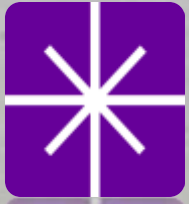




# Best Practices & Problem Avoidance



# Preconstruction Meetings

- The most valuable tool to avoid problems.
- Must take place 1 month prior to construction.
- Must include an owners representative and the concrete producer.
- Must discuss expectations.
- Must be documented.
- Must include reference to scopes of work.
- Must address the key issues.



# Preconstruction Meeting

## Key Issues

- Safety including ventilation.
- Ambient Conditions.
- Temporary services including water, lights, and vented heat.
- Specifications & tolerances.
- Drawings and details.
- Materials to be used.
- Methods of construction.
- Joint layout.
- Mock-ups for architectural work.
- Concrete mixes.
- Granular base elevations.
- Schedule of placements and joint filling.
- Site walk-through.
- Any perceived problems or concerns by anyone.



# Position Statements

- Designed to avoid problems caused by division of responsibilities in scopes of work.
- Position Statements are on-line at the this link:

[www.concretefloors.ca/position.htm](http://www.concretefloors.ca/position.htm)

**Position Statement: Granular Bases**

**Comments:**  
Granular bases often vary greatly in both elevation and quality. These issues are critical for the performance of a concrete slab on grade.

**Position Statement:**  
Each project has unique concrete characteristics that require very careful consideration. It is recommended that the specifier requirements be readily discussed at the pre-construction meeting with the participation of the earthworks contractor.

**Further references:**  
• CSA A22.1 Material or  
• OGC4 Best Practices 2  
• Occupational Health and

**Footnote Statement:**  
All values in the bracketed words that are associated with movement, displacement or temperature increases, "subjected by others" and not be the responsibility of the concrete floor contractor, seal, joint pins, sealant/mastics, hatches, surfaces, shrinkage cracking etc.

**Position Statement: Concrete Purchasing**

**Comments:**  
The performance of freshly mixed concrete continues to evolve rapidly and it is essential that the concrete producer be carefully managed for a successful flow installation. The contractor of the concrete must be responsible for purchasing the correct concrete mix, ordering and on-site management of the concrete to ensure an acceptable work result.

**Position Statement:**  
Each project has unique concrete characteristics that require very careful consideration. It is recommended that the specifier requirements be readily discussed at the pre-construction meeting with the participation of the concrete floor contractor and ready mixed concrete producer.

**Further references:**  
• OGC4 Best Practices 2  
• Occupational Health and

**Footnote Statement:**  
All values in the bracketed words that are associated with movement, displacement or temperature increases, "subjected by others" and not be the responsibility of the concrete floor contractor, seal, joint pins, sealant/mastics, hatches, surfaces, shrinkage cracking etc.

**Position Statement:**  
Labour overtime costs associated with delays in concrete delivery shall be the responsibility of the concrete purchaser.

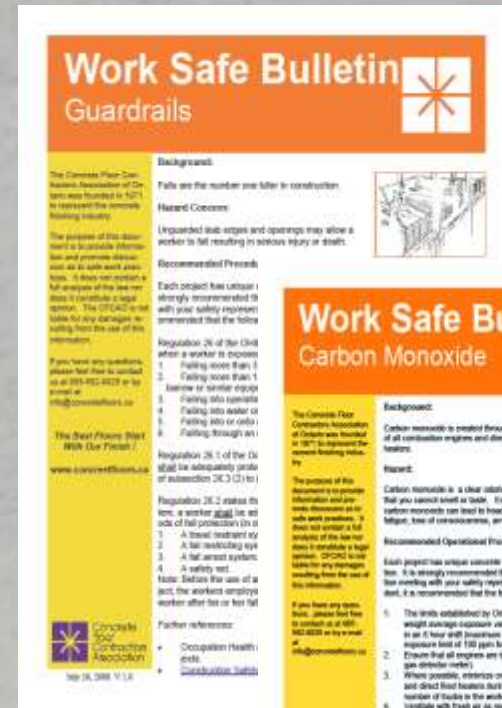
**Further references:**  
• Occupational Health and Safety Act and Regulations for Construction Projects  
• CSA A22.1 Material and Methods of Concrete Construction  
• OGC4 Best Practices Guidelines for Concrete Construction



# Work Safe Bulletins

- Designed to promote safety awareness and planning.
- Work Safe Bulletins are on-line at this link:

[www.concretefloors.ca/safety.htm](http://www.concretefloors.ca/safety.htm)





# Technical Bulletins

- Designed to provide technical guidance on issues relating to concrete floor construction.
- Technical Bulletins are on-line at this link:

[www.concretefloors.ca/tech.htm](http://www.concretefloors.ca/tech.htm)

## Technical Bulletin Dipstick Calibration

The Concrete Floor Contractors Association of Ontario was founded in 1971 to represent the concrete flooring industry.

Technical Bulletins are designed to provide state-of-the-art information to owners, specifiers and contractors to both improve quality and reduce problems.

We hope that this information will assist you in this goal.

If you have any questions, or comments, please feel free to contact us at 905-882-8822 or by e-mail at [info@concretefloors.ca](mailto:info@concretefloors.ca)

The Best Floors Start With Our Floor!  
[www.concretefloors.ca](http://www.concretefloors.ca)



June 2, 2008 V1.0

### F Number Tolerance Measurement:

Tolerance measurements using the F Number system may be made using either a Dipstick or F Meter measurement device. These devices are extremely accurate and measure variations in increments of 0.001".

### Problem:

In order to collect data accurately, the Dipstick measurement device MUST be "zeroed" or calibrated prior to the collection of measurements. It is the responsibility of the user to ensure that the device is properly calibrated.

### "Zeroing" C:

1. Place in
  2. Mark the carpenter position
  3. Record (now)
  4. Lift the Dipstick
  5. Record
  6. If the res is the Dipstick ready.
2. For new formed models, ally.

### Further refer

- The Fac

## Technical Bulletin Sawcut Contraction Joints



### Sawcut Contraction Joints

Cracking in slabs on grade is commonly related to the drying shrinkage potential of the concrete mixture being used compounded by stresses which may develop through the restraint of the concrete as it shrinks (eg. under slab friction).

Sawcut contraction joints are installed into freshly placed concrete floors to reduce these shrinkage stresses in an effort to minimize shrinkage cracking. The joint layout for each project should be discussed and finalized at the pre construction meeting.

### Concern:

Sawcut contraction joints which are installed too late, which are not deep enough or are spaced too far apart can lead to the development of random drying shrinkage cracks.

### Recommendations:

- Sawcuts may be installed using specialized "Softcut" dry process cutting or by using conventional wet-cutting saws.
- Softcut sawing should commence immediately following final bowling to the depth recommended by the equipment manufacturer.
- Wet cutting should commence within 12 to 24 hours of slab casting depending upon ambient conditions (warmer in higher temperatures) to a depth of 1/3 the slab thickness.
- Sawcut contraction joints must be spaced in relation to the slab thickness from approximately 2.5m on centre each way (o.c. e.w.) for 120mm slabs to no more than 4.5m o.c. e.w. for a 175 mm or thicker slabs.
- Sawcuts should be reinforced against differential vertical movement using smooth dowel bars or slab reinforcing (eg. wire mesh/steel 9-bars).

### Further References:

- CSA A23.1 Concrete Materials and Methods of Concrete Construction
- ACI 302 Guide for Concrete Floor and Slab Construction



August 28, 2008

[www.concretefloors.ca](http://www.concretefloors.ca)



# On the Web @ concretefloors.ca

## Technical Library

**CFCA** Home RFQ Members News Site Map Contact Us

### Technical Library

Many factors effect the quality of a new floor slab. The following is a list of reference areas recommended for consideration when designing or building a new concrete floor (product information is also available from our [Product Library](#) as well).

If you require other information, please refer to our [Help Desk](#) or submit your questions through our [request for information](#) page or send us an e-mail.

The purpose of these documents is to provide information and promote high quality concrete floors. It does not contain a full analysis of the law nor does it constitute a legal opinion. CFCAO is not liable for any damages resulting from the use of this information.

<b>Technical Bulletins:</b>	<b>Materials:</b>	<b>Methods:</b>	<b>Design:</b>
<ul style="list-style-type: none"> <li>• <a href="#">Cast-in-Place</a></li> <li>• <a href="#">Sawcut Construction Joints</a></li> <li>• <a href="#">Sloping Floors</a></li> <li>• <a href="#">T-Tee/Joint Intersections</a></li> </ul>	<ul style="list-style-type: none"> <li>• <a href="#">Air in Concrete</a></li> <li>• <a href="#">Coloured Finishes</a></li> <li>• <a href="#">Concrete Best Practices Guide</a></li> <li>• <a href="#">Curing</a></li> <li>• <a href="#">CSA A23.1</a></li> <li>• <a href="#">Liquid Densifiers</a></li> <li>• <a href="#">Polished Concrete</a></li> </ul>	<ul style="list-style-type: none"> <li>• <a href="#">Cold Weather</a></li> <li>• <a href="#">Environmental Issues</a></li> <li>• <a href="#">Exhaust Fumes</a></li> <li>• <a href="#">Inspection Issues</a></li> <li>• <a href="#">Maintenance Instructions</a></li> <li>• <a href="#">Protection</a></li> </ul>	<ul style="list-style-type: none"> <li>• <a href="#">Cobblecrete Mason</a></li> <li>• <a href="#">Curling of Joints</a></li> <li>• <a href="#">Track Pit Angle Detail</a></li> <li>• <a href="#">Track Pit Schematic Layout</a></li> <li>• <a href="#">Drying Time for Applied Finishes</a></li> <li>• <a href="#">Dry-Shake Aggregate Handovers</a></li> <li>• <a href="#">F-Number Tolerances</a></li> <li>• <a href="#">Joint Sealants &amp; Fillers</a></li> <li>• <a href="#">Steel Fibre Reinforcing</a></li> <li>• <a href="#">Super Flat Floors</a></li> <li>• <a href="#">Thickness</a></li> <li>• <a href="#">Unreinforced Floors</a></li> </ul>

## Product Library

**CFCA** Home RFQ Members News Site Map Contact Us

### Product References

Polished Concrete	Plastered Concrete	Steel Fibres
"Green" Floors	Concrete Guide	Liquid Densifiers

## Presentations:

- Concrete Floors & Paving: A Guide to Problem Solving and Problem Avoidance
- How to prepare for a concrete floor placement
- Polished Concrete
- Green Concrete Floors
- Architectural Flatwork Finishes

[www.concretefloors.ca](http://www.concretefloors.ca)



# Problem Avoidance



- Workmanship
- Materials
- Inspection
- Joint Faulting
- Shrinkage Cracking
- Vapour Retarders
- Slab Thickness
- Plastic Shrinkage
- Bumpy Surfaces
- Freezing
- Curling
- Spalled Joints
- Delaminations
- Scaling
- F/T Deterioration
- Aggregate Pop-outs
- Mortar Flaking
- Aggregate Failure
- Cracking
- Dusting
- Acid Attack
- Rain Damage
- Steel Corrosion
- Exterior Joint Failure
- Drying Time for applied finishes
- Liquid Densifier Timing



# Workmanship

- Management of workmanship is often the weakest link.
- Last minute contract awards eliminate the opportunity to plan.
- Too little prequalification is done in specifications beyond the general contractor.
- There is a great need to complete the work to defined industry standards (eg: CSA & ACI).
- CFCA members are quality leaders.





# Materials Selection

- Materials selection should be based upon a variety of factors including workability and durability.
- A list of the materials should be submitted by the concrete finishing trade contractor (which can be used by inspectors).
- Beware material substitutions.





# Inspection



- *INSPECTION IS CRITICAL TO SUCCESS !!!*
- Inspectors are part of the quality team.
- Full time inspection on pour days is an investment in quality.
- Inspect and record the quantity and source of all materials being used (fibres, sealers, plasticizer, hardeners, concrete etc.).
- Site inspection letters can be requested from major materials suppliers.
- *Inspection stops mistakes, last minute substitutions and ensures value for your money !*



# Lack of Reinforcing

“Steel is the best thing that ever happened to concrete”



*Uneven joints are a major failure*



*Beware formed isolations*

Dowel between pours  
Reinforce across joints



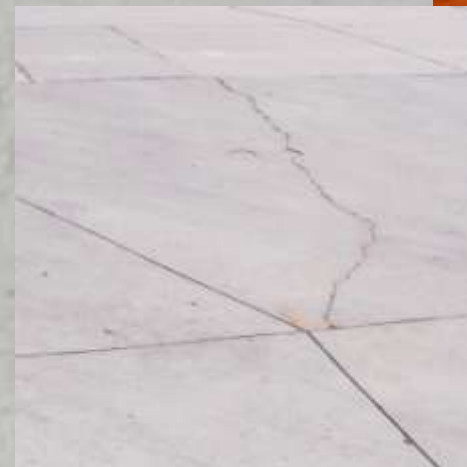
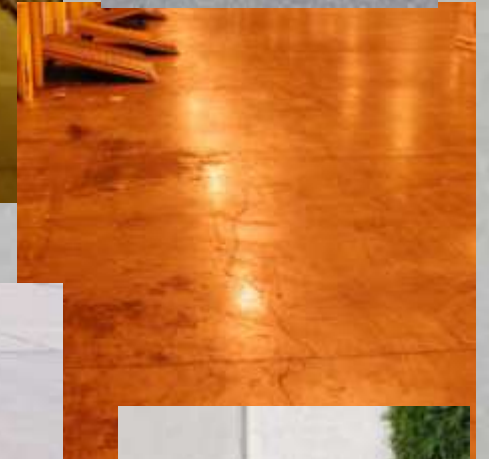
# Shrinkage Cracks

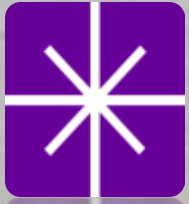


There are many causes:

- Contraction joint spacing too far apart, too late or not deep enough.
- Points of restraint not isolated with sawcut layout.
- High water/shrinkage concrete.
- Conduits cast into the slab.
- Contraction joints held together by reinforcing.
- Abrupt change in slab thickness.
- Granular base settlement.
- Concrete over-loaded / under-designed.

Review and approve the joint layout at the preconstruction meeting.





# Vapour Retarders ~~Barriers~~

- To avoid future delamination of non-breathing finishes.
- Can REDUCE vapour movement into the concrete.
- May be required in some parts of Canada due to swelling soils or radon gas emissions.
- Locate directly under the concrete slab.
- Will aggravate curling and cracking potentials - reinforce and use low slump plasticized concrete.
- Review finish schedule at the preconstruction meeting.
- Must be 10 mil thick and remain undamaged with lapped and sealed joints.





# Slab Thickness

- CSA A23.1 stipulates that granular bases “SHALL” be within  $\pm 10\text{mm}$  on the specified elevation.
- Requires inspection prior to ordering a pour.
- Variations in granular bases and surface elevations can combine.
- Average slab thickness “SHALL” be no less than 10mm from specified for the overall floor.
- Verify theoretical concrete usage against actual usage.



***GRANULAR BASES REQUIRE INSPECTION PRIOR TO POURING & CORRECTION DURING CONCRETE PLACEMENT !***



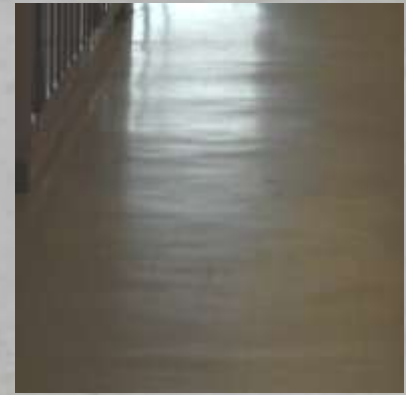
# Plastic Shrinkage

*Mixes that don't bleed are becoming more common*

- Drying shrinkage of the surface paste caused by a lack of bleeding and evaporation.
- Protection of the plastic surface by fog spraying is acceptable but not always possible.
- Bumpy surfaces are often created under similar conditions due to premature surface drying.
- Aggravated by: retarding admixtures, thick slab sections, sulfate resistant and low-heat cements, and high percentage rates of supplementary cementing materials (especially flyash and silica fume).



# Bumpy Surfaces



Visible surface bumps caused by:

- Premature surface drying through evaporation (crusting).
- Cold joints due to delays in concrete delivery.
- Variations in set between adjacent truck loads (slump and batch times).
- More common in thick, retarded set, HVSCM mixes.
- Lack of accessibility for proper finishing equipment.
- Poor finishing methods.



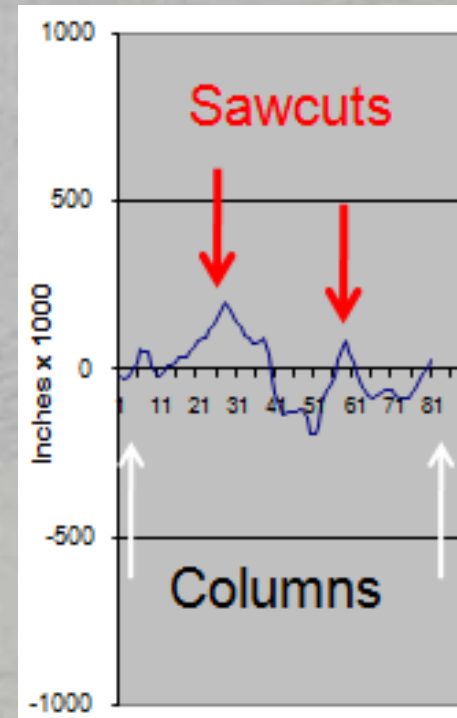
# Freezing

- The minimum temperature for placing and curing of concrete is 10°C (CSA A23.1).
- Permanent damage can occur if the concrete freezes at less than 3 MPa (500 psi).
- Strength gains are significantly delayed at temperatures below 5°C (concrete becomes dormant).
- Heaters should be vented to remove both carbon dioxide (bad for concrete) and carbon monoxide (bad for people).



# Curling

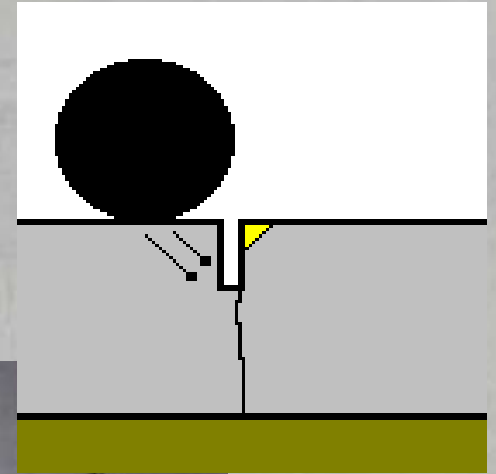
- Curling is caused by the difference in moisture content and temperature between the top and bottom of a slab.
- Reinforcing should be employed to restrain tolerance losses caused by drying shrinkage curling for each owners particular usage.





# Spalled Joints

- Unfilled sawcuts and construction joint edges will deteriorate under forklift traffic over time.
- Joints should be filled full depth with a semi-rigid filler material.
- Floor joints should be inspected on a semi-annual basis and repaired promptly.





# Delaminations

Localized surface failures caused by:

- Poor mix characteristics causing a delayed bleed and entrapment of mix water below the surface.
- Too high a hardener application rate for the application method, concrete mix or ambient conditions.
- Too much water in the concrete.
- Surface hardener application on air entrained concrete.
- Cold weather conditions causing a delayed set.

*Beware cold weather conditions*



May be shallow (<3mm)  
or deep (5-15mm)



# Scaling



An overall thin surface delamination caused by:

- A complete lack of curing.
- Poor concrete (low strength, w/c or inadequate air content).
- Finishing over applied water or rain.
- Early freezing and de-icer application on early age concrete.





# F/T Deterioration

- Incorrect air content, water:cement ratio, or strength can lead to pronounced deterioration in exterior environments.
- Use correct mixes per CSA A23.1.
- Test concrete for air entrainment prior to placement.





# Aggregate Pop-outs

Conical surface defects which result from Impurities / poor quality aggregates which expand and split when absorbed water freezes.

Use a freeze-thaw durable coarse aggregate (always review carefully with local ready-mix producer).





# Mortar Flaking

- Similar to pop-outs but without any underlying aggregate failure.
- Occurs more often in hot weather conditions.
- Protect the concrete from premature drying in hot weather using fog sprays.
- Consider options in very hot weather conditions.





# Coarse Aggregate Failure

- Weak aggregates fail in compression caused by heavy traffic.
- Use a hard coarse aggregates (always review carefully with local ready-mix producer).





# Crazing

- Fine surface “spider web” cracks which are caused by mix water evaporation.
- More common in troweled floor surfaces without a surface hardener.
- Easily visible when the slab is damp.
- Use 20C water for curing.
- While visible, they do not cause any performance problems.





# Interior Dusting



Soft “dusty” surfaces caused by:

- A complete lack of curing.
- Low strength, high w/c concrete mixes.
- Carbon dioxide contamination of the cement from the use of non-vented heaters (carbonated).
- Can be sometimes treated with liquid hardeners, or otherwise by grinding or an applied coating.



# Acid Attack

- Concrete is aggressively attacked by acids.
- Should be protected locally by a suitable epoxy coating.
- May be slowed, but not eliminated, through the use of silica fume or other densifying additives.





# Rain/Snow Damage

- Avoid pouring without a roof and walls.
- Check that openings are sealed.
- The responsibility for environmental surface damage lies with the ordering party.





# Steel Corrosion

- Occurs through the electro-chemical attack of the reinforcing steel created by de-icing chlorides in a wet environment.
- Long term corrosion of the reinforcing steel can cause delaminations of the concrete cover over the reinforcing bars and lead to structural failure.
- Rebar in exterior pavements should be carefully located.
- Steel fibres do not cause delaminations.
- Can be eliminated through: proper slopes and drainage, adequate concrete cover, high quality concrete and protective membranes.



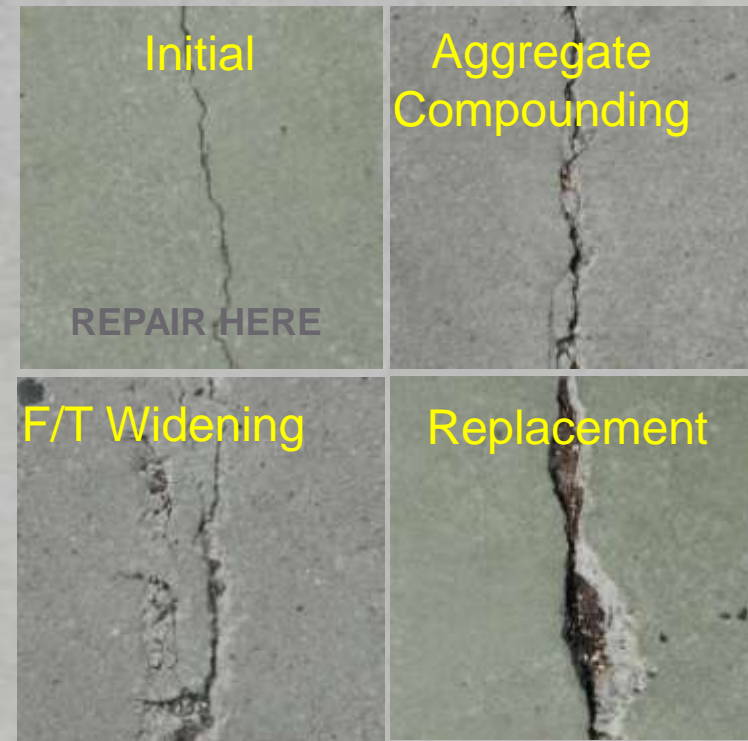


# Exterior Joint Decay



- Dirty, unfilled joints will decay over time through freezing.
- Exterior joints need to be kept clean of debris.
- Exterior joints should be filled to stop debris accumulation.
- Fillers may fail due to thermal movement alone (fill in the fall or spring).
- Hot rubber has highest elasticity but only comes in black.

## 4 Phases of joint failure





# Drying Time for Applied Finishes



The approximate drying time for a 100mm SOG to reach 3lb/1000sf/24hrs with a 0.4 w/c is 60 days. For a 0.5 w/c the drying time increases to 180 days and for a 0.6 w/c it increases to more than 1 year.

The drying time for applied finishes can be reduced as follows:

- Decrease the water:cement ratio of the concrete to between 0.40 and 0.45 (use less water, plasticize for workability & increase cement content).
- Do not use a curing membrane (wet cure for 3 days).
- Protect the slab from environmental re-wetting.
- Minimize the slab thickness.
- Increase temperature and reduce the RH of the drying environment can assist in reducing the drying time.
- Avoid lightweight concrete aggregate mixes (when possible).



# Liquid Densifier Timing



- The early application of liquid hardeners is not as effective as following a drying period of one month.
- Silicate liquid densifiers react chemically with calcium hydroxide ( $\text{CaOH}$ ) to densify the concrete surface.  $\text{CaOH}$  is a by-product of cement hydration and develops as follows:
  - 7 days: 50%
  - 28 days: 90%
- Water based liquid densifiers cannot easily penetrate into a water saturated concrete surface without a drying period.





# Summary

- Hold pre-construction meetings !
- Refer to our website for technical and product assistance.
- Call or e-mail if you need help !

**Tel: 905-582-9825**  
**[www.concretefloors.ca](http://www.concretefloors.ca)**



 **The Best Floors Start With Our Finish!** <sup>TM</sup>

*- Shouldn't yours ?*



