Concrete 101- The Basics of Concrete

Opening Comments

- Anti-Trust Statement
- Recording this webinar
- IRMCA website www.irmca.org

EUCLID CHEMICAL

CTLGROUP

Swederski Concrete Construction Inc.

ST MARYS

KIENSTRA

Buzzi Unicem USA

Sika

POINT READY MIX
SAFETY QUALITY SERVICE

CARBON CURE

ILLINOIS CEMENT COMPANY

GLCPC
WI MI IL IN OH

MASTER® BUILDERS SOLUTIONS

OZINGA

CONTINENTAL CEMENT
Consistent Quality
Superior Service
Great Experience

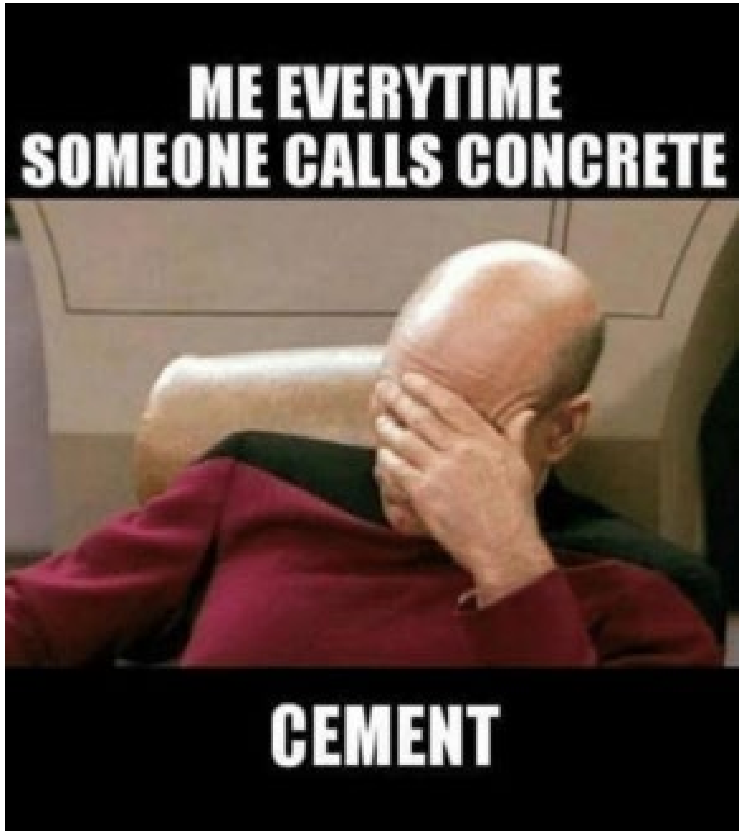
FIBERFORCE
abcpolymer

XYPEX

PRAIRIE MATERIAL

Today’s Presenter

- Theron Tobolski The Assistant Executive Director of The Illinois Ready Mixed Concrete Association


ME EVERYTIME
SOMEONE CALLS CONCRETE
CEMENT


7482
7482

First Things First!!!!

ACI – American Concrete Institute
ASTM -American Society for Testing and Materials
AASHTO - American Association of State Highway and Transportation Officials
FHWA – Federal Highway Administration
FAA- Federal Aviation Administration

These Agencies Make Rules, Standards, Guidelines, and Certifications for the Industry so that Concrete is Designed, Produced, Tested, and Placed Properly

Read Them – Learn Them – Preach Them – Practice Them

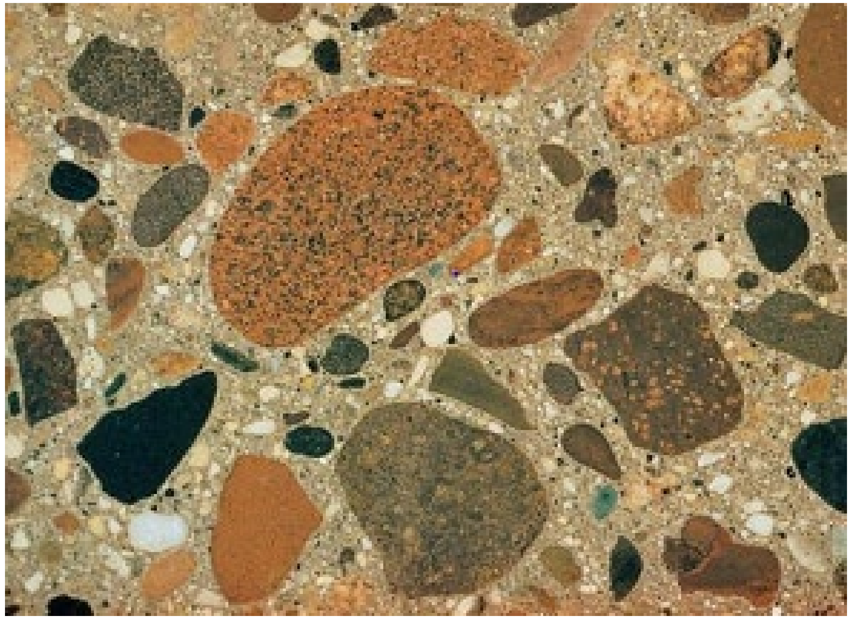
Where Do We Supply Concrete To?

IDOT – Illinois Department of Transportation
Municipal Work
County Work
CDOT - Chicago Department of Transportation
The Tollway Authority
Airports

Modify and Enforce
Follow and Enforce

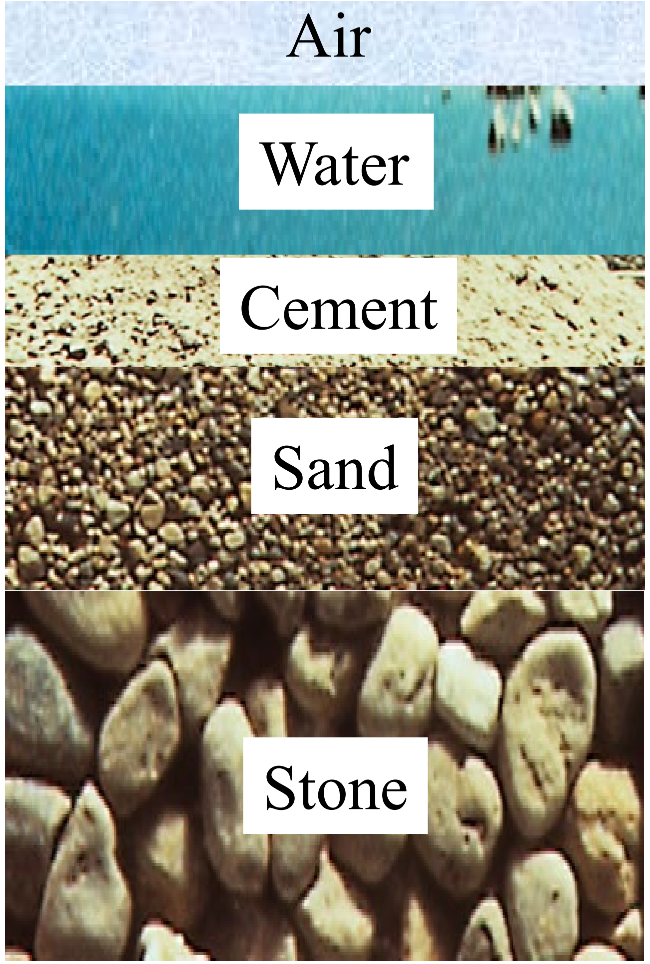
Residential Work
Commercial /Industrial
Healthcare and Schools
High-Rise Buildings

What is Concrete?



- Concrete is essentially a mixture of two ingredients – aggregates and paste
- The paste is made up of cementitious materials such as portland cement, fly ash, slag, portland limestone cement, silica fume, etc., plus water
- The paste binds the aggregates, forming a rock-like mass after hardening
- The various components can be adjusted to achieve differing concrete properties

A Typical Cubic Yard of Concrete



Weight

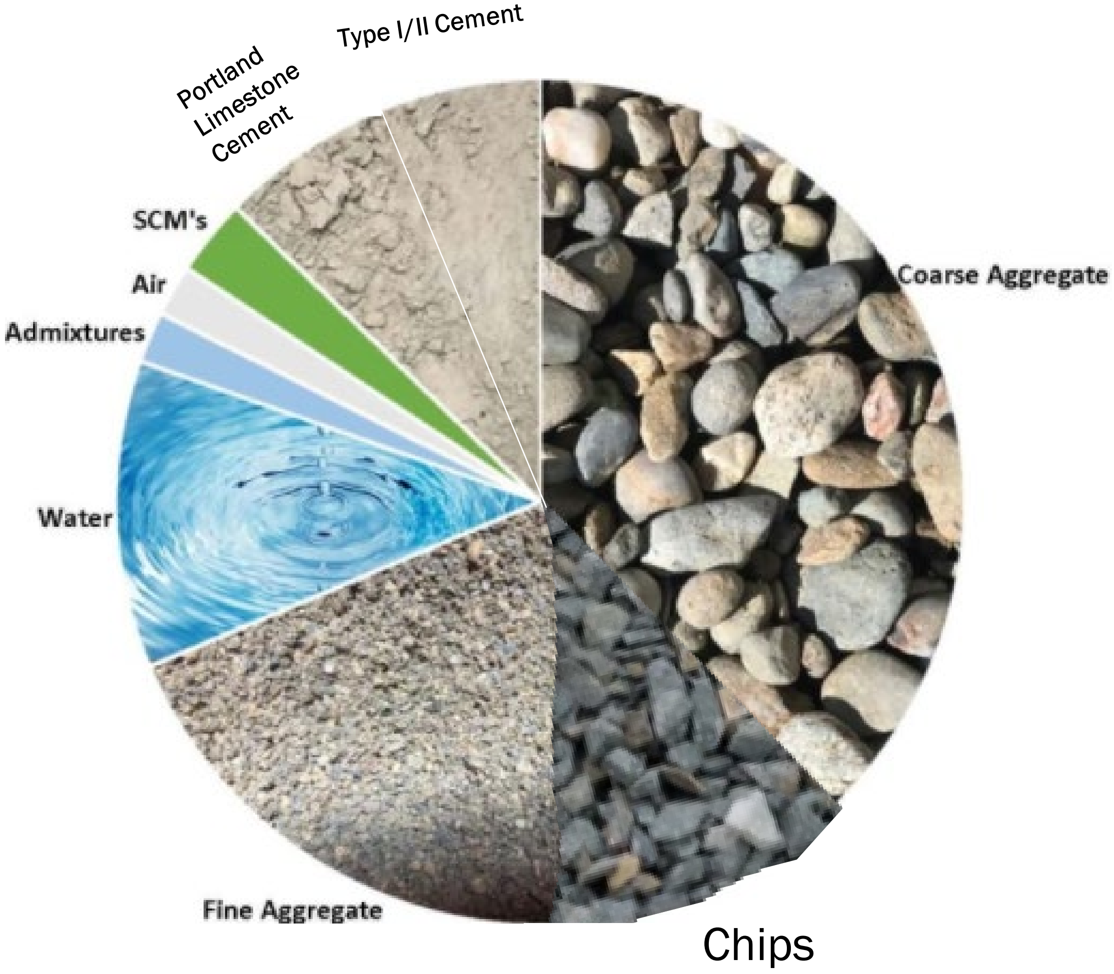
--

300 lb.

564 lb.

1200 lb.

1800 lb



Types of Portland Cement

- ASTM C150/AASHTO M 85
  - Type I – Normal Use
  - Type II – Moderate Sulfate Resistance
  - Type III – High Early Strength
  - Type IV – Low Heat of Hydration
  - Type V – High Sulfate Resistance

Various Cement Types

ASTM C595 – Blended Hydraulic Cements

- Type 1L – Portland-Limestone Cement (a.k.a PLC, similar to GUL in Canada)
- Types included in ASTM C595 standard (which is nearly identical to **AASHTO M240**):
  - IS (x) – Portland blast-furnace slag
  - IP (x) – Portland-pozzolan cement (e.g. ash)
  - **IL (x) – Portland-limestone cement**
  - IT (Ax)(By) –Ternary blended cement
    - (x) indicates nominal mass percentage of the added ingredient
- Type IL is limited to a maximum of 15% (per ASTM 595)

Portland-Limestone Cement (PLC)

- Same durability
- Same resilience
- 10% carbon footprint reduction
    - PLC gives specifiers, architects, engineers, producers, and designers a greener way to execute any structure, paving, or geotech project, with virtually no modifications to mix design or placing procedures.
- www.greenercement.org

Illinois Department of Transportation

Illinois Tollway

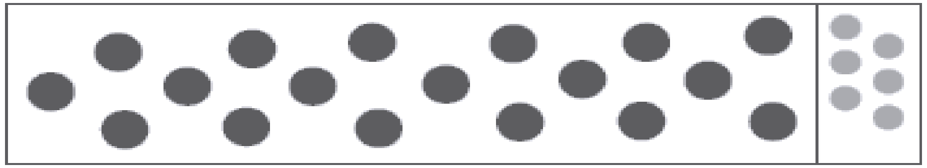
How is Portland Limestone Cement Different From Type I/II Portland Cement?

- PLC is made by intergrading regular clinker with up to 15% limestone while regular portland cement contains up to 5% limestone
- PLC is a finer ground product than regular portland cement

PORTLAND CEMENT ASTM C 150

95%
Ground Clinker

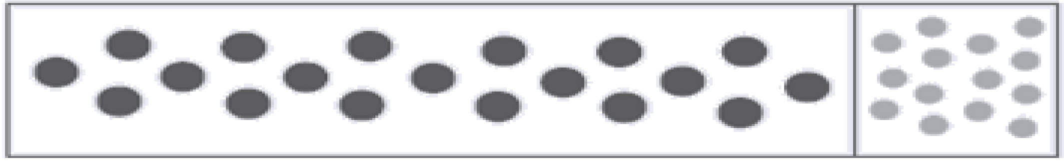
5%
limestone



PLC ASTM C 595

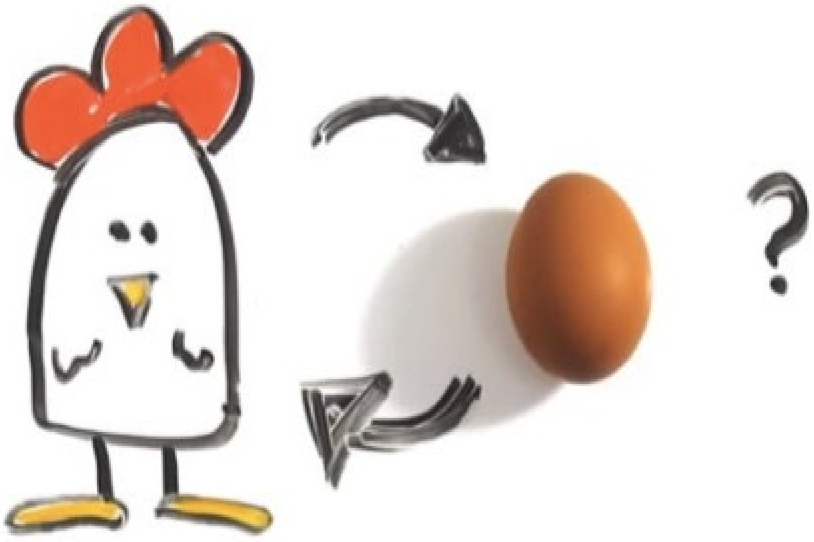
85%
Ground Clinker

15%
limestone



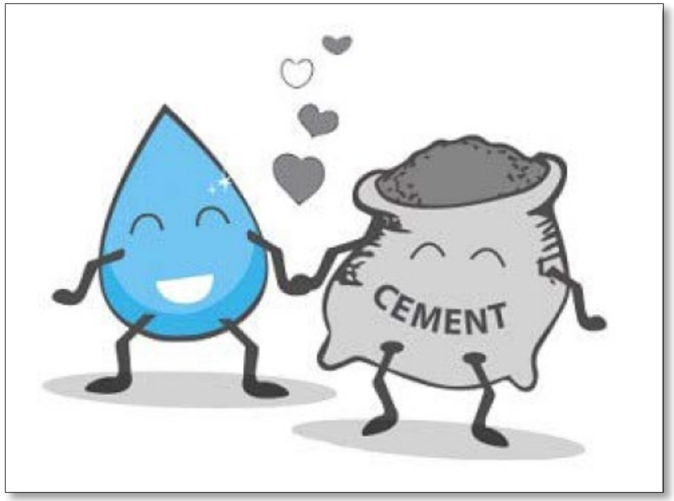
Why are concrete produces still using Type I/II Cement instead of using Portland Limestone Cement?

- Specifications/Silo Space/Availability

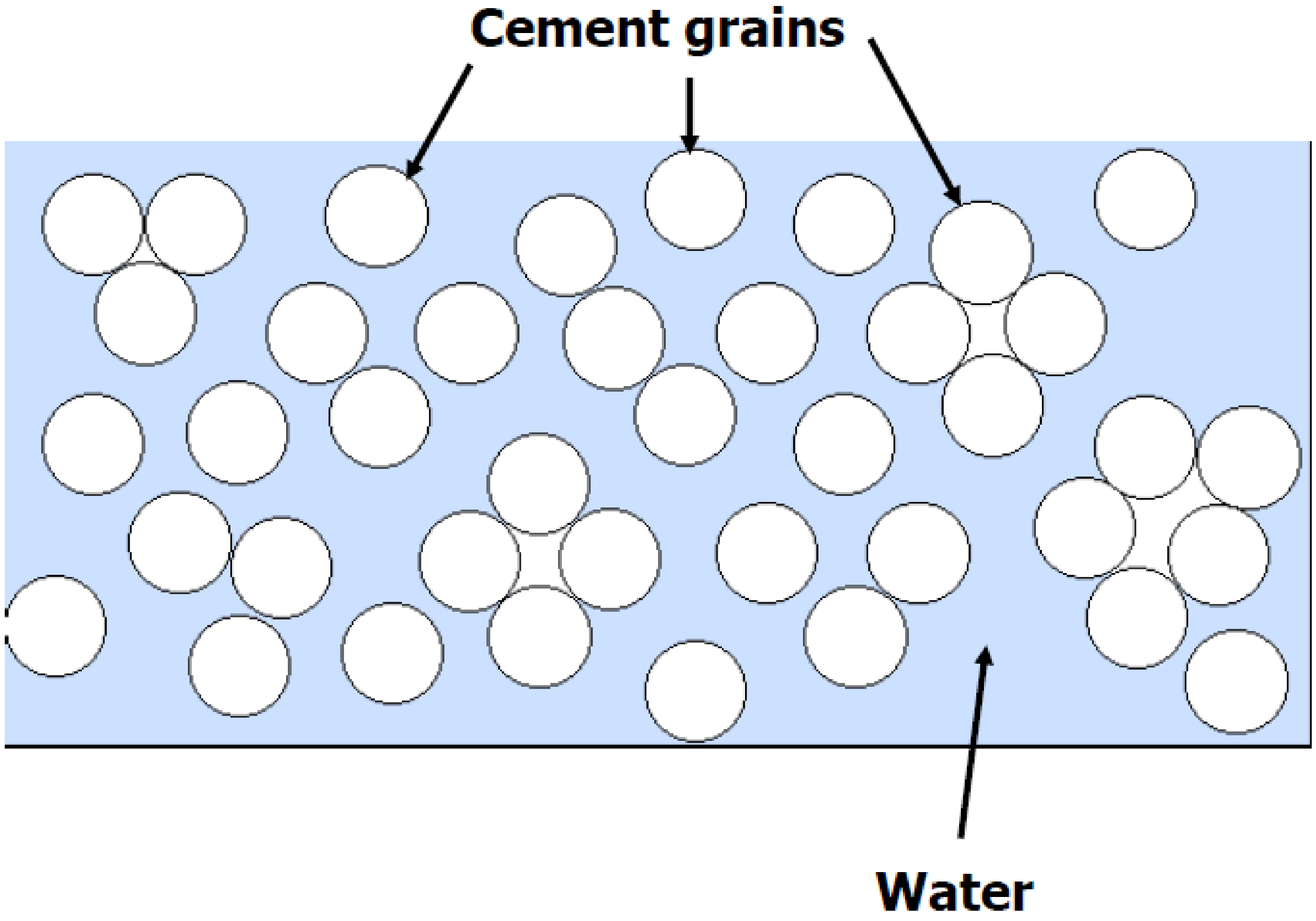


Water/Cementitious Ratio (w/cm)

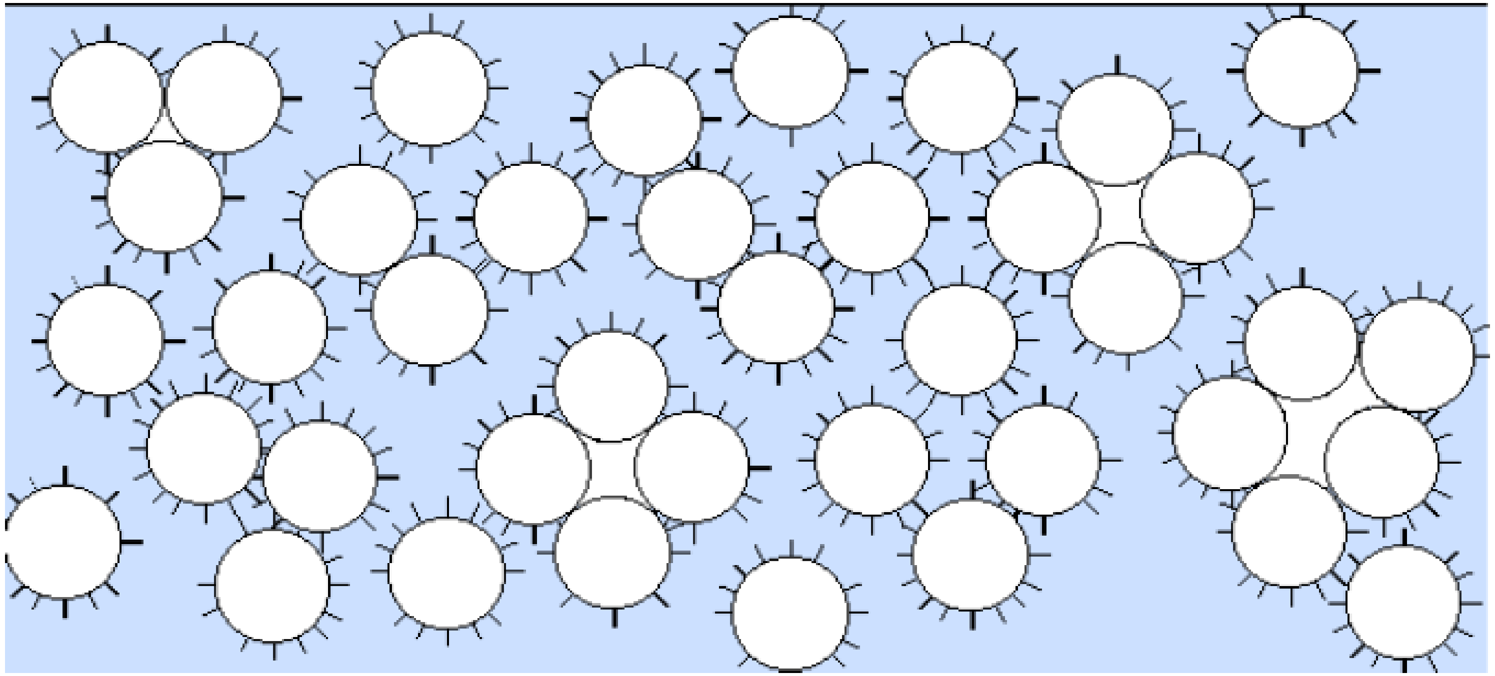
- Weight of water divided by weight of cementitious material in the mix (portland cement, fly ash, GGBFS, etc.)
- 275 lbs. of water (33 gallons x 8.33) ÷ 564 lbs. of cement = .49 w/c
- Minimum 0.23 w/cm ratio required for full hydration
- Excess water increases pore space between crystals resulting in weaker and more porous concrete



IRMCA

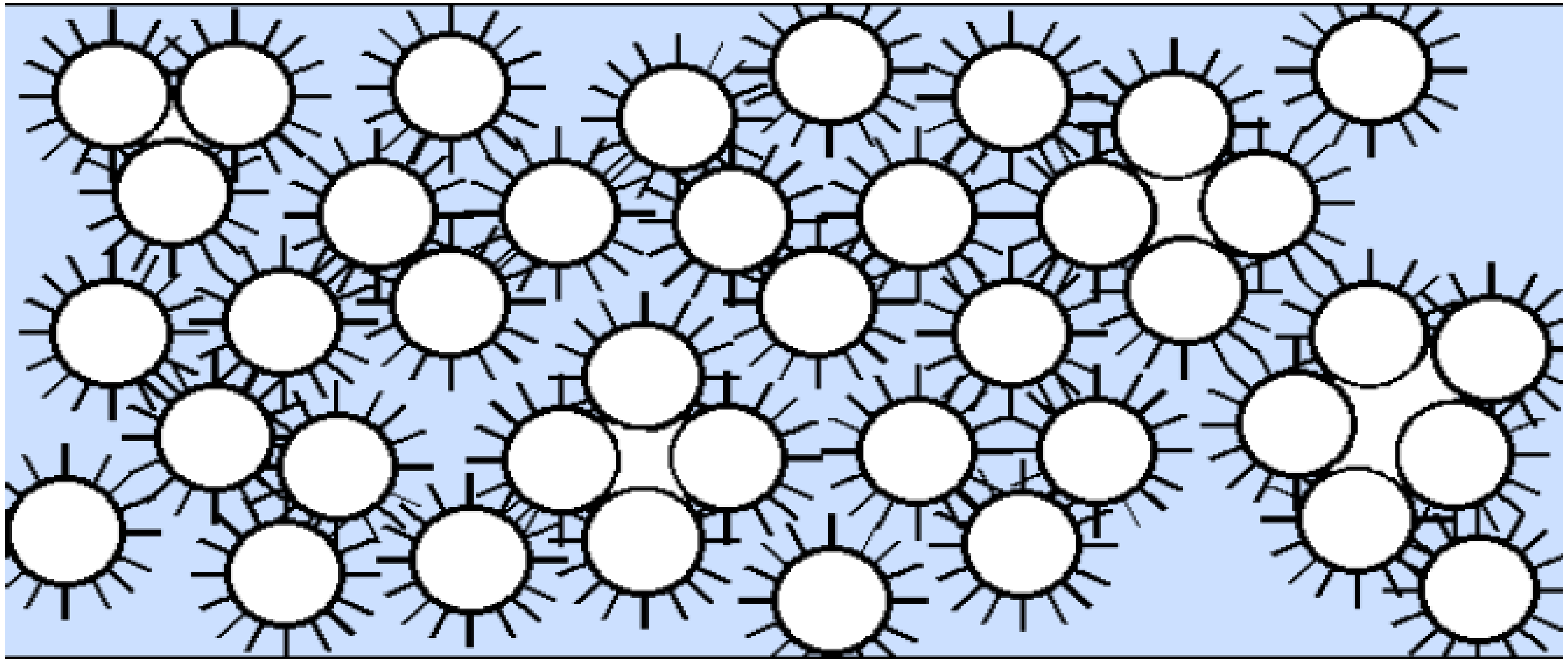

Cement grains
Water

As the cement grains chemically react with water...



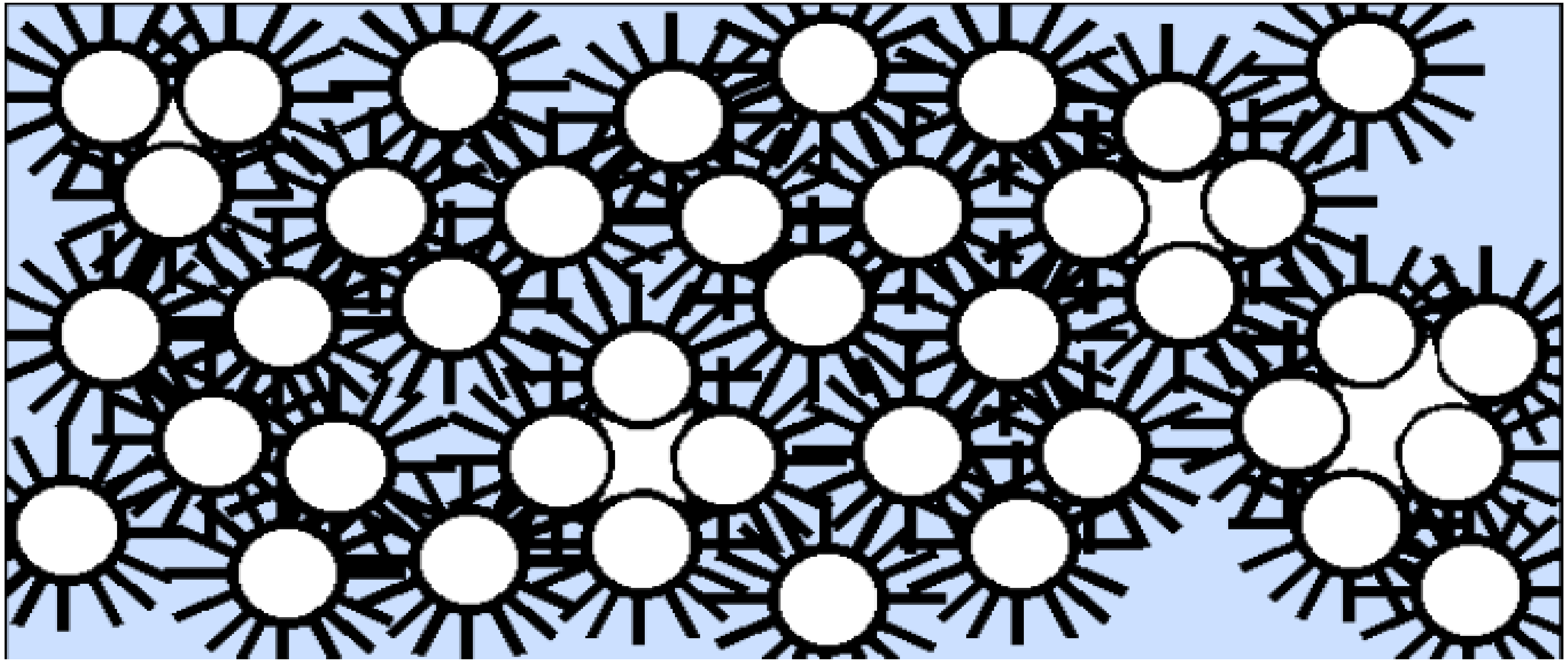
...fuzzy, "finger-like" crystals reach out to each other

These fingers start to lock together...



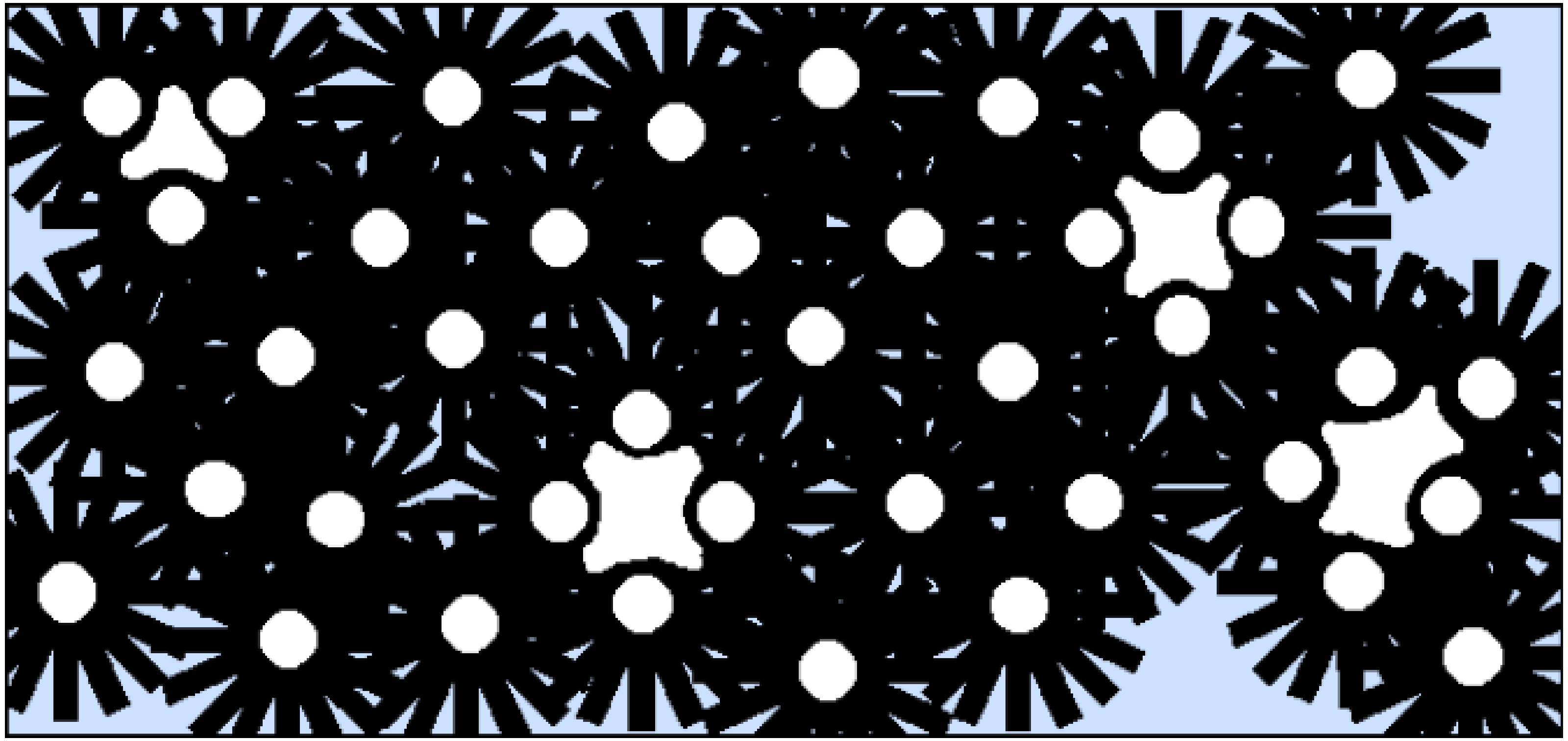
...and grab onto sand and gravel particles as well

Eventually, these crystals get so intertwined that the concrete stiffens...



...this is what we call "setting."

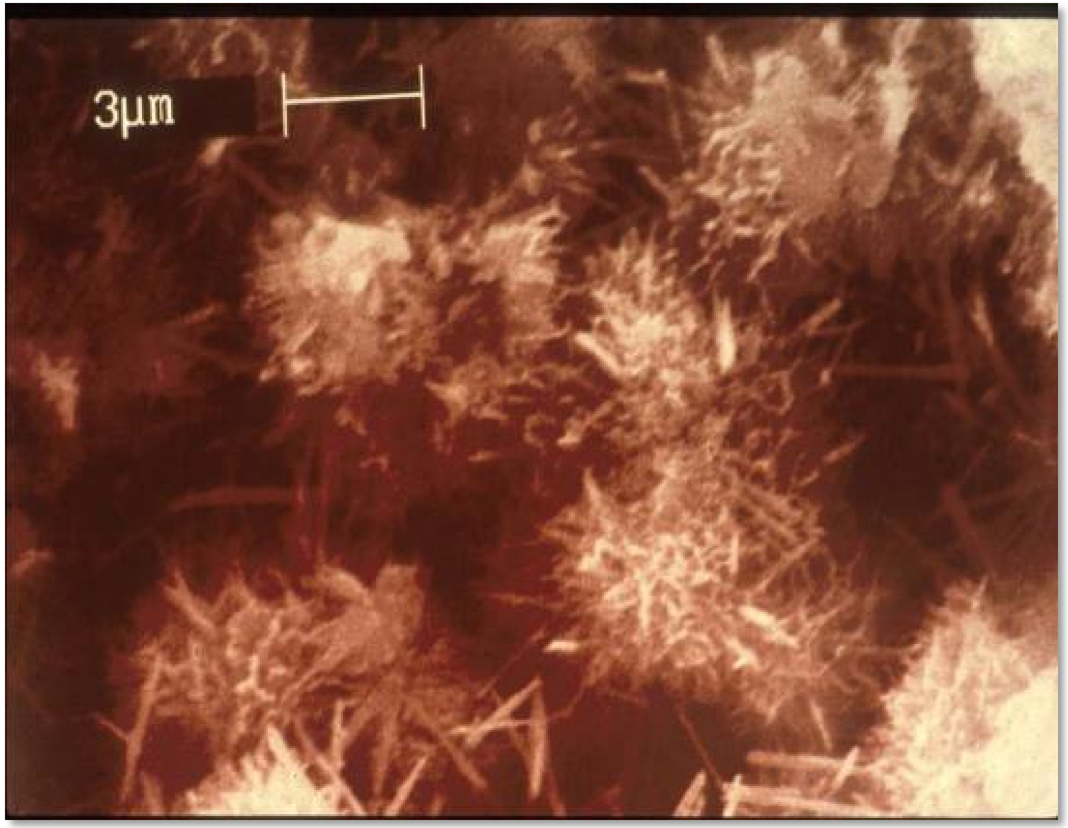
As the water and cement are used up, the crystals form a hard, dense structure



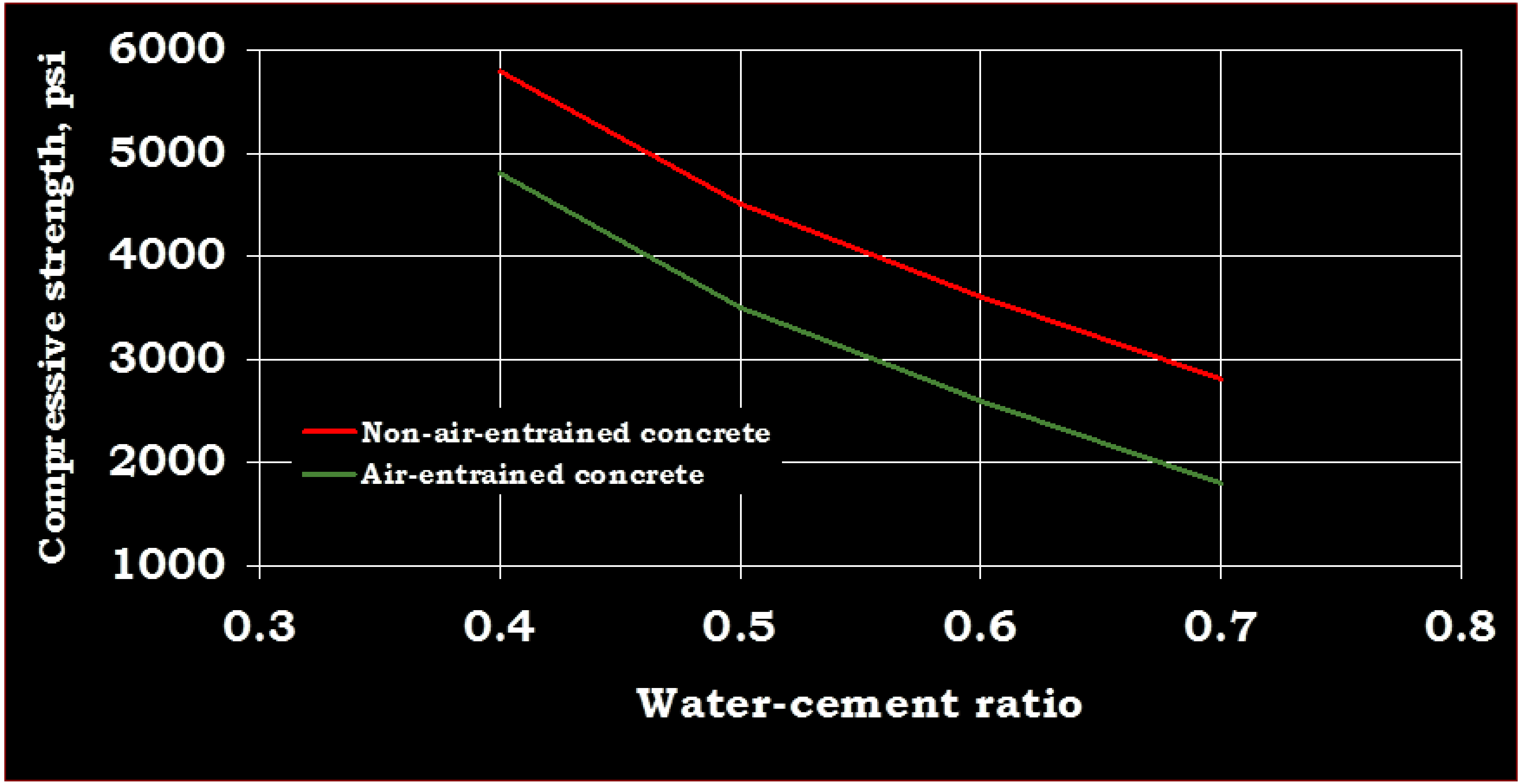
...water that isn't used in the chemical reaction evaporates, leaving spaces and channels in the concrete

Portland Cement Hydration

- Water contacts cement grains
- Chemical reaction is called hydration
- Hydration is exothermic (gives off heat)
- Small needlelike crystals begin to form and interlock



Effect of Water Content On Compressive Strength



Adding One Gallon of Water

- Increase the slump about one inch
- Cut the compressive strength about 200 psi
- Waste the effect of 1/4 sack of cement
- Increase the shrinkage potential about 10%
- Decrease the Freeze thaw resistance about 20 %
- Decrease the resistance to de-icing salts
- Increase cracking about 10%
- Increase air content about 1 %
- Increase segregation
- Increase dusting
- Increase finishing time for your expensive labor

Supplementary Cementitious Materials

- Fly ash
- Slag
- Natural pozzolans
- Silica fume

ACI 301 Specification For Structural Concrete

Limits for Supplementary Cementitious Materials

Supplementary cementitious material	Maximum percent of total cementitious material by mass*
Fly ash or natural pozzolans conforming to ASTM C618	25
Slag cement conforming to ASTM C989/C989M	50
Silica fume conforming to ASTM C1240	10
Total of fly ash or natural pozzolans, slag cement, and silica fume	50†
Total of fly ash or natural pozzolans and silica fume	35†

*Total cementitious material also includes ASTM C150/C150M, C595/C595M, and C1157/C1157M cement. The maximum percentages above shall include:

(a) Fly ash or natural pozzolans present in ASTM C1157/C1157M or C595/C595M Type IP blended cement.

(b) Slag cement present in ASTM C1157/C1157M or C595/C595M Type IS blended cement.

(c) Silica fume conforming to ASTM C1240 present in ASTM C1157/C1157M or C595/C595M Type IP blended cement.

†Fly ash or natural pozzolans and silica fume shall constitute no more than 25 percent and 10 percent, respectively, of the total mass of the cementitious materials.

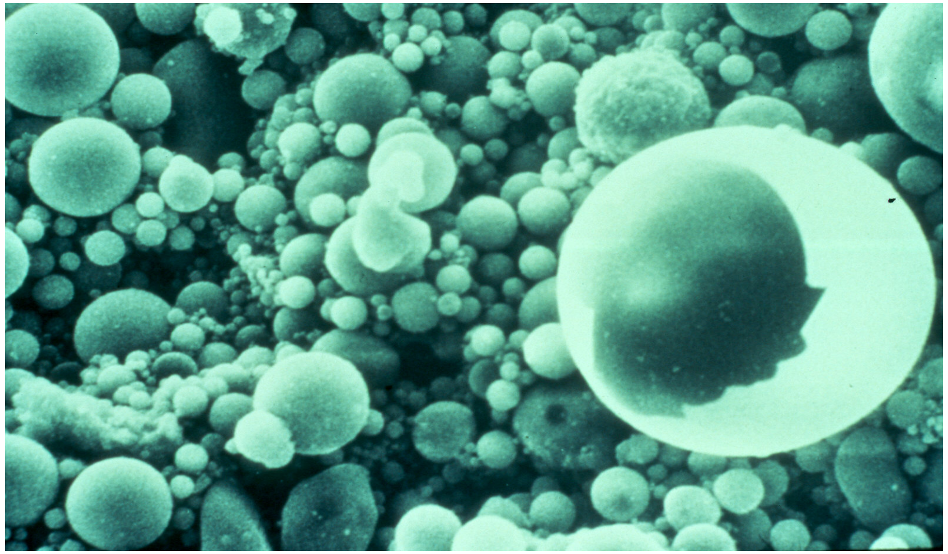
Fly Ash – ASTM C618

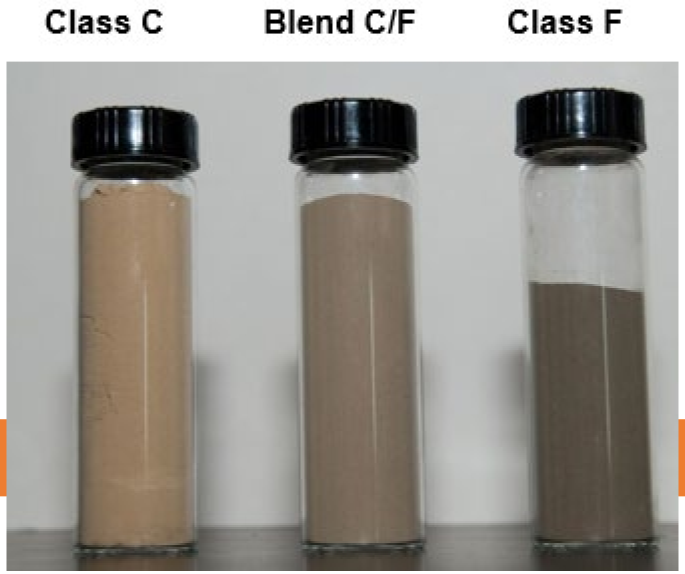
Supplementary Cementitious Material (SCM)

- Byproduct from burning coal in power generating plants
- Two main types – Class C and Class F

Advantages

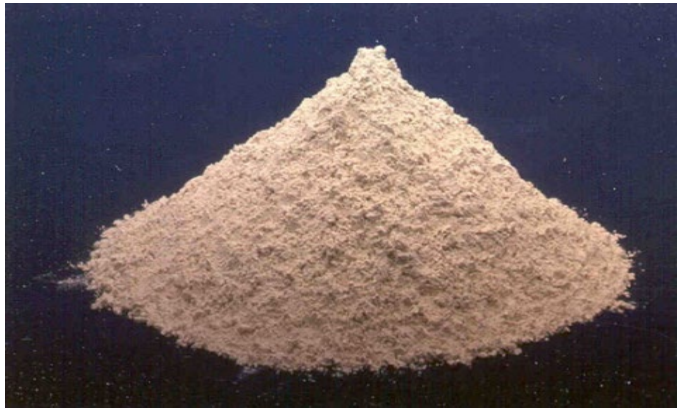
- Increased workability
- Reduced permeability
- Improved sulfate resistance
- Improved ASR mitigation





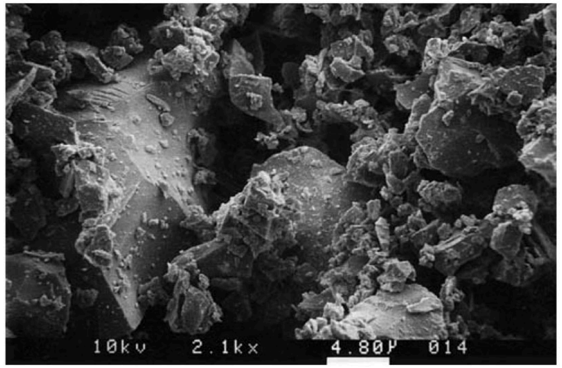
Typical Amounts of SCM in Concrete by Mass of Cementing Materials

- Fly ash
  - Class C 15% to 40%
  - Class F 15% to 20%
- Slag 30% to 80%



Caution should be taken when using over 35% replacement with SCMs for pavement exposed to Freeze Thaw conditions

Slag – ASTM C989



Supplementary cementitious material

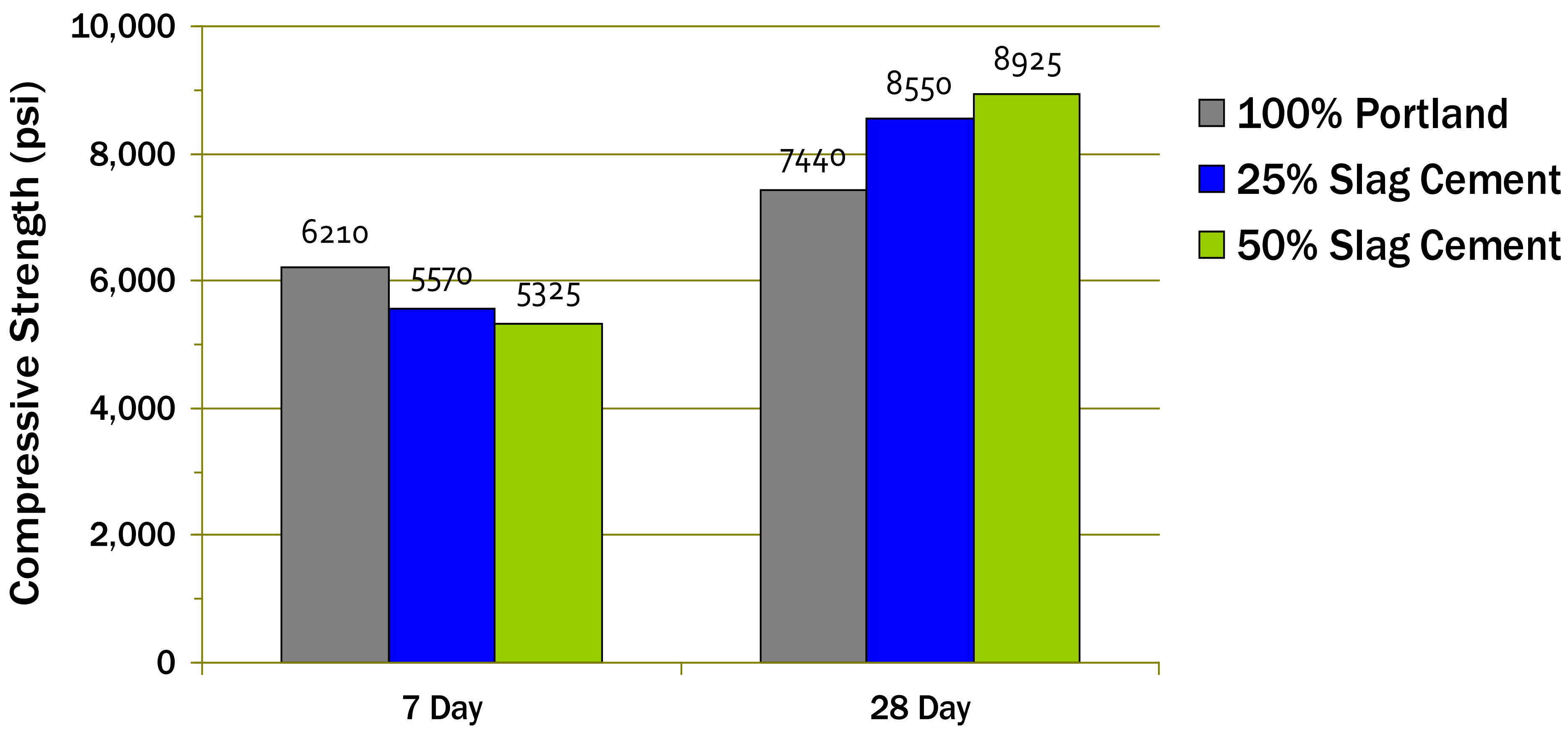
- Byproduct of iron and steel-making from a blast furnace
- Three types – Grades 80, 100, and 120

Advantages

- Increased workability
- Reduced permeability
- Improved sulfate resistance
- Improved ASR mitigation

Typical amounts in concrete mixes

- Direct replacement for portland cement up to 95 percent
- 40 to 50 percent replacement is most commonly used


10,000
8,000
6,000
4,000
2,000
0
Compressive Strength (psi)
6210
5570
5325
7440
8550
8925
7 Day
28 Day
100% Portland
25% Slag Cement
50% Slag Cement

4000 PSI with Air

Ingredients	Straight Cement	Binary	Binary	Tieranry
Cement	**564**	**420**	**420**	**390**
Fly Ash	0	0	**100**	**45**
Slag	0	100	0	**90**
Water	33	31	31	31
Stone	1800	1800	1800	1800
Sand	1275	1275	1275	1275
Air	1.0 oz	1.0 oz	1.0 oz	1.0 oz
Water Reducer	0	3.5 oz	3.5 oz	3.5 oz

Reduced Permeability

What is permeability?

- Measure of how easy it is for water and other substances such as chloride ions, sulfates to enter concrete
- Commonly measured by ASTM C1202 – rapid chloride permeability
- Low permeability concrete can reduce corrosion potential of embedded reinforcing steel

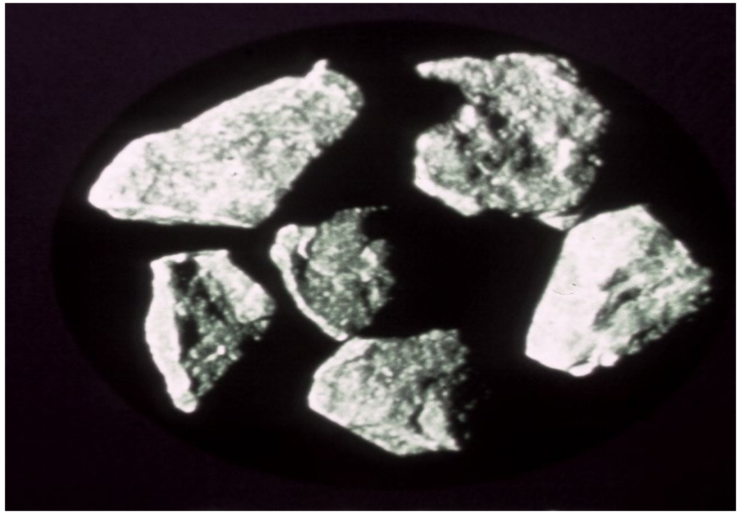
How does slag cement affect permeability?

- Low permeability can be achieved, in binary or ternary mixtures, with **25 to 65%** slag cement substitution

Impacts of Fly Ash and Slag in Concrete

- Higher over all strengths
- Reduces environmental impact of concrete
- Lower early strength
- Slower Set Time. Great for Summer not recommended in Winter
- Slows down the heat of hydration. Good for Mass Concrete
- Has lower permeability so less salts and chemicals can enter the concrete and cause harm
- Reduces the water demand. *****The lower the water demand the higher the strength.
- **Slows down the Bleeding process. BE CAREFUL!!! Do not finish the concrete until it is done bleeding. Early finishing of concrete will cause Scaling, Delamination, or Mortar Flaking.**

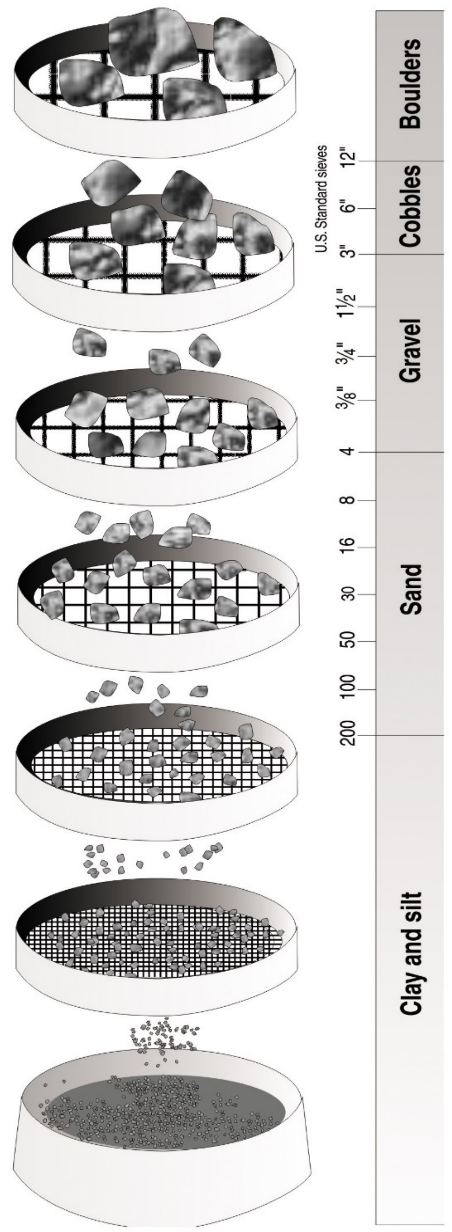
Needs to be Properly CURED 7 DAYS!!!!!!! To get full benefit. If not cured properly you can increase your potential to see Scaling



Concrete Aggregates

IRMCA

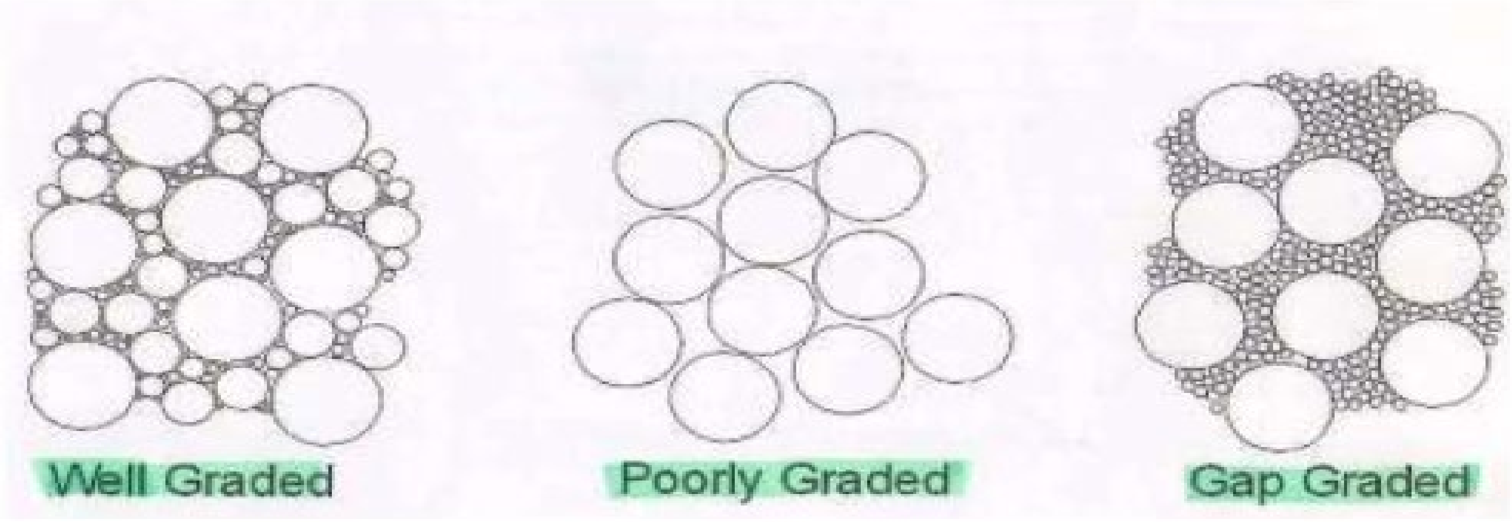
SIEVE ANALYSIS



Sieve	Ind. Weight Retained	Cum. Weight Retained	Cum. % Retained	Ind. % Retained	% Passing	Specification IDOT 022CM1101 Passing Range: Lower Limit	Upper Limit
3"							
2.5"							
2"							
1.75"							
1.5"							
1"	0.0	0.0	0.0%	0.0%	100.0%	100%	100%
3/4"	405.0	405.0	7.5%	7.5%	92.5%	84%	100%
5/8"	763.0	1168.0	21.6%	14.1%	78.4%		
1/2"	1312.0	2480.0	46.0%	24.3%	54.0%	42%	58%
3/8"	1115.0	3595.0	66.6%	20.7%	33.4%		
1/4"	1168.0	4763.0	88.3%	21.6%	11.7%		
#4	396.0	5159.0	95.6%	7.3%	4.4%	0%	12%
#8	172.0	5331.0	98.8%	3.2%	1.2%		
#10							
#16	20.0	5351.0	99.1%	0.4%	0.9%	0%	6%
#30							
#40	0.0	5351.0	99.1%	0.0%	0.9%		
#50							
#80							
#100							
#200	14.0	5365.0	99.4%	0.3%	0.6%	0%	1.0%
Pan	3.0	5368.0	99.5%	0.1%	0.5%		
	5368.0			100.0%		Test Result = Pass	

Gradations

Gradation is a size distribution of aggregate particles by separation with standard screen sieves



A change in gradation can change:

The ability to entrain air, strength, durability, rate at which concrete bleeds, and workability/finishability

Gap Graded Aggregates

- Segregates more easily
- Difficult to place
- Higher amount of fines
- Requires more cement
- Greater water demand

Well Graded Aggregates

- Less prone to segregation
- Easier to place
- Lower amount of fines
- Require less cement
- Less water demand

Chemical Admixtures

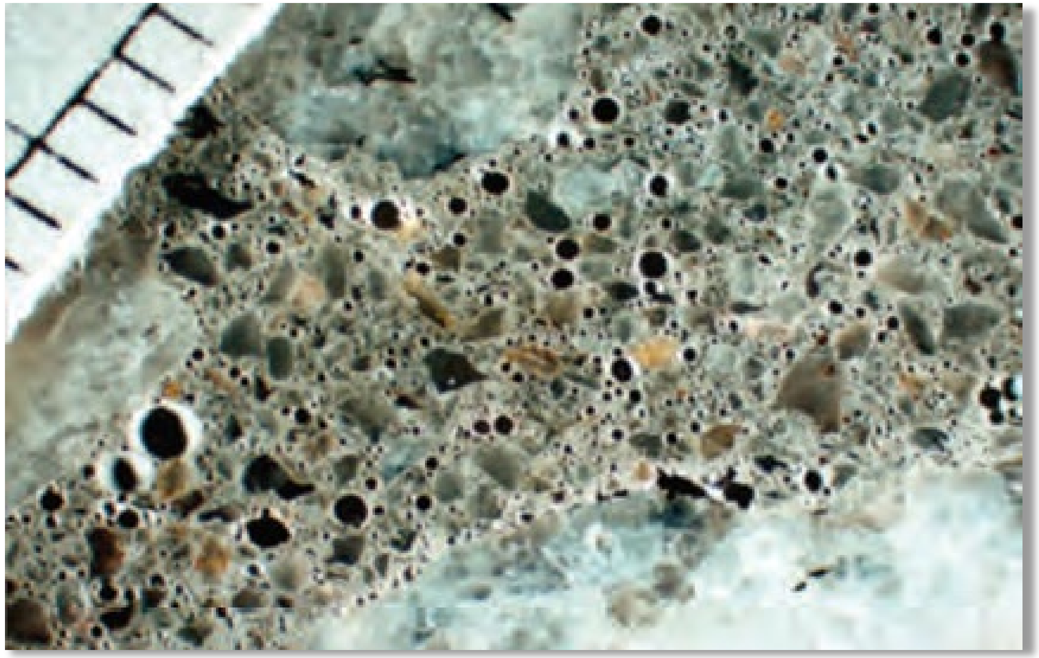
- Air Entraining
- Water Reducers
- Super Plasticizers
- Hydration Stabilizers
- Waterproofing
- Corrosion Inhibitors
- Shrinkage Reduction
- Color Pigments

Concrete Admixtures ASTM C494/C260

- Type A Water Reducing
- Type B Retarding
- Type C Accelerating
- Type D Water Reducing and Retarding
- Type E Water Reducing and Accelerating
- Type F Water Reducing, high range
- Type G Water reducing, high range, and retarding
- Type S Specific Performance
- ASTM C260 Air Entrainment

Air Entraining Admixtures

- Primary purpose is to stabilize and entrain millions of tiny bubbles to improve concrete's freeze/thaw durability
- Improves workability
- Reduces strength
- Minimizes segregation
- Inexpensive



What affects air at the plant?

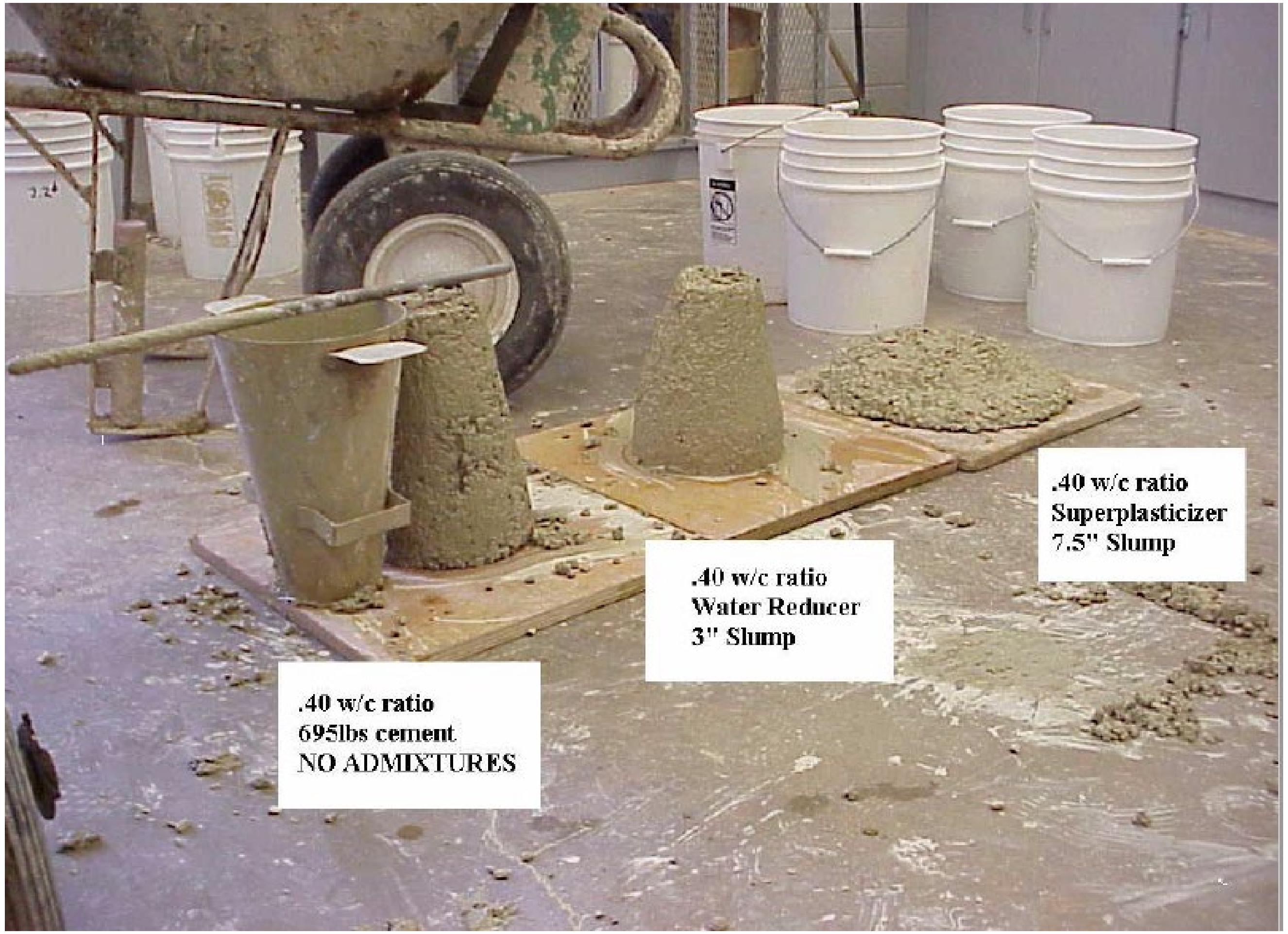
- ✓ Cement content – increase in content lowers air
- ✓ Increase in alkali raises air
- ✓ Fly ash carbon content lowers air- carbon absorbs air
- ✓ GGBFS increased fineness may lower air
- ✓ As MR dosage goes up less AEA is needed
- ✓ New HRWRs low dose less- SCC more is needed
- ✓ Increase in SAND content can raise air
- ✓ Air increases with increased W/C ratio
- ✓ Hot water/ high temps- cold water/ low temps

What affects air at the job site

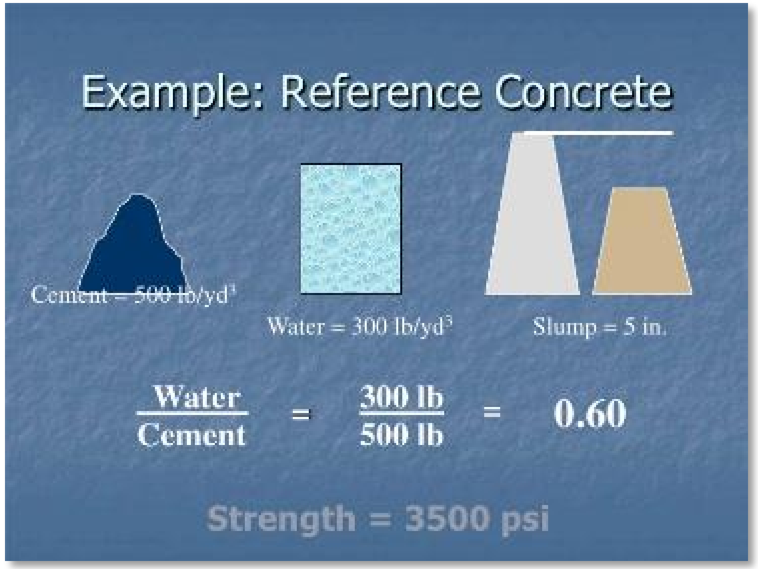
- ✓Slump loss
- ✓Retempering
- ✓Length of time on truck
- ✓Jobsite addition of admixtures
- ✓Addition of pigments or color
- ✓Fibers
- ✓Improper testing
- ✓Pumping

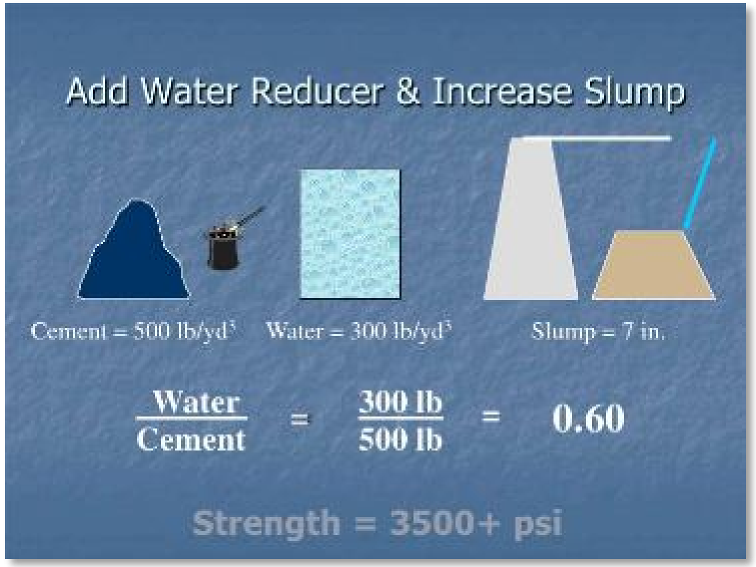
Water Reducing Admixtures – ASTM C494

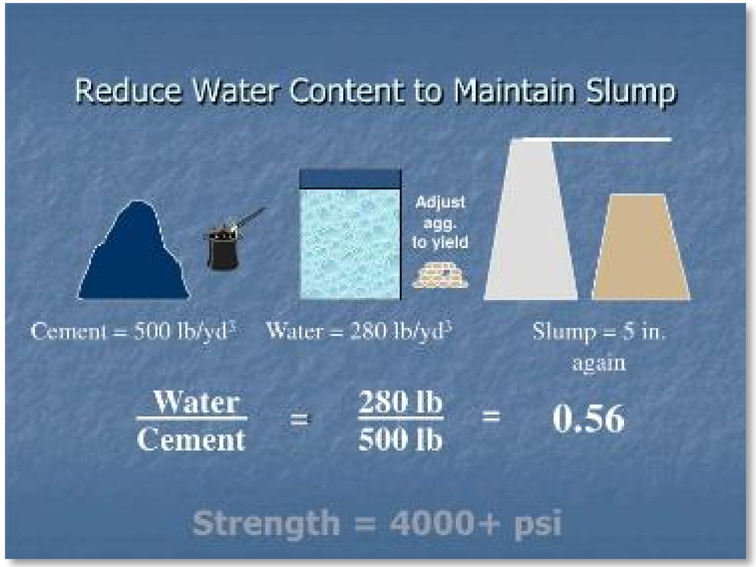
- Low Range
  - 5% to 10% water reduction
- Mid Range
  - 6% to 12% water reduction
- High Range
  - 12% to 40% water reduction
  - Superplasticizers



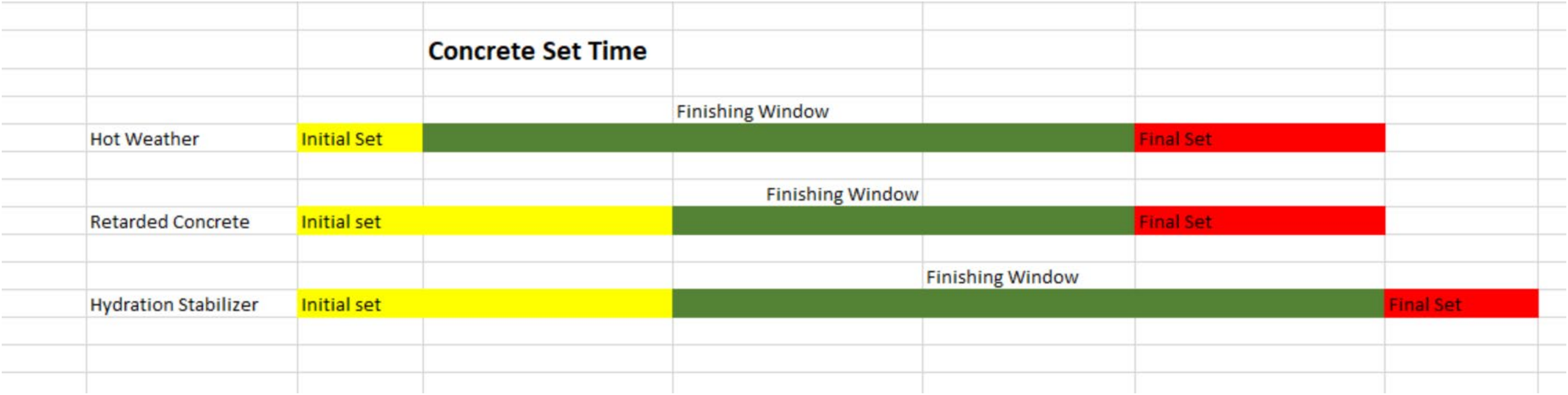
Water Reducing Admixtures



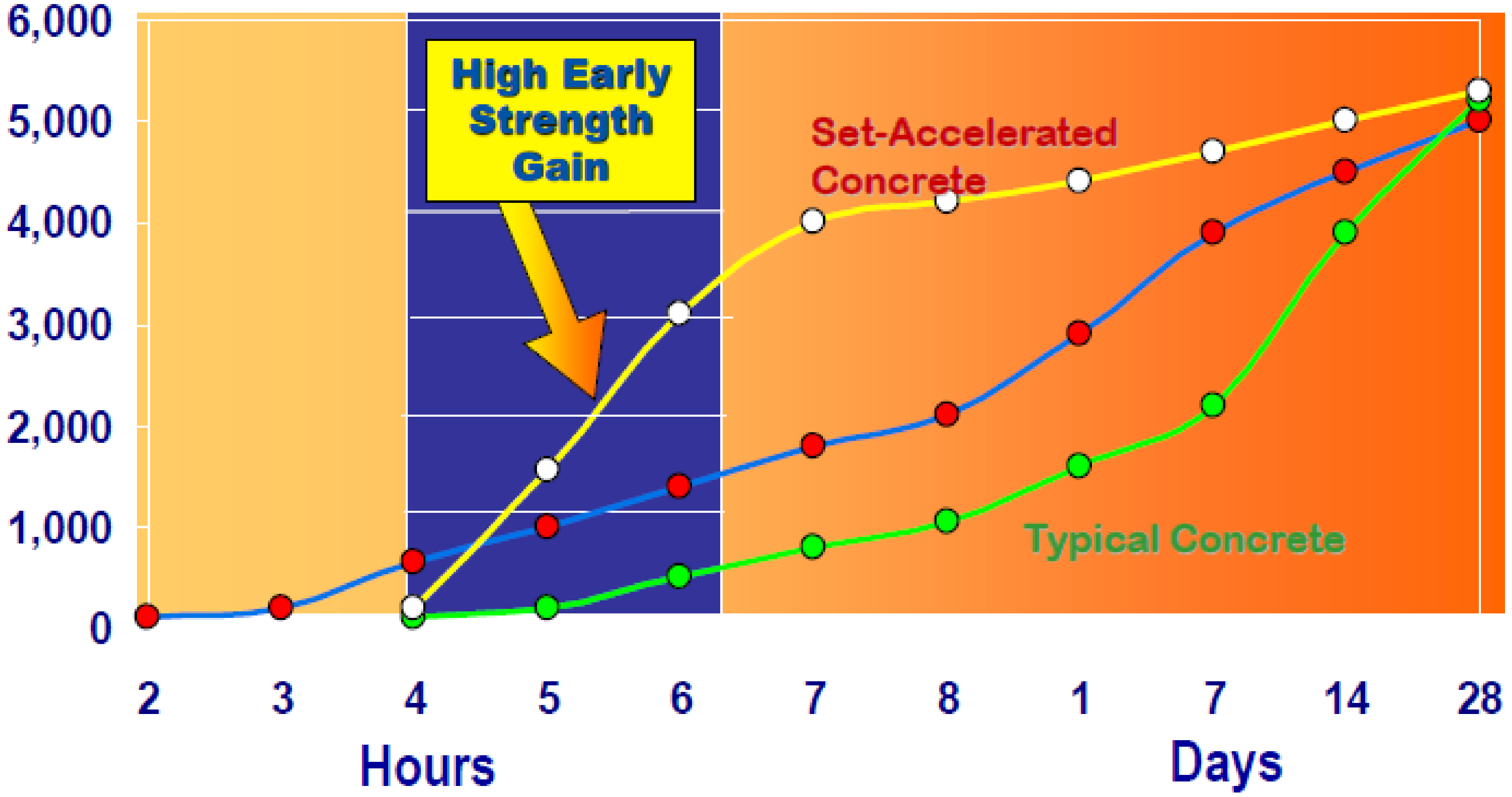




Retarders vs Hydration Stabilizers



High Early Strength Gain



Benefits of Chemical Admixtures

For Fresh Concrete:

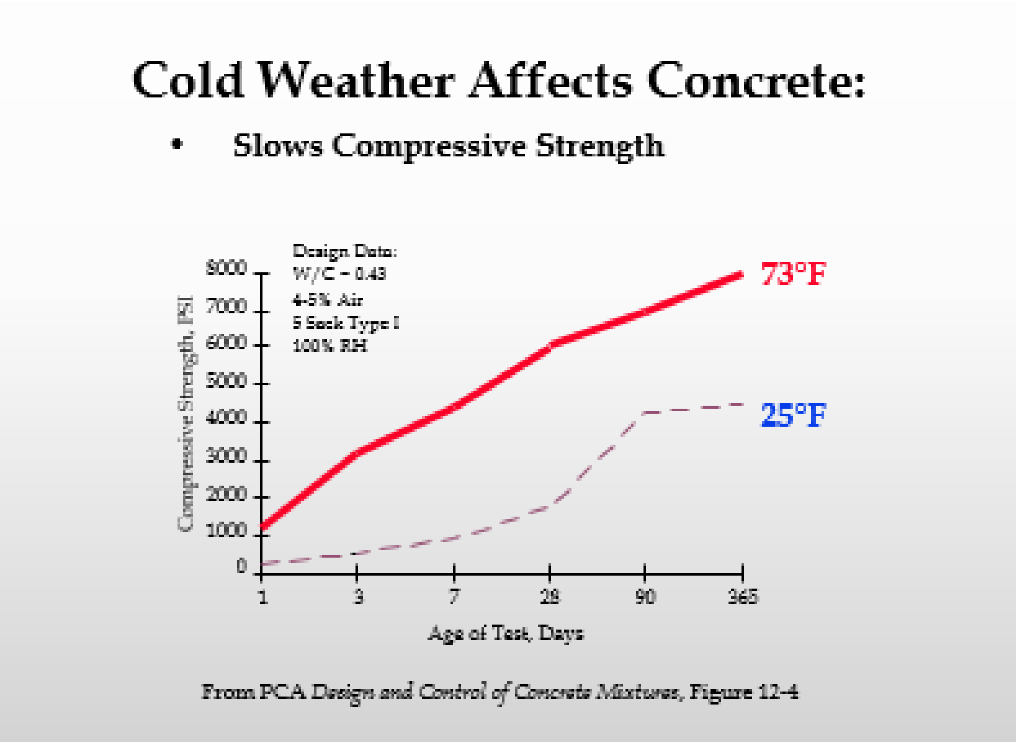
- Reduce the amount of water need in the concrete
- Increase workability without adding water
- Retard or accelerate set time
- Reduce slump
- Modify the rate or capacity of bleeding
- Decrease shrinkage
- Reduce plastic/drying shrinkage cracks
- Reduce corrosion of embedded materials
- Produce colored concrete
- Produce cellular concrete (non-structural lightweight)

Cold Weather effect on Set Time?

Temperature	Approximate Set
70° F	6 hours
60° F	8 hours
50° F	11 hours
40° F	14 hours
30° F	19 hours
20° F	NO SET

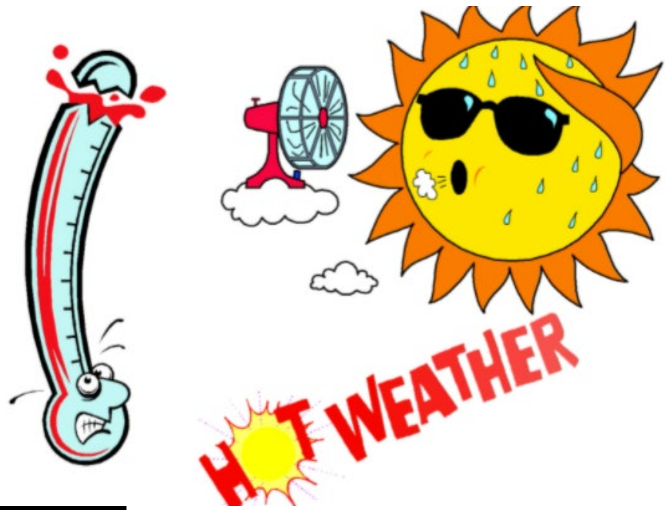
For every 20° F change in concrete temp set time is doubled!

Cold Weather Affects on: Concrete Strength



IRMCA

Hot Weather Affects on Setting Time?



Setting Time of Concrete at Various Temperatures

Temperature	Approximate Setting Time
100°F (38°C)	2 hours
90°F (32°C)	3 hours
80°F (27°C)	4 hours
70°F (21°C)	6 hours

Fibers

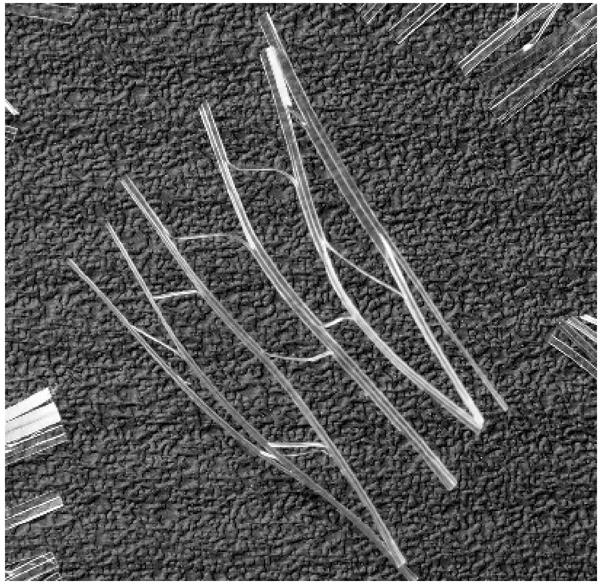
Monofilament, Stealth, or Finishing Fiber (Made from Polypropylene)

Dosage: 1/2 to 1 lb. per c/y

- Plastic Shrinkage Cracks

Fibrillated Fibers

- Dosage ¾ to 3 lbs. per c/y (1 to 1.5 lbs. per c/y most common)
- Will replace welded wire fabric (wiremesh) driveway/patio applications
- No Post Crack Control

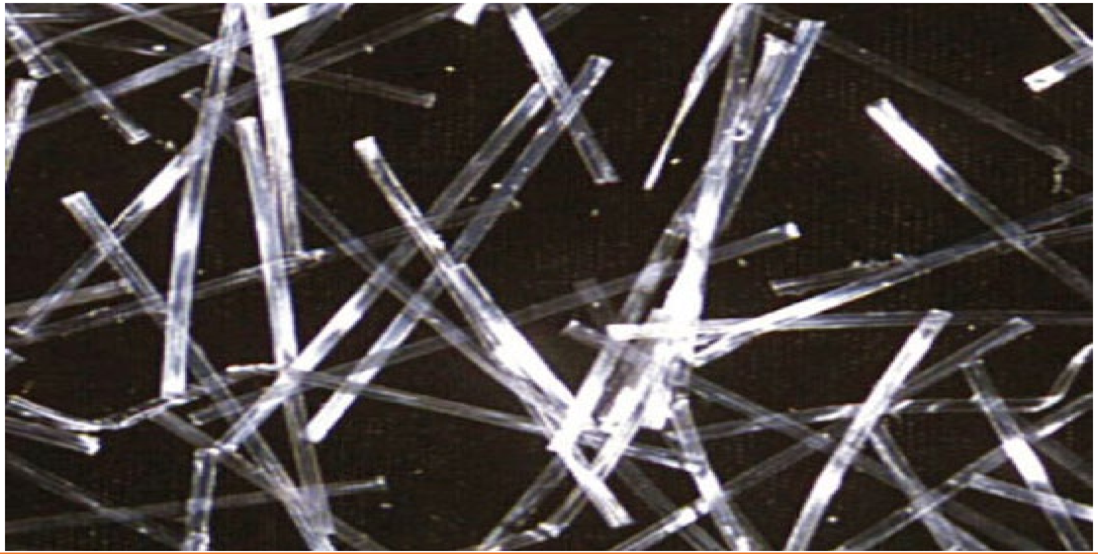


Macro Fibers

Dosage Rate 3 to 12 Lbs. per c/y (3.5 to 4 lbs per c/y typical)

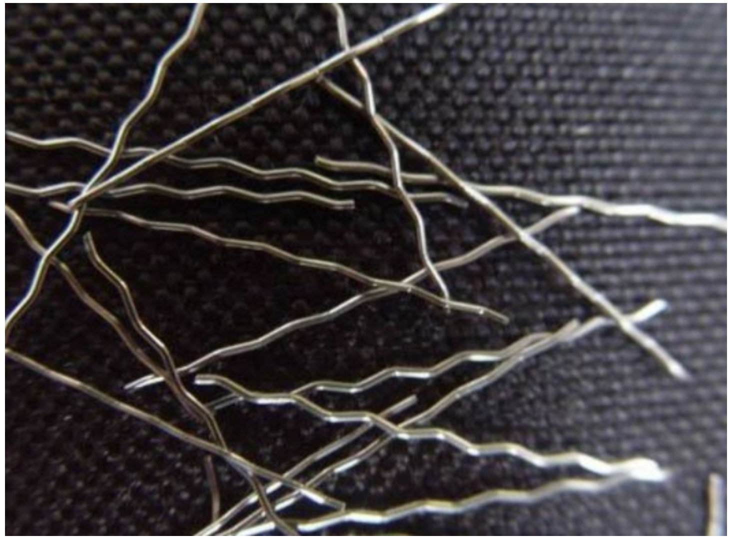
Replaces wire mesh, Steel Fibers, Light Rebar and other secondary reinforcing in slab-on-grade and composite steel floor decks

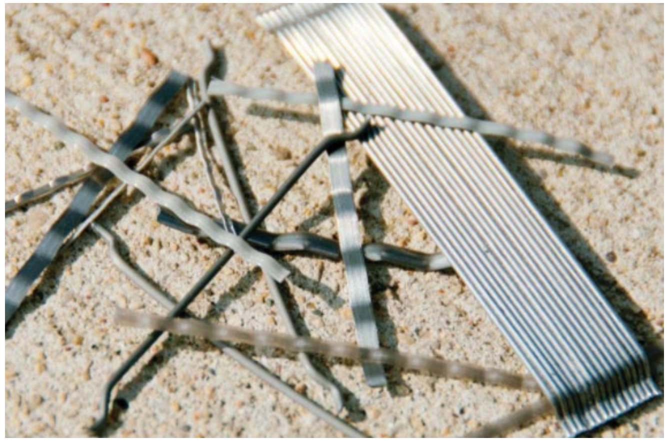
Provides Post Crack Control Performance



Steel Fibers

- Increased Flexural Strength
- Fatigue
- Impact Resistance
- Ductility
- Arrests Microcracks
- Relieves Internal Strain
- 40 to 70 lbs. per c/y





Concrete Testing Methods

Standards developed by ASTM International (ASTM)

- ASTM C172 (Sampling)
- ASTM C143 (Slump)
- ASTM C231 (Air – Pressure)
- ASTM C173 (Air – Volumetric)
- ASTM C138 (Unit Weight)
- ASTM C1064 (Temperature)
- ASTM C31 (Making / Curing Cylinders)

ASTM C 172 Sampling Freshly Mixed Concrete

Requirements:

- Sample size ≥ 1 ft^3
- Less than 15 min between first and last portion of sample
- Sample should not be taken from first or last portion of batch discharge

ASTM C 143 Standard Test Method for Slump of Hydraulic Cement Concrete

- Fill 3 lifts
- Rodd 25 times each
- Lift 5±2 seconds
- Measure Original Center

ASTM C 1064 *Temperature of Freshly Mixed Portland Cement Concrete*

- Minimum 3” into concrete
- Close void around thermometer
- Minimum 2 minutes
- Maximum 5 minutes

ASTM C 138 Standard Test Method for Unit Weight, Yield, & Air Content (Gravimetric) of Concrete

ASTM C 231Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

- Fill 3 layers
- Rod 25 times
- Tap each layer 10 to 15 times

ASTM C 31 – Standard Practice For Making and Curing Test Specimens in the Field

4”x8”
- Fill 2 layers
- Rod 25 times per layer
- Tap 10 to 15 times each layer

6”x12”
- Fill 3 Layers
- Rod 25 times per layer
- Tap 10 to 15 times each layer

- Initial
  - at project site up to 48 hours
  - Protected Initial Cure (60-80°F temperature environment)

- Final Cure
  - 73.5 Degrees plus or minus 3.5 Degrees at lab in moist cure room or water immersed

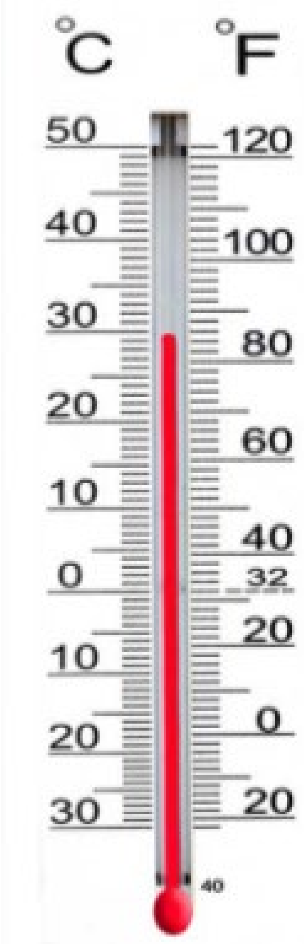
What Causes Low Cylinder Breaks?

- Cylinders not made properly
- Cylinders are not stored properly: After making store for a period of 48 hours in a temperature range of 60 to 80 Degrees F and in an environment preventing moisture loss
- Cylinders were moved around before they were set
- Cylinders left out in the sun on hot days
- Cylinders are not stored on a level ground
- Cylinders are in the field too long: only 48 hours
- Concrete Producer Shipped the wrong mix
- ADDITION OF WATER!!!!!!!!
- High Air
- Review the batch sheet: Problem with the plant cause something to over or under weight

Curing

Definition

- Curing is the maintenance of a satisfactory ***moisture content*** and ***temperature*** in concrete …….for a sufficient period of time immediately following the placing………………… so that the desired properties are meet.



Curing has a strong influence on the following properties of hardened concrete:

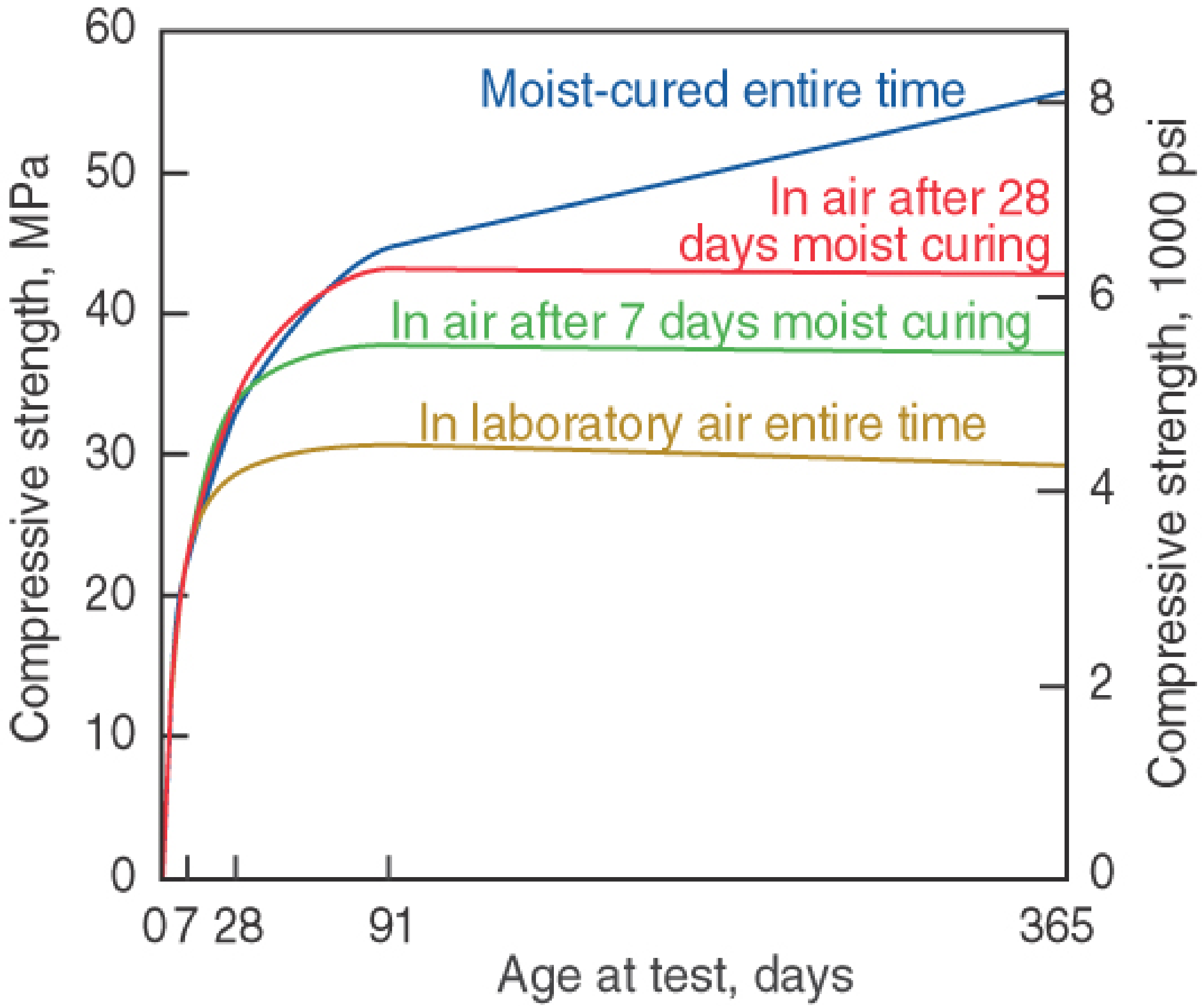
- Minimizes or Eliminates Cracking
- Improves Strength.
- Water-tightness.
- Increases Abrasion resistance.

Improves Durability

- Improves Resistance to freezing and thawing.
- Improves Resistance to deicer salts.

Exterior concrete slabs are especially sensitive to curing.

Curing Effects on Strength Development



Curing Compound Application

New Trends In The Concrete Industry

- E-Ticketing
- Liquid Nitrogen
- Low GWP (reduced CO2) Concrete Specifications for parking lots and interior floors
- Portland Limestone Cement
- Concrete Parking Lots
- IDOT Special Provisions for a Cement Slurry for FDR

Safety

Convenience

Ease of Use

Production Efficiency

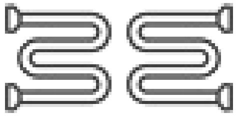
Mix consistency

Can cool concrete in excess of 40 degree delta's.

BENEFIT TO READY MIX – CONVENIENCE

REPLACE

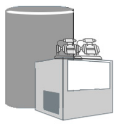
COOLING TUBES



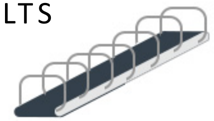
CHILLERS

AGG. SILO/BIN AC

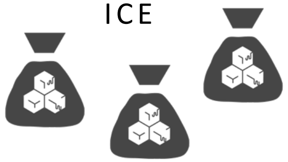
ICE MACHINES



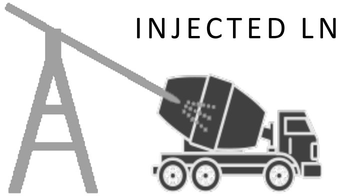
WET BELTS



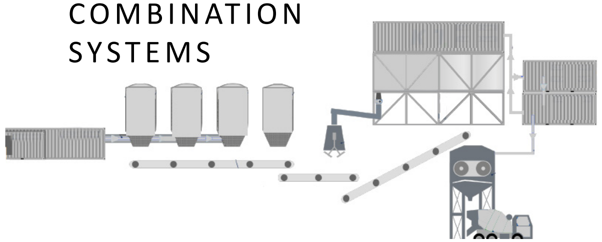
ICE



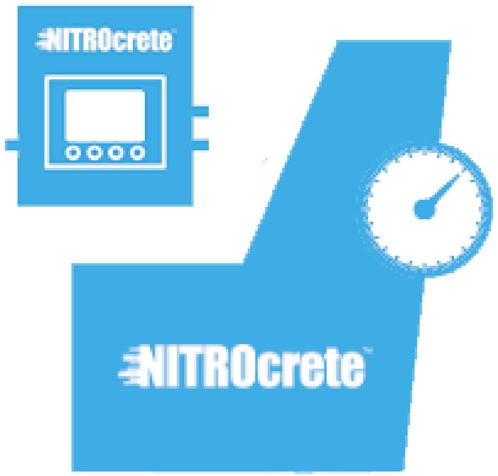
INJECTED LN



COMBINATION SYSTEMS



NITROCRETE SYSTEM



ONE SOURCE

for all cooling needs.

CIP 1-44 (Single Set) Concrete In Practice

- CIP 1 Dusting Concrete Surfaces
- CIP 2 Scaling Concrete Surfaces
- CIP 3 Crazing Concrete Surfaces
- CIP 4 Cracking Concrete Surfaces
- CIP 5 Plastic Shrinkage Cracking
- CIP 6 Joints in Concrete Slabs on Grade
- CIP 7 Cracks in Residential Basement Walls
- CIP 8 Discrepancies in Yield
- CIP 9 Low Concrete Cylinder Strength
- CIP 10 Strength of In-Place Concrete
- CIP 11 Curing In-Place Concrete
- CIP 12 Hot Weather Concreting
- CIP 13 Blisters on Concrete Slabs
- CIP 14 Finishing Concrete Flatwork
- CIP 15 Chemical Admixtures for Concrete
- CIP 16 Flexural Strength of Concrete
- CIP 17 Flowable Fill
- CIP 18 Radon Resistant Buildings
- CIP 19 Curling of Concrete Slabs
- CIP 20 Delamination of Troweled Concrete Surfaces
- CIP 21 Loss of Air Content in Pumped Concrete
- CIP 22 Grout
- CIP 23 Discoloration
- CIP 24 Synthetic Fibers for Concrete
- CIP 25 Corrosion of Steel in Concrete
- CIP 26 Jobsite Addition of Water
- CIP 27 Cold Weather Concreting
- CIP 28 Concrete Slab Moisture
- CIP 29 Vapor Retarders Under Slabs on Grade
- CIP 30 Supplementary Cementitious Materials
- CIP 31 Ordering Ready Mixed Concrete
- CIP 32 Concrete Pre-Construction Conference
- CIP 33 High Strength Concrete
- CIP 34 Making Concrete Cylinders in the Field
- CIP 35 Testing Compressive Strength of Concrete
- CIP 36 Structural Lightweight Concrete
- CIP 37 Self Consolidating Concrete (SCC)
- CIP 38 Pervious Concrete
- CIP 39 Maturity Methods to Estimate Concrete Strength
- CIP 40 Aggregate Popouts
- CIP 41 Acceptance Testing of Concrete
- CIP 42 Thermal Cracking of Concrete
- CIP 43 Alkali Aggregate Reactions (AAR)
- CIP 44 Durability Requirements for Concrete

Closing Comments

- Next Webinar is on June 16th 12:00 PM CST Titled:

Full-Depth Reclamation with Cement Using a Ready Mixed Concrete Truck

Speakers

- Don A. Clem, PE (Colorado) Vice President Local Paving National Ready Mixed Concrete Association
- Jonathan Pease CEO/Founder Rock Solid Stabilization and Reclamation

- Registration Opens on Monday June 7th 2021

- IRMCA also offers Free Engineering Assistance

Theron Tobolski at ttobolski@irmca.org or 708.473.0117

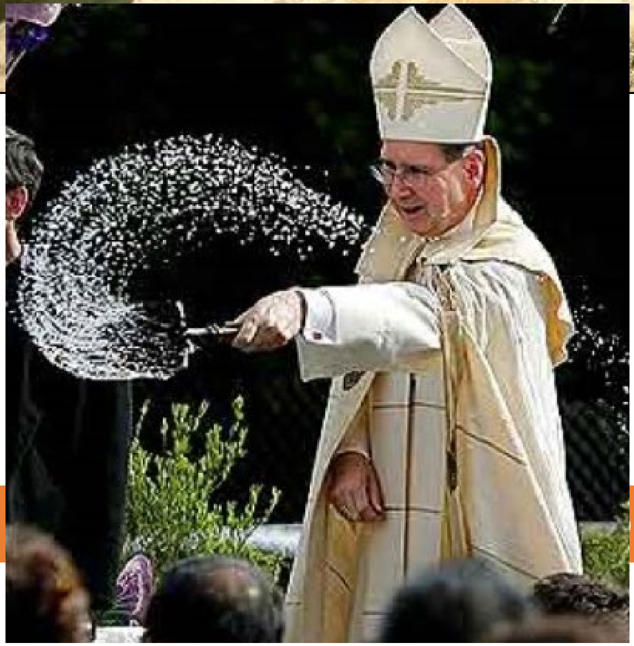
Scaling

Peeling off of the concrete surface due to freezing and thawing

- Non Air Entrained Concrete or Over-finishing and lowering the air at the surface
- Aggressive Deicer chemicals
- "Blessing" the concrete
- Close the surface and trap bleed water
- Lack of curing
- Jobsite added water lowers strength and durability
- 99% of the time scaling happens because a Best Practices for Concrete was not followed
- Freezing and Thawing typically doesn't cause scaling it attacks a weakness caused by the contractor or producer (GREEN Above)

How many concrete streets have you seen that has scaling on it?

What is the difference between Residential and Road or Street Concrete?



Plastic Shrinkage Cracking

- Forms when a rapid loss of moisture from the surface before the concrete has set and finished bleeding
- Dry windy conditions Cracks are frequently parallel
- Spaced farther apart than craze cracking
- Light fogging and wind breaks can help
- **Cure! Cure! Cure!**
- Use Evaporation retarders
- Fibers will help!!!!

Popout

No Chert Free Aggregate

Crazing/Map Cracking

- Caused by hard trowel finish or finishing while bleed water is present
- ***Lack of cure***
- Drying out of the surface
- Concrete with a high w/c
- Blessing the concrete
- Excessive floating or jitterbugging of the surface – brings up the fines and cement particles
- Very Shallow
- Mostly Cosmetic
- No Structural damage
- Fibers help

Joints in Concrete Pavement

Cut joints 25% of the depth of the slab.

- 4" thick slab should have joints 1" deep
- 5" thick slab would be 1.25" deep

Control joints should be spaced in feet 2 to 3 times the slab thickness in inches.

- 4 inch slab the joint space should be 8 to 12 feet apart
- 5 inch slab the joint space should be 10 to 15 feet apart

Jointed panels should be as close to square as possible. Keep the length divided by the width of a panel (aspect ratio) no more than 1.5

- 4" thick pavement if the panel is 12 feet long it should be no less than 8 feet wide (8" x 1.5 ratio = 12")
- 5" thick pavement if the panel is 15 feet long it should be not less than 10 feet wide

Words of Wisdom

There is an admixture to help solve most problems that a contractor faces while placing concrete and finishing concrete in cold weather and warm weather conditions. Most of them will save the contractor time and money

Cementitious materials like Slag and Fly Ash enhance some characteristics in concrete. Don't be afraid to use them…. just know when they are applicable.

Cold weather and warm weather concrete practices should be a line item to bid on during the bidding process.

Zoom Quality Control Meetings **should** be part of every project before any construction starts. The owner, engineer, general contractor, concrete contractor, concrete producer should all participate.

Sticking to a W/C ratio and following good finishing and curing practices will keep you out of trouble!!!!!!!!

A slab will never crack from too many joints. The more joints the better.