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

Work Safe Bulletins

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

  www.concretefloors.ca/safety.htm

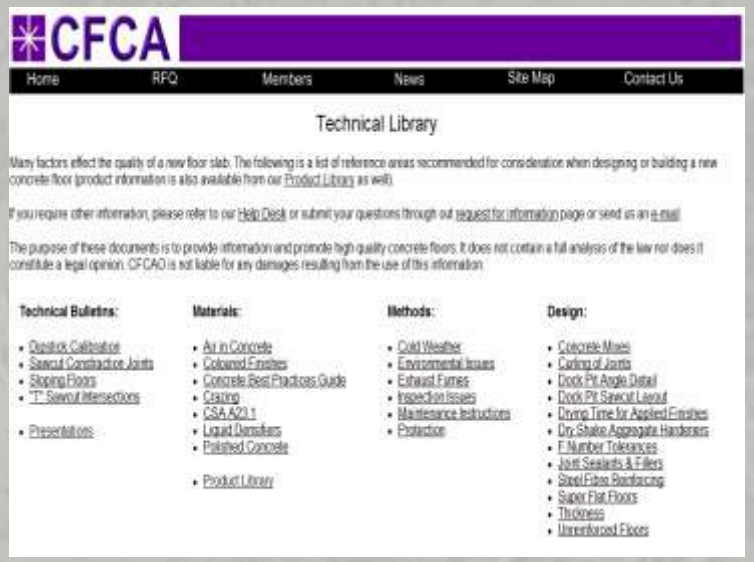
Technical Bulletins

- 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

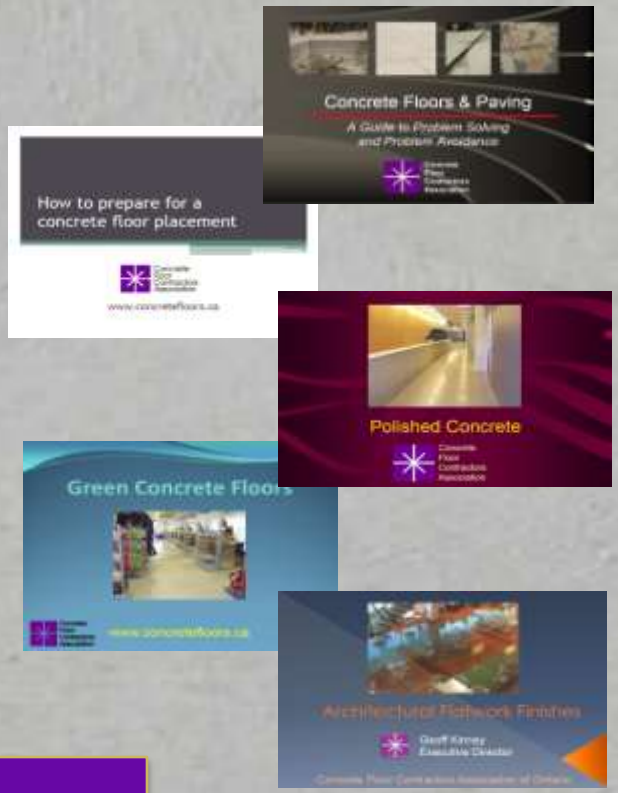
On the Web
@ concretefloors.ca

Technical Library



Product Library

Presentations:



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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
- Crazing
- 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 finsihing 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

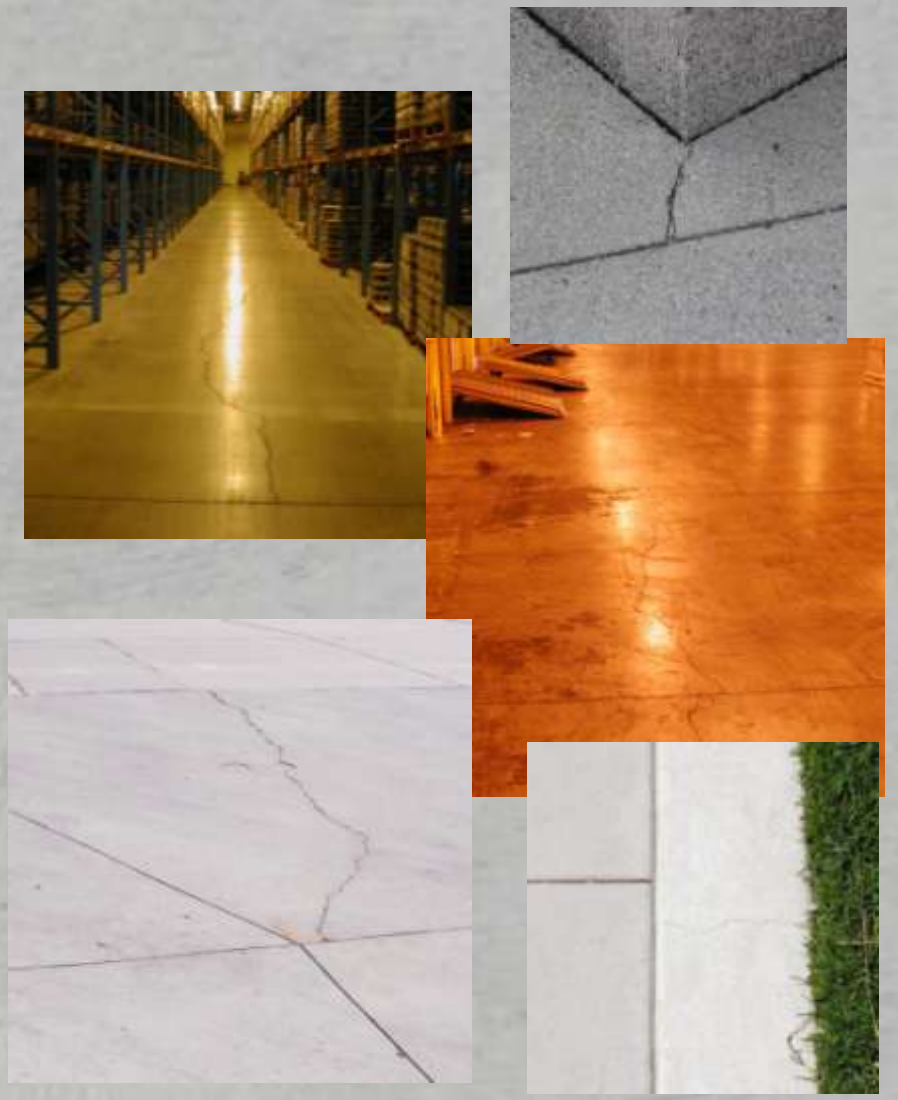
Dowel between pours
Reinforce across joints

Shrinkage Cracks

There are many causes:

- Contraction joint spacing too far apart, too late or not deep enough.
- Points of restrain 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.

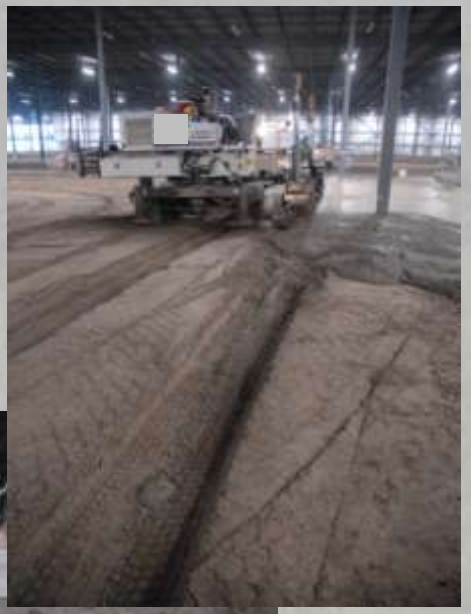


Vapour Retarders ~~Barriers~~

- 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 ± 10mm 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:

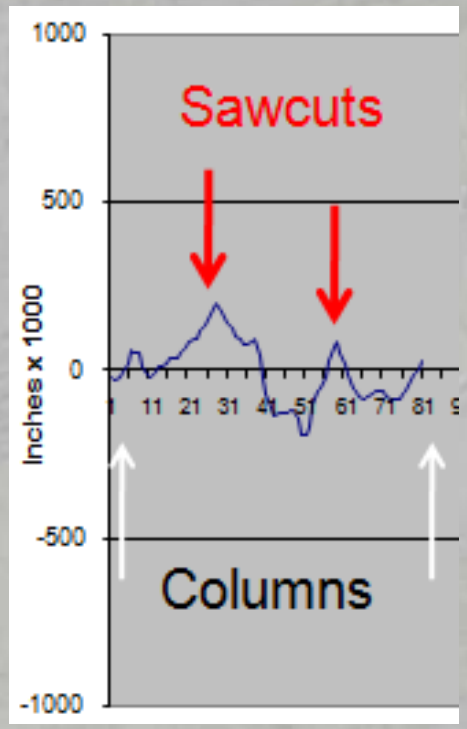
- Premature surface drying through evaporation (crusting).
- Cold joints due to delays in concrete delivery.
- Variations in set between adjacent truck loads (slump and batch times).
- More common in thick, retarded set, HVSCM mixes.
- Lack of accessibility for proper finishing equipment.
- Poor finishing 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 5ºC (concrete becomes dormant).
- Heaters should be vented to remove both carbon dioxide (bad for concrete) and carbon monoxide (bad for people).

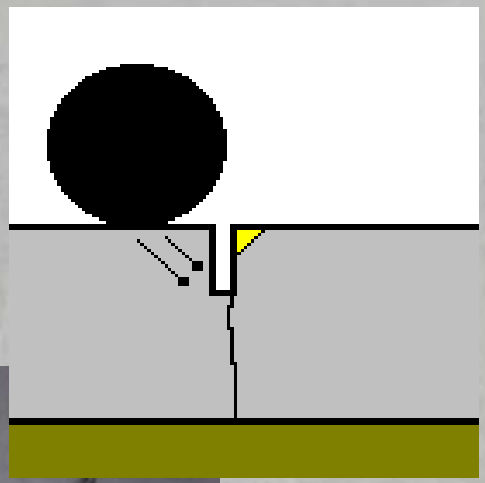
Curling

- 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

Beware cold weather conditions

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.

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 pre-mature 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.

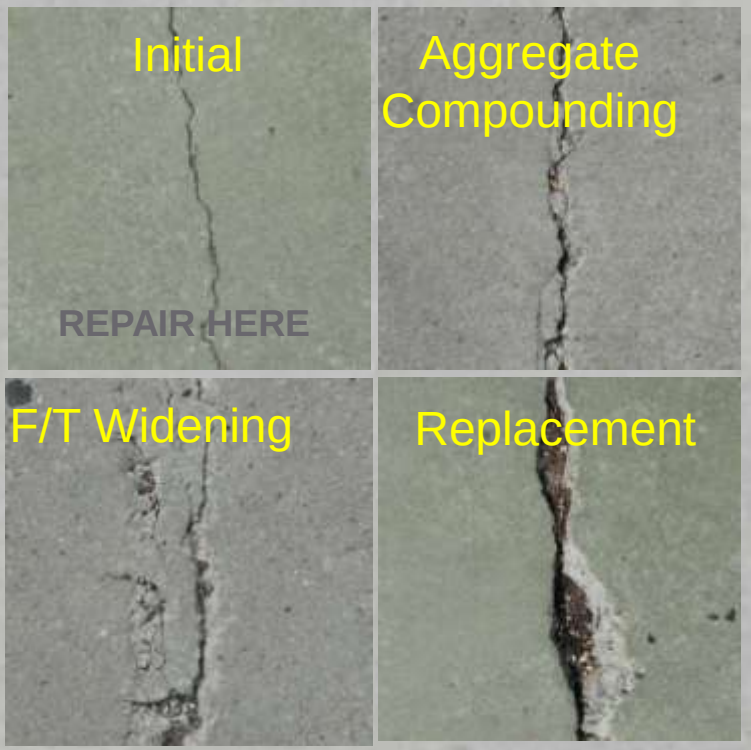
Steel Corrosion

- 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 (CaOH) to densify the concrete surface. 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 !

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