Associate Member Webinar Series – Euclid Chemical

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Housekeeping

GoToWebinar

- Approximately 40 minute webinar with Q & A at the end, followed by a Kahoot! Pop Quiz
- All participants are muted
- Questions? Use the GoToWebinar ‘Questions’ Pane
- Webinar will be recorded and posted on the Concrete Ontario website along with a PDF copy of the presentation.
- https://www.rmcao.org/publications/webinar-presentations/

Presenter

Darryl Murray

Technical Services Representative

Euclid Chemical

d.murray@euclidchemical.com

Presenter

Michael Mahoney, M.A.Sc., P.Eng., FACI

Director of Marketing & Technology, Fiber Reinforced Concrete

Euclid Chemical

mmahoney@euclidchemical.com

EUCON BARACADE WPT

Water Repellent Admixture with Weatherproofing Technology

WOC 2020 Most Innovative Product!

The Euclid Chemical Company
6,311 followers
3w •

Euclid Chemical won World of Concrete's Most Innovative Product award for our submission of EUCON BARACADE WPT in the Materials for Concrete Construction category. We are proud to receive the Editor's Choice award! Congratulations to all other MIP winners!

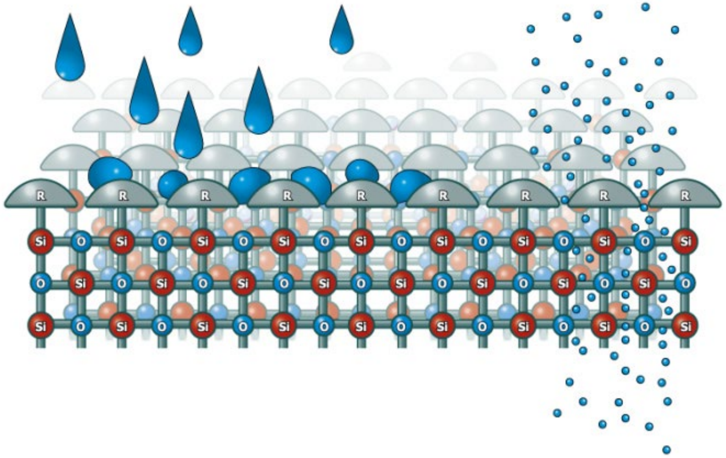
Eucon Baracade WPT is a high performance liquid water repellent admixture used to improve the durability and surface integrity of concrete exposed to harsh weather conditions. By resisting moisture and chloride ion penetration, concrete produced with EUCON BARACADE WPT reduces the potential for scaling, spalling, and other moisture-related degradation.

For more information: https://lnkd.in/eajDWgX

#MIP2020 #concrete #woc2020

98 • 5 Comments

Weatherproofing Technology



Eucon Baracade WPT is a highly dispersible, water-based emulsion that provides full-depth protection that is consistent throughout each batch.

A high performance, liquid water repellent admixture based on silicone polymer weatherproofing technology that integrally seals concrete to provide greatly improved weathering resistance, durability, and long-term visual appeal.

https://www.youtube.com/watch?v=OxoGwlgtI7g

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Sustainable High Performance Floor Systems

Concrete Construction using Shrinkage Additives and Fiber Reinforcement to Provide Reduction of Carbon Footprint

Presented to:

CONCRETE ONTARIO

c.2021

Sustainable Construction

Construction techniques to improve durability of concrete and reduce environmental impacts have become more prevalent in today's concrete construction industry.

The use of improved concrete mix designs, advancements in shrinkage technologies and fiber reinforcement can contribute to reduction of concrete joints and potential thickness while also contributing to the reduction of overall greenhouse gas emissions, or carbon footprint.

This presentation will focus on material advancements and measurements on how to evaluate high performance, low shrinkage, fiber reinforced concretes to improve durability and strengthen service life.

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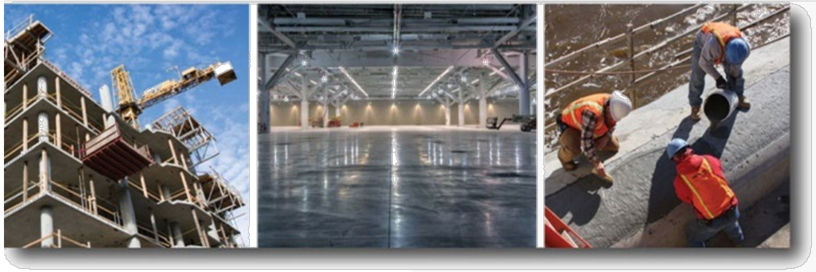
Euclid Chemical

A construction chemicals leader in the Americas that delivers products and engineered solutions to the built environment with a primary focus on concrete construction.

Est. 1910

PROVEN.
CONCRETE.
SOLUTIONS.



Chemical Admixtures • Fibers • Waterproofing
Decorative Concrete • Integral Color • Joint Fillers & Sealants
Grouts • Repair & Restoration • Mining & Tunneling

Your Speaker:

- Michael A Mahoney, P.Eng. FACI
- Director of Marketing and Technology, Fiber Reinforced Concrete
- 18 years with Euclid Chemical
- Research Professional, Technical University of Nova Scotia
- Member of ACI, ASTM, FRCA, NPCA
- Holds 2 patents on fibers for concrete

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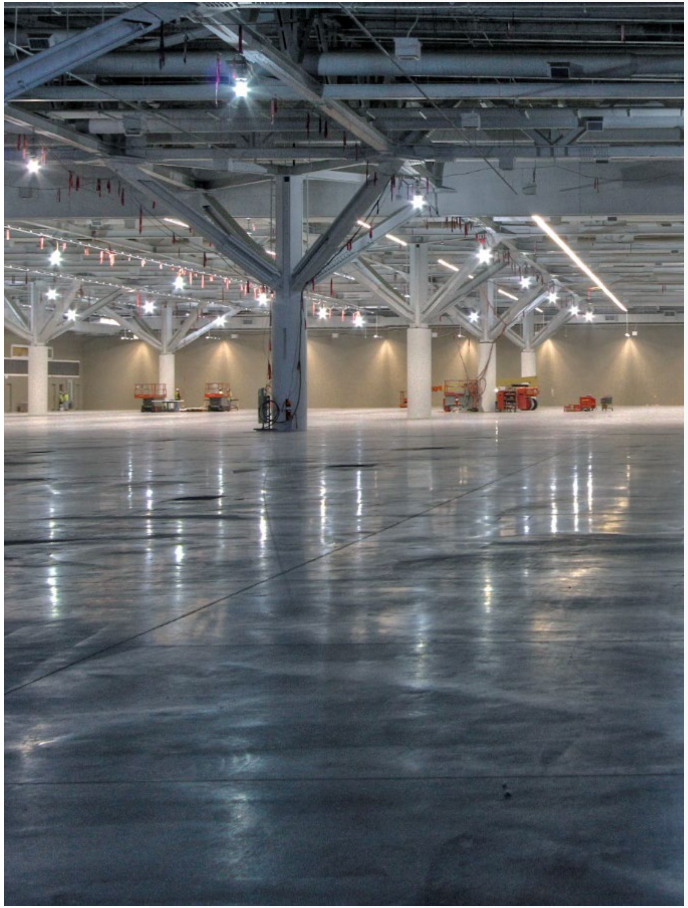
Program Outline

- Concrete & Sustainability
- Floor Design & Construction
- Concrete Mix Design & Admixtures
- Fiber Reinforcement
- Topical Treatments



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Sustainable Development

Build, but build responsibly!

Reduce the impact on the environment and future generations!

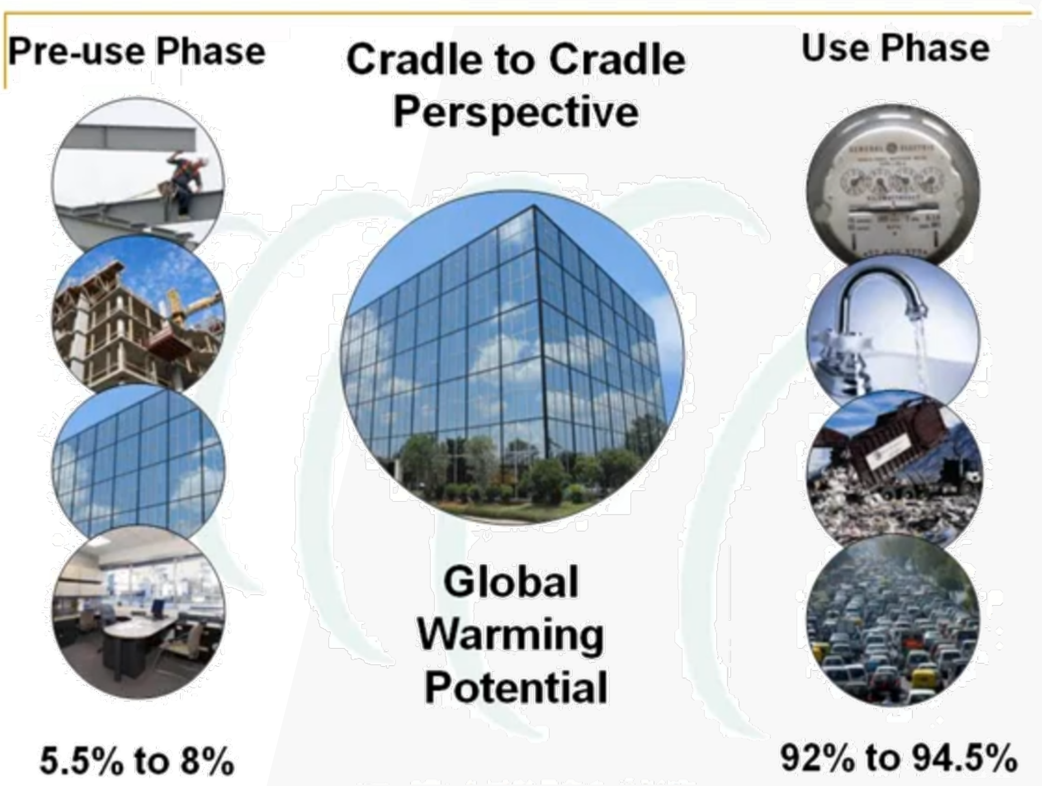
Concrete and the Built Environment

CONCRETE is the second most used material in the world, per capita, after water!
CONCRETE does contribute to CO2eq emissions!

- Reduce carbon footprint of raw materials
- Reduce VOC in topical products
- Improve energy & light efficiency
- Improve durability & life cycle
- Improve structural resilience

Carbon Footprint

Use Phases



Source: Architecture 2030

Carbon Footprint Reduction Goals

Source: Architecture 2030

Building Sector CO_2 Emissions

- Most in-depth studies from Japan and Europe
- 39-43% US emissions from building activities over lifetime
- Largest contributor is concrete
- Decrease emissions by decreasing time and material, substitutions

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Concrete as a Building Material

CONCRETE is already one of the most sustainable building material, compared to timber, steel, asphalt, etc:

- Lower embodied energy
- Using local materials
- Better life cycle / durability
- Thermal mass and energy efficiency
- Light reflectivity
- Minimized waste
- Customized properties

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Concrete Construction

- Common, and low maintenance material
- Concrete is a high compressive strength, but low tensile strength material
- Reinforcing bars are used to carry tensile stresses
- Steel can have a high carbon footprint and corrosion concerns

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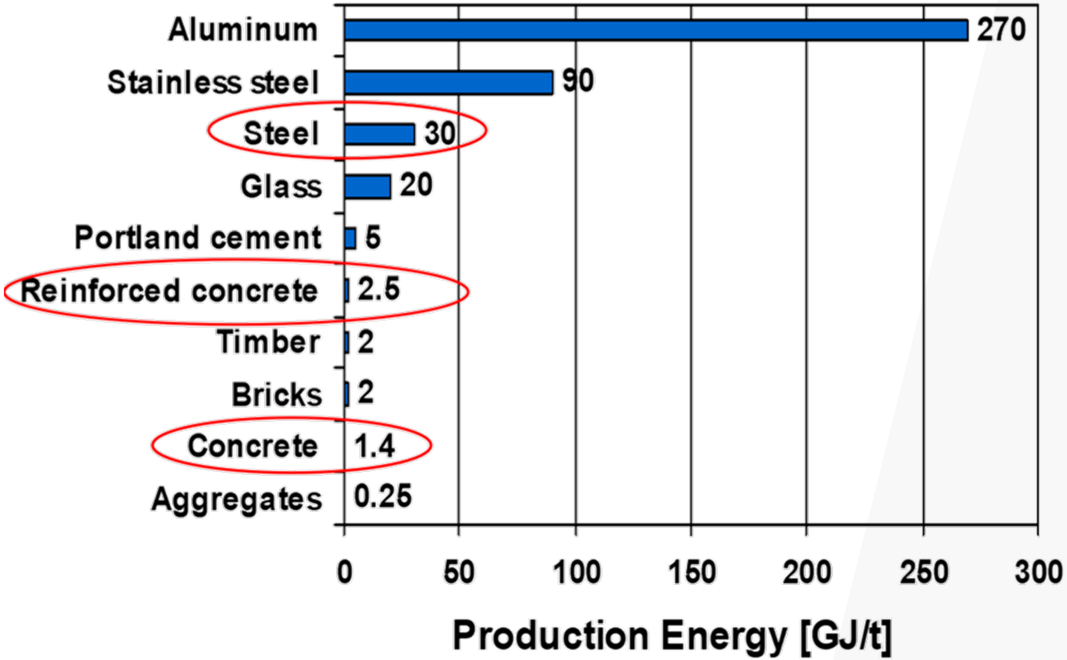
Embodied Production Energy for Materials



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Environmental Protection Declaration (EPD)

Nutrition Facts

8 servings per container
Serving size **2/3 cup (55g)**

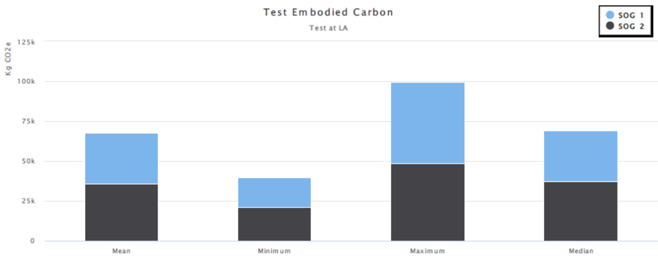
Amount per serving
Calories **230**

	% Daily Value*
Total Fat 8g	**10%**
Saturated Fat 1g	**5%**
Trans Fat 0g	
Cholesterol 0mg	**0%**
Sodium 160mg	**7%**
Total Carbohydrate 37g	**13%**
Dietary Fiber 4g	**14%**
Total Sugars 12g	
Includes 10g Added Sugars	**20%**
Protein 3g	
Vitamin D 2mcg	10%
Calcium 260mg	20%
Iron 8mg	45%
Potassium 235mg	6%

* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

EMBODIED CARBON REPORT FOR: TEST
TEST

NATIONAL READY MIXED CONCRETE COMPANY



This project report was generated from National Ready Mix's database of environmental product declarations (EPDs). All EPDs were created with Climate Earth's EPD Generator and verified according to ISO standards and the product category rules for ready mix concrete.

Concrete performance requirements vary by application. Please contact National Ready Mix to discuss all your performance requirements for each mix design.

Results of analysis in table form:

Application	PSI	QTY	Mean		Minimum		Maximum		Median	
		(cyd)	Kg Co2e	%	Kg Co2e	%	Kg Co2e	%	Kg Co2e	%
SOG 1	4,000	100	32,319	48%	18,754	47%	51,292	51%	31,872	46%
SOG 2	5,000	100	35,509	52%	20,814	53%	48,334	49%	37,104	54%
		TOTAL	67,827		39,569		99,625		68,976	

ENVIRONMENTAL IMPACTS

Declared Product:

1 3000PSI PU PL
Compressive strength: 3000 PSI at 28 days

Declared Unit: 1 m^3 of concrete

Global Warming Potential (kg CO_2-eq)	352
Ozone Depletion Potential (kg CFC-11-eq)	8.9E-6
Acidification Potential (kg SO_2-eq)	1.08
Eutrophication Potential (kg N-eq)	0.41
Photochemical Ozone Creation Potential (kg O_3-eq)	22.5
Abiotic Depletion, non-fossil (kg Sb-eq)	1.6E-6
Abiotic Depletion, fossil (MJ)	394
Total Waste Disposed (kg)	2.91
Consumption of Freshwater (m^3)	3.14

Product Components: natural aggregate (ASTM C33), Portland cement (ASTM C150), batch water (ASTM C1602), admixture (ASTM C494)

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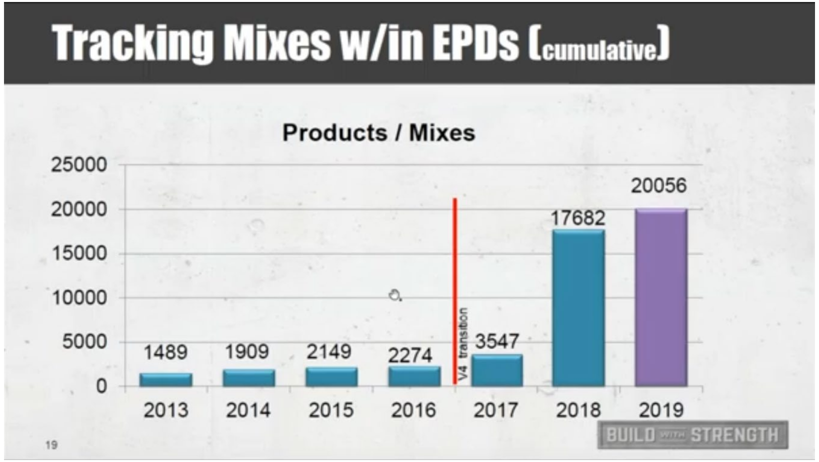
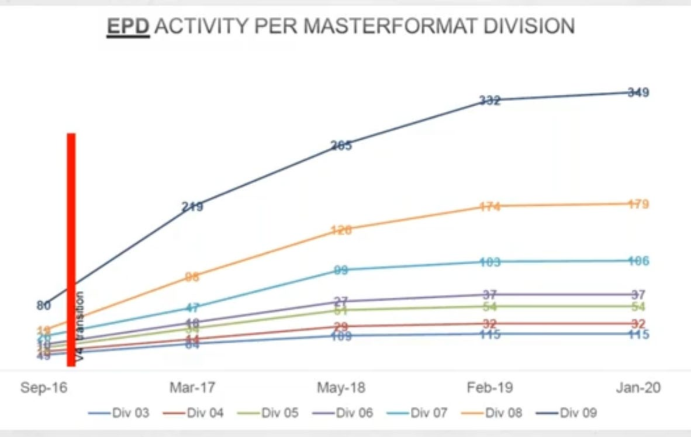
Industry Trends





Source: https://www.nrmca.org

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Carbon Footprint of Reinforced Concrete

- Carbon footprint studies still provide consistent and complete data
- In the US, building activities result in 39-43% of the total GHG emissions over lifetime of structures
- Biggest contributor to emissions in building sector is the concrete and the construction phase
- 1 kg of cement produced equals emission of 0.98 kg of CO_2 with the corresponding energy footprint of 346,275 ton of CO_2 per year
- Fiber is much lighter than steel, and the transportation related CO_2 emissions could be reduced significantly

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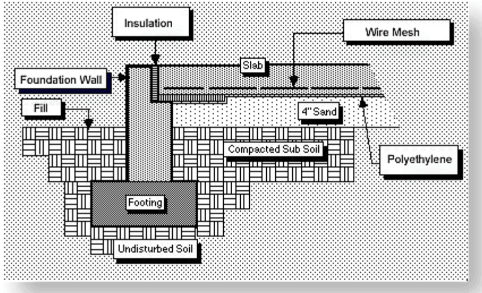
Floor and Pavement Design in Construction

What is the goal?

- More Durable and Sustainable Construction
- Improved Concrete Properties
- Increased Joint Spacing with Reduced Curling (less maintenance)
- Less site impacts and construction time

Typical Concrete Floor Construction Site



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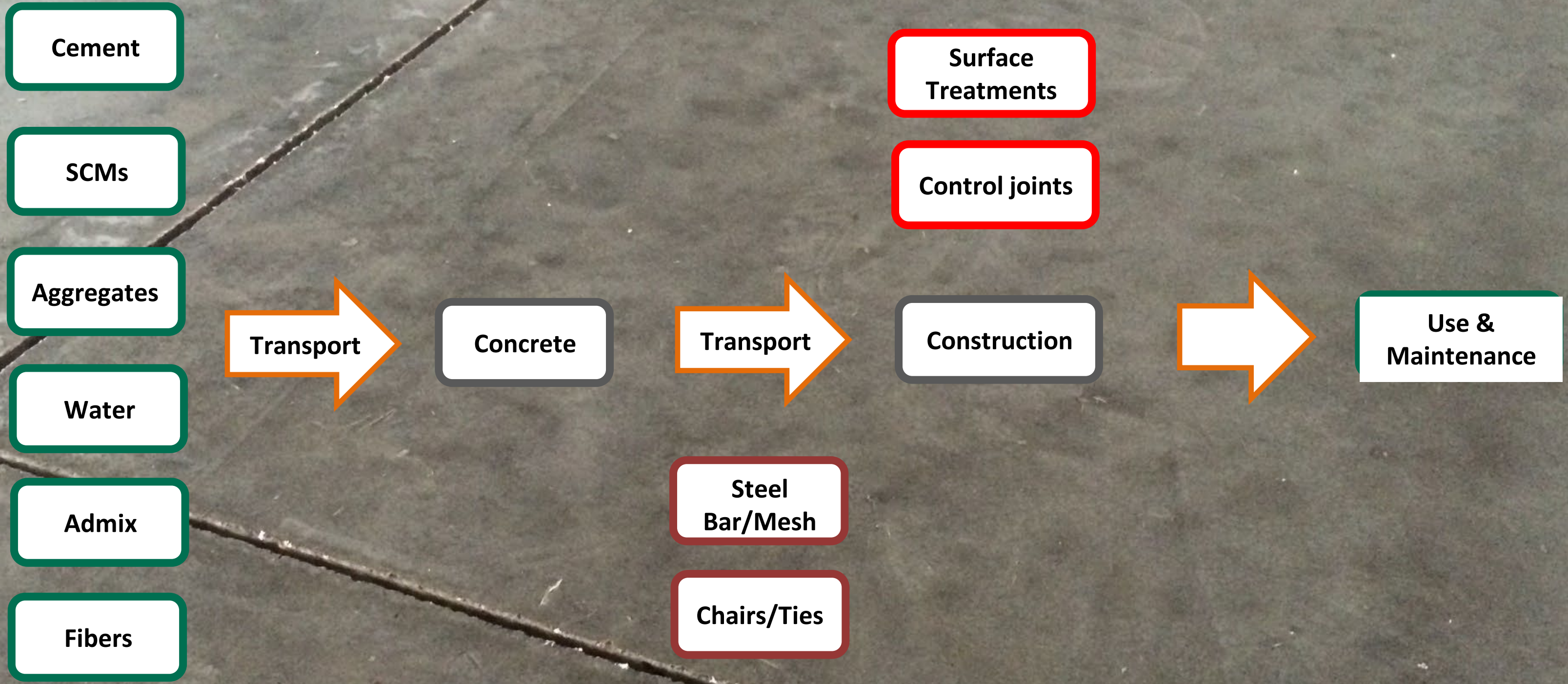
Concrete Floor Construction Process



ACI 360 Design

Or approved engineering designs

- slab thickness by design
  - concrete properties (strength, durability, etc.)
  - applied loads
  - soil properties
- flexural strength
  - lab testing vs field verification (f’c → f’r)
  - statistical validation
- site execution
  - on-site testing
  - specification compliance

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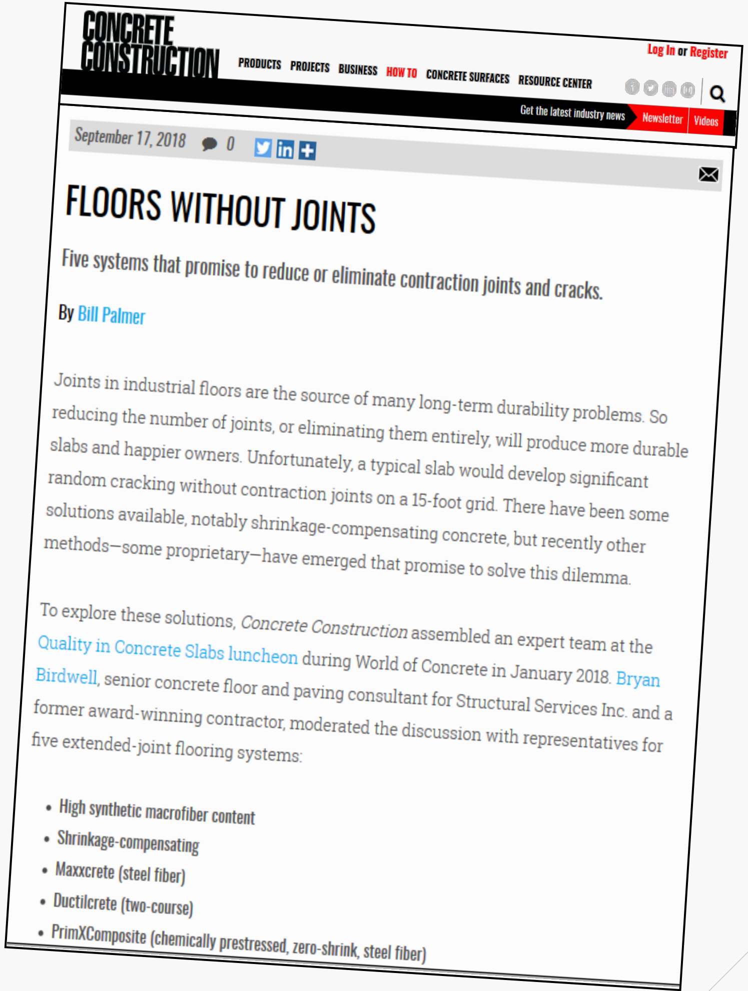
Floor Construction

Extended joint discussion

Increasing spacing of floor joints are becoming a common discussion topic, however, important details are being left out by many promoters:

- Base shrinkage of concrete
- Subgrade preparation
- Placing and finishing
- Curing
- Maintenance
- Impact on Sustainability



CONCRETE CONSTRUCTION

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September 17, 2018 0

FLOORS WITHOUT JOINTS

Five systems that promise to reduce or eliminate contraction joints and cracks.

By Bill Palmer

Joints in industrial floors are the source of many long-term durability problems. So reducing the number of joints, or eliminating them entirely, will produce more durable slabs and happier owners. Unfortunately, a typical slab would develop significant random cracking without contraction joints on a 15-foot grid. There have been some solutions available, notably shrinkage-compensating concrete, but recently other methods—some proprietary—have emerged that promise to solve this dilemma.

To explore these solutions, *Concrete Construction* assembled an expert team at the Quality in Concrete Slabs luncheon during World of Concrete in January 2018. Bryan Birdwell, senior concrete floor and paving consultant for Structural Services Inc. and a former award-winning contractor, moderated the discussion with representatives for five extended-joint flooring systems:

- High synthetic macrofiber content
- Shrinkage-compensating
- Maxxcrete (steel fiber)
- Ductilcrete (two-course)
- PrimXComposite (chemically prestressed, zero-shrink, steel fiber)

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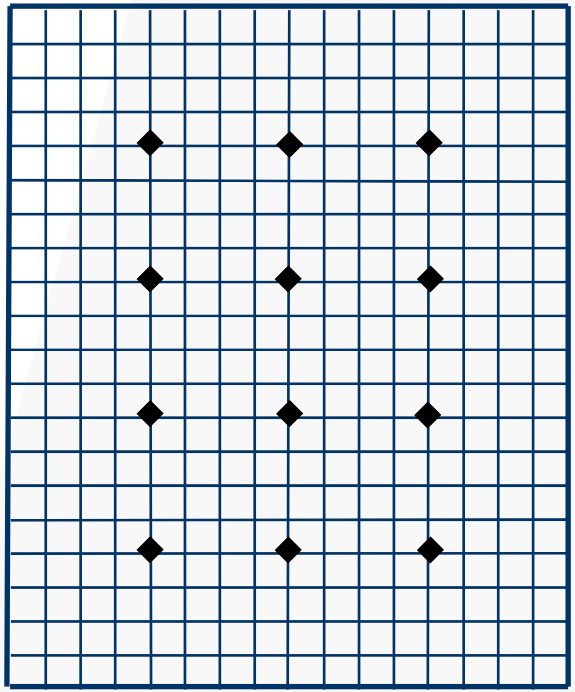
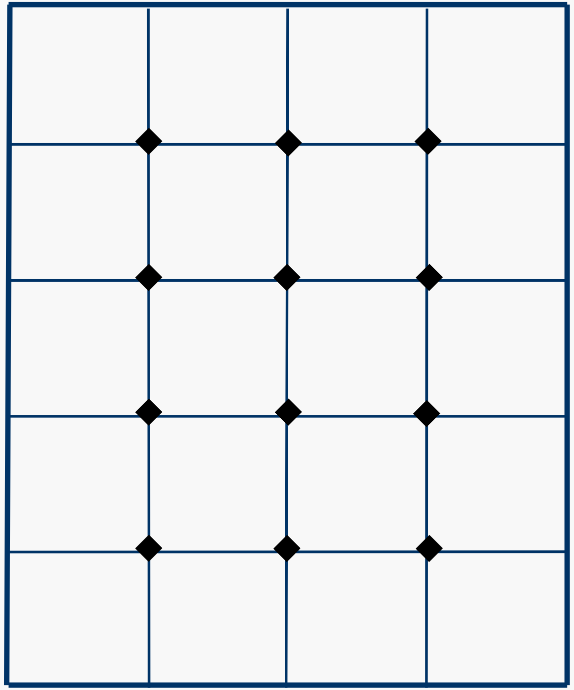
The goal and the results

Example floor – 200 x 250’, 6”, columns @ 50’ (50k ft^2)

joints @ 12.5’ (3.8 m), 7500 ft of joints



joints @ 50’ (15.2 m), 1550 ft of joints



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Floor Joints

The most common question that comes up on floors and pavements designed with fiber reinforced concrete is the spacing of joints.

While it is possible to increase joint spacing, it is still recommended to utilize current joint spacing and cutting practices as outlined with ACI and other technical documents for 'normal' floors. R&D for fibers is happening now with some proprietary mixtures being used in the market.

There are many other factors that control joint spacing recommendations:

- **subgrade characteristics**
- **concrete quality (gradation, w/cm ratio, supplemental materials)**
- **site conditions (interior / exterior, curing, finishing)**

Flexural Strength

Note1: In slab design, it's the flexural strength (modulus of rupture) that is the main necessary engineering property, not the compressive strength.

Note2: To increase MOR, use larger coarse aggregates and more of it! Increased MOR does not necessarily mean increased strength

Table A1.1—Allowable distributed loads for unjointed aisle with nonuniform loading and variable layout (Packard 1976)

Slab thickness, in.	Subgrade k,* lb/in.^{3}	Allowable load, lb/ft^2†			
		Concrete flexural strength, psi			
		550	600	650	700
5	50	535	585	635	685
	100	760	830	900	965
	200	1075	1175	1270	1370
6	50	585	640	695	750
	100	830	905	980	1055
	200	1175	1280	1390	1495
8	50	680	740	800	865
	100	960	1045	1135	1220
	200	1355	1480	1603	1725
10	50	760	830	895	965
	100	1070	1170	1265	1365
	200	1515	1655	1790	1930
12	50	830	905	980	1055
	100	1175	1280	1390	1495
	200	1660	1810	1965	2115
14	50	895	980	1060	1140
	100	1270	1385	1500	1615
	200	1795	1960	2120	2285

*k of subgrade; disregard increase in k due to subbase.
†For allowable stress equal to 1/2 flexural strength.
Note: Based on aisle and load widths giving maximum stress.

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Shrinkage vs Cracking

Shrinkage (%)	Shrinkage per 100 ft	Probability of Cracking
0.08	1”	Almost certain
0.06	3/4”	Very Probable
0.05	5/8”	Likely per Corps of Engineers
0.04	1/2”	Probably Not Many
0.02	1/4”	Probably Very Few
0.0	0”	Very Few, If Any Cracks

Note: Specify shrinkage limit for slabs (0.04% or less)

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Durability of Concrete Floors

- Making the concrete denser and less permeable
- Minimizing cracking potential
- Controlling the cracks / crack widths
- Use topical treatments for improved resistance

Supplementary Cementitious Materials

Property (Hardened)	GGBFS	Fly Ash	Metakaolin	Silica Fume	Rice Hull Ash
Sulfate Resistance	▲▲	▲▲	▲	▲	▲
ASR Mitigation	▲▲	▲▲	▲	▲	▲

Significantly Improves (GGBFS, Fly Ash)

Improves (Metakaolin, Silica Fume, Rice Hull Ash)

- Partially replace cement
- Reduce landfill
- Improve durability

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Chemical Admixtures

Water reducers and plasticizers can be added to concrete to improve flowability, consolidation and quality of concrete.

Admixtures can vary from:

Air-entraining admixtures
Water-reducing admixtures
Mid/High range Plasticizers
Accelerating admixtures
Retarding admixtures

Hydration-control admixtures
Corrosion inhibitors
Shrinkage reducers
ASR inhibitors
Coloring admixtures

Note: Some admixtures are calcium chloride based.
- If used, risk of steel corrosion must be addressed.

Note:
Follow manufacturers recommendations when using admixtures to check for compatibility with cement, application (exposure), other admixtures and mixing conditions.

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Aggregate Size Effect

- ¾” Top size aggregate, 0.45 w/c, 2” initial slump mix prior to addition of water reducers.
- 315 lbs water - Dictated by top aggregate size.
- 700 lbs. of cement – Dictated by w/c ratio spec and water demand.

315 lbs water

1.0 (density) x 62.4 pcf = 5.04 cf

700 lbs cement

3.15 (density) x 62.4 pcf = 3.56 cf

Total Paste Content 8.60 cf

- 1 ½” Top size aggregate, 0.45 w/c, 2” initial slump mix prior to addition of water reducers.
- 275 lbs water - Dictated by top aggregate size.
- 611 lbs. of cement – Dictated by w/c ratio spec and water demand.

275 lbs water

1.0 (density) x 62.4 pcf = 4.41 cf

611 lbs cement

3.15 (density) x 62.4 pcf = 3.11 cf

Total Paste Content 7.52 cf

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Case Study Comparison

Comparing 2 similar mixes:

- Both 4,000 psi and W/C = 0.49
- Both straight cement ~ 600 lb/yd
- Main difference: Mix A has ¾” top size vs. Mix B with 1.5” top size

Observations:

- Shrinkage for Mix A is 0.052%
- Shrinkage for Mix B is 0.040% → 23% lower
- GWP for Mix A is 421 kg CO_{2eq}
- GWP for Mix B is 409 kg CO_{2eq} → 3% lower

Conclusion:

- Positive impact of low shrinkage only shows itself in LONG TERM and in LIFE CYCLE ANALYSIS!
- Similar note for using specialty admixtures!

Courtesy: National Ready Mix

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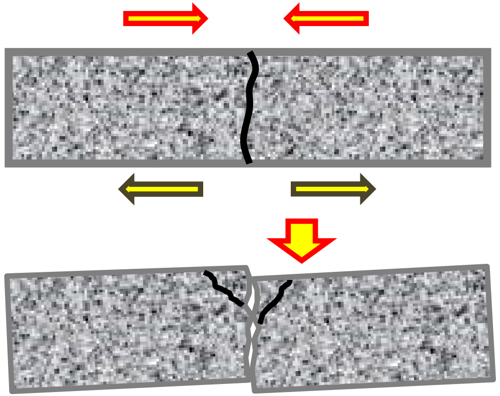
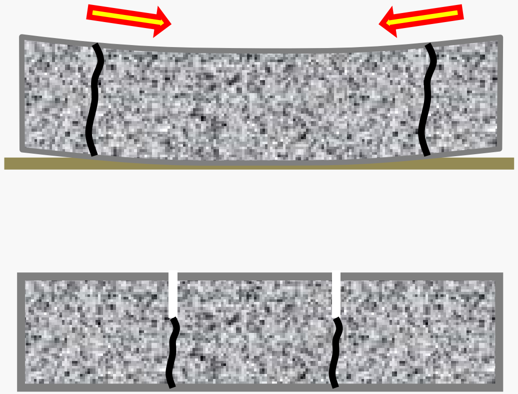
Concrete Shrinkage

Cause and Affect (Effect)

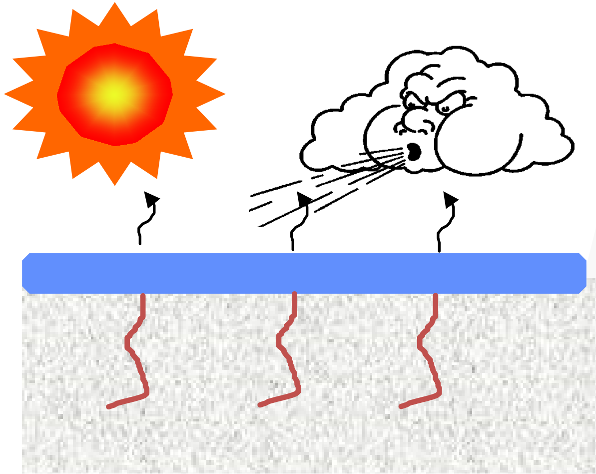
- Cracking - caused by subgrade restraint, curing, mix design, others.
- Curling - long term serviceability issue
- Load transfer - design, performance and maintenance
- Joint spacing - mitigate cracking, design implications





Shrinkage Cracking

- Plastic shrinkage is the most common reason for cracking when concrete is fresh (plastic).
- Water evaporates → volume change (shrinkage), this produces tensile stresses in fresh concrete that are too high → cracking



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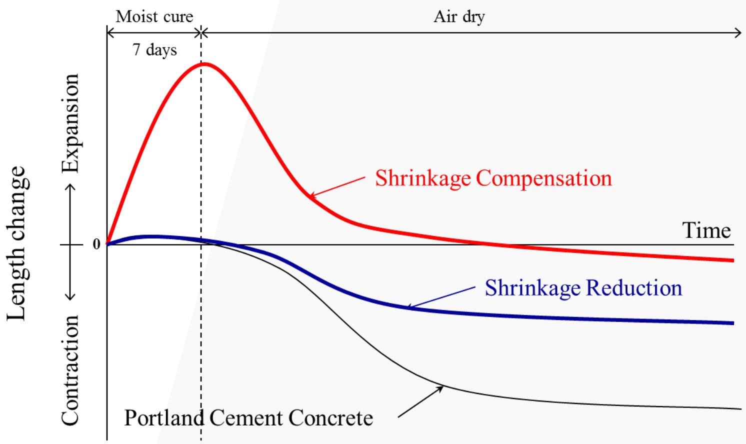
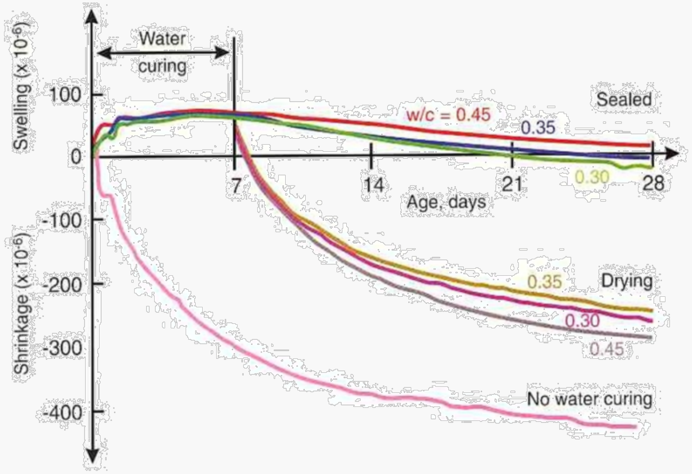
Theories of Shrinkage

Plenty of research





- ACI 223 graphic
- curves dependent on many factors
- no influence from fibers

- importance of curing illustrated
- mix design can influence
- testing diligence is very important

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Minimizing Shrinkage

Approach to minimizing cracking and curling due to shrinkage

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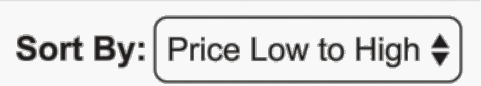
Mix design approach

Reduction through admixtures and additions approach
- Water Reducers
- Shrinkage Reduction
- Superplasticizers



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Compensation approach
- Type K Cement, Type G Expansive Components (CONEX)

In any case: Testing, Specs & Follow-up Required

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Setting Expectations

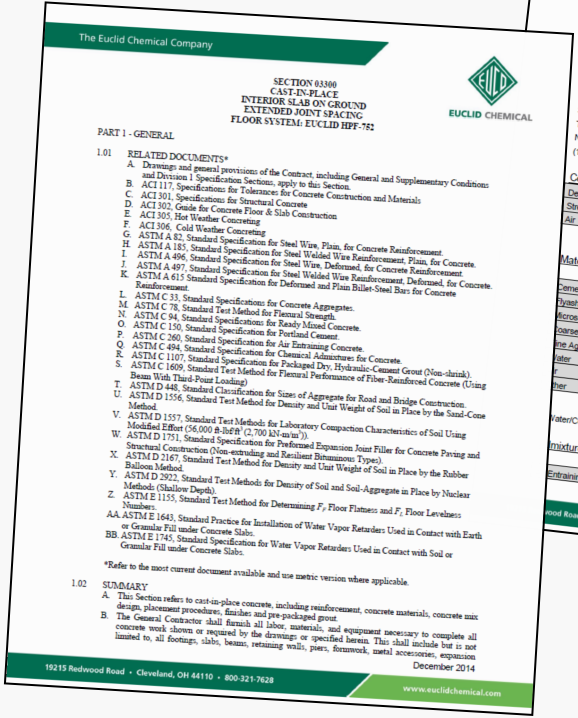
Pre-job checklist

- define roles & responsibilities
- provide education on cracking mechanisms
- note that mid-panel cracking may occur
- document problems – types of cracks, widths, location, timing
- traditional repair methods and procedures if necessary

Specification

Cast in Place Concrete, Section 03300

- summary
- submittals
- quality assurance
- materials
- concrete mix & mixing
- testing
- project execution
    - installation
    - placement
    - finishing
    - joints
    - tolerances
    - curing


The Euclid Chemical Company

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SECTION 03300
CAST-IN-PLACE
INTERIOR SLAB ON GROUND
EXTENDED JOINT SPACING
FLOOR SYSTEM: EUCLID HPF-752

PART 1 - GENERAL

1.01 RELATED DOCUMENTS*
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
B. ACI 117, Specifications for Tolerances for Concrete Construction and Materials
C. ACI 301, Specifications for Structural Concrete
D. ACI 302, Guide for Concrete Floor & Slab Construction
E. ACI 305, Hot Weather Concreting
F. ACI 306, Cold Weather Concreting
G. ASTM A 82, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
H. ASTM A 185, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
I. ASTM A 496, Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
J. ASTM A 497, Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.
K. ASTM A 615 Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
L. ASTM C 33, Standard Specifications for Concrete Aggregates.
M. ASTM C 78, Standard Test Method for Flexural Strength.
N. ASTM C 94, Standard Specifications for Ready Mixed Concrete.
O. ASTM C 150, Standard Specification for Portland Cement.
P. ASTM C 260, Standard Specification for Air Entraining Concrete.
Q. ASTM C 494, Standard Specification for Chemical Admixtures for Concrete.
R. ASTM C 1107, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).
S. ASTM C 1609, Standard Test Method for Flexural Performance of Fiber-Reinforced Concrete (Using Beam With Third-Point Loading)
T. ASTM D 448, Standard Classification for Sizes of Aggregate for Road and Bridge Construction.
U. ASTM D 1556, Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
V. ASTM D 1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
W. ASTM D 1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
X. ASTM D 2167, Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
Y. ASTM D 2922, Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
Z. ASTM E 1155, Standard Test Method for Determining F_F Floor Flatness and F_L Floor Levelness Numbers.
AA. ASTM E 1643, Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs.
BB. ASTM E 1745, Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

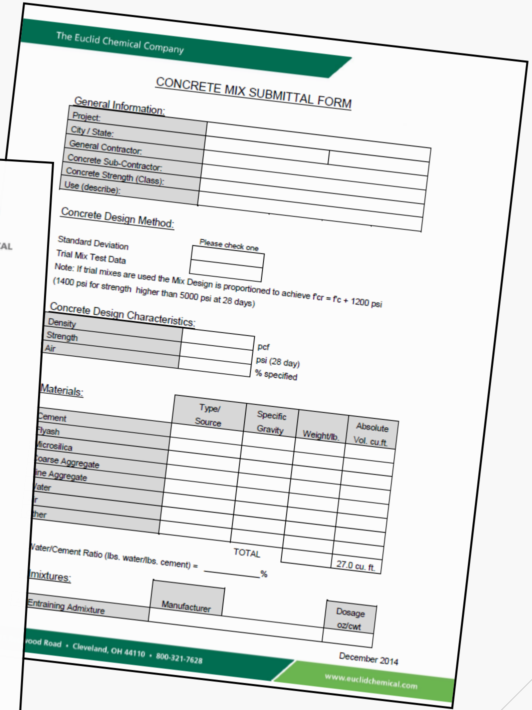
*Refer to the most current document available and use metric version where applicable.

1.02 SUMMARY
A. This Section refers to cast-in-place concrete, including reinforcement, concrete materials, concrete mix design, placement procedures, finishes and pre-packaged grout.
B. The General Contractor shall furnish all labor, materials, and equipment necessary to complete all concrete work shown or required by the drawings or specified herein. This shall include but is not limited to, all footings, slabs, beams, retaining walls, piers, formwork, metal accessories, expansion

December 2014

19215 Redwood Road • Cleveland, OH 44110 • 800-321-7628

www.euclidchemical.com



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The Concrete Mix

KISS rule – keep it simple

• shrinkage	0.02% @ 28 days
• coarse agg	largest size available; maximum content
• cement	minimized to achieve required strengths
• workability	5 - 6” max (125-150 mm) - 3” water slump; SP to 8”, add fibers
• flexural strength	750 psi ;not necessarily high f’c (5.2 MPa)
• admixtures	SP & SRA’s
• fibers	designed by requirements of applied loads

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Specification Direction

Proper Construction Techniques

- Subgrade — 150 pci (0.041 N/mm^3) at time of concrete placement
- Curing — 7 day wet
- Isolation Joints — ACI guides
- Saw Cutting — min D/3; immediate soft cut, follow up @ 4-6 hrs final
- Slip Sheets — yes; 10 mil min single sheet, tape overlaps
- Joint Filling — > 120 days

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Are there alternatives?

There are always options in concrete

- what if you can't achieve 5 MPa, 0.02?
  - there is nothing "new" in this approach.
  - we are taking the best parts of our knowledge base and tying it together in a package to present to GC's and owners to compete with other growing systems in the field.
  - Alternatives exist!!
    - low shrinkage concrete floors are desired by owners.
    - HP floors are an attempt to "package" a system that can provide performance assuance.

  - We are not currently promoting changes to flexural strength, different shrinkage values and higher fiber dosages – further study is needed; the correlation of these variables is variable

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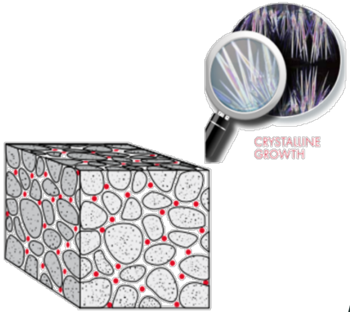
Specialty Products and Innovations

Integral Waterproofing and Shrinkage Additives

- **Eucon Vandex AM-10**, patented integral admixture powder, has been used for years on successful projects, improving capillary and durability behavior of concrete.
- **CONEX®** is a powdered admixture used for the compensation and total overall reduction of net shrinkage for concrete.



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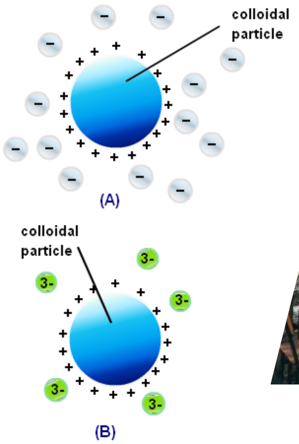
Rheology Modifiers and Corrosion Inhibitors

EUCON STASIS EUCON AWA EUCON ABS

Unique formulations developed to prevent segregation, excessive bleeding, loss of cement in underwater applications and to modify concrete viscosity.



EUCON CIA SENTINEL

Products for corrosion inhibition and prevention, reducing the need for additional accelerating admixtures in cold weather. Euclid Chemical also offer also the last technology in sacrificial anodes to prevent corrosion.

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Concrete Fibers

Fibers in concrete can be used to mitigate and control cracking in both the plastic and hardened state

Benefits to contractors, engineers, owners and Ready-Mix:

Can reduce construction time compared to steel
New advancements in project acceptance
Engineering support and new CODE approvals
Successful Track Record

All fibers can have an impact on workability and other final properties of concrete – it is important to understand rheological impacts of FRC

Micro-synthetic fibers (plastic shrinkage crack control)
Macro-synthetic fibers (moment resistance)
Steel fibers
Natural fibers

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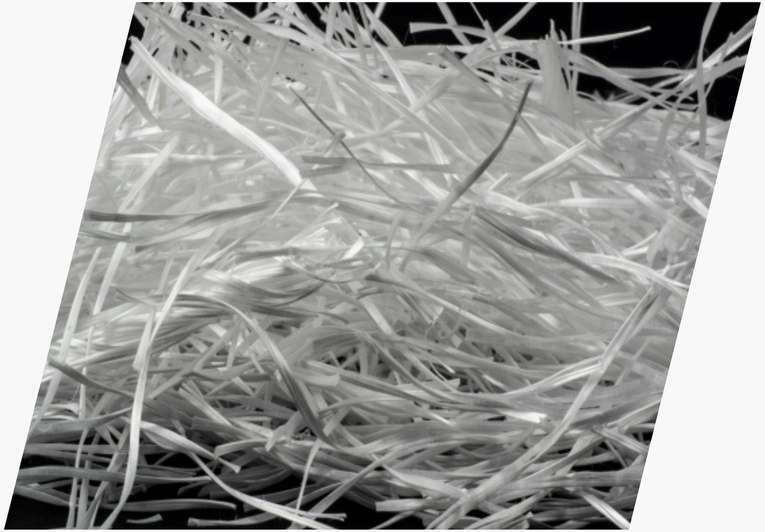
Macro-Synthetic Fibers

Performance designed FRC

- Synthetic macrofibers with dosage rate as designed using appropriate design tools and guidance (ACI 544)
- minimum 5 pcy (3 kg/m^3) with fe_3 > 200 psi (1.4 MPa); Re_3 > 25% regardless of design
- performance specification required
- coordinated direct field and technical support



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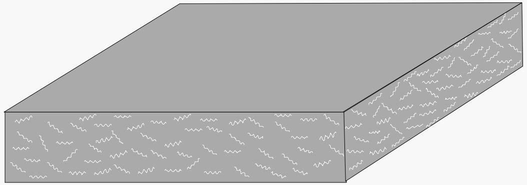
Benefits of Using Fiber Reinforced Concrete

During construction
- Reduced labor and costs
- Reduced construction time
- Increased safety
- Potential reduction in thickness
- Added value for RM



After construction (in service)
- Three dimensional reinforcement
- Shorter and thinner cracks (if any)
- Less spalling and chipping
- Increase in long-term durability
- Lower maintenance costs

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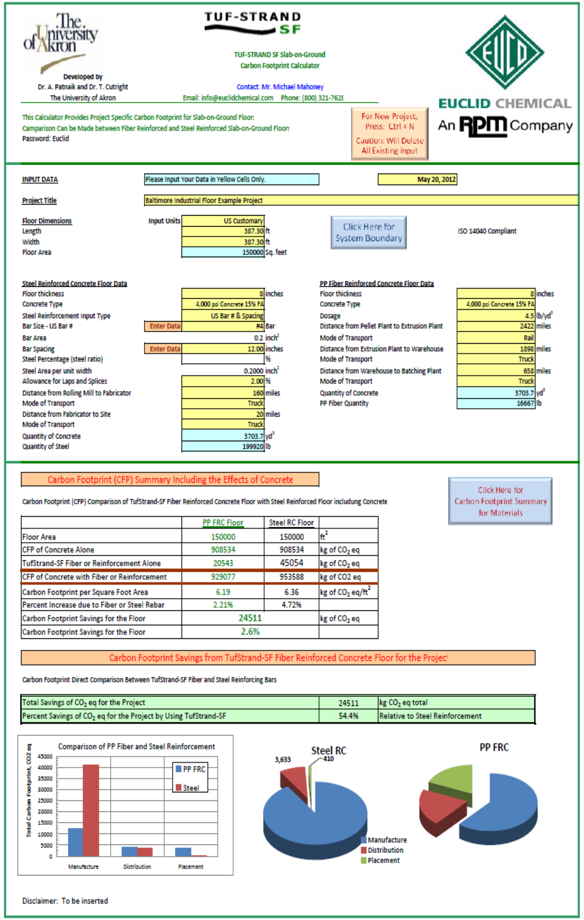
Sustainability Angle

Site Impacts

CARBON FOOTPRINT CALCULATOR

- In 2012, Euclid Chemical funded a research project to establish the savings in GHG emissions associated with replacing steel with fiber, primarily for floor projects
- analysis was for cradle to “site” on fiber projects
- shipping distance of steel vs fiber needed for the calculator and quantified by $CO_{2\ eq}$
- savings of fiber over steel can be greater than 50% CO_2 reduction



The University of Akron

TUF-STRAND SF

TUF-STRAND SF Slab-on-Ground Carbon Footprint Calculator

Developed by Dr. A. Patnaik and Dr. T. Cutright, The University of Akron

Contact: Mr. Michael Mahoney

Email: info@euclidchemical.com Phone: (800) 321-7628

EUCLID CHEMICAL An RPM Company

This Calculator Provides Project Specific Carbon Footprint for Slab-on-Ground Floors

Camparison Can be Made between Fiber Reinforced and Steel Reinforced Slab-on-Ground Floors

Password: Euclid

For New Project, Press: Ctrl + N

Caution: Will Delete All Existing Input

INPUT DATA — Please Input Your Data in Yellow Cells Only. — May 20, 2012

Project Title: Baltimore Industrial Floor Example Project

Floor Dimensions	Input Units	US Customary
Length		387.30 ft
Width		387.30 ft
Floor Area		150000 Sq. feet

Click Here for System Boundary

ISO 14040 Compliant

Steel Reinforced Concrete Floor Data			
Floor thickness		8	inches
Concrete Type		4,000 psi Concrete 15% FA	
Steel Reinforcement Input Type		US Bar # & Spacing	
Bar Size - US Bar #	Enter Data	#4	Bar
Bar Area		0.2	$inch^2$
Bar Spacing	Enter Data	12.00	inches
Steel Percentage (steel ratio)			%
Steel Area per unit width		0.2000	$inch^2$
Allowance for Laps and Splices		2.00	%
Distance from Rolling Mill to Fabricator		160	miles
Mode of Transport		Truck	
Distance from Fabricator to Site		20	miles
Mode of Transport		Truck	
Quantity of Concrete		3703.7	yd^3
Quantity of Steel		199920	lb

PP Fiber Reinforced Concrete Floor Data		
Floor thickness	8	inches
Concrete Type	4,000 psi Concrete 15% FA	
Dosage	4.5	lb/yd^3
Distance from Pellet Plant to Extrusion Plant	2422	miles
Mode of Transport	Rail	
Distance from Extrusion Plant to Warehouse	1898	miles
Mode of Transport	Truck	
Distance from Warehouse to Batching Plant	658	miles
Mode of Transport	Truck	
Quantity of Concrete	3703.7	yd^3
PP Fiber Quantity	16667	lb

Carbon Footprint (CFP) Summary Including the Effects of Concrete

Click Here for Carbon Footprint Summary for Materials

Carbon Footprint (CFP) Comparison of TufStrand-SF Fiber Reinforced Concrete Floor with Steel Reinforced Floor includung Concrete

	PP FRC Floor	Steel RC Floor	
Floor Area	150000	150000	ft^2
CFP of Concrete Alone	908534	908534	kg of CO_2 eq
TufStrand-SF Fiber or Reinforcement Alone	20543	45054	kg of CO_2 eq
CFP of Concrete with Fiber or Reinforcement	929077	953588	kg of CO2 eq
Carbon Footprint per Square Foot Area	6.19	6.36	kg of CO_2 eq/ft^2
Percent Increase due to Fiber or Steel Rebar	2.21%	4.72%	
Carbon Footprint Savings for the Floor	24511		kg of CO_2 eq
Carbon Footprint Savings for the Floor	2.6%		

Carbon Footprint Savings from TufStrand-SF Fiber Reinforced Concrete Floor for the Project

Carbon Footprint Direct Comparison Between TufStrand-SF Fiber and Steel Reinforcing Bars

Total Savings of CO_2 eq for the Project	24511	kg CO_2 eq total
Percent Savings of CO_2 eq for the Project by Using TufStrand-SF	54.4%	Relative to Steel Reinforcement

Disclaimer: To be inserted

Concrete Floor Surface (Topical) Treatments

- To achieve strength targets
- To increase abrasion resistance
- To increase chemical resistance
- To provide water repellency

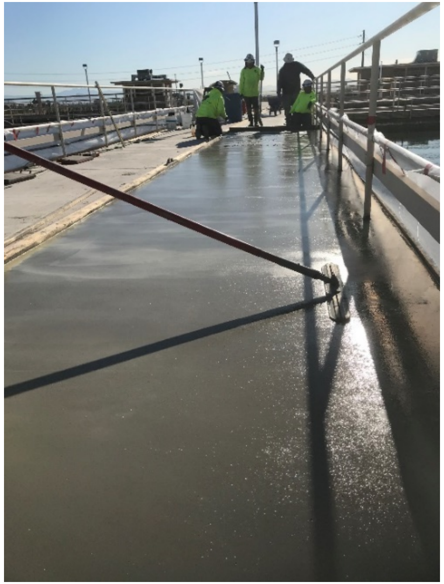
To improve durability & service life

Note: the choice of products & technologies depends on specific applications & exposure conditions!

Curing, Sealing, Coating

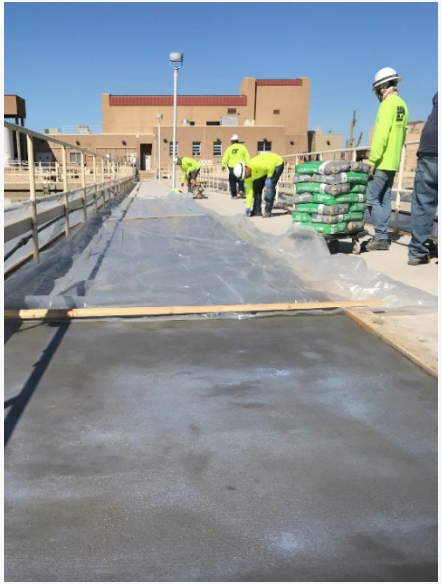
Concrete Curing

Wet Curing:
Water Ponding, Sprinkling



Curing by Covering:
Plastic, Blankets, Burlap, Paper

Curing Compounds:
Cure, Cure & Seal



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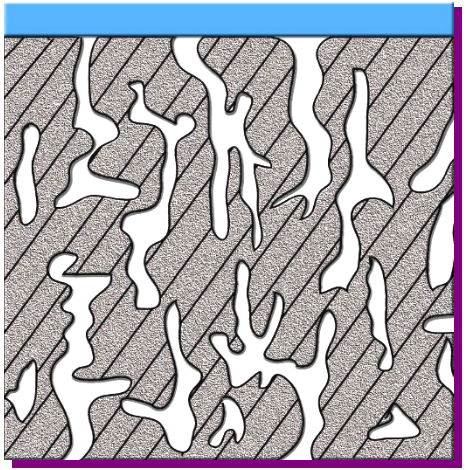
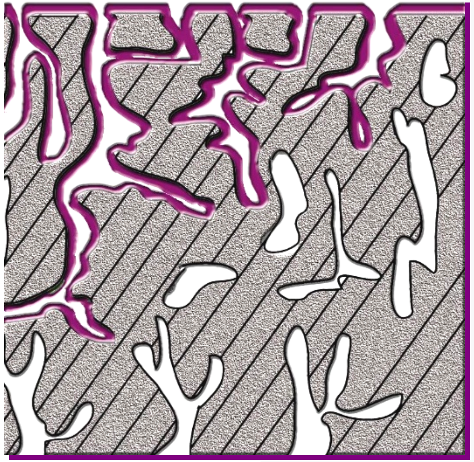
Concrete Sealing

Surface Sealer



- acrylic
- silicone

Penetrating Sealer



- silane
- siloxane
- silicate
- siliconate

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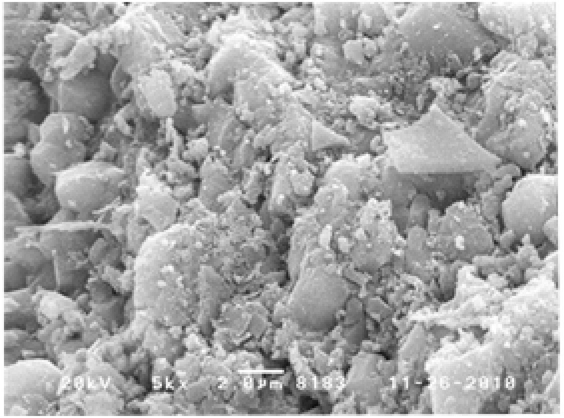
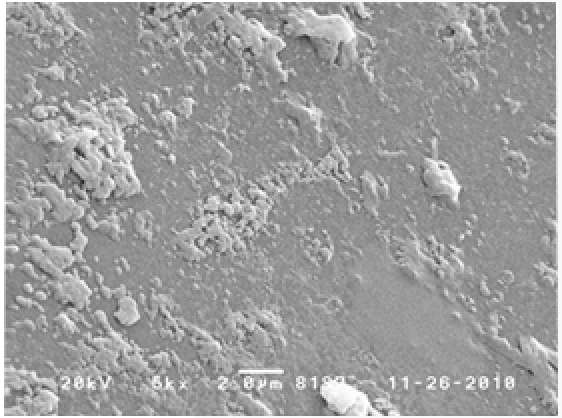
Closer Inspection

Scanning electron microscope images, 5000x magnification



Untreated concrete surface



Treated with silicate

$$\text{Silicate} + Ca(OH)_2 \longrightarrow \text{CSH}$$

Calcium Hydroxide

Calcium Silicate Hydrate

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The Little Things

CURING & SEALING CONCRETE
PRODUCT ADVANTAGES

CURING COMPOUNDS	ADVANTAGES
KUREZ DR VOX Dissipating curing compound	• Dissipates over time with exposure to UV light and traffic
KUREZ DR-100 Low VOC dissipating curing compound	• Less than 100 g/L VOC content
KUREZ VOX WHITE PIGMENTED Light reflective curing compound	• Efficient curing • Keeps concrete cool
KUREZ W VOX General purpose, low VOC	• Low odor • Economical curing option for concrete pavement

SOLVENT BASED CURING AND SEALING COMPOUNDS	ADVANTAGES
SUPER DIAMOND CLEAR High solids, non-yellowing acrylic blend	• Highest performance non-yellowing cure and seal • Excellent for architectural concrete • Good for re-sealing
EVERCLEAR Breathable, 100% acrylic	• Excellent sealer for decorative concrete • Non-yellowing • Enhances color and texture
DIAMOND CLEAR Non-yellowing acrylic blend, low viscosity	• Non-yellowing • Excellent for initial curing and sealing of concrete
LUSTER SEAL 300 Pure acrylic sealer	• Non-yellowing
SUPER REZ-SEAL High solids acrylic polymer blend	• High viscosity formulation provides greater coverage • Excellent curing, durable seal
REZ-SEAL Acrylic co-polymer, low viscosity	• Good initial cure • Seals surface to dustproof and protect
BROWNTONE CS Pigmented cure & seal for exposed aggregate concrete	• Highlights tone of exposed aggregate concrete surfaces • Excellent seal for exposed aggregate precast panels

LOW VOC, EXEMPT SOLVENT BASED CURING AND SEALING COMPOUNDS	ADVANTAGES
EVERCLEAR 350 Exempt solvent, pure acrylic cure & seal	• Low VOC • Enhances decorative concrete • Non-yellowing, breathable formula
SUPER DIAMOND CLEAR 350 Exempt solvent, cure & seal	• Low VOC • Non-yellowing
DIAMOND CLEAR 350 Low solids, non-yellowing	• Cures new concrete • Easy to apply
LUSTER SEAL 350 Exempt solvent, pure acrylic cure & seal	• Low VOC • Non-yellowing • Quick dry time is helpful in cool weather
BROWNTONE CS 350 Pigmented cure & seal for exposed aggregate concrete	• Enhances color • Provides a glossy appearance

WATER BASED CURING AND SEALING COMPOUNDS	ADVANTAGES
EVERCLEAR VOX Pure acrylic, low VOC cure & seal	• VOC compliant nationwide • Blush resistant
DIAMOND CLEAR VOX Non-yellowing acrylic polymer blend	• Non-yellowing
SUPER DIAMOND CLEAR VOX Non-yellowing, high solids	• High solids, best curing and gloss • Non-yellowing
AQUA-CURE VOX Low odor cure & seal	• Good for interior use
SUPER AQUA-CURE VOX High solids, low odor	• High solids formula
EUCOCURE VOX Acrylic co-polymer cure & seal	• Economical • Good initial cure & protection
BROWNTONE VOX Brown pigmented cure & seal	• Low VOC • Highlights color

LIQUID DENSIFIERS	ADVANTAGES
EUCO DIAMOND HARD Silicate/siliconate densifier & sealer	• Improves surface durability • Dustproofs and seals • Reduces tire marking
ULTRASIL LI+ Lithium silicate densifier	• Seals and densifies floors • Easy to apply
EUCOSIL Sodium silicate densifier	• Densifies and dustproofs • Economical
SURFHARD Fluorosilicate remedial dustproofer	• Improves surface durability of dusting floors

PENETRATING SEALERS	ADVANTAGES
BARACADE SILANE 100 100% silane	• Highest performance • Prevents damage from water and chlorides • Low VOC formulation
BARACADE SILANE 40 Solvent based silane	• Deep penetrating formulation • Excellent water and chloride barrier • Available in an IPA formulation
BARACADE WB 244 High performance water based silane/siloxane blend	• Water and salt repellent for concrete pavement and floors • Low VOC, low odor • Meets NCHRP 244 standards
CHEMSTOP WB REGULAR, HEAVY DUTY Water based silane/siloxane	• Low VOC water and salt repellents • Two formulations for customized performance
EUCO-GUARD 100 Solvent based siloxane	• Water and salt repellent for concrete pavement
EUCO-GUARD 350 Low-VOC solvent based siloxane	• Water and salt repellent for concrete and masonry
WEATHER-GUARD Economical solvent based siloxane	• Water repellent especially suited for vertical concrete and masonry
BARACADE M.E. Concentrated siloxane water repellent	• Dilute with water on the jobsite • Customizable for specific applications

FILM-FORMING SEALERS	ADVANTAGES
EUCO #512 VOX EPOXY SEALER Water based epoxy sealer	• Low VOC, low odor • Provides chemical resistance
DURAL 50 LM Low viscosity epoxy sealer	• Heals hairline cracks; seals surfaces • 100% solids formula
DURAL 335 Low viscosity epoxy crack healer-sealer	• 100% solids formula • Seals surfaces; heals hairline cracks

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Conclusions

Concrete can be green too.

Sustainable Construction Practices

- Use good concrete mixing and placement practices
- Optimized mix designs
- Use of alternative reinforcing materials
- Jobsite activities and post placement construction work

Questions / Comments?

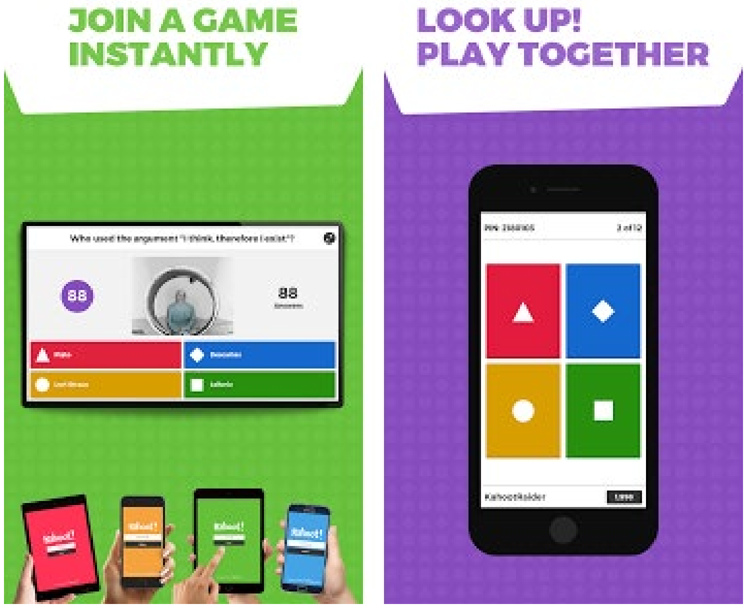
Thank you for attention

Concrete Ontario Pop Quiz

Please use your smart phone to access the following website:

www.kahoot.it

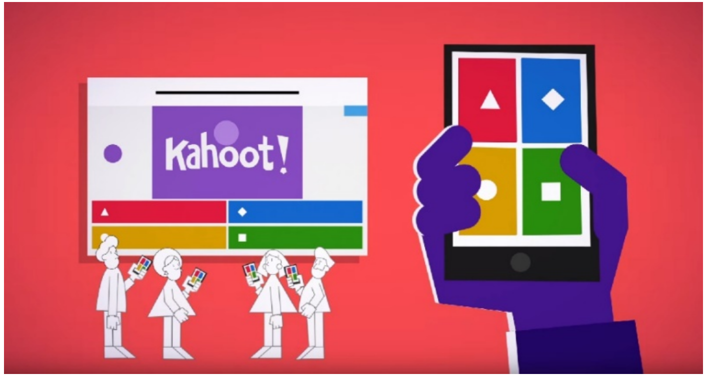
- Please enter the Game **“Pin”** that will be shown on the screen shortly
- Enter both your email address (so we can send you a prize if you finish in the top three) and your “**Nick Name**” (please think of your **HR** department and don’t use something you will regret!)
- The faster you answer each question the more points you can earn for correct answers



Concrete Ontario Pop Quiz

Amazon Gift Cards for Today's Competition

- First Place = $150
- Second Place = $100
- Third Place = $50



Next Webinar

- **May 13th, 2021** at 10:00 am – 11:00 am
- **BMH Systems** will be presenting on high-performance concrete batch plants

BMH SYSTEMS

Thank you!