Concrete Inspection

Code Officials Conference of Michigan

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What is the..
MCA Representation

- **Producer members** include companies of all sizes collectively supplying about 80 percent of the ready-mixed concrete placed in the state.

- **Paving Contractor members** construct approximately 90 percent of the concrete pavements in the state.

- **Cement supplier members** manufacture and/or distribute cement based products.

- **Concrete contractor members** include general, flat-work, tilt-up, forming & poured wall, pumping, sawing and cast-in-place contractors.

- **Allied industry members** include suppliers and producers of admixtures, bulk material haulers, embedded material, aggregate, concrete equipment, concrete products and structural elements.

- **Associate members** have an interest in supporting the objectives of the association, participate in the training, and provide engineering consulting and service to the concrete industry.
MCA Objectives

- Promote the use of concrete
- Influence national, state and local levels of government to assure adequate investment, fair regulations, and sound policies and legislation
- Advance the use of concrete materials through investigations, studies, education and research
- Improve the quality of concrete
- Inform members about new ideas, products and promotional efforts
- Educate members and consumers about the use and maintenance of concrete
READY MIXED CONCRETE. READY FOR ANYTHING.

Strength. It’s a term that gets used a lot. And while it’s one of the most essential components of any building, it’s more than the strength itself that’s important. It’s the benefits of strength that make a difference in what you build.

5 Key Elements to Building with Strength:

1. **Stands the test of time**
   - Concrete structures are designed to last for centuries. Unlike other materials, concrete only gets stronger over time.

2. **Sustainable**
   - Concrete’s strength, durability and energy efficiency make it an environmentally friendly material—especially when you consider the entire lifecycle of the building.

3. **Simple to use**
   - If a material isn’t easy to use, it doesn’t matter how strong it is. Good thing concrete can be molded into any shape, size or design you can imagine.

4. **Safe and strong**
   - Building with concrete gives you a fire resistant structure. When combined with other fire safety systems, you can exceed building requirements—instead of just meeting them.

5. **Value that lasts**
   - Concrete won’t rot, mold, rust or deteriorate. It’s energy efficient and virtually maintenance-free—which means the resources you invest now will last for decades to come.

Concrete. Choose it first— to last. Learn more at BuildWithStrength.com.
What is the role of an inspector?

- A **Concrete Construction Inspector** is a person qualified to inspect and record the results of concrete construction based on codes and job specifications. Inspection may occur during pre-placement, placement, and post-placement operations. (ACI)

- Duties will vary based on the complexity of the project and cost.
The infamous sidewalk inspector

Duties will vary based on the complexity of the project and cost.
The Codes and Specifications provide the rules by which we complete the project...
When applying a specification we must ask some basic questions...

- What is the project application? Roads (highway, local), sidewalks, curb/gutter, structural.
- What type of environmental conditions are we dealing with during placement and are there any time constraints for construction?
- What type of long term durability issues must we be concerned with?
Bottom Line

- When our specifications are clear and achievable, we are more likely to get a quality product at a good price.

Ann Arbor Saline Road over I-94, Ann Arbor, 2014
MCA Concrete Construction Inspection

US-10 Overlay
Coleman, MI  2013
MCA Concrete
Construction Inspection

Downtown
Iron River, 2014
MCA Concrete
Construction Inspection

Selden Alley Pervious Concrete, Detroit, 2014
MCA Concrete Construction Inspection

Fowlerville Proving Grounds Twist Road
Aisin Development of North America, Inc. 2013
Inspection and testing are both important to achieving a quality product.

Other tools to help us include:

• Well Defined Specifications
• Training (i.e. CQP – Construction Quality Partnership, Certifications Level 1 and 2 Concrete Testing Technician
What is the key to a good concrete project?

• Good Communication and Organization.

• Consistent supply of materials which leads to good project flow.
Top Tips for Concrete Inspection

1. Review the project construction plans, codes and specifications.
   - ACI, MDOT, County, City, Private Company, QA and QC

2. Attend and/or coordinate a pre-paving / pre-construction meeting with Engineer and Contractor.

3. Know the contractor’s key site contact and who the materials supplier(s) will be.

4. Know who the testing company is and who will be performing the tests, what tests will be run and when.
Top Tips for Concrete Inspection

5. Touch base with the contractor representatives throughout the project, discuss logistics, notifications and potential weather concerns and precautions that might need to be taken.

6. Check concrete supplier tickets to ensure that the specified concrete mix is being used along with appropriate materials.

7. Verify that the concrete construction work is according to the plans…if not, stop and ask why!

8. Keep track of the paperwork and take good field notes, and document observations of any potential issues.

9. Verify that the concrete is properly protected during curing and that appropriate signage is in place if required.
Delivery of Concrete
Has it been Planned For?

- How old will the concrete be at time of placement?
- Can the concrete be delivered at the required rate?
- Does the pour require more than one delivery point?
- What is the on-site haul route?
- Do you need traffic control?
- Where will the trucks wash out?
Concrete Testing

Concrete must be between 45 and 90 degrees Fahrenheit at the time it is placed.
Concrete Testing

- Slump – mix design dependent
Concrete Testing - Air

Pressure Method

Volumetric Method
Bases, Subbase & Subgrade

Concrete Pavement

Base

Subbase

Subgrade

Layer(s) of material directly below the concrete pavement.

Natural ground, graded, and compacted on which the pavement is built.
Subgrade

- A uniform and stable subgrade is required for long term durability of the pavement. (In general, subgrade uniformity and stability are more important than subgrade strength for pavement performance.)

- Three major causes of subgrade non uniformity - expansive soils, frost action, and pumping – must be controlled.

- Spread the subbase material evenly and compact to specified % compaction and optimum moisture content.

- Pavement subgrade may need to be improved temporarily (soil modification) or permanently (soil stabilization) through the use of additives or binders.

- Remove poor soil if necessary.
Why do you need to water the grade prior to placement

- We do not want to steal water from the concrete mix which is necessary for proper hydration.

When shouldn’t you water the grade.

- There are some interior application where you need the ground to absorb some of the excess moisture from the mix so that you can place a flooring material. (eg, gluing down a tile floor)
Base/Subbase

- Provide and place aggregate with a uniform gradation, free of contamination and segregation.
- Do not place aggregate base on frozen, soft, unstable or rutted subgrade.
- Balance must be achieved between the degree of drainage and stability of base. Stability should not be sacrificed for the sake of drainage.
Grade Control

- Survey layout must be completed well ahead of placement.
- Remember we only place one lift, so we need to get it right.
- Connections to existing concrete must be checked.
  - Remember it takes two points to make a line.
Form Setup

- Check the base on which forms are to be placed for line and grade and correct irregularities.
- Check forms before placing concrete.
- Treat the inside of all forms with a release agent that will not discolor the concrete.
- Check grade by pulling string between forms
- Securely join, lock and stake each form segment.
Concrete Placement

Quality placement begins with...

Proper vibration and consolidation of the concrete mix!
Concrete Placement

- Place concrete on a moist base as close to the final resting place as possible.
- Keep tops of forms free of concrete and other substances during placing and finishing.
- Inspect vertical surfaces of previously placed concrete and the adjacent grade and clean materials that would prevent adjoining pour to properly consolidate.
- Before adjoining pour, inspect open graded base for contamination.
- Spread and strike off concrete as soon as it is deposited on the base. Avoid segregation.
Finishing

➢ To obtain a durable surface on unformed concrete, proper procedures should be carefully followed.

➢ The concrete should be of the lowest practical slump

➢ The concrete should be properly consolidated, preferably by means of internal vibration

➢ Screeding, floating and first troweling should be performed in such a manner that the concrete will be worked and manipulated as little as possible to produce the desired result. (ACI 304 R-21)

➢ The key is to complete placement and finishing while the concrete is still fresh.
Consolidation

- Freshly placed unconsolidated concrete contains entrapped air. If allowed to harden in this condition, the concrete will be porous and poorly bonded. It will have lower strength, high permeability, and poor resistance to deterioration.

- Concrete should be consolidated if it is to have the properties desired and expected by its owners.

- The most widely used consolidation method is vibration.
  - Including vibrating screeds, vibrating roller screeds, plate & grid vibratory tampers & vibratory finishing tools.

- **NOTE:** Do NOT use vibrators to move concrete!
Strike off

- 2 x 4
- Straight Edge
- Paver
- Truss Screed
- Spinning Tube
- Laser Screeds
Bull Floating

The purpose of bull floating is to fill in and seal any voids in the surface

- Check the straightness of the equipment prior to use.
- Bull float as flat as possible with maximum surface contact, Note: the greater the surface area touching the fresh concrete, the less that the bull float will sink.
- Each pass of the bull float should overlap the previous pass.
- Once the surface is smooth and straight bull floating should cease.
- Over manipulation of the concrete brings excess fines and water to the surface, which lessens the quality of the finished surface, causing checking, crazing and dusting. (ACI 304 R-21)
Blessing Your Concrete

The practice of adding moisture to the surface of the concrete.

- The surface of the concrete should not be allowed to dry out during the finishing process.
- It is an acceptable practice to replace only the moisture lost due to evaporation in the concrete surface.
  - A fine mist spray, not a fire hose
- Lubricating bull floats, however making them easier to slide, does not aid in sealing the surface of the concrete.
- Adding excessive moisture degrades the surface and instead of sealing the concrete, the holes are fill with gray water.
Surface Texture Options

There are many surface texture options, the project application will dictate which type to use.

- Burlap drag
- Artificial turf drag
- Broom
- Trowel
- Tine
- Exposed aggregate
- Diamond grinding
- Colored Stamped
Surface Texture

A uniformly Textured concrete surface is a good indicator of quality.
Finishing – Bleed water

Bleed Water will form in some mixes after 20-30 min

- With the exception of a troweled finish, finishing needs to be completed before bleed water begins to develop on the surface
- Finishing while bleed water is accumulating mixes water back in to the concrete surface, thus increasing the w/cm ratio and decreasing strength and durability in the surface region.
- Remixing bleed water can also decrease the air content at the surface, further reducing durability
Trowel finish

The Trowel finish is a smooth textured finish.

- Troweling should not start until the bleed water has ceased.
- Excess water should be removed from the surface before troweling.
- The finishing is most common in interior applications with no air entrainment.
Texturing

- Attempts to texture the concrete beyond final set usually requires the addition of water to the surface. This practice should not be allowed because of the loss of surface strength and durability that results from the addition of water to the concrete surface.
Texturing Issues
Texturing Issues
Texturing Issues
Curing

- The process by which hydraulic-cement concrete matures and develops hardened properties over time as a result of the continued hydration of the cement in the presence of sufficient water and heat.

- The rate of curing depends upon the natural environment surrounding the concrete and on the measures taken to modify this environment by limiting the loss of water, heat or both, or by providing moisture & heat.
Cure System

- Too often it is the last thing on our minds
- More critical with admixtures in use today
  - less bleed water
  - more critical with low water cement ratio
  - concrete can dry out and not hydrate
- We need to keep the moisture in the concrete to reduce curl effects
- Cool air will have a lower humidity than warm air and tend to increase the evaporation rate
- The cure system should be on-site and tested prior to concrete placement
When should you cure?

- As soon as possible – in the first 30 min if possible
  - In the past, waiting until bleeding subsides was recommended
- Today most mixes have low or no bleed rates and any delay in curing is not advisable
- If the surface **looks dry** – it is & you are behind!
- Hairline cracks may develop which will allow water to penetrate and hurt the surface in the near future
Methods of Curing

- Curing compound (Most Common) – liquid membrane forming compounds placed on concrete to reduce evaporative water loss.
  - Can be applied almost immediately
  - Does not need to be kept wet
  - Easiest to use
- Fogging or Sprinkling the surface with nozzles or spray
  - Lawn sprinklers or soaker hoses
- Burlap, mats and other absorbent materials
  - A continuous supply of moisture must be present
- Ponding or Immersion (seldom used)
- Plastic film
Good Curing Practice?
Good Curing Practice?
Good Curing Practice?
Concrete Durability
Construction Practices

- Finally, improper curing can affect durability. If micro cracks are allowed to form in the pavement surface, this can allow moisture to enter the pavement.
Protection from Traffic

Cured concrete looks like a good place to drive. How will you keep traffic off for full cure period?
Questions??

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