What’s New in Concrete Construction

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What’s New In Concrete Construction

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World of Concrete
Editor at Large

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45th Edition

54,000 registered professionals

1,310 Exhibitors

The Concrete Industry Management (CIM) program held its 15th annual unreserved silent and live auctions at World of Concrete 2020. The silent and live auctions broke all previous records bringing in more than, $1,217,000
Six Cities of the Future Being Built Now

Forest City, Malaysia

Xiong’an New Area, China

nurkent

colombo port city sri lanka
Six Cities of the Future Being Built Now

sino-oman industrial city

New Clark City
Five Trends Affecting Concrete Construction

- The Horizontal integration of IoT
- Using Data Analytics for Big Data
- Virtual & Augmented Reality
- Additive Manufacturing
- New Materials
top 5 trends for 2018

IRMCA 2018
The Horizontal integration of IoT

Definition
The IoT creates an intelligent, invisible network fabric that can be sensed, controlled and programmed. IoT-enabled products employ embedded technology that allows them to communicate, directly or indirectly, with each other or the Internet.
Five Trends Affecting Concrete Construction

Applications

• Paperless Employee Timekeeping
• Job Site Awareness
• Employee Safety
• Concrete Maturity

The Horizontal integration of IoT
IRMCA 2018
IRMCA 2018
Definition

Big data is an evolving term that describes a large volume of structured, semi-structured and unstructured data that has the potential to be mined for information and used in machine learning projects and other advanced analytics applications.
Five Trends Affecting Concrete Construction

Applications

• Building Information Modeling
• Artificial Intelligence in Project Management
• Machine Learning in Concrete Maturity
• Asset Management for Concrete Ingredients
• Slump Control of Fresh Concrete While in Transit
• Maintaining Floor Flatness During Placement
BIM – Building Information Modeling

A/E Design → Contractor → Suppliers
Verifi Slump Reading

IRMCA 2018
Five Trends Affecting Concrete Construction

Maintaining Floor Flatness During Placement
Five Trends Affecting Concrete Construction

Maintaining Floor Flatness During Placement
Application of machine learning in superplasticizer design

Kimberly Kurtis

Newell Washburn

Researcher are exploring how to develop hybrid algorithms based on physical models and machine learning to leverage data and domain knowledge for predictive modeling of cementitious systems could enable broader adoption of a diversity of pozzolans in advanced binder systems.

Calcined clay – ‘metakaolin’
Application of machine learning in superplasticizer design
Virtual & Augmented Reality

Definition

Virtual Reality and Augmented Reality are two sides of the same coin. Augmented Reality simulates artificial objects in the real environment; Virtual Reality creates an artificial environment to inhabit.
Five Trends Affecting Concrete Construction

Virtual & Augmented Reality

Applications

• Training
• Design
• Increased Tolerances
• Embedment Locations
Five Trends Affecting Concrete Construction

Virtual & Augmented Reality

Concrete Pump Operator Training

https://youtu.be/XBj-UNNMzZw
Five Trends Affecting Concrete Construction

Virtual & Augmented Reality

Concrete Surface Repair Technician Certification Program.

https://youtu.be/k9V0zIVpXR0
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Five Trends Affecting Concrete Construction

Virtual & Augmented Reality

With the Doka AR-VR app (www.doka.com/ar) customers can experience selected Doka solutions in augmented and virtual reality. The applications range from the projection of Doka formwork onto printed plans, through the placement of 3D models in their surroundings, to the immersion in Doka solutions in virtual reality. An additional 3D view of the models, as well as a QR code reader, are additional features of the app. Individual 3D models also provide the option of hiding and showing components, or calling up an animated construction sequence.
Five Trends Affecting Concrete Construction

Virtual & Augmented Reality
Drones using a software that relies on virtual reality can be used to measure construction tolerances. This is a picture of a bridge deck and the structural tendons prior to concrete placement.

**Embedment Locations**
EZ Cast is a complete system that includes a head set, processor and connectivity equipment. The headset features special goggles that allows the user to “see” a wall’s virtual layout. This includes the shape and location of all embedded objects. After placement, the virtual goggles allows the installer to then verify the placement of each embed for future reference.
Manhattan West is an eight-acre, six-building mixed-use development located in Manhattan’s new Hudson Yards district. The project manager is using AI to speed construction.

**Increased Tolerances**
Additive Manufacturing

Definition
Additive manufacturing uses data computer-aided-design (CAD) software or 3D object scanners to direct hardware to deposit material, layer upon layer, in precise geometric shapes. As its name implies, additive manufacturing adds material to create an object.
Additive Manufacturing

Applications

• Stringless Concrete Road Paving
• Shotcrete
• Pre-stressed Hollow-core Slabs for Earthquake Zones
• 3-D Structural Printing
• 3-D Architectural Printing
• 3-D Field Printing
Five Trends Affecting Concrete Construction

Additive Manufacturing

Stringless Concrete Road Paving
Additive Manufacturing

Shotcrete
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3-D Structural Printing

World of Concrete Asia 2018
Additive Manufacturing

Pre-stressed Hollow-core Slabs for Earthquake Zones
Additive Manufacturing

Vollert Introduces the Motus Construction system. The hollow-core slabs are produced on pallets in a production system.

Pre-stressed Hollow-core Slabs for Earthquake Zones
Five Trends Affecting Concrete Construction

Additive Manufacturing

3-D Structural Printing
Five Trends Affecting Concrete Construction

3-D Structural Printing
Additive Manufacturing

The 3D-printed, prestressed concrete bicycle bridge over the Peelse Loop at Gemert was the first in the world manufactured with a 3D printer. The bicycle bridge is 8 meters long, 3.50 meters wide and 0.90 meters thick.
Additive Manufacturing

Printing a bridge segment Picture of Bridge prior to deck installation
Additive Manufacturing

3-D Field Printing
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Additive Manufacturing

3-D Field Printing

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New Materials

- Biomimetic materials
- C02 Injection
- Growth Inducing Concrete
- Nano Technology
- Pozzolan Materials
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World of Concrete Asia 2018
Five Trends Affecting Concrete Construction

**WHAT IS BIO CONCRETE**

- It is a special type of concrete invented by a group of microbiology researchers under the head of Henk Jonkers.

- Bio concrete is also called as BACTERIAL CONCRETE or self healing concrete.

- It's specially made to increase the lifespan or the durability of concrete structure by the self healing action of that concrete.
Five Trends Affecting Concrete Construction
Five Trends Affecting Concrete Construction

What's New in Concrete Materials

December 2017
Five Trends Affecting Concrete Construction

World of Concrete Asia 2018
Five Trends Affecting Concrete Construction

World of Concrete Asia 2018
Specify emerging admixture technology that can increase a concrete’s contribution to a more sustainable environment.

Nanomaterials

Emerging nanomaterials include:
• nano-silica (nano-SiO$_2$),
• nano-alumina (nano-Al$_2$O$_3$),
• nano-ferric oxide (nano-Fe$_2$O$_3$),
• nano-titanium oxide (nano-TiO$_2$),
• carbon nanotubes (CNTs),
• graphene and graphene oxide.
Five Trends Affecting Concrete Construction
Specify emerging admixture technology that can increase a concrete’s contribution to a more sustainable environment.

**Nanomaterials**

These nanomaterials can be added to cement with other reinforcement materials such as steel fibers, glass, rice hull powder and fly ash. Optimal dosages of these materials can improve the compressive, tensile and flexural strength of cement-based materials, as well as their water absorption and workability. The use of these nanomaterials can enhance the performance and life cycle of concrete infrastructures.
Nanomaterials

Nanotubes bond chemically with the cement paste, becoming a functional part of the concrete, offering strength beyond simple mechanical benefits.
Nanomaterials

EdenCrete® is a carbon nanotube enriched liquid additive that makes a denser, stronger, tougher, and more durable concrete.

In addition to improving the 7 properties of concrete, shown below, EdenCrete® has a neutral impact on batch times and fresh properties, while positively affecting modulus of elasticity and application life cycle costs.
Nanomaterials

<table>
<thead>
<tr>
<th>Mix Identification</th>
<th>Compressive Strength (lbs./in.²)</th>
<th>Notes</th>
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<tr>
<td></td>
<td>16-hr</td>
<td>24-hr</td>
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<tr>
<td>Summer Mix: No Accelerator</td>
<td></td>
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<td>Reference</td>
<td>6450</td>
<td>6930</td>
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<tr>
<td>0.50 gpy EdenCrete</td>
<td>7390</td>
<td>7860</td>
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<td></td>
<td>17-hr</td>
<td>7-day</td>
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<tr>
<td>Reference (3 gpy CNI)</td>
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<td>13080</td>
</tr>
<tr>
<td>1 gpy CNI + 0.50 gpy EdenCrete</td>
<td>9060</td>
<td>12140</td>
</tr>
<tr>
<td></td>
<td>16-hr</td>
<td>7-day</td>
</tr>
<tr>
<td>1 gpy CNI + 0.50 gpy EdenCrete</td>
<td>7630</td>
<td>11350</td>
</tr>
</tbody>
</table>

Trial Results:
- Reduction in cement, accelerator & viscosity modifier
- Reduction in finishing defects and patch work
- Achieved form stripping strength 30% faster
- Reduced amount of non-compliant beams; reduced waste

What's New in Using Admixtures to Produce Better Concrete
Researchers looking for to reduce concrete’s carbon footprint:

- Materials Replacing Portland Cement
- Materials Replacing Aggregates
- New Sustainable Materials in Concrete
What’s New In Using Recycled Materials in Concrete

- Reclaimed Coal Fly Ash
- Glass - Recycled
- Glass – Plate
- Plastic
- Processed Natural Ash
- Sea Shells
What's New In Using Recycled Materials in Concrete

Materials
Replacing Portland Cement

Flyash
What's New In Using Recycled Materials in Concrete
Materials Replacing Portland Cement

What's New In Using Recycled Materials in Concrete
Properties of Fly Ash-Based Geopolymer Mortars
Authors: A.M. Said, O. Saleh and A. Ayad
Glass - Recycled

Materials Replacing Portland Cement

What's New In Using Recycled Materials in Concrete
What’s New In Using Recycled Materials in Concrete
The presence of irradiated plastic along with fly ash strengthened the concrete even further, increasing its strength by up to 15 percent compared with samples made just with Portland cement, particularly in samples with high-dose irradiated plastic.
The higher the irradiated dose, the higher the strength of concrete, so further research is needed to tailor the mixture and optimize the process with irradiation for the most effective results. The method has the potential to achieve sustainable solutions with improved performance for both structural and nonstructural applications.”
• Municipal Waste Slag
• Reclaimed Asphalt Pavement Aggregates
• Recycled Aggregates
• Returned Concrete
• Rubber/Tires
• Plastics
Bio-concrete
Batching Returned Fresh Concrete
Adding CO2 to Concrete
Colloidal Silica
Kaolin
Precipitated calcium hydroxide
Vegetation Composites
Adding CO2 to Concrete

New Sustainable Materials in Concrete

What's New In Using Recycled Materials in Concrete
Adding CO2 to Concrete

This picture is a prototype samples of 3D-printed concrete. concrete that incorporates carbon dioxide as part of a binder.
Colloidal silica
LC3 is a new type of cement that is based on a blend of limestone and calcined clay. LC3 can reduce CO2 emissions by up to 30%, is made using limestone and low-grade clays which are available in abundant quantities, is cost effective and does not require capital intensive modifications to existing cement plants.

Kaolin
LC3 is an innovative blended Portland cement that includes addition of metakaolin (calcined kaolinite clay) and limestone. The main components of LC3 are:
CLINKER – 50%
CALCINED CLAY – 30%
LIMESTONE – 15%
GYPSUM – 5%
Precipitated calcium hydroxide

The pulverized limestone is dissolved in the acid at one electrode and high-purity carbon dioxide is released, while calcium hydroxide, generally known as lime, precipitates out as a solid at the other. The calcium hydroxide can then be processed in another step to produce the cement, which is mostly calcium silicate.
Vegetation Composites

Hemcrete is a bio-composite, thermal walling material made from hemp, lime and water.
Thank you

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