Grouting:In case of voids or high permeability concrete, cement grouting techniques can be resorted to densify the concrete. It is advisable to use a non-shrink admixture in conventional cement grouts to impart the grout non-shrink characteristics. Ready to use, polymer modified grouts which are workable at low water cement ratios develop strengths of about 35 N/mm2 are very suitable for grouting even where the strengths are the criteria. All joints / voids should be neatly grouted.

Honeycombing: The techniques adopted for repairs of honeycombed patches will depend upon the extent of honeycombing. If the areas are large, the concrete of same grade as of base concrete is fully suitable, when the concrete is still green. The aim should be to make the concrete or mortars non shrink and incorporate a bonding agent in the system for effective bonding of old substrate to new repair material. Prepacked, polymer modified repair compounds, which combine non-shrink, bonding as well as high strength characteristics are more suitable on account of price considerations as compared to epoxy mortars. Figure 6 shows Filling of afftected / honeycombed areas.

Leakage and seepage spots: Using polymer modified Quick Setting Plugging mortars can stop leakages. If water is leaking through cracks, releasing the pressure and re-routing of water is required before using quick setting plugs might be necessary. Figure 7 shows application of Quick-Setting Plugging Mortars.

Figure 6: Filling of afftected / honeycombed areas

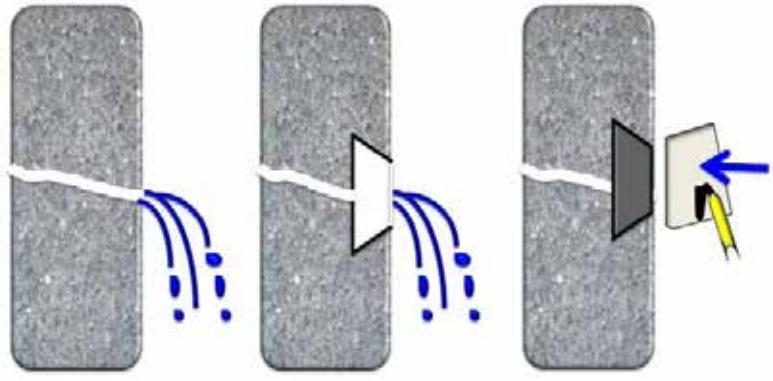


Figure 7:Application of Quick-Setting Plugging Mortars to stop leaks

These measures should stop the leakages completely before application of surface barriers. If leakages are still observed, PU injections should be resorted to. Water compatible PU injections can also be undertaken as Grid Injections if larger areas show leakage due to bad and porous concrete. Only after the leakages are controlled, surface barriers can be applied. In case of negative waterproofing the repairs should be total. The repairs should be followed with proper surface preparation depending upon the type of treatment foreseen.

The surface preparation plays a key role in success of any waterproofing system, whether the materials are conventional or new generation. Prior to waterproofing it should be ensured that the surfaces are totally free from remnants of form oils or curing compounds. The surfaces should be totally free from loose materials, dust, oil, grease and other contaminations. Bonding of surface barrier materials has to be ensured. Depending upon selected barrier materials, degree of surface water / moisture content of the substrate is to be checked.

7.3.2 Application of Barrier Coatings

One of the major parts of waterproofing is the selection and application of surface waterproofing barriers. The main function of these barriers is to arrest the passage of water through the body of concrete either by capillary action or hydrostatic pressures. The surface applied barrier materials are not a substitute to joint sealants, which are to be applied in the third dimension. Only few of these materials can be applied both for Positive side and Negative side waterproofing. The performance of barrier materials for Waterproofing and Damp proofing should also be checked for exposure to aggressive soil contaminants.

Though several materials are available as surface protective systems, the concept of waterproofing has remained the same, which is the tanking system. Waterproofing acts as protective envelope to arrest entry of water into the concrete. Built up bituminous waterproofing membranes were very popular few years back and they were bonded to the surface either by self-adhesion cold application or heat welding. Major difficulty in the application of bituminous or polymeric bituminous membranes was covering the geometry of the structure, overlapping joints and use of moisture sensitive adhesives to bond the membrane to the substrate.

Liquid Applied Membranes became more popular in the last decade on account of their ease of application and mouldability to form seamless membranes over any curvature. Some Liquid Applied Membranes are of the non-breathable type and this would give rise to blisters and craters, which would eventually affect the barrier performance.

Waterproofing by cementitious slurries is becoming more popular on account of ease of application, compatibility with substrate as well as competitive pricing. The slurries are available in rigid and flexible types. Cementitious slurries are manufactured by incorporating acrylic polymers either in powder or liquid form depending upon flexibility required. Old generation Waterproofing slurries were rigid and therefore were not suitable for Waterproofing because of transference of cracks from base concrete to the Waterproofing system. Availability of new acrylic raw materials made the formulations of flexible waterproofing slurries possible to counteract the rigidity factor.

Crack bridging characteristics is one of the most important criterions for the flexible slurries as well as chloride diffusion is an added feature for underground structures. These slurries are of breathable type, which contribute to better waterproofing on account of no blistering and bubbles. There are other properties imparted to waterproofing slurries like crystallization. However, some data of testing available concludes that this property is not established with respect to permeability testing. The crystalline and chemical coatings react chemically with the free lime in cement in presence of moisture and provide capillary repellency. Small shrinkage cracks are also autogenously healed. Careful surface preparation is the key to success of these cementitious waterproofing slurries. The biggest advantage of waterproofing slurries is its ability to adhere to damp, wet or moist surfaces. Another benefit, these waterproofing membranes provide is equivalent cover to concrete. For e.g. MC's

2-Component Flexible Cementitious Elastic Material at 2mm thickness provides a cover equivalent to 72 cm of well-compacted M30 Concrete. Figure 8 shows this concept. This feature allows these materials to be used in repair and protection projects apart from waterproofing applications.

Some Additional properties / advantages of 2 component cementitious Liquid applied Membrane Forming Systems include:

- Crack bridging
- Breathable
- Thermal resistance
- Water tight
- Easy application to both dry and moist surfaces
- Good bonding to the substrate
- Resistant to aggressive waters, chlorides, sulphates, etc.

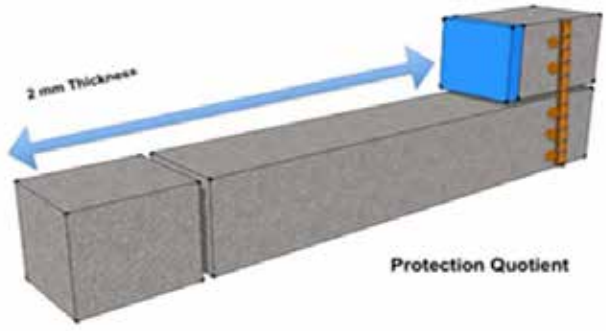
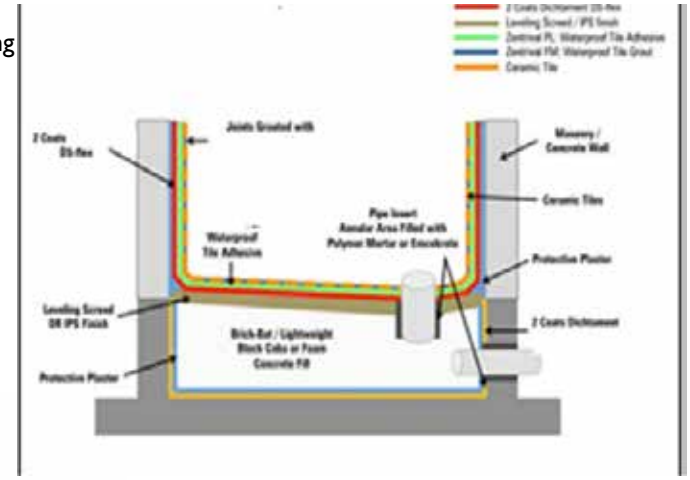


Figure 8:Concept of Equivalent Cover provided by 2K Flexible Cementitious Systems

One disadvantage of this material is resistance to abrasion, which can be very easily addressed by means of a waterproof plaster, screed or tiling system. Applications for these kind of membranes are multifold, in basements, wet areas, swimming pools, tanks, dead-walls, terraces, terrace-gardens, structural elements and so on. The main point to remember while using a slurry-applied membrane is the correct detailing of joints, water-stops and interfaces (covings) between horizontal and vertical surfaces. Flexible 2 component cementitious systems, when used in conjunction with injection grouting, crystallization based waterproofing slurries, waterproof plasters, tile adhesives, etc. and applied over good concrete fortified with a Dynamic SynCrystallization Based Integral Waterproofing Additive, has shown tremendous success over the last decades. As always, detailing is the key to successful application. Figures 9, 10 and 11 show in-depth detailing for basement structures, wet area bathrooms and swimming pools. Using the same material systems with varied detailing can help enhance durability of waterproofing on key-projects.

Figure 9:In-depth Detailing of Bathroom Waterproofing



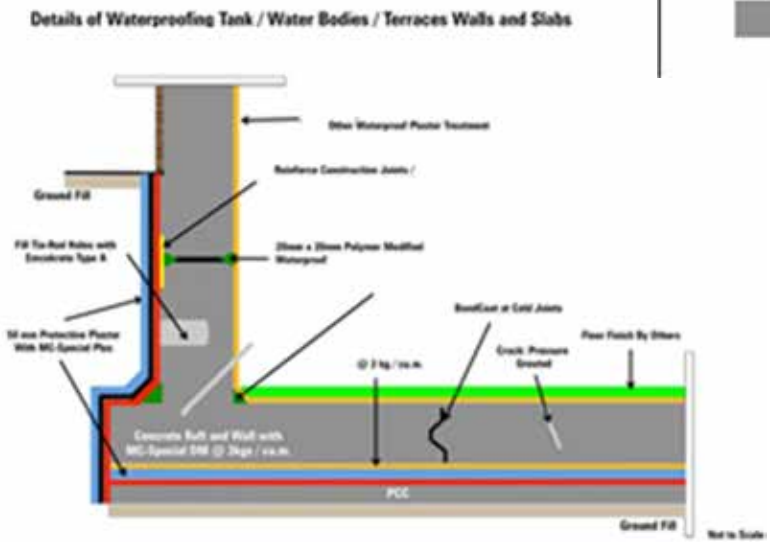


Figure 10: In-depth Detailing of Basement Waterproofing

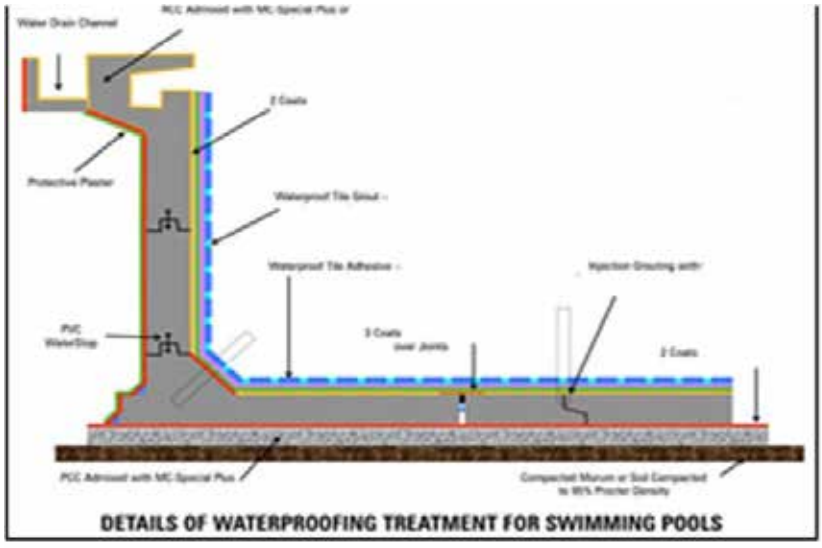


Figure 11: In-depth Detailing of Swimming Pool Waterproofing

7.3.3 Advanced Surface Barrier Coatings

There are many types of high quality surface barrier coatings available as per current technology. These include:

1. Crystalline Based Cementitious Coatings
2. 2K Polymer Modified Highly Flexible Mineral based coatings
3. Epoxy or Polyurethane Resin based coatings
4. Polyurea based coatings
5. 1K Highly flexible Acrylic Coatings

These systems need to be evaluated for use. For e.g. Acrylic and Acrylic Modified Cementitious coatings are flexible and breathable are lower in abrasion resistance. Epoxy, PU or Polyurea are better in abrasion and chemical resistant but not breathable. Each coating can easily be modified for use with supplementary systems for use in diverse applications. However the field of advanced barrier coatings is fast advancing. Some of the latest advancements in this line are:

High Performance bitumen based coatings: These coatings are state-of-the art in bituminous coatings. These coatings are resin free, liquid applied bitumen coatings, which can easily be applied to damp surfaces, are relatively breathable and have excellent resistance to underground chemical compositions. Figure 12 shows these coatings. Some advantages of these systems are:

- Highly flexible and crack bridging
- Simple and economic application
- Applied by spray or trowel
- Cold applied – even on vertical surfaces
- Solvent-free – non-toxic, non-polluting
- Impervious to pressurized water
- Bonds to damp surfaces

Figure 12: Non-Resin Based Bituminous Waterproof Coating

Flexible Underwater Mineral Coatings: Concrete surfaces subject to permanent water loading require particular protection – especially when water and pollutants are able to penetrate through cracks into the building structure. The self-cross-linking and crackbridging new generation a mineral coating offers a waterproofing that fulfills these requirements.

This system can protect concrete surfaces in fire-water basins, service water tanks, clarifiers, process water plants, collection basins, and comparable structures from damaging substances with lasting effect. The revolutionary mode of action of this material is founded on the BaseCoat. The rolled on base coat doesn't just lie on the concrete surface, but is additionally absorbed by the concrete's capillary pore system where it crystallizes. The capillary pore system thus seals itself; this greatly reduces water transport and osmosis, thereby waterproofing the structure. Figure 13 shows working mechanism of this coating.

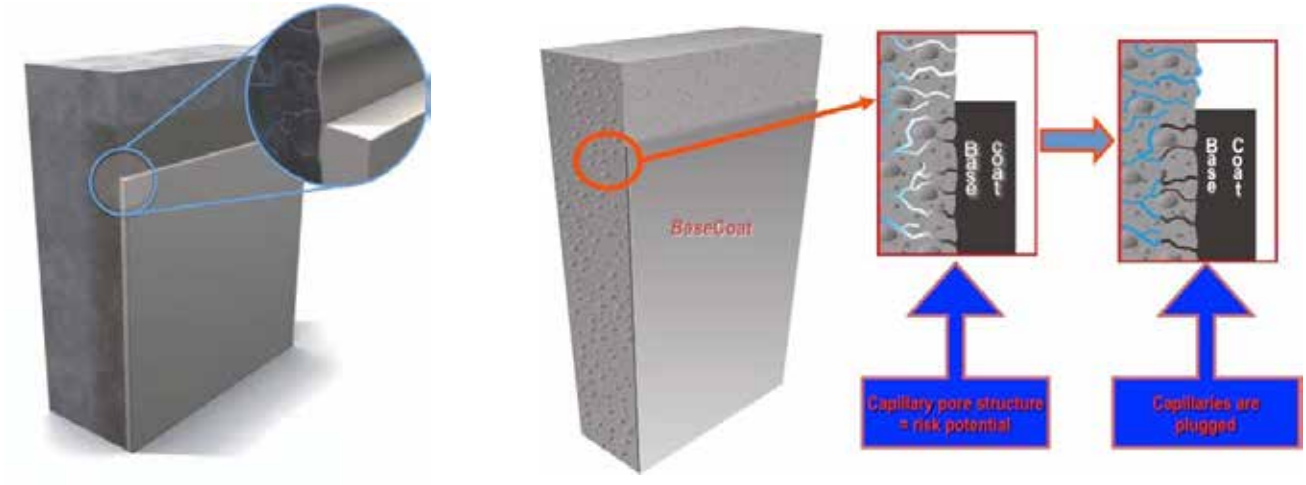


Figure 13:Working Mechanism of Flexible Underwater Mineral Coating

EHS Based Green Waterproof Coating:Bitumen is valued for its plasticity and flexibility. Theseproperties are vital for perfect waterproofing.But there's also a "green" solution:The experts in innovative waterproofing systems have developeda solution that works without bitumen. Furthermore, theperformance of the new "green" generation actuallyexceeds the requirements for the waterproofing of buildingstructures by a wide margin. These Elastomer hybrid skin (EHS) based coating covers the building like a skin: It is highly flexible, highyieldingand extremely stable under water pressure. However, thisproduct is capable of more: It is suitable for multipurposeapplicationswhilst being hygienic and ecologically safe – itis ideal for use where there is contact with groundwater.This is shown in Figure 14.

Advantages:

- Environmentally friendly because it contains no solvents
- Bitumen-free
- Highly flexible
- Multipurpose applications
- Hygienic and ecologically safe, even in contact with groundwater

Figure 14:Working Mechanism of Flexible Underwater Mineral Coating

8.0 Conclusion

Today's specifier or constructor has innumerable materials at his disposal, each claiming to be the best. Most of these materials are characterized by generic properties. These properties are suitable for Quality Control to produce batch certificates, but do not address the waterproofing system as a whole. The best waterproofing system is made of Good Base, Good Material and Good Application.

The success of waterproofing system depends not only on the materials alone, but also more on application and understanding limitations of the materials in question. Rather than asking for Guarantees from applicators, which has not stopped failures, the adherence to Quality Assurance systems should be reverted to. Guarantees can only be asked from bonafide, qualified and authorized applicators. There are quasi-governmental institutions abroad, e.g. BZB in Germany, which issues IRP certificates to trained, qualified applicators. Such qualifications should form a part of specifications. Under most circumstances the concrete cast should be Waterproof High Performance Concrete, keeping in mind the "prevention is better than cure" motto. Even for such materials test certificates conforming to international codes and certified by bonafide agencies must be procured.

Finally, it is the best practices to be followed in construction, which will ensure that the longevity of the structure is maintained and the structure is cost effective over its design life.

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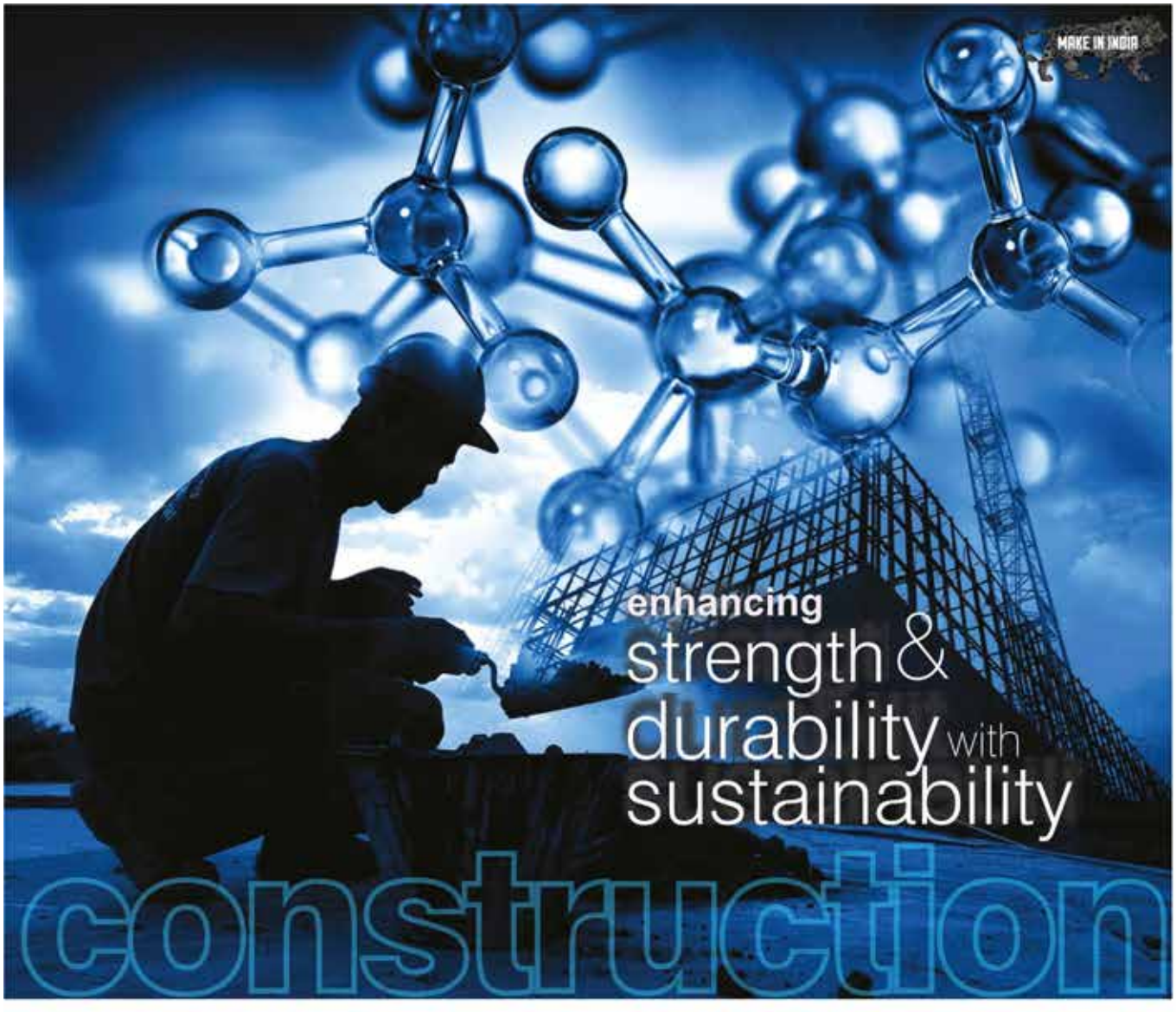

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CASE STUDY: Large waterproofing of the podium of a leading mall in the CBD of Bangalore

SUNIL R K

The project was a leading Luxury Mall – UB City located in the CBD of Bangalore. UB City is a mixed development with a mall, office towers and serviced apartments. The developer had severe problems due to seepage of water from podium level to the basement car parks and service areas like DG room, electrical panel room etc. Team of professionals from contractors was selected to propose a waterproofing scheme and to execute the same.

Undertook a thorough study of the situation and noted that there is a high volume movement of vehicles on the podium and identified majority of the water leakage happening thru static cracks & construction the water seepage was mainly through the construction joints and static-cracks, which has developed on the podium slab.

It was then suggested a waterproofing treatment based on the site conditions and client's budget. The treatment executed with very high quality chemicals and company trained technicians. The following treatments were adopted:

1. Sealing all Joints by using highly flexible PU sealant
Since podium was supposed to get continuous vehicle movement, the joint were treated with PU sealant capable of cyclic expansion & compression movement

2. Filling the cracks by usingmoisture insensitive epoxy putty
Epoxy putty were carefully selected to see that it should have impact resistance & good mechanical properties. Care was also taken to see that EP putty forming excellent bond even on damp surfaces

3. Pressure grouting the cracks & joints by using high performance elastic PU
High performance PU injection system were selected & adopted to make sure that it will form permanent watertight sealing & absorb movements in the cracks & joints to which it is applied

4. Laying of APP Membrane system with proper termination detailing
Based on the budget, 3mm mineral finish APP membrane was selected & it was applied to the podium slab with proper termination detailing as per the advised specifications

Above system is was overlaid with screed & pavers after making sure that there is no leak during waterpond test for 7Days. Podium slab is operational since 2014 without further water leakage issues

About Author :
SUNIL RK, M.E. (Str).
Founder& CEO
M/s.3E-SERVICES

CAC Products at Glance.... Concrete Admixtures

CAC
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Sr.No.	Product Name	Description	Specification
1	CAC-Chemplast	Water reducing plasticiser for concrete	ASTM C 494 – Type A IS 9103: 2007
2	CAC-Retardplast	Retarding plasticiser for concrete	ASTM C 494 - Type B & D IS 9103: 2007
3	CAC-Retardplast 10 / 30	Water reducing & retarding plasticiser for concrete	ASTM C 494 - Type B & D IS 9103: 2007
4	CAC-Setplast	Accelerating Plasticiser to reduces Setting time of concrete	ASTM C 494 - Type C IS 9103: 2007
5	CAC-Superflow / SF / LF	High Range Water Reducing Superplasticiser for Precast concrete	ASTM C 494 - Type F IS 9103: 2007
6	CAC-Superflow RD	High Range Water Reducing Superplasticiser for Re-dosing	ASTM C 494 - Type F IS 9103: 2007
7	CAC-Superflow 35 / 35 U / 35 C / 30 / 30G	High Range Water Reducing and Retarding Superplasticiser for Lower Grades Concrete	ASTM C 494 - Type G IS 9103: 2007
8	CAC-Superflow 60 / 60 (S2) / 65 / 66 / 65 (PSC)	High Range Water Reducing and Retarding Superplasticiser for Higher Grades Concrete	ASTM C 494 - Type G IS 9103: 2007
9	CAC-Hyperfluid / HES 40 /HES 46 / SS / LF	Superplasticiser for High Performance concrete based on Poly-carboxylic Ether	ASTM C 494 - Type F IS 9103: 2007
10	CAC-Hyperfluid R / R40/ R150/ A1	Superplasticiser for High Performance Concrete based on Poly-Carboxylic Ether (Above M60 grade of concrete)	ASTM C 494- Type G IS 9103: 2007
11	CAC-Hyperfluid Plus (G)	Superplasticiser for concrete based on Poly-Carboxylic Ether (From M45 to M55 grade of concrete)	ASTM C 494 - Type G IS 9103: 2007
12	CAC-Hyperfluid Plus H2 / H5 / H6	Superplasticiser for concrete based onPoly-Carboxylic Ether (Special Techno-commercial PCE polymer use upto M45 grades of concrete with 100% crushed sand with minimum cement content)	ASTM C 494- Type G IS 9103: 2007
13	CAC-Hyperfluid R 100	Superplasticiser with retention for High Performance concrete & Self Compacting Concrete based on Poly-carboxylic Ether	ASTM C 494 - Type G IS 9103: 2007
14	CAC-Superflow (P)/ CAC-Hyperfluid (P)	Powder superplasticiser for concrete / mortar.	ASTM C 494- Type F / G IS 9103: 2007
15	CAC-VMA	Viscosity Modifying Admixture (VMA) for Self Compacting Concrete.	EFNARC – Guidelines for VMA for concrete - September 2006
16	CAC-MS	Densified Microsilica	ASTM C 1240 – 2001
17	CAC-LIW	Liquid Integral Waterproofing admixture for concrete and plaster	ASTM C 494- Type A & D
18	CAC-Corrobit	Corrosion Inhibiting admixture for RCC	ASTM C 494- Type C
19	CAC-MRA	Mould Release Agent	-
20	CAC-Easy Prime	Concrete pump & pipe line primer. It is a powder packed in pre-weighed pouches to be mixed with water at site.	-
21	CAC-Expacreet CG 50 / 60 / 70 / 90	Cementitious non-shrink grouts.	BS 1881- Part 116: 1983 BS 4551- 1998 ASTM D 469- 1994
22	CAC-ENVOPLAST	Ready Mixed Plaster. Plastering made easier than ever. Open + Add Water + Apply. As simple as it sounds.	-
23	CAC-ENVOFIX	Thin bed jointing mortar for blocks	-
24	CAC-Bonding Agent / 50	Acrylic based Bonding / waterproofing agent	-
25	Curewell WB 16 (W) / 20	Wax based curing compound for concrete	ASTM C 309 Type II Class A
26	CAC-Shotcrete AFA	Alkali Free Accelerators for shotcrete	BS EN 934 EFNARC specification of sprayed concrete
27	CAC-Shotcrete AA	Alkali Accelerators for shotcrete	BS EN 934 EFNARC specification of sprayed concrete
28	CAC-Rockfix^{RB}	Un-saturated Poly Ester Resin based capsule for Rock Bolting	-
29	CAC-Rockfix^{CB}	Cement based capsule for Rock Bolting	-
30	CAC-Mahashakti CDH 5035	Hook ended Steel Fibers for shotcrete	-

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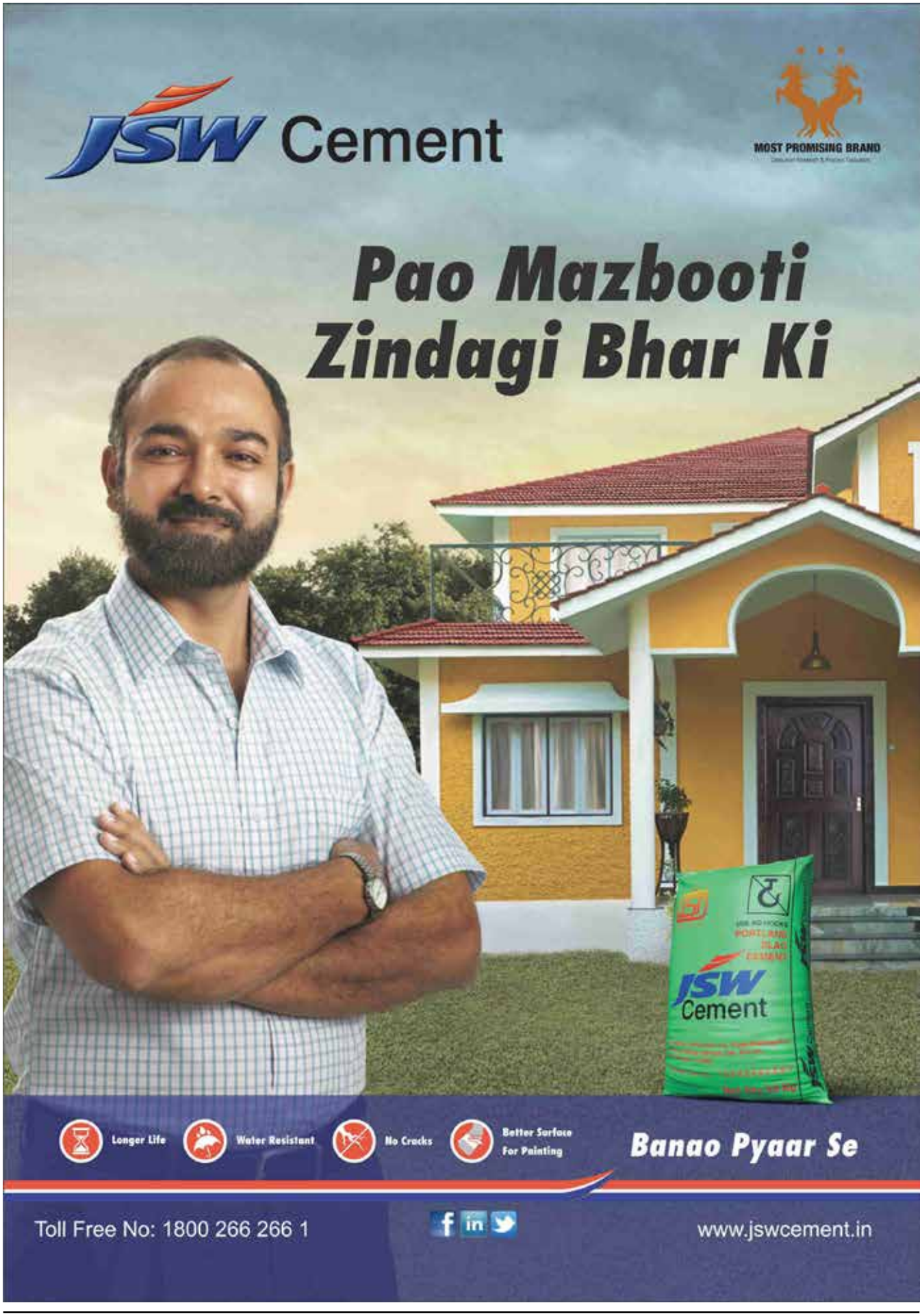
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About company:

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About company:

Brief about Products/Services: Pidilite Industries is a pioneer and market leader in adhesives and sealants, construction chemicals, art and craft products as well as polymer emulsions, in India. Pidilite has some of the biggest brands in adhesives and sealants category including Fevicol, M-seal and Fevikwik where Fevicol have become synonymous with adhesives to millions and is ranked amongst the most trusted brands in the country.

Pidilite manufactures and markets a wide range of construction chemical products under the brands - Dr. Fixit, Roff and Pagel. Dr. Fixit is a leading waterproofing brand, with a comprehensive range of system solutions for waterproofing, catering to the needs of new construction as well maintenance. Roff has a complete range of tile fixing solutions, whereas Pagel is known for its precision grouts and special mortars. Pidilite exports to over 20 countries and has manufacturing facilities in India, Thailand, UAE and Singapore. With a goal to create 'Leak free & Damp free' India, Dr. Fixit continuously work towards imparting the right knowledge and thus has invested significantly in enhancing the workmanship of the applicators and contractors by giving training on the right application techniques, thus propagating healthy construction.

Pioneers in innovative solutions with cutting-edge R&D centers and state-of-the-art manufacturing facilities in India and Singapore, manned by an excellent pool of professionals. All the products are manufactured under ISO 9000 certification and in consultation with the marketing and technical service team, in order to meet the continuously changing requirements of its customers.

Company Name	:	**PENETRON INDIA PVT LTD.**
Mailing Address	:	

Name	:	Allahbaksh R Shaikh
Department	:	BDM - South India
Email	:	baksh@penetron.co.in
Contact Details	:	+91-8884101301
Website URL	:	www.penetron.com

About company:

PENETRON ADMIX® (integral crystalline waterproofing admix) is added to the concrete mix at the time of batching. PENETRON ADMIX® consists of Portland cement, very fine treated silica sand and various active, proprietary chemicals. These active chemicals react with the moisture in fresh concrete with the by-products of cement hydration to cause a catalytic reaction, which generates a non-soluble crystalline formation throughout the pores and capillary tracts of the concrete. Thus the concrete becomes permanently sealed against the penetration of water or liquids from any direction. The concrete is also protected from deterioration due to harsh environmental conditions. The Penetron Admix has been specially formulated to meet varying project and temperature conditions.

RECOMMENDED FOR

- Reservoirs
- Sewage and Water Treatment Plants
- Secondary Containment Structures
- Tunnels and Subway Systems
- Underground Vaults
- Foundations
- Parking Structures
- Swimming Pools
- Pre-Cast, Cast-in-Place and Shotcrete applications.

Company Name	:	**JSW Cement Limited**
Mailing Address	:	Regional office: No. 7, Embassy Complex, 2nd Floor, 10 Cross, Wilson Garden, Bangalore - 5600227, INDIA.
Name	:	Mr. L.R. Manjunatha
Department	:	AGM-Techno Marketing-GGBS
Email	:	manjunatha.ramachandra@jsw.in
Contact Details	:	+91 9480682100 / (080) 2222 0835 / 0385
Website URL	:	www.jsw.in

About company:

JSW Cement is the new diversification of JSW Group, a part of USD 16 billion O.P Jindal Group. The group has grown into USD 10 billon conglomerate with interests across various core economic sectors- steel, Energy, Cement, Natural Resources, Maritime infrastructure and IT. It has plants located in various parts of the world.

In an industry known for its high consumption of energy, natural resources, JSW Cement stands out for its eco-friendly systems. . A pioneer in the green cement industry, it is truly committed to its efficient resource management along with their Eco-friendly practices and products. The utilization of industrial by-products from JSW steel industry fulfils the basic concept that gave rise to JSW Cement, keeping the company focused towards providing a product that is durable and at the same time eco-friendly. It is an excellent example of Resource Conservation and Pollution Management adding high grade value to the product, helping it keep ahead of the curve at all times. JSW Cement has pioneered the adoption of several contemporary technologies.

JSW has an integrated cement plant at Bilakalguduru near Nandyal in Andhra Pradesh and a grinding unit at Thoranagallu near Bellary in Karnataka and Dolvi, Maharashtra. The total installed capacity of JSW Cement Limited is 6 million MT per annum. JSW Cement offers eco friendly products such as Portland slag Cement (PSC), Ground Granulated Blast furnace Slag (GGBS) and Granulated Blast Furnace Slag (GBS) to promote Sustainable construction. Slag is a non metallic product consisting essentially of glass containing silicates and Alumino silicates of lime. At JSW cement, we use superior quality Slag produced from our steel plant which conforms to IS: 12089 to produce PSC.

Company Name	:	**ASHTECH (INIDA) PRIVATE LIMITED**
Mailing Address	:	CORPORATE OFFICE: "ASHFORD CENTRE" 9th floor

Name	:	Er. PRAKASH SRINIVASAN
Department	:	Vice President – Marketing
Email	:	prakash.sreenivasan@ashtech.co.in
Contact Details	:	0-9513354901
Website URL	:	www.ashtechindia.net

About company:

In just 19 years of existence,ASHTECH an IS0 9001:2008 certified organizationhas earned anoutstanding reputation asaleading Processor, Distributor & Exporter of Fly Ash.

Over the years we have been able to distinguish ourselves as a leading supplier by constantly defining and refining excellence in products, process and customer care.

In our zeal to expand our wings and cater to the constant demand from clients, we have also been actively engaged in the manufacturing & distribution of:

- Fly Ash
- Gypsum Powder & Plaster Boards
- Ashtech Wall Putty
- Ready Mix Plaster
- DecoCrete Concrete Solutions
- Ready Mix Concrete
- Solid & Hollow Concrete Blocks
- Reflective Pavers & Tiles
- Aggregates
- RAK White Cement

We at ASHTECH take special care in understanding the client's need. Customers have come to count on our expertise and our willingness to work in total co-operation towards maximum & optimum benefit out of usage of Fly Ash and allied products.

A commitment to uncompromising quality, responsive service, competitive pricing through continuous innovation in process, productivity, motivated work force, efficient marketing and wide distribution network keeps us ahead in our mission to excel in our chosen fields.

ASHTECH's Fly Ash used in World's Tallest Tower Burj Khalifa, Dubai.

Company Name	:	**BASF India Limited**
Mailing Address	:	29, Krishnanagar Industrial Area, Taverekere Main Road, Off Hosur Road, Bangalore 560029
Name	:	Mr. JaswanthSobhana
Department	:	Sales Manager
Email	:	Jaswanth.sobhana@basf.com
Contact Details	:	+91 9900115108
Website URL	:	www.master-builders-solutions.basf.com

About company:

Master Builders Solutions from BASF offer advanced chemical solutions for new construction, maintenance, repair or renovation of structures. Our employees form a global community of construction chemicals experts that are passionate about solving our customers' specific challenges at all stages of construction as well as throughout the lifecycle of the structure.

Under the Master Builders Solutions brand BASF combines its technological know-how and comprehensive product portfolio to provide the right solutions, based on our experience gained in countless construction projects worldwide.

Master Builders Concrete admixtures, cement additives, solutions for underground

Master Builders Construction, waterproofing systems, concrete repair and protection

Solutions portfolio: Systems, performance grouts, flooring systems.

Company Name	:	**KEMPER SYSTEM GROUP**
Mailing Address	:	Kemper System (I) Pvt. Ltd.Indo-German Technology Park, S. No. 297-299, A/p: Urawade, Tal: Mulshi, Dist: Pune - 412 108.
Name	:	Mr. Sandeep Neve
Department	:	Director
Email	:	neve@kemperindia.com
Contact Details	:	+91-20-66740650/51/53
Website URL	:	www.kemperindia.com

About company:

KEMPER SYSTEM is an international specialist for liquid applied waterproofing and coating systems. Based in the centre of Germany, our company provides waterproofing solutions globally for the most challenging projects.

It was Dr. Heinz Kemper who gave his name to the system when, in 1957, he set up a company for plastics and paints in Vellmar near Kassel in the heart of Germany. The development of waterproofing products began soon after, in the 1960s, and has continued to this day – essential, if the company is to do justice to what the market expects of the "Number One" in this sector.

The company maintains subsidiaries in UK, France, Italy, Poland, the USA, Canada,India, China and Brazil plus partnerships with qualified contractors and distributors in a number of countries.

KEMPER SYSTEM has evolved to become a worldwide specialist for waterproofing and coatings based on liquid-applied resin systems and it has addeddecorative and industrial floorings to its range of products.

Waterproofing…..surfacing…..coating – whatever the project Kemper offer dedicatedsolutions that are purpose-designed for the task. Working with specifires and engineers we offer total support from design through to completion.

KEMPER SYSTEM (INDIA) PVT.LTD.

Kemper System (India) Pvt. Ltd., the Indian member of the KEMPER SYSTEM Group was established in the year 2000 at Pune. Since its inception the company has been involved in providing solutions to many critical waterproofing and coating requirements. Our products have consistently risen to the challenge where alternatives have failed. Be it the tropical climate of Pondicherry or humid conditions in Mumbai our products continue to provide long-term protection under extreme conditions.

Brief description of the product

The products of KEMPER SYSTEM GmbH & Co. KG can be divided into three product groups:

KEMPEROL® = waterproofing systems

Waterproofing systems using liquid polymers based on reaction resins and reinforced with polyester fleece.

KEMPERTEC® = primers and accessories

Diverse primers for enhancing the bond with the substrate, filling compounds and repairmortars, quartz sands, cleaning agents and accessories.

KEMPERDUR® = decorative surface finishes

Wearing courses and surfacing systems with smooth surfaces and decorative chippings or mineral materials worked into the surface.

Company Name	:	**SIKA INDIA PVT LTD**
Mailing Address	:	Sika India Pvt. Ltd: 601 A wing, Infinity Tower, Mindspace, Off Link Road, Malad (west), Mumbai - 400064
Name	:	Mr. ArijitBasu
Department	:	Managing Director
Email	:	basu.arijit@in.sika.com
Contact Details	:	
Website URL	:	www.ind.sika.com

About company:

Sika, a global specialty chemicals company. Sika India is a 100% subsidiary of Sika AG ofSwitzerland, and is part of the Sika Global Operations spread across 5 continents in more than90 countries.

Sika India had the distinction to become the first company in its trade to get an ISO 9001certification in 1996. It has a 'Research and Development' facility in Kalyani in West Bengal thatis recognized by the Government of India.

Sika is a company with a strong innovative tradition, constantly striving for new levels ofexcellence. This means developing innovative technologies that will open up new opportunitiesfor the company, its employees and its partners in trade and industry. Sika is active in the fieldof specialty chemicals dividing its activities into two business areas; the Construction Divisionand the Industry Division. Sika is an independent Swiss group founded in Zurich in 1910, with a clear mission to optimize the construction process & to contribute significantly to improveperformance, quality and sustainability.

Company Name	:	**Fosroc Chemicals (India) Limited**
Mailing Address	:	Sapthagiri Palace, No.38, P.O. Box 2406, II & III Floor, 12th Cross, CBI Road, Ganganagar, North, Bangalore 560024. INDIA.
Name	:	Mr. B N. Chandrashekar
Department	:	General Manager
Email	:	Chandrashekhar.Nagarajaiah@Fosroc.com
Contact Details	:	+91-80-42521900
Website URL	:	www.fosroc.com

About company:
Fosroc Chemicals (India) Limited is a division of worldwide JMH Group. For over 50 years, Fosroc has developed intellectual properties in specialised products and services that are acknowledge being the cutting edge of construction technology.

Fosroc product portfolio:

Cement and Concrete Technology	Finishes	Barriers	Repair and remediation
Cement Additives	Industrial Flooring	Waterproofing	Concrete Repair Mortar
Admixture – SNF and PCE based	Heavy duty flow applied flooring	Joint Sealants	Crack Injection Resins
Corrosion Inhibitors	Surface Coating	Membrane Waterproofing	Corrosion Control
Surface Treatment Curing compound and release agents.	Protective Coating	Liquid applied, food grade certified waterproofing	Micro-concrete and Under water repairs
Grouts and Anchors Epoxy and cement based	Breathable protective coating	Pre-applied and spray applied robust water proofing system	Spray applied structural grade mortars FRP laminates and wraps

Fosroc is an ISO 9001: 2000 certified company which ensures that the quality of all products and service and the level of customer satisfaction are on par with highest standards in the concrete industry.

Company Name	:	**Talrak Construction Chemicals Pvt Ltd**
Mailing Address	:	NO.148, SRI GURURAGHAVENDRA COMPLEX, BEML III rd STAGE, BASAVESHWARA CIRCLE, RAJARAJESHWARI NAGAR, BANGALORE-98
Name	:	Chethana B G
Department	:	Marketing Executive
Email	:	chethana.g@talrak.co.in; info@talrak.co.in
Contact Details	:	+91 9663101013 Tel: +91-80-28608000
Website URL	:	www.talrak.co.in

About company:
TALRAK was founded in Bangalore in 2014 with an objective of providing world class Construction Chemicals to the Indian Construction and Infrastructure industry.

TALRAK has placed a great emphases on research and development in order to provide technically superior products suitable for every type of civil engineering construction and maintenance. Most of the products are aimed at conforming to the ecofriendly and sustainability norms meeting IGBC requirements. Further TALRAK has established a sales and technical service network at different Geographical locations in the Country to offer efficient technical assistance that is valued by Architects, Engineers, Constructors and Owners.

Talrak Construction Chemicals has a strategic alliance with KOSTER BAUCHEMIE AG of Germany, to market their products in India.

KOSTER BAUCHEMIE, for over two decades has been developing and manufacturing waterproofing materials. Today, Koster Bauchemie is a group of 27 companies with worldwide presence. We offer entire range of KOSTER products in India backed with technical support.

Talrak Construction Chemicals Pvt Ltd., other range of products

Talrak Construction Chemicals Pvt. Ltd. Manufactures and markets the following high performance products that would help to enhance the quality, performance and durability of constructions:

Talrakplast Range of New Generation Hyper Plasticizers

Talrakfreecem range of Duel Shrinkage Compensation free flow Cementitious grouts

Talrakfibcem – FRCM Fibre Reinforced Cement Matrix – FRCM composite for structural strengthening

Corrosion inhibitors – for combating corrosion of embedded rebars in concrete.

Talrakrendercem range of Fibre Reinforced Cementitious Repair Mortars

Talrakmicrokrete range of Micro – Concrete.

RMC Readymix (India)
(A Division of Prism Cement Limited)
Mix with the best

Company Name	:	**RMC Readymix (India)** (A DIVISION OF **PRISM CEMENT LIMITED)**
Mailing Address	:	BCP Towers, No. 386, 9th Main, 7th Sector, HSR Layout, Bangalore-560 102.
Name	:	Mr. RAVI PRAKASH
Department	:	MANAGER – TECHNICAL
Email	:	raviprakash@rmcindia.com
Contact Details	:	9845535945 / 008-41102470 / 71
Website URL	:	www.rmcindia.com

About company:

The company is one of the largest ready-mixed concrete manufacturers in India. Set up way back in 1996 (coinciding with the inception of the industry), RMC India expanded business rapidly and currently operates 81 ready-mixed concrete plants in 39 cities and towns across the nation. Possessing the enviable backing of such a rich history, it is no wonder that the Company has been the forerunner in setting high standards for plant and machinery, production, quality systems and product services in the ready-mixed concrete industry.

RMC – Commercial Concrete

The Commercial Concrete Vertical is RMC India's core business which not only caters to the needs of metro cities and semi-urban areas, but also serves as a steadfast contributor to the prolific development of urbane India. The Company caters to a gamut of concrete requirements encompassing lofty buildings to a cherished individual house, solutions for mild exposure to the harshest of off shore works, for soft and aesthetic requirements to the jumbo strength & performance required for prestigious infra and industrial projects. RMC's state-of-the-art plants are an ensemble of high commitment towards service. Right from sating municipal & environmental norms to incessantly braving the never ending traffic snarls, it seems to be a recurring miracle when the Company's concrete laden transit mixers reach the customer's sites on time, every time.

RMC India is the first Indian company to receive the prestigious Quality Council of India [QCI] certification at its RMC plants.

RMC - AGGREGATES

Aggregates occupy 70 % of concrete volume. Understanding such a critical importance of good quality aggregates, RMC India ventured into the aggregates business in the year 2000 and currently operates large quarries and crushers. It manages high-tech aggregate setups in Mumbai, Bengaluru, Hyderabad, Mangaluru, Sawantwadi, Chennai and Vizag.

The Aggregates Vertical maintains product quality by selecting the right quarries, employing the best techniques in the industry to extract good quality rock with proper fragmentation and engaging machinery and plants of internationally proven standards. The skilled workforce is trained to maintain these crushers in immaculate working condition and derive the full bounty of their produce, in line with international norms.

RMC – Mega Projects

In 2009, the Company decided to extend its core business activity of ready-mixed concrete to meet the growing demand for high quality RMC in Key Infrastructure sectors namely – Highways, Power, Petroleum Refineries, Ports and Jetties. The Company has harnessed a persistent team that sets up and operates RMC plants in remote locations that are far flung from the comforts of civilization. The Mega Projects Vertical of RMC India has since then successfully executed more than 25 mega projects defying odds and overcoming many operational challenges.

Company Name	:	**KIRAN GLOBAL CHEMS LIMITED**
Mailing Address	:	
Name	:	Mr. RAMANI R V
Department	:	DIRECTOR (R & D)
Email	:	ramani@kiranglobal.com
Contact Details	:	+91 87544 78595 / +9144 4225 4700
Website URL	:	www.kiranglobal.com / www.geocement.in

About company:

MS Jain Group started its journey in the chemical manufacturers industry as a small scale manufacturing unit with the vision to leave its mark as a visionary innovator. From 1979 to this date, the company has grown under the able leadership of founder and Chariman Mr. MS Jain as a leading conglomerate with international presence. We have manufacturing units in more than five countries and our chemicals import- export business spans the five continents.

We are renowned for our seamless supply chain and quick and efficient response to customers. We are the largest manufacturers of sodium silicate in India with annual turnover of 3, 00,000 tonnes. Our manufacturing units are largely setup in South India with Offices in the North India.

Our product range includes chemical intermediaries that have versatile application across several industries including construction, ceramics, textiles, paper, foundries, ceramics, and candles among others. We are fully equipped to meet large scale customer demands with plants and machineries of latest technologies and highly qualified engineers, trained personnel ad domain experts. The organization operates with over 600 direct employees and 300 indirect employees globally. Our state of the art laboratories often work in collaboration with leading research institutes to develop innovative solutions.

The companies aim is to deliver market-driven products that enhance process at minimum environment cost.

Company Name	:	**BESTO Mining India Pvt Ltd**
Mailing Address	:	No 52/44, 8th Main, II Cross, Ganesha Block, Mahalaxmi Layout, Bangalore – 560096 India
Name	:	Mr. Shenoy Devadas
Department	:	General Manager
Email	:	Shenoydevadas@yahoo.co.in , Devadas@bestomining.com
Contact Details	:	+91 7022895610,9986692919
Website URL	:	www.bestomining.com

About company:

Besto sand	Natural Sand
Contains no organic impurities, hence it gives increased strength of concrete with same cement content.	Contains harmful impurities like mud, soil, silt,salt,alkalis, coal, shoal, sea shell, bone, organic matter etc.
Gradiation of sand is controlled in the manufacturing process, hence mix design can be accurately used due to consistent gardiation.	No consistency in particle sizing due to different sources, hence accuracy of mix design becomes doubtful
Does not harm 5the environment in any way.	Extraction of sand from River beds is an environmental hazard.
No wastage since sand is already sieved in the required size (below 4.75mm).	Irregular sizing results in wastage in the form of singles to the tune of 10-15%
Unintrepeted supply even during mansoon, huge saving in inventory cost.	Huge inventory cost during monsoon for non-availability of material
Consistency in supply as well as stability in prices help in controlling the project cost.	Eartic supply and fluctuating prices make it difficult to control project cost
Conforms to is 1542-1992 and is 383-1970.	Not Conforms to is 1542-1992 and is 383-1970
Sizing-below 4.75mm is always consistent.	Sizing-below 4.75mm is very difficult to get
Silt and organic matter- NIL. Made of 100% black basalt (stone) and always guaranteed.	Silt and organic matter- not guaranteed
Finess modulus- difficult to maintain between 2.6 – 2.9.	Finess modulus- difficult to maintain between 2.6 – 3.

Company Name	:	**Sri Chowdeshwari Concrete India Pvt Ltd**
Mailing Address	:	Sri Chowdeshwari Concrete India Pvt Ltd 3-A, 1ST Phase, KIADB Kumbalagudu, Survey No. 40&41, Kumbalagudu Village, Kengeri Hobli, Bangalore-560074
Name	:	Mr. Arun Kumar
Department	:	Marketing Manager
Email	:	arun11.r11@gmail.com
Contact Details	:	9900006090
Website URL	:	www.sccconcrete.in

About company:

SCC Transportation: SCC started initially in the year 1998 with transportation of Sand and aggregates to major construction companies like SP, M Far, BLK & sons etc with initially starting from 2 vehicles and ending up with 18 vehicles...

SCC Crusher: With the base of transportation and likely demand for aggregates SCC established a Crushing unit in the year 2005 at Sri. Rangapatna Tq, Mandya Dist and supplying aggregates for Mandya and Mysore dist majorly.

SCC Construction: As construction became the core developmental business SCC started Construction in the year 2006 with major Government projects in BBMP and PWD department.

SCC Ready Mix Concrete: With the continuing boom in the Construction field RMC became a necessity part and SCC started RMC in 2013 with the motive of supplying Quality and timely service with Quality at its best.

Quality Commitment: "SCC RMC is committed to providing quality products and services to our customers. All of SCC products are manufactured to the highest quality standards.

Our commitment to quality and total customer satisfaction is the responsibility of every employee and is demonstrated by our quality system, on-going management review, and continual improvement based on customer feedback."

Core Values : Transparency, Integrity, Honesty, Professionalism, Simplicity, Consistency, Future-readiness.

At SCC our core values are not just cornerstones for the new realities we construct. It's what our customers have turned into our strengths. And in turn, it helps us help them build their futures based on these values.

Company Name	:	**Ambuja Cement Limited - Alccofine Products**
Mailing Address	:	PremaGanga, 89, 7th Cross, 4th Main, 5th Block, BSK 3rd Stage, 3rd Phase Bhuvaneshwari Nagar, Bangalore - 560085
Name	:	Ms. Sapna Devendra
Department	:	Regional Manager- South
Email	:	sapna.devendra@ambujacement.com
Contact Details	:	+91 9964090888
Website URL	:	www.ambujacement.com . www.holcim.com . www.alccofine.com

About company:

Holcim

Holcim is a global company employing some 80,000 people, with production sites in around 70 countries. Holcim is more globally spread than any other building materials group, allowing us to create a strong foothold in each individual market.

Ambuja Cement

Ambuja Cements Ltd. (ACL) wholly owned subsidiary of Holcim, is one of the leading cement manufacturing companies in India having capacity of more than 25 million tonnes. ACL enjoys a reputation of being one of the most efficient cement manufacturers in the world. Its environment protection measures are on par with the finest in the country.

Counto Microfine Products Pvt. Ltd.

CMPPL is a joint venture company of Ambuja Cements Ltd and Alcon group Goa. It is pioneer in the country for patented micro fine mineral additives technology. It has one of the world's biggest dedicated manufacturing facilities of micro fine materials at Goa.

Company Name	:	**BHARATHI CEMENT CORPORATION LIMITED**
Mailing Address	:	#24, B / 34, 1st Main, Vyalikaval, Bangalore-560 003
Name	:	Mr. Ganaraj Shetty
Department	:	Sr. Manager – Technical Services
Email	:	ganaraj.s@bharathicement.com
Contact Details	:	+91-9686446933, 080-30518700
Website URL	:	

About company:

We are glad to introduce ourselves as Bharathi Cement Corporation Limited, with the plans and vision to be one of the major cement players in India.

Our company has set up a cement plant (green field project) with a state of art technology, equipped with modern machineries from M/s F.L.Smidth, Loesche India Pvt ltd, L&T and Takraf (I) Pvt Ltd (Pioneers in their own field) to manufacture superior quality cement and cater to the customers. Overall annual capacity of the plant is 5 million tons.Theplant is located at Nallalingayapalli (Kadapa dist) which is known for its rich and quality deposits of limestone.

Our company manufactures wide range of products like OPC 53 grade, OPC 43 grade, PPC and also plans to come out with the PSC.

At Bharathi cement, what goes in every bag is our passion for excellence and what comes out is a product par excellence. Produced in a plant powered by next generation technology and tested in ROBOTIC LAB, Bharathi cement offers you consistent quality in every bag. Packing will be done using laminated bags (imported material) with usage and safety tips on it (one of its kind in the industry). Company also plans for additional capacities at various locations and emerge as a lead brand. .

Company Name	:	**MC- Bauchemie (I) Pvt. Ltd**
Mailing Address	:	
Name	:	Mr. Govind Ramani
Department	:	Assistant Manager Coordination
Email	:	smcbindia@yahoo.co.in
Contact Details	:	+91 09764443290
Website URL	:	www.mc-bauchemie.com

About company:

MC-Bauchemie (India) Private Limited is a leading name in Construction Chemicals, in terms of trust and reliability for over Twenty-Five Years in India. We manufacture over 200 construction chemicals in Technical and Financial Collaboration with MC-Bauchemie, Germany, a 50-year-old International organization. MC-Bauchemie India, an ISO 9001: 2008 Certified Company, has a pan India presence through technically trained and qualified Channel Partners and IRP (Germany) trained applicators. Top-level technical advisors, support our Distribution Network. Our strength lies in Quality and Reliability. We provide free technical services to solve constructional problems, along with detailed technical specifications and proposals. On-site, On-time delivery is our motto.

Globally MC is producing innovative products and systems to improve concrete and protect and preserve structures.

Solutions we provide include Additives & Systems for Concrete improvement, Mortars & Plasters, Demoulding, Curing, Waterproofing of concrete structures, flooring, Heritage structures, Grouts, Micro-Concrete, repair & rehabilitation & protective coatings.

Company Name	:	**JYOTHI CONMIX READYMIX CONCRETE**
Mailing Address	:	Sy. No- 93/2, Avadadenahalli, Kasaba Hobli, Anekal Taluk, Bangalore- 562106
Name	:	Mr. Rakesh Babu
Department	:	Managing Director
Email	:	rakeshbabu@jyothiconmic.com / jyothiconmix@gmail.com
Contact Details	:	+91-99000-83352 / 99001-54910
Website URL	:	www.jyothiconmix.com

About company:

We are glad to introduce ourselves as Bharathi Cement Corporation Limited, with the plans and vision to be one of the major cement players in India.

Our company has set up a cement plant (green field project) with a state of art technology, equipped with modern machineries from M/s F.L.Smidth, Loesche India Pvt ltd, L&T and Takraf (I) Pvt Ltd (Pioneers in their own field) to manufacture superior quality cement and cater to the customers. Overall annual capacity of the plant is 5 million tons. Theplant is located at Nallalingayapalli (Kadapa dist) which is known for its rich and quality deposits of limestone.

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Company Name	:	**ARDEX ENDURA (INDIA) PRIVATE LIMITED**
Mailing Address	:	Unit No. 406 & 407, "Brigade Rubix", No. 20, HMT Campus, Yeshwantpur Hobli, Bengaluru - 560013
Name	:	REKHA H.S
Department	:	Sr. Manager - Marketing / Sales & Marketing - Admin
Email	:	honnavalli.rekha@ardexendura.com
Contact Details	:	: +91 9945126661 / +91 80 6674 6542
Website URL	:	www.ardexendura.com

About company:

ARDEX - A GLOBAL PERPECTIVE: The Company's heritage dates back more than 60 years and, as a global manufacturer of high performance specialty building materials, ARDEX has remained at forefront of the world's leading suppliers for the building & construction industries

ARDEX ENDURA – INDIA: BAL ENDURA ADHESIVES (INDIA) PVT LTD was re-branded as ARDEX ENDURA (INDIA) PVT LTD after the joint venture between ARDEX Group, Germany and Prism Cement Limited, India.

With the guidance and full support from the ARDEX group, ARDEX ENDURA remains the quality leader for the industry, offering excellent building chemicals with supreme processing reliability. With 31 branches all over India and strategically positioned state-of-the art manufacturing plants,

The comprehensive portfolio of products encompasses Tiling & Stone Care products, Industrial &

Commercial flooring solutions, Waterproofing systems, Concrete Repair and Decorative finishes.

ARDEX ENDURA is the brand of choice for Architects, Engineers, Contractors, Masons…….in fact for everybody associated with the Building & Construction industry

Our vision is to be one of The World's Leading Solution Providers of High Performance Specialty Building Materials.

Company Name	:	**ELEMATIC INDIA PVT. LTD.**
Mailing Address	:	1st Floor, Demech House, Law College Road, Pune- 411004, India
Name	:	Mr. Shridhar Rao, B.E, M.B.A
Department	:	Regional Manager -South- Sales and Marketing
Email	:	Shridhar.Rao@elematic.com
Contact Details	:	Mobile: +91 9591847722 Tel: +91 (20) 2566 6560
Website URL	:	www.elematic.com

About company:

ELEMATIC OY is a Finland based company offering Precast Technology.

Elematic has footprint in more than 100 countries and has delivered more than 3600 installations of Precast Plant and Machinery

In India Elematic active since 2007, offering complete services for implementing Precast Technology and has 17 active plants operational.

Elematic offers complete handholding and services in implementing Precast Technology;

The Technology available is used in manufacturing of the following Precast Elements:

1. Pre stressed Hollow core slab and solid slab on long line production system
2. Precast wall and slab production on Carousal system
3. Precast column and Beam production
4. Precast Staircase and Lift shafts
5. Partition wall Technology using Acotec plant

Elematic is a Technology partner and can associate from Design stage to implementation of Precast Technology.

Elematic has the capacity to deliver the full range of Precast Technology and holds 450 patents that allow you to manufacture building structures that allow faster and economical construction that we call as "Smart Evolution".

Company Name	:	**Don Construction Chemical India Limited**
Mailing Address	:	#62,2nd floor, 19th Main Road, 2nd block, Rajajinagar,Bangalore 560010
Name	:	Mr. Venkoba Rao A
Department	:	Regional Sales Manager
Email	:	venkoba.rao@dcp-int.com
Contact Details	:	+91 9686815711
Website URL	:	www.dcp-int.com

About company:
Don Construction Products (DCP) has accumulated over 80 years of experience in developing, manufacturing and marketing innovative construction materials. DCP has operations in Europe,Africa, Middle East and Asia with 14 manufacturing locations and a distribution network to over 25countries.

DCP Commitments

Expertise

DCP provides exceptional level of expertise and support services both at the office and on site.

Quality: All products are produced to comply with the best relevant international standards.

Full Range: DCP offers a comprehensive range of products covering a wide range of civil and aesthetic

Requirements of construction projectProduct Summary

Full Product Range:

The focus of our full product range below caters to our 3 core business units: Concrete &Cement Technology, Construction Projects Materials Technology & Building Finishing Products.

Concrete Admixtures, Surface Treatments, Grouts & Anchors, Concrete Repair, Flooring Systems

Protective Coatings, Sealants & Joints,Waterproofing,Adhesives,Tile Adhesives & Grouts, Building Finishing Products, Structural Strengthening.

Company Name	:	**Silicon Valley Waterproofing Company**
Mailing Address	:	No. 163, Trupti, 2nd Floor, 4th Cross, Dollars Colony, 4th Phase,
		J. P. Nagar, Bangalore – 560 078.
Name	:	Mr. R. Sridhar Rao
Department	:	General Manager
Email	:	siliconvalleywpf@gmail.com
Contact Details	:	9740 116 116
Website URL	:	

About company:

Silicon Valley waterproofing company (SVWC) was founded by Mr. R. Sridhar Rao who is in the waterproofing field for over 3 decades associated with BITUMAT since 1986. Mr. R S Rao earlier was a Director and head of the roofing division for a reputed multi divisional company in Muscat involved in marketing as well as execution of number of prestigious government, semi government and private projects in Muscat (Oman).

BITUMAT Company limited (Kingdom of Saudi Arabia) represented in Karnataka state by SVWC for marketing the well-known BITUMAT membranes , liquids , Water stops, Non Woven Geo Textiles and Extruded Polystyrene Insulation all over India.

SVWC have the exclusive rights for marketing BITUMAT's products and in a span of just 10 years SVWC have executed hundreds of prestigious projects in Bangalore , Mysore, Hyderabad, Pune, Kolkata, Trivandrum, Nagpur, Chennai, Wardha and Nashik. SVWC are one of the most trusted, reputed quality roofing contractors in India. SVWC is proud to be associated with BITUMAT who is the leading manufacturer of waterproofing products in the world based in Dammam - Kingdom of Saudi Arabia.

BITUMAT are the pioneer in bringing state of art non - woven technology to the middle east and set up the only plant of its kind in the entire middle east. BITUMAT products are accepted worldwide and marketed through the exclusive distributor network. BITUMAT products are available worldwide from Latin America to Australia and New Zealand.

BITUMAT was awarded ISO9002 certification during 1995 in recognition for its excellence in management and manufacturing facilities. BITUMAT is extremely careful in appointing their distributors as they market their products only through highly reputed organizations who are well versed with the application of their products and systems.

BITUMAT has been consistently honoring Mr. R.S Rao with various types of awards year after year for his excellent contribution not only in marketing BITUMAT's products but also in giving the correct solutions to customer's problems.

With the kind of knowledge and expertise Mr. R.S. Rao is quite competent to provide solutions to consultants, Architects and the end users on various waterproofing problems.

Company Name	:	**PERMA CONSTRUCTION AIDS PVT. LTD.**
Mailing Address	:	611/612, Nirmal Corporate Centre, L. B. S. Marg, Mulund (W), Mumbai – 400 080, India,
Name	:	Mr. Nandan Niwate
Department	:	
Email	:	info@permaindia.com,
Contact Details	:	+91- 22- 2591 8911 / 2567 4690, Fax : +91 - 22- 2590 3008,
Website URL	:	www.permaindia.com /www.permaindia.net

General Profile :

From the beginning of twentieth century cement concrete and cement mortar based on ordinary Portland cement, have been accepted as the main building materials for the construction of buildings and the infra-structures, considering the ease, speed and the strength they offer. But this new building material that is the ordinary Portland cement, suffered from some initial drawbacks such as shrinkage cracks and leakages when compared to the then existed lime concrete and lime mortar. So this product needed some modifications to get over its inherent weaknesses, which was achieved by use of some chemicals. With the increase in demand for bigger, higher and stronger structures in various environmental conditions, the ordinary concrete required further modifications to perform as per the expectations and deliver the end strengths in various climatic and critical conditions. This was again achieved through addition of chemicals to modify the behavior of cement concrete to give the desired end results. With time the performance demands on concrete increased and research and development of chemicals for modification of concrete became a regular industry which is now known as CONSTRUCTUION CHEMICALS INDUSTRY. To keep with the pace of developments, construction chemicals industry took upon itself to develop products which not only make construction of modern structures possible by imparting easy workability, better strength development characteristics and expected performance in extreme environmental conditions and also to maintain structures through various climates extending their life. Now a concrete admixture has become an essential fifth ingredient of concrete and construction and completion of a new structure can't be imagined without the use of construction chemicals at various stages of construction.

CONSTRUCTION CHEMICALS

Starting from water proofing compounds, construction chemicals have expanded range to ease the workmanship in demanding situations at various stages of construction. Today each full-fledged construction chemicals manufacturer manufactures fifty to hundred various construction chemicals. These construction Chemicals can be generally divided into the following groups:

Water Proofing Compounds, Tile Fixing Adhesives and Joint Fillers, Repair and Renovation Products

Admixtures for concrete and mortars, Coating and protection products, Construction and workmanship aids

CODES AND STANDARDS

As Portland Cement was developed in Europe so also the construction chemicals. Suitable codes and guidelines were also framed there to take the full advantage of these new developments in the advancing civil engineering industry. In India we adopted the use of Portland cement very fast and our government recognized the cement industry as the one essential in Nation building, and supported the industry by easing the norms in its classification in excise and its treatment in sales tax etc. in the beginning of the twentieth century itself. This industry grew rapidly. But after independence the construction practices and the building technology did not develop with the same speed leaving our own civil engineering codes and practices far behind when compared with the developed nations. Because of this reason Construction chemicals were very slow to enter our market, and did not get the due recognition they deserved. Now generally construction chemicals are thought of when the structure is leaking or in distress or in situations when some extraordinary requirements are expected out of structural member such as very high strength bridge girder or superior industrial floor etc. For creating safe healthy structures for mankind we need to revise our age old meaningless building codes and civil engineering practices and over haul the civil engineering syllabus in the engineering colleges to incorporate the latest technology and available materials. We not only need to create new codes for civil engineering but also for construction chemicals so that wrong materials do not enter the construction arena putting the structures to risk.

Company Name	:	**Thriveni Sands Aggregates LLP**
Mailing Address	:	
Name	:	Mr. Parthiban
Department	:	Engineer – Technical
Email	:	parthi.thriveni@gmail.com
Contact Details	:	+91 9500 979455
Website URL	:	www.thriveni.com

About company:
Thriveni Sands is a Company under Thriveni Earthmovers Pvt.Ltd. Basically a mining company, we are into Iron Ore, Coal and Bauxite. We are India's largest MDO (Mine Development & Operation) in Iron Ore as well as in Coal. We are also having own Coal Mines in Indonesia.
For further information, do visit : www.thriveni.com

Few words about our Company:
Thriveni Sands and Aggregates LLP is the Company name. It was started by 2006 as a small aggregate division. After that we entered in-to Sand manufacturing. It's the perfect substitute to river sand (used for construction). In Bengaluru availability of Quality Premium river sand is very low, and this river sand segment is governed by un-organized sector. Hence price of quality river sand is quite high. Also in Bengaluru river sand actually is totally banned.

Thriveni sands is our Brand and we are a specialized Sand Manufacturer.

Unique points about Thriveni Sands:

1. Thriveni Sands are having vast Engineering Knowledge and Expertise in Sand Manufacturing
2. This particular division is operated by more than 250 employees, among them more than 100 Engineers from various streams of specialization are working in the Sand Manufacturing
3. Thriveni Sands are having three plants for Sand Manufacturing :
   - Two plants located in Hosur, Tamil Nadu [150TPH (TonnePer Hour)] : This caters to Bengaluru market
   - One Plant located in Perindesam, Near Tirupati, Andhra Pradesh
4. Perindesam plant isindia's largest sand plant (100% Metso plant) having the capacity of 450TPH.

Products manufactured by us :
We have two kinds of Sand
1. Concrete Sand
2. Plastering Sand

About Concrete Sand :
Wemanufacture Concrete Sand as per ISIStandards . Concrete Sand is basically for concrete and this can be used for brick laying and cement flooring. Absolute substitute for Quality Premium river sand. There is no clay, silt & contamination. No wastage at all. No need to sieve. Directly we can use. Each and every particle of Sand isperfectly shaped / grounded with our Specialized Technology and Infrastructure.
About Plaster sand:
This is exclusively for plastering purpose. It is also made as per ISI Standards. This will be 100 % replacement of river sand. Applications for this plaster sand are : for Inner wall plastering, Outer wall plastering, Ceiling plastering & tile laying. There is no clay, silt & contamination. No wastage at all. No need to sieve. Directly we can use. Each and every particle of Sand is perfectly shaped / grounded with our Specialized Technology and Infrastructure.
This also available in 50 Kgs Bag in Bengaluru market.

Our strength in Bengaluru Market:
1. We are having 400 Corporate customers in Bengaluru.
2. For plastering sand, we are having 120 corporate customers in hand
3. Monthly we are supplying to Bengaluru 1,40,000 Metric Tonne of both Concrete and Plaster Sand

Company Name	:	Bureau Veritas Certification (India) Private Limited
Mailing Address	:	# 1030, 13th Cross, Banashankari, 2nd Stage, Bangalore 560 070
Name	:	Suresh Krishnan / Venkatesh Manjunath
Designation	:	Regional Manager –Sales & Marketing / Marketing Manager – CTC
Email	:	suresh.krishnan@in.bureauveritas.com/
		Venkatesh.manjunath@in.bureauveritas.com
Contact Details	:	09845229714 / 07829777451
Website URL	:	www.certification.bureauveritas.co.in

About company:

Created in 1828, Bureau Veritas is a global leader in Testing, Inspection and Certification (TIC), delivering high quality services to help clients meet the growing challenges of quality, safety, environmental protection and social responsibility.

As a trusted partner, Bureau Veritas offers innovative solutions that go beyond simple compliance with regulations and standards, reducing risk, improving performance and promoting sustainable development.

Bureau Veritas core values include integrity and ethics, impartial counsel and validation, customer focus and safety at work.

Bureau Veritas Certification (BVC) is accredited by QCI to audit as per the set standards for manufacturing RMC & subsequent to satisfactory level of conformance, certify such plants for "RMC Capability Certification". BVC have already certified several top quality RMC manufacturers to this standard and many more certifications of major cement manufacturers are in progress.

CIVIL-AID, a Group company of Bureau Veritas, Services encompass a wide spectrum of Civil Engineering activities. CIVIL-AID Laboratories are accredited by NABL as per ISO:17025 - 2005 for Mechanical Testing (Construction Materials & Geotechnical, Non-Destructive Testing and Chemical Testing). Apart from Specialist Engineering personnel, CIVIL-AID also has a panel of Advisors who help in special and critical assignments. With the above infrastructure, CIVIL-AID has the expertise to understand and solve challenging problems. A wide spectrum of satisfied clients is a testimony to its proficiency.

Company Name	:	**CBS CHEMICALS**
Mailing Address	:	
Name	:	Mr Ajay Karthik
Department	:	Managing Partner
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Contact Details	:	+91 9845082365
Website URL	:	www.cbschemicals.com

About company:
We are construction industry specialists and facilitators of stability who manufacture a wide range of premium quality construction chemicals. Established in 2013,CBS Chemicals is led by a group of competent professionals with over two decades experience in the construction industry. With extensive research and development that we undertake, we aim to be a "Total Solutions Provider" with quality products and onsite technical support. Quality, innovation and reliability are our key strengths. Our extensive product line comprises of a wide range of concrete admixtures and allied products, used by concrete producers, contractors and builders for more efficient construction practices. At CBS, we are persistent winners, and are insistent partners in our clients' progress.

Technical expertise, strong direction, solid support capability and a right combination of resources and dedication are what we owe our success to. As a total solutions provider we also guide our clients to make the right choice of admixture, and undertake appropriate repairs and rehabilitation measures to meet desired structural integrates of buildings. Working in an ever-evolving industry, we stay ahead of the pack by focusing on extensive research and development to churn out cutting-edge solutions. We stand ground with our technical expertise, we charge ahead with our client servicing and support and we roar our mastery with our quality and R&D.

Resources: Infrastructure Capabilities
- An adept team to execute tasks diligently with a quick-response time frame.
- Fully-equipped R&D concrete lab for product development and QC checks.
- Proactive and stringent quality control measures to ensure consistency in offerings
- Well-equipped manufacturing facility with a production capacity of 6000MT/p.a. and uninterrupted power backup

Our Product Range
- SNF Superplasticizers: CPLAST Series
- Polycarboxylate admixtures: CFLOW Series
- Pumping Aids : CSLICK Series
- Integral waterproofing : CPROOF Series
- Bonding agents: CBOND Series
- Retarders : CSTOP Series
- Accelerating admixtures : CSET Series
- Air Entrainers: CAIR Series
- Flooring : CFLOOR Series
- Solid Blocks : CBLOCK Series
- Curing Components: CKURE Series

Company Name	:	**Lacrete Durakem (India) Pvt Limited**
Mailing Address	:	136, SLV Arcade, 2nd Floor, 1st 'K' Block, Dr. Rajkumar Road, Rajajinagar, Bengaluru-560 010.
Name	:	J. Srinivas Prasad
Designation	:	Co- Founder & Managing Director
Email	:	jsprasad@lagreensindia.com
Contact Details	:	9900819917
Website URL	:	www.lagreensindia.com

About company:

Lacrete Durakem (India) Pvt Limited is a JV partner with BerryMan Chemicals Inc . USA . Lacrete Durakem has the capability to design , develop , manufacture and market Construction Chemical products of International standards and continuously endeavours to increase the portfolio of the value added products.

Berryman Chemicals Inc USA has a subsidiary by name Quality Grinding Aids (QGA) in Texas , Houston , USA . Quality grinding Aids is established in Year 2000 and is market leader in Cement Grinding Aids in USA , Canada , Mexico AND South American Markets and is supplying to TOP Cement Brands of the world like Cemex , Lafarge , Holcim , Heidelberg , Mitsubishi , Italicementi , Vicat (Cement Francis) cements etc.,

Lacrete Durakem has a wide range of Technology Products such as Admixtures , Repair & Retrofitting Products, Protective Coatings and Waterproofing range .

We are currently operating in India and Nepal .

Company Name	:	**KRYTON BUILDMAT CO. PVT. LTD.**
Mailing Address	:	136 – 137, Centrum Plaza, Golf Course Road, Sector 53, Gurgaon
Name	:	Mr M KUMARAVEL
Department	:	REGIONAL SALES MANAGER (SOUTH)
Email	:	kumaravel@kryton.in
Contact Details	:	+91 8050834868
Website URL	:	www.kryton.in

About company:

- KrytonBuildmat is one of India's oldest and most respected Concrete Crystalline Waterproofing manufacturers. An early entrant in the Indian market, KrytonBuildmat Co. Pvt. Ltd. (Kryton-India) celebrated 20 years of building a waterproof India in 2015. The company boasts of the first Crystalline manufacturing unit in India. The Company prides itself in delivering customised solutions for technically complicated projects. Kryton-India is headed by Civil Engineers with decades of Indian and international experience between them. The Company has worked closely with engineers, developers and architects from across the country to develop products that are ideal for the challenging Indian sub-continent construction needs. Approved and recommended by Central Public Works Department (CPWD), Engineer's India Limited (EIL), Municipal Corporation of Delhi (MCD), the Company's promise of quality is ensured through the ISO Certification, BIS and IS yearly qualification/audits.

Company Name	:	**CERA-CHEM PRIVATE LIMITED**
Mailing Address	:	# 6, Park Street, Kilpauk Garden Colony, Chennai-600 010
Name	:	Pooja Sreeram
Designation	:	Secretary - Corporate Affairs
Email	:	pooja@cerachemindia.com
Contact Details	:	044-26441013, 26453498
Website URL	:	www.cerachemindia.com

About company:

We, Cera-Chem Private Limited take pride to introduce ourselves as one of the leading manufacturers of construction chemicals based at Chennai with ISO 9001:2008 certification having wide range of products suiting the requirements of every construction industry.

We have five manufacturing facilities, two near Chennai, one each in Baroda, Hyderabad & Coimbatore. Our range of products includes Tile Adhesives & Tile Joint Fillers, Stone Care solutions, Concrete Admixtures, Waterproofing coatings and membranes, Industrial Grouts, Anti Corrosive Coatings, Protective and Decorative Coatings, Concrete repair Products, Precast Solutions, Non Metallic Floor Hardeners & Epoxy/PU based Industrial Floorings etc. We have a wide distribution network for trading, and techno-servicing agents for execution of contracts using our construction chemicals.

We believe in quality service to our customers that drives our passion for innovations, leading to transformative products that supports different climatic conditions in India. We specialize in the speedy delivery of our products to customers. We analyze the current trends, developments and challenges in the construction chemical industry and focus on these issues to overcome the challenges.

In the past two decades, our products have been approved and specified by various consultants and architects such as Delhi Metro Rail Corporation (DMRC), Larsen & Toubro, M/s C.R. Narayan Rao Architects, etc. Cera-Chem's product range has also been specified with various Government departments such as Indian Space Research Organization (ISRO), Public Works Departments, Postal & Telegraph department, Southern Railways, Harbour Engineering Department, Bharat Sanchar Nigam Limited, Vikram Sarabhai Space Centre, Tamil Nadu State Electricity Board, Bangalore Metro, and Chennai Metro etc.

Company Name	:	**SV CONCRETE PRODUCTS PVT LTD**
Mailing Address	:	No-72 & 78/1, Koppa, Hulimangala Post, Jigani Hobli, Anekal Taluk, Bangalore-560105.
Name	:	Mr. R. Subramanya Naidu
Department	:	General Manager
Email	:	rsngm@svconcrete.co.in
Contact Details	:	+91 8494916667
Website URL	:	www.svconcrete.co.in

About company:

M/s S.V.Concrete Products Pvt. Ltd., is one among the leading Ready Mix Concrete manufacturer in Bangalore, and has started their first commercial plant with the state of the art plant of 60cum/ Hour (M1 Plant) supplied by M/s Stetter at Koppa near Jigani during May'2008. Koppa plant is catering to the need of both industrial and Residential buildings covering up to Sarjapura on the South, Kengeri, on East Bangalore, Basavanagudi – on the West and Jayanagar on the North.

With the demand surging, a Second unit of M1 Plant got commissioned during April'2009 within 1 year after the launching of its first unit. Koppa Unit has the distinction of being the only plant having produced consistently a volume of about 15000 cum among 6-8 competitors in the vicinity of 10-12 Km radius. M/s SVCPPL 2nd unit got commissioned off Mysore Road near Bidadi during March'2011 with the commissioning of first Simem 90 cum/ Hour plant in South India.

Today M/s SVCPPL, unit III is the highest volume producing plants among the various National Brands.

Dedicated Units (4 Nos) With the reputation of supplying quality concrete with Timely supply, M/s SVCPPL could able to bag very prestigious orders for setting up Dedicated batching plants to various Construction Congloromate like M/s Sattva Salarpuria, M/s Mantri Serenity, M/s Brigade Group, M/s Reddy Infrastructures etc., etc.,

TECHSEAL INDIA PVT LTD

Company Name	:	**TECHSEAL INDIA PVT. LTD.**
Mailing Address	:	No.147/64, sidco industrial estate. Ambattur, Chennai - 600 098.
Name	:	Mr. M.S. Divakara
Department	:	
Email	:	coatsealindia@gmail.com, Techsealindia@gmail.com, Techsealfixa@gmail.com.
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Website URL	:	

About company:

Techseal India Pvt. Ltd is a market leader in Distribution of world class, Construction Waterproofing chemical,sealant, and adhesive's. We market ground breaking and reliable construction chemical that make construction project not only safer but also stronger and environmentally viable. We supply domain specific chemicals in bulk aswell as in small quantity to meet the end customer and buyer's demand. We take complex task and provide suitable solution, whether it is a new construction project or refurbishment of existing building. We ensure that the quality and timelines are affirmed right from the initiation to completion of work. We have our office at Chennai, Coimbatore, Bangalore and Kerala (Thirssoor)

We business partnered with:

1.FIXA YAPI KIMYASALLARI SAN.VE.TIC.LTD.STI, TURKEY

FIXA CONSTRUCTION CHEMICALS

Distributor for All India.

FIXA Construction Chemicals is founded in Istanbul in 2001 and has achieved to be one of the preferred brands of construction chemicals industry within a short period. Their products are classified under the main groups, such as water proofing, mortar admixturestile grouts, repair ,reinforcement, , floor systems, , adhesives,heat insulation, sealants and foams, For this purpose, company has obtained quality certificates of TSE and TSEK as well as ISO 9001: 2008 quality management system certificate and other quality certificates requested in international markets.

mSupply.com
Build . Renovate . Do Interiors

Company Name	:	**msupply.com**
Mailing Address	:	# 117, 27th Main, HSR Layout, Sector 2, Next to NIFT, Bangalore - 560 102, India
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Department	:	Business Head
Email	:	saleem@msupply.com
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Website URL	:	www.msupply.com

About company:

mSupply.com is a marketplace for construction, finishes, interiors and decor related products & materials. While constructing, renovating, refurbishing or redesigning our homes, offices etc., most of us have limited understanding about material cost, quality and quantity to be used. Thus there is always an ambiguity in the planning and budgeting of the overall process. And more often than not, we all overshoot budget & timeframe by large margins. Opaque pricing, quality issues and a complex supply chain make procurement of materials, products and services a daunting task.

At mSupply.com, with extensive knowledge of our in-house industry experts and partners combined with our robust fulfilment& customer care, we ensure to assist you at every stage of your construction, interior, renovation and refurbishing related needs. Besides providing you with transparency, pricing information, product variety and onsite fulfilment, essentially, mSupply helps you with expertise - what to buy, how much to buy, and when to buy.

Our Vision

Provide holistic solutions to consumers by simplifying procurement of materials, products & services.

Our Mission

Become India's largest marketplace for suppliers & consumers in the construction, finishes & interiors segment.

Our Values

Simplify buying

Keep it transparent

Unify the eco system

Company Name	:	**Eagle Electricals**
Mailing Address	:	46/6, 14th Cross, 12th Main, 1st Stage Rajajinagar,Bangalore - 560010,
Name	:	Dr. Sathyapal Hegde
Department	:	
Email	:	
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Website URL	:	

About company:

Eagle Electricals started operations in the year 1970 as an electrical contracting company. Over the years we have undertaken Sub station, High tension and Low tension works,Transformer erection, Line works, Electrification of commercial, MS building , Heavy industries etc and have become one of the most sought after electrical contractors.

Since the last decade we have diversified into various other verticals such as Manufacturing, Software development, Project execution, Project Liaisoning/departmental clearances and Equipment supplies

We represent FLIR SYSTEMS INDIA PVT LTD.in Karnataka

FLIR Systems is the world's largest commercial company specializing in the design and production of thermal imagingcameras, components and imaging sensors. Based inWilsonville, Oregon, United States, and founded in 1978. The company makes thermal cameras and components for a wide variety of commercial and government applications.

Having revenue of $1.5 billion (2013) and 2,800 employees worldwide FLIR Systems are market leaders in thermal imaging technology.

Company Name	:	**RDC CONCRETE INDIA PVT. LTD.**
Mailing Address	:	# 117, 27th Main, HSR Layout, Sector 2, Next to NIFT, Bangalore - 560 102, India
Name	:	Mr. TAGORE
Department	:	COO
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Website URL	:	www.rdcconcrete.com

About company:

Having started its operations in 1993, RDC Concrete (India) Pvt Ltd is now become the largest non-cement ready mix concrete company in India.

Over the years, RDC Concrete has established a reputation for being able to deliver cost-effective and innovative building solutions to meet a variety of requirements. Among the first to recognize the constantly evolving nature of the industry, RDC Concrete has consistently invested in building and maintaining state-of-the-art R&D, manufacturing and quality control infrastructure. It is this focus on quality and innovation that has enabled RDC Concrete to build a client base that includes some of the most respected names from the Indian building and construction sector.

Having captured a significant share of the market in many parts of India, RDC Concrete is now spreading its network to other locations in India to serve the requirements of the rapidly growing Indian construction industry.

Company Name	:	**MAPEI CONSTRUCTION PRODUCTS INDIA PVT LTD**
Mailing Address	:	#402, 3rd Floor, Tudor Court, No. 40, Lavelle Road, Bangalore -560001
Name	:	Mr. Abhijit Dutta
Department	:	Managing Director
Email	:	info@mapei.co.in
Contact Details	:	Tel +91 80 22221820 Fax +91 80 22221810
Website URL	:	www.mapei.co.in

About company:

Founded in Milan in 1937, Mapei is today's world leader in the production of adhesives and chemical products for building. Starting in the 1960's Mapei put its strategy of internationalization into action in order to have maximum proximity to the needs of local markets and reduce shipping costs to a minimum.

The Group now counts 71 subsidiaries with 66 production facilities in operation over 31 countries and 5 continents.Mapei has always placed great emphasis on research. In fact, the Group invests 12% of its company's total work-force and 5% of its turnover in R&D; in particular, 70% of its R&D efforts are directed to develop eco-sustainable and environmentally friendly products which meet LEED requirements. Furthermore, Mapei has developed a sales and technical service network with offices all over the world and offers an efficient Technical Assistance Service that is valued by architects, engineers, contractors and owners.

Mapei Group Figures:
2.5 billion turnover in 2014, 66 plants worldwide, more than 1500 products, 7500 employees and more than 60000 customers worldwide

Mapei has built its strategy along three principal guidelines:

SPECIALIZATION: Mapei offers a vast range of specific, technologically advanced products to satisfy any possible need of its customers.

RESEARCH AND DEVELOPMENT: every year Mapei invests 5% of its annual turnover and employs 12% of its workforce in research. In addition to its 66 quality control labs, Mapei has 10 research and development laboratories: in Milan, Villadossola (Italy), Treviso (Italy), Laval (Canada), Deerfield Beach, Winterhaven, Dalton (USA), Sagstua (Norway), Wiesbaden (Germany) and Toulose (France).

INTERNATIONALIZATION: starting in the 1960's Mapei put its strategy of internationalization into action. Its basic strategy is always the same: maximum proximity to the needs of local markets and reduction of logistic costs to a minimum.

Mapei manufactures the following product lines:

- Products for Ceramics and Stone Materials
- Products for wooden floor
- Wall Protective and Decorative Coatings
- Products for the repair of Masonry
- Elastic Sealants and Adhesives
- Products for Waterproofing
- Admixtures for Concrete
- Products for Acoustic Insulation
- Products for Resilient and Textile Materials
- Products for Cementitious and Resin Flooring
- Products for Building
- Products for Structural Strengthening
- Products for Thermal Insulation
- Products for Underground Constructions
- Grinding Aids for Cement

Company Name	:	**Core Logistic Company**
Mailing Address	:	No.3,3rd Floor,Embassy Tower,no.55, Montieth Road,Egmore,Chennai-08
Name	:	
Department	:	
Email	:	clc.chennai10@gmail.com
Contact Details	:	044-42034552 / 044-28590710
Website URL	:	

About company:

Company Name	:	**Shri Laxmi Trading Company**
Mailing Address	:	# 71, 1st Floor, West of Chord Road, 2nd Stage, Mahalaxmipuram, Bangalore - 560 086
Name	:	Mr. Subhas Gulashetti
Department	:	Proprietor
Email	:	sltcggbs@gmail.com
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About company:

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		AN ISO 9001-2008 CERTIFIED COMPANY
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About company:

Karavali Build Chem-Private Limited(KBCPL) has accumulated over 22 years of experience in developing manufacturing and marketing for Range of Construction chemicals.

Karavali Build Chem PVT Limited Product Portfolio

Karavali Build Chem PVT Limited has developed by R&D facilities managed by specialists experienced professional to advice on all aspects of the application of the products in the construction field. Its product range offers innovative environmentally friendly solution to entire civil construction industry.

1. BUILDPLAST&BUILDPLAST-150: INTEGRAL CEMENT WATERPROOFING ADMIXTURE FOR CONCRETE AND PLASTER WITH BIS MARK: STANDARDS: IS 2645-2003
2. BUILDPLAST –SP: SUPERPLASTICISER AND WATER REDUCING ADMIXTURE FOR CONCRETE AND PLASTER FOR SNF AND PCE BASED ADMXITURES COMPLAINS WITH IS:9103-1999
3. BUILDPLAST -100:PLASTICISER AND WATER REDUCING ADMIXTURE FOR CONCRETE COMPLAINS WITH IS:9103-1999.
4. BUILDGUARD:A CEMENTITIOUS WATER PROOFING COATINGS FOR ROOF WATER TANK BATH ROOM etc.
5. MAISTRY:A SEMILIQUID FLEXIBLE UV RESISTANT WATER PROOFING COATING.
6. MORBON:A LIQUID BONDING AGENT FOR CONCRETE TO MORTAR.
7. BUILDPLAST RC-105:ACRYLIC BASE COATING MATERIAL FOR WATERPROOFING COATING
8. BUILDPLAST –EBS:HIGH MOLECULAR EPOXY BASED SEALANT.
9. BUILDPLAST-COAT: SOLVENT FREE TWO COMPONENT EPOXY RESIN BASED COATING MATERIAL.
10. BUILDPLAST-TILELINK:TILEFIXING ADHESIVE
11. BUILDPLAST TILE CLEANER:LIQUID CLEANER FOR CERAMIC TILES AND CONCRETE FLOORS.
12. BUILDPLAST-TJF:TILE GROUT FOR FILLING OF TILES JOINTS(COLOUR)
13. BUILDPLAST SEAL-PASTE: SINGLE COMPONENT READY TO USE CRACK FILLER.
14. BUILDPLAST QUICKSEAL: SINGLE COMPONENT CEMENTITIOUS POLYMER MODIFYING FILLING AND REPAIRING CRACKS.
15. BUILDPLAST-100Q:FOR QUICK SETTING CONCRETE ADMIXTURE.

S.N.ENTERPRISES

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With head office in Chamarajpet, S.N.ENTERPRISES provides superior services for trading and distributors of constructions chemicals. Serving the retailers, S.N.Enterprises brings a fresh and innovative approach to constructions and trading services, acting as liaison between the end-user and the construction chemicals providers. Our goal is to exceed the expectations of every client by offering outstanding customer service, increased flexibility, and greater value, thus optimizing Trading functionality and improving operation efficiency. Our Firm is distinguished by their functional and technical expertise combined with their hands-on experience, thereby ensuring that our clients receive the most effective and professional service. As Experts in Trading and Distribution, S.N.ENTERPRISES is involved in every stage upon client selection of trading and distribution management offering continual functional and technical support of construction chemicals. Our extensive skills encompass all aspects of Trading and Distribution operation, including business requirements definition, development of functional specifications for client approval, and overseeing development teams customizing construction chemicals to fit specific client needs. Typically, we are on-site at the retailer's locations handling client contact, providing functional and technical training and support, and resolving any and all troubleshooting issues that arise when the client initiates construction chemicals usage in a live setting. In order to meet the individual needs of clients, S.N.ENTERPRISES maintains a wide range of qualifications. At S.N.ENTERPRISES, we are continually expanding upon our knowledge and services to assist clients with successfully implementing Sales of construction chemicals. Exceptional, functional and technical expertise coupled with extensive industry knowledge makes S.N.ENTERPRISES, the ideal choice for a Trading and Distribution firm to manage the Sales implementation of BASF Constructions Chemicals.

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ABOUT ACCE(INDIA)

Association of Consulting Civil Engineers (India) was formed and registered in 1985 by a group of Consulting Civil Engineers in Bangalore. ACCE(I) has its head quarters at Bangalore and has since grown into a National Association with 17 Centres formed all over India including Bangalore, Ahmedabad, Bidar, Chennai, Coimbatore, Chidambaram, Davangere, Dharwad, Hyderabad, Indore, Karimnagar, Mangalore, Madurai, Mysore, Nagpur, Nashik and Vishakhapatnam.

Broadly, the objects of the Association are:

- To encourage and foster the ideals of the profession.
- To hold conferences/meetings/seminars for dissemination of knowledge amongst the Civil Engineers in particular and society in general.
- To promote friendship, establish rules for professional and ethical conduct and to develop social awareness and responsibility amongst the members.
- To bring the latest technological advancements in the world to the members and prepare them to carry out futuristic design with an eye on assurance of quality.
- To facilitate access to technical papers, books and computer software.
- To arrange lectures by distinguished Engineers/Professionals from India and abroad and conduct study tour of projects.
- To act as spokesman for the Consultant to deal with Government, Corporations and other agencies regarding policy matters.
- To identity the areas in which the Consultants can contribute to the betterment of the country like Rural Housing, Urban Development, Low Cost Housing, Infrastructure Development, Economic and Safe Design and Construction Practice, etc.,

Company Nam	:	INSTRUCT – INSTITUTE FOR RESEARCH DEVELOPMENT & TRAINING OF CONSTRUCTION TRADES & MANAGEMENT
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Write up about company:

A well trained workforce is more efficient and effective team in the Construction Industry. With a view to empower India's Construction workforce the institute was conceived as " Centre of Awareness' in Construction and Engineering" (CACE) during october1989 by few likeminded , dedicated professional to provide vocational training to grass root level and middle level managers. During December 1993, it was registered as Regional Institute of Construction Management and Research (RICMAR) under Karnataka Co-operative Societies Act. In 1997, it was renamed as Institute for research Development and training of Construction trades and Management (INSTRUCT). INSTRUCT Specializes in Designing and customizing training programmes for all levels of targets group on sponsorship basis. Training programmes for artisans on plumbing, masonry, bar bending, awareness programmes, training programmes of any duration, say one day to one month duration for masonry and small contractors, with the objective of promoting education training and skill formation in the civil engg fraternity and undertake pilot projects demonstration projects in urban and rural environment among many other vision. It is proud that INSTRUCT is recognized by CIDC –Construction Industry development Council Since 2008 with collaboration adopted 3 Year Diploma Courses for candidates who were interest to pursue diploma engineering. Since the last 6 years INSTRUCT has been in the forefront of providing value added training programmes and short term courses, for the construction industry. INSTRUCT has entered into the Corporate sector like L&T, RNA Corp and such other industries and has many inroads into the training of their personnel. INSTRUCT boasts of providing training to more than 26,000 personnel and have conducted more than 1100 programmes. After considering the above facts, CIDC have assessed INSTRUCT to be awarded the "Partner in Progress" Award in 2013 at the 5th Vishwakarma Awards and for the continued efforts by INSTRUCT, CIDC have recommended for the consecutive award for the "Achievement for Construction Education in 2014", 6th Vishwakarma Award. Efforts to provide quality training and knowledge dissemination is continuing unstintingly and the Office Bearers and the Board of Governors are not leaving any stones unturned.

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Practical usage of UHPC and HPC Materials with generative development and optimization methods

Dr.-Ing. Thomas Teichmann

Ultra High Performance Concrete – Sustainable and Cost Effective

Ultra high performance concrete is one of the modernist concrete that was developed during the last ten years. It's a material that is in general characterized by having a high compressive strength from 120MPa to 200MPa. Slowly more and more projects are going to be realized worldwide and these are showing the potential of this new kind of cement bonded material.

G.tecz Engineeringis specialized on cement bonded high-tech materials and especially on the development of ultra high performance concrete with local raw-materials and local production facilities. With a long lasting experience on these kind of cement bonded high-tech materials and since about 8 years more than 150 projects worldwide were realized and are demonstrating, that new UHPCconcrete technology can lead to cost-effective and sustainable solutions. In more than 30 research projects G.tecz developed new purchases and technologies for using the generical models for densifiying the microstructure by increasing the packing density and optimizing the surrounding water-film thickness.

Modern cement bonded high tech materials that are developed by the Quantz® technology. These nano optimized materials do have much better mechanical respective physical properties than ordinary concretes or high-performance concretes: Not only the quasi structural performance is much higher than, these concretes do have ceramic like surface behaviors, are non water and gas permeable, can be highly heat resistant or work as insulation material. These materials, that can be seen as the next generation of high performance materials and can be used in classical building applications like structural pre-cast elements, facades, columns but also in the machinery-industry for e.g. form-giving tools and integrated parts of machineries. Next to that they are inspiring designers, architects and engineers to complete new applicationswhere concrete wasn´t a choice before.

TECHNOLOGY - Quantz is a material technology by matching of the physical and chemical complex interactions, such as packing density, waterfilm thickness, interparticle forces, as well as the stoichiometric coordination of all raw materials reserves substantial potential in the concrete. Due to the densificationUHPC is characterized by an dense micro structure with a very low amount of capillary pores (< 1.8 vol.-%) that leads to increasing the corrosion resistance next to increasing the compressive strength: 80 MPa to 500 MPa are possible. The G.tecz clients are usually using a 135 MPa or 185 MPa material in their standard production for façade elements, bridges or other pre-cast elements. UHPC reinforced by a sufficient amount of steel, other high performance fibersor fiber mesh canreach atensile strengthof more than20 MPa and in particular casesaflexural strength up to 75 MPa for a 6 mm thick panel. Especially the high compressive strength allows a high grade of pre-stressing that is very interesting for pre-fab columns or monolithic bridges like the Goosebridge in Utrecht, produced by ROMEIN Beton with a G.tecz developed UHPC.

figure 1: Goosebridge, fibre-reinforced UHPC, no steelbar re-inforcement inside; production: Romein Beton, NL; material development: G.tecz Engineering, Germany

The Goosenbrueck, Utrecht, NL, is made with a maximum grain size of 5 mm with a span of about 20 m and cross section tapering was monolithically with a minimal amount of reinforcement and prestressing steels and a pumpable ultra-high strength concrete . Except for the prestressing reinforcement and the steel fibers, no additional reinforcing steel is in the bridge. The developed concrete including steel fibers was pumped with a conventional rotor-mounted concrete pump for SCC and could be pumped into a closed mold.

For a further reduction of the CO2 footprint the OPC content was reduced under 450 kg/m3 and only the materials of the concrete facility were used. Only one fine powder had to ordered extra.

What makes an individual developed UHPC interesting is, that all the material parameters can be influenced individually. This means for example: workability, early strength, compressive strength, flexural strength and even costs can be adapted regarding the clients requirements. 'Performance' doesn't only represent compressive strength but all the other essential parameters that are fundamental for high-tech products. Possible is this material technology a) by using mathematical algorithms to calculate the optimal packing density in combination with the optimal waterfilm thickness around each particle in the mix and b) by using the local available raw-materials and the available production technologies of the client. The raw-materials and their properties will be characterized by laser-diffraction, SEM and EDX. Also their rheological compatibility with other fines, water and admixtures will be investigated, so that their advantages or disadvantages can be used for the design of the concrete formulation. By using this technology, the ratio of the reactive binder, add-ons and chemical additives can be reduced. In general the developed material consists only of 4 or 5 components, that makes it easy for the production. At the same time the UHPC formulation will be developed regarding e.g. the mixer-technology to guaranty that the developed material works in production as well as in the final product. Due to the usage of local raw materials and reducing transport and necessary concrete volume material costs and emissions can be reduced significantly.

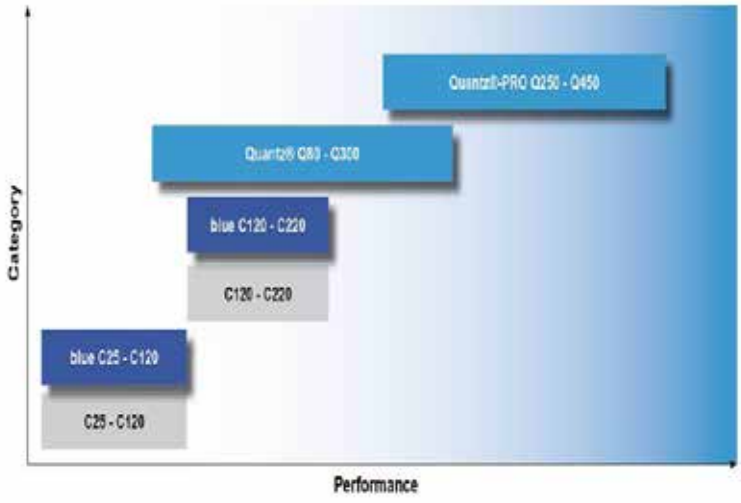
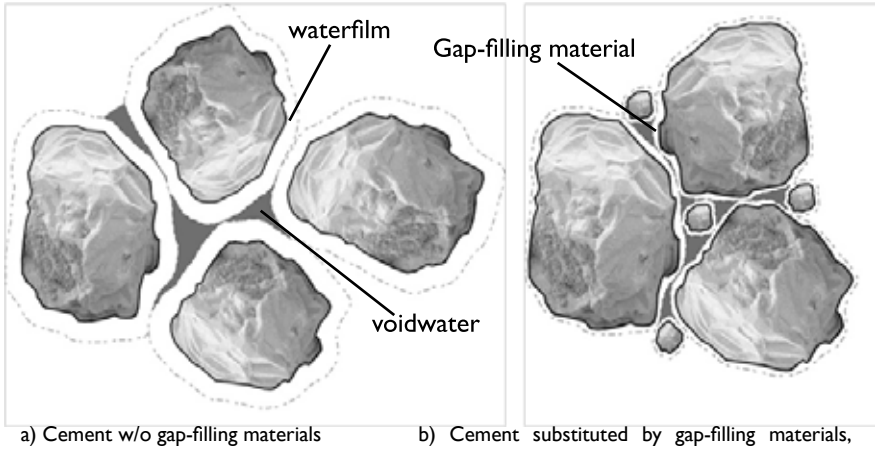


figure 2: range of performant concretes

All given raw materials will be analyzed by laser diffraction, optical and scanning electronical observation methods and characterized by derived mathematical numbers. With these input datas the optimal packing density in the range from 0 to 0.125 mm can be calculated by including the water film thickness in an evolutionary, non-linear cross-over calculations process.



a) Cement w/o gap-filling materials

b) Cement substituted by gap-filling materials, water-film thickness optimized

figure 3: scheme for demonstration of the effectiveness of gap-filling materials. [1]

figure 4: Quantz-Pro panel with a glas-fiber mesh, flexural strength: 73 N/mm2

figure 5: C170with 0.99 vol.-% steel fibers

The special effect of water film thickness related of he packing density shows the following example [1].

In a) the water film thickness around the cement grains with the cavity water is shown. When replacing the cement by a cavity-filling substitute the solid content is increased and displaces the water from the cavities. This water can then be saved and used to optimize the water film thickness as b). The scheme shows that in addition to the cavity filling the reduction of the water film thickness is essential to ensure that the increased computational density can be effective.

Often in concretes a high flexural strength instead of a high compressive strength is required. Through the targeted combination of high tensile strength, bond strength and limp nonmetallic reinforcing elements 6 mm were thin, plate-like elements having a flexural strength of 70 MPa developed, which are already used industrially and open up wide areas of application far beyond the facade technology addition . The thickness of the plates can be adjusted in wide ranges.

Often planetary mixers are available in precast plants, with insufficient mixing intensity in fines graded concrete systems. By intelligently controlled mixing and dosing processes also these mixers are processable to mix a concrete with a compressive strength of above 180 MPa. Shortest mixing times, even below one minute, are possible with high-performance intensive mixer with increased efficiency.

Figure 1 shows a highly flowable ultra-high strength concrete C170 with 0.99 vol .- % fine steel fibers and 5 mm maximum particle size, produced in a commercial planetary mixer. The workability was assessed with a slump flow of 95 cm and a low dynamic viscosity (t500 < 5 sec.). Segregation or sedimentation could not be found in a variety of experiments. The compressive strength after 28 days without heat treatment was 185 MPa. With respect to a smallest possible shrinkage the

content of hydraulically active substances (f.e. cement, puzzolane) was kept as low as possible without compromising the tightness and durability of the material.

Other positive side effects when using Quantz in the precast production are the high early age strength. After 2 days, the compressive strength is usually about 90 MPa, whereby the storage in the factory can be substantially reduced.

Through the use of ultra-fine and finer cements the strength development could be accelerated significantly, as table 1 shows. Especially the rapid development of flexural strength is remarkable and allows a very early demoulding of the concrete elements. The specimens were stored thermally insulated to simulate the state of the element.

Table1: development of the early age strength of acc. UHPC, no fibers, max. grain size < 5 mm

Concrete age	2h	4h	8h	24h
Compr. Strength, cube, 10x10x10 cm	25 MPa	45 MPa	50 MPa	110 MPa
Flex. Strength, prism 4x4x16 cm	2,5 MPa	4,5 MPa	4,5 MPa	11,0 MPa

The combination of high matrix density with a stoichiometric optimization of concrete composition and the adaptation of the formwork surface together with an appropriate, specially developed, but not expensive storage method in the young age of concrete leads to new concrete surface features that were previously only possible with additional sealings. In this concrete surfaces the crystallisation of calcium carbonates is reduced to the extent that they visually can no longer be detected. Corresponding formwork surfaces provide a significant reduction of micro canyons and plateu in the concrete surface, which can be referred to as "easy to clean" surfaces . For example, a stroke of a permanent marker (Edding 400 or 3300) could be removed by wishing.

figure 6: TAKTL©-Panel with Quantz, thickness: 10 mm, blue pigmented concrete

COST EFFECTIVINESS – Using local raw-materials is a key-factor for a successful development of cost-effective high-tech concretes. G.tecz is doing this categorically because usually no additional shipped or imported raw-material is needed. Due to low prizes of the available resources, low transportation costs and an optimized formulation where the expensive raw-materials are used in an optimum, Quantz respective UHPC is very cost effective. Comparisons of G.tecz clients all over the world approved, that costs are three to four times lower compared to UHPC pre-mixes offered on the market.

Next to the material costs itself, the new design of the pre-cast elements can lead to more filigree, lighter and 'greener" products. By downsizing dimensions and sections, the costs per element are equal or lower compared to regular concrete because you can save concrete volume. Not only volume but using these new high-tech concretes means reduction of steel-reinforcement, mold costs, labour costs and so on. Finally, the overall costs of a Quantz or UHPC pre-cast element are the essential factor for calculating the economic efficiency and the return of investment in these new technologies.

SUSTAINABILITY – the economic effects, structural advantages and the overall performance of the new materials are directly related with each other. The whole development of e.g. a pre-cast element must be seen holistic, from scratch on till series production. To give you an example:

Together with the structural engineers from Bollinger+Grohmann located in Frankfurt, Germany a case-study for a mega-column of a skyscraper was calculated. Originally, the 2 m by 2 m thick column is planed with a C60 and was intended by substituting it with a C190 material. The amazing result was a downsizing of the section to a 1 m by 1m column. At all, about 75% of material can be saved by just substituting the concrete with an UHPC; that's about 100 ton of concrete only for one mega-column. Next to these fact, the carbon footprint as well as the necessary primary energy to produce the materials and column can be reduced. Now imagine, that it's not only the mega-column but all columns and for example the floor beams. By saving all the concrete volume for the structure of a high-rise building , you can also decrease costs for the foundation because the whole structure get's lighter.

Sustainabilityalso includes the aspect of strengthening local know-how, market positions, leading technologies as well as strengthening local third parties to increase the current revenue. By using these new concrete technologies, companies will be able to accomplish unique selling propositions.

OUTLOOK–Since the last 10 years, a lot of new cement bonded materials were developed; mostly focused on the standard concrete business. Outstanding materials like the ultra high performance concrete or Quantz are now getting common on the market and are door openers for new applications and inventions. Based on industrial research or scientific research projects in the laboraties of G.tecz a wide variety of different materials were developed: High compression strength materials withabout 300MPa for form-giving tools in the automotive industries,OPC based UHPC with a temperature resistance up to 1600°C within 60 seconds and resists this permanent high temperature over years. Light weight concrete and foam concrete with high strength that can be used for insulation or acoustic barrier elements. For example, the new developed Aerogele Quantz does have an insulation factor of lambda 0.07 that is comparable to the newest three-glass window systems. §D-printable and 3D-extrudable concrete. 15cm to 25cm thin Pre-fab walls can be produced endless with this material and no other insulation materials will be needed. One of the latest scientific research projects together with a german company is the development of a ceramic like Quantz that is used in 3D rotation molds to produce hollow casings with a wall-thickness of only 2 to 3mm thickness. The market development shows, that cement bonded materials are getting more and more accepted by other industries.

figure 7: 3D printed concrete housing element for a prototype for Plug´n Charge

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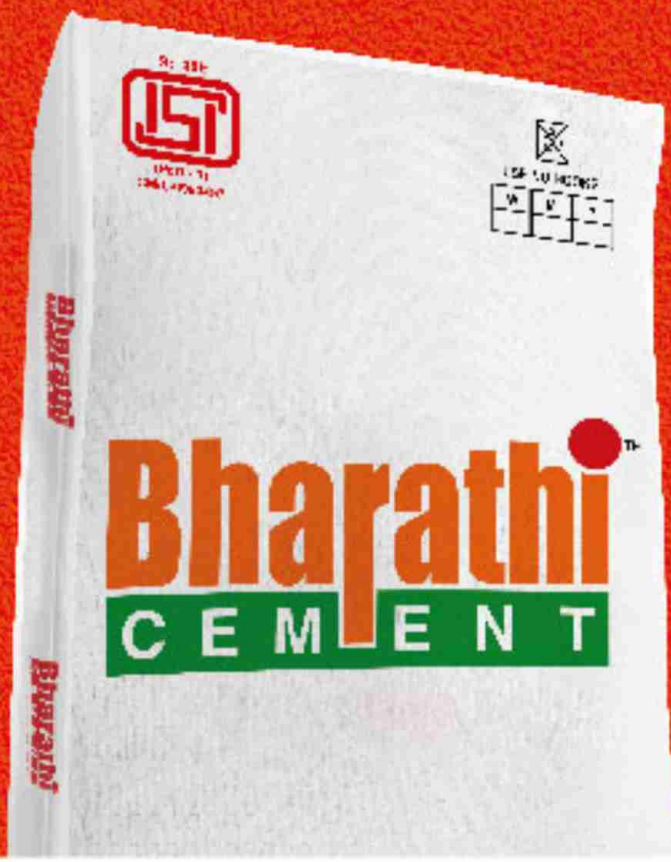

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