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These documents should not be used as a substitute for competent engineering advice, experience or project specifications. Cemstone cannot be responsible for misuse of these guidelines. Please contact your Cemstone Representative at 800-CEMSTONE or go to cemstone.com for more information.
SAFETY: CEMENT BURNS

EXPOSURE TO WET CONCRETE CAN LEAD TO SERIOUS INJURIES!
Exposure to concrete without proper use of the appropriate personal protective equipment can damage the skin. “Cement burns” range from minor redness or irritation to serious chemical burns.

ALKALI BURNS FROM WET CEMENT
Wet cement is caustic (with a pH as high as 12.9) and can produce third-degree alkali burns after 2 hours of contact. People must be aware of the potential danger from prolonged contact with wet cement. All people working with cement should be warned about its dangers and advised to immediately wash and dry the skin if contact does occur.

The primary irritant action of plastic (unhardened) concrete on the skin can be attributed to its abrasive, hygroscopic, and alkaline properties. Abrasive concrete components, such as sand and aggregate, can chafe the skin, thus weakening the skin’s defense against attack by the natural causticity of plastic concrete. The sensitive skin of the ankles, shins, wrists, and forearms seems most susceptible to this type of irritation. It is likely that small particles of sand work their way between the skin and clothing and abrade the skin when the clothing rubs against them.

Portland cement, which constitutes approximately 14% of the weight of concrete, is hygroscopic and, as such, tends to draw moisture from the skin. This can result in abnormally dry skin that can crack, thus further increasing susceptibility to attack by alkaline materials.

Portland cement contains 0.2% to 0.8% alkali (sodium and potassium oxides) and 0.1% to 1.0% free lime. When water is added to the dry ingredients of concrete, a caustic solution is produced; prolonged skin contact with the solution may cause first, second, or third degree chemical burns.

PREVENTION AND PERSONAL PROTECTIVE EQUIPMENT (PPE)
The best way to prevent cement-related skin problems is to minimize skin contact with wet portland cement. Compliance with OSHA’s requirements for provision of PPE, washing facilities, hazard communication and safety training, along with the good skin hygiene and work practices listed below, will protect against hazardous contact with wet cement.

- Anyone who may come into contact with wet portland cement should wear proper gloves. In question, consult the glove supplier or the cement manufacturer’s MSDS for help in choosing the proper gloves. Butyl or nitrile gloves (rather than cotton or leather gloves) are frequently recommended for caustic materials such as portland cement.
- Use only well-fitting gloves. Loose-fitting gloves let cement in. Often the use of gloves and clothing makes exposure worse when cement gets inside or soaks through the garment. Use glove liners for added comfort.
- Wash your and dry hands before putting on gloves. Wash your hands every time that you remove your gloves.
- Follow proper procedures for removing gloves, whether reusing or disposing them.
- Protect your arms, hands and legs by wearing a long sleeve shirt pants, duct-taped to your gloves and boots to prevent wet cement from getting inside.
- Wear protective goggles or face shield, hardhat, and protective over-boots.

SKIN CARE
- Wash areas of the skin that come into contact with wet cement in clean, cool water. Use a pH-neutral or slightly acidic soap. Check with the soap supplier or manufacturer for information on the acidity and alkalinity of the soap.
- Consider using a mildly acidic solution such as diluted vinegar or a buffering solution to neutralize caustic residues of cement on the skin.
- Do not wash with abrasives or waterless hand cleaners, such as alcohol-based gels or citrus cleaners.
- Avoid wearing watches and rings at work since wet cement can collect under such items.
- Do not use lanolin, petroleum jelly, or other skin softening products. These substances can seal cement residue to the skin, increase the skin’s ability to absorb contaminants, and irritate the skin. Skin softening products also should not be used to treat cement burns.
DANGER - CONCRETE MAY CAUSE BURNS TO EYES AND SKIN!

ROUTES OF ENTRY AND HEALTH EFFECTS: WARNING: INJURIOUS TO EYE, CAUSES SKIN IRRITATION. READ THIS WARNING BEFORE USING.

SKIN/EYE CONTACT: Fresh ready-mixed concrete has an alkalinity level of pH12 to pH13, and therefore may cause irritation and alkali burns, particularly when exposure is an area of skin previously subjected to abrasive or IRRITATION. Prolonged or repeated contact may cause allergic dermatitis in sensitive individuals. Skin contact may cause local irritation of the affected areas. Preexisting skin conditions may be aggravated by exposure.

INGESTION: Unlikely, may cause irritation.

INHALATION: Fresh ready-mixed concrete does not pose an inhalation hazard. However, sawing, grinding, cutting, drilling, or otherwise disturbing hardened concrete may contribute to elevated of airborne repairable silica dust, which may cause silicosis. Always use appropriate respiratory protection in dusty environments.

EMERGENCY AND FIRST AID PROCEDURES: DANGER: MAY CAUSE BURNS TO EYES AND SKIN, READ BEFORE USING.

SKIN CONTACT: Wash skin with large amounts of soap and water. For minor irritation, apply a lanolin-containing cream to skin after washing. Contact a physician if persistent or severe irritation or discomfort occurs/

EYE CONTACT: Contact a physician immediately. Flush eyes with large amounts of water for at least 15 minutes.

INGESTION: Due to the nature of this material, it is unlikely that it will be ingested. If this does occur, remove individual from the area. If the individual is conscious, two or three glasses of milk or water should be provided to dilute stomach contents. Do not induce vomiting. Contact a physician or poison control center.

AVISO: CONCRETO MEZCLADO FRESCO PUEDE CAUSAR IRRITACIÓN DE LA PIEL, GRAVES QUEMADAS QUÍMICAS O DAÑO PERJUDICIAL A LOS OJOS!!!

(vea el lado contrario para precauciones)

- Evite contacto con la piel y lárese pronto las partes expuestas con agua.
- Si él polvo del cemento o la mezcla fresca de concreto le cae eu los ojos, enjuáguese los ojos inmediatamente y repetidamente cou agua y obtenga pronto atencion medica.
- Evite contacto indirecto a través de la ropa. Enjuangle la ropa que h estado en contacto, cemento con el contreto, cemento o mortero mojado.

No Corra et Riesgo!

CEEB TOOM: COV XIS MAS UAS NYUAM QHUAV TOV TAU MUAJI PEEV XWM UA KOM YUS TEJ TAWV NQAIJ MOB KHAUS, MUJA TSHUAJ KUB, LOSSIS UA KOM QHOV MUAG PÚAS.

(xyuas sap nrauv kom paub txhuag)

- Ua knm cov tawv nqaij bhob moba Mob, muab dej ntxuav kom huv si.
- Yog cov hmoov lossis cov xis mas uas nyuam qhav tov tau nkag rau hauv qhov muag yuav tsum tau maub ntxuav tamn tamv thiab if sij ntxuav lb lwm thiab yuav tau maub tschuaj rau.
- Tsis txhob pub kom cov hmoov xis mas paug rau cov khaub ncaws. Maub cov khaub nc0aws uas paug lossis lo xis ntvxua.
- Yog yuav tov lossis pua xis mas yuav tsum hnav cov khaub ncaws raws li nmam no:
  - rau cov khaub roj hmab siab, rau cov khaub kom mws siab es cov xis mas thialj li nkag tsis tau
  - rau hnav rj los rob roj hmab
  - hnav ris nev, muab ntwas rau hauv nkawm khau
  - rau cov loj hauv caug thaij dej
  - rau cov iav taiv qhov muag

Tsis Txhob Kav Liam!
CONCRETE GUIDELINES

Cement
- Request the same type and/or source of cement to ensure color/shade consistency if available.

Coarse Aggregate
- Cemstone uses aggregates that comply with ASTM C 33 class designation 4S for exterior flatwork. According to the ARM of Minnesota “Understanding Concrete Pop-outs”, an average of 20 - 30 pop-outs per square yard can be expected when using gravel or limestone. Request ASTM C33 5S (MnDOT Class A) for architectural concrete where pop-outs are a concern.

Slump Recommendations
- 4 inches maximum without the use of a mid or high range water reducing chemical admixture. A higher slump can be delivered using chemical admixtures UPON REQUEST.
- Do not allow slump to greatly vary from load to load.

Durability Recommendations
- Water/cementitious materials ratio less than or equal to 0.45.
- Strength greater than or equal to 4500 psi at 28 days.
- An air content of 5 to 8 percent for ¾” maximum size coarse aggregate at the time of placement is recommended.
- The use of calcium chloride may cause discoloration. Avoid the use of calcium chloride for concrete containing reinforcing steel. A non-chloride accelerator may be used in these situations.

CONSTRUCTION AND FINISHING GUIDELINES

Subgrade
- Should be uniform in composition and provide adequate support throughout. A subgrade material that drains is recommended.
- If quality of subgrade is in question, contact a geotechnical engineer.
- Prior to placement, subgrade should be damp but not saturated.

Surface Slope
- Approximately 1/8 inch per-foot minimum without birdbaths.

Adding Water at the Job Site
- Water should NOT be added at the site in excess allowed by the water/cement ratio of the mix design. If additional slump adjustment is needed, water reducer must be used.
- A batch weight ticket noting available water to add can be requested from dispatch when placing your order for concrete.

Finishing
- All finishing should be conducted in accordance with the Portland Cement Association’s “Concrete Finishers Guide.” Contact your Cemstone Account Representative or refer to cement.org for more information.
- Steel trowels and aggressive or early finishing practices should be avoided to prevent blistering and damage to the surface air void system of air entrained mixes.

JOINTING GUIDELINES

Control Joints
- Joints should be installed in a timely manner and installed in accordance with ACI 302. Depending on subgrade conditions, install joints at spacings not exceeding 24 times the slab thickness in inches. (Example: a 4 inches x 24 = 8 feet, so joints cut every 8 feet in both directions).
- Joint spacing should not exceed 15 feet.

Joint Depth
- The joint depths should be 1/4 to 1/3 of the slab thickness.

Isolation Joints
- Install isolation joints wherever the slab abuts any other slab or structure.
APPLIcATIONS

The Cemstone’s Extreme Series performance concrete mix designs contain materials and proportions that have a proven track record. This series is streamlined to have one specific mix per application. If you are wondering which footing mix, wall mix, interior flatwork mix or exterior flat-work mix to use, just request the Extreme Series mix for your application.

Cemstone has spent extensive time performing durability testing and customer workability testing to come up with X-Series mixes that will provide the best performance results for the application. When the best finishing and most durable exterior concrete flatwork mix is wanted, then choose extreme performance mix XDRIVE.

MPCA CONCRETE WASHOUT GUIDELINES

Comply with all municipal, state, federal and/or environmental agency Construction Site Regulations and Permits. Customer acknowledges that they will not request or direct Cemstone to perform in any manner that is not in accordance with applicable regulations and permits. Cemstone will not wash out on construction sites, or be required to utilize any waste material containment system other than that provided by Cemstone. Cemstone will retain its own wash water utilizing a Cemstone provided wash out system or other approved Cemstone service, and will return wash water to a Cemstone plant for disposal and/or recycling in accordance with fees and regulations.
CURING CONCRETE GUIDELINES

ALKALI-SILICA REACTION (ASR)

With warmer ambient temperatures or heated environments the potential for Alkali-Silica Reactions (ASR) pop-outs increases. ASR is a chemical reaction between the alkalis from cement and reactive silica minerals in aggregate which form a gel. The gel expands causing internal pressure leading to cracking, spalling and superficial pop-outs. Fine aggregate pop outs can start soon after finishing and continue for several days. All of the native sand in Minnesota have the potential to contain a small amount of alkali-silica reactive material. Most sands are produced to conform with Mn/DOT 3137 or ASTM C33 and can contain amounts of these materials. While these pop outs do not affect the structural performance of the slab, they can present an aesthetic concern. The problems can be even more troublesome when they occur below resilient flooring materials.

ASR MITIGATION

- The problem can be prevented by flushing the concrete surface with water after finishing and before curing. This flushing will remove the alkalis the surface and effectively halt the reaction before the pop outs occur. The use of certain flooring materials or adhesives may cause the alkalis from the cement to concentrate beneath the flooring material. Caution should be taken when selecting the adhesive used to secure the flooring materials as they may also cause an increase of alkali concentration.
- Flushing should be performed any time the following conditions occur: (Ambient Temperature °F) + (Concrete Temperature °F) ≥ 160° F.
- Ensure that the temperature of the concrete surface is as low as practicable. Direct sunlight on the concrete should be avoided.
- Reduce the surface evaporation by curing the concrete with water. The use of ponding or wet burlap has been shown to greatly reduce the potential for pop outs. This should be done after the surface has been flushed with water.
- Do not use chemical hardeners that contain potassium silicate or sodium silicate.
- The use of acrylic curing compounds can potentially increase the likelihood of pop-outs. The acrylic curing compound can trap the alkalis that cause this problem.

CURING CONCRETE

Begin curing IMMEDIATELY after final finishing. To increase the surface durability and service life of your concrete, it must be properly cured. Properly cured concrete retains the water added at the time of batching to maximize the hydration process of the concrete. Properly hydrated concrete increases strength, abrasion and freeze/thaw resistance. It also decreases permeability and thereby extends the service life of your concrete. Inadequate curing will result in a significant loss of surface strength and durability.

Methods of curing include:

1. Moist curing (ponding, continuous sprinkling or fogging)
2. Wet coverings (wet burlap, burlene, etc.)
3. Impervious paper and plastic sheets (preferably light in color)
4. Membrane-forming curing compounds

![Effect of Curing on Compressive Strength of Concrete](image-url)
CURING CONCRETE GUIDELINES

CURING CONCRETE BEFORE OCTOBER 1ST

MEMBRANE FORMING CURING COMPOUND
Apply a uniform curing compound membrane immediately after the final finishing is completed. In hot weather, flush the surface with water when safe to do so without marring the surface, and before curing to minimize alkali-silica reaction (ASR).

Method 1: Wet Cure or CPC Dissipating Cure (water base)
Wet curing methods are chosen to provide thorough hydration, and a more evenly cured slab. New (recommended) wet curing products manufactured with natural cellulose fabric provide constant hydration and maintain 100% relative humidity condition on the slab providing a curing period up to 14 days.

Apply CPC Dissipating Cure water base at a rate of 300-400 square feet per gallon for broom finished concrete. Reference the product data sheet for coverage rate on all other concrete finishes.

Method 2: CPC CURE & SEAL (Solvent or Water Base)
Apply CPC Cure & Seal at a coverage rate not to exceed 300 square feet per gallon for broom-finished concrete. Over application may result in uneven color or discoloration. Reference the product data sheet for coverage on all other concrete finishes.

NOTE: Timing of the concrete cure is MORE crucial with ALL granite, quartzite and trap rock coarse aggregate mixes.

CURING CONCRETE AFTER OCTOBER 1ST
SPECIAL PRECAUTIONS MUST BE TAKEN WHEN PLACING/SEALING EXTERIOR CONCRETE AFTER OCTOBER 1ST TO ALLOW AMPLE TIME (generally 28 days) FOR THE CONCRETE TO DRY BEFORE UNDERGOING FREEZE/THAW CYCLES. Contact your Cemstone Sales Representative for more information.

SEALING CONCRETE
Properly sealing concrete helps maintain the appearance and durability of the concrete. Sealers should be applied approximately 28 days following placement. Sealing is designed to keep moisture and contaminants like deicing chemicals from penetrating into the concrete. Sealing your concrete should be implemented by one of the following methods:

SEALING CONCRETE BEFORE OCTOBER 1ST

Method 1: IF THE CONCRETE HAS BEEN CURED WITH CPC DISSIPATING CURE WATER BASED:
Approximately twenty-eight (28) days after installation seal the concrete by applying CPC Siloxane, (a penetrating water repellent sealer), at a rate of 100 to 200 square feet per gallon. Surface finish will determine actual coverage rate. An aggressive power washing or power brooming may be required to remove the dissipating cure prior to sealing.

NOTE: Using a dissipating cure or wet cure method allows for the flexibility to use ALL the recommended concrete sealers.

Method 2: IF THE CONCRETE HAS BEEN CURED WITH CPC CURE & SEAL (SOLVENT BASED OR WATER BASED):
Approximately twenty-eight (28) days after installation apply CPC Cure and Seal, CPC Super Clear Coat, CPC Super Diamond Glaze, DURA-CRETE® Weather Shield or CPC Siloxane Final Seal to the concrete. Recommended coverage rate varies by product and concrete finish, please verify recommended manufacturer’s coverage rate. DO NOT USE CPC SILOXANE.

SEALING CONCRETE AFTER OCTOBER 1ST
SPECIAL PRECAUTIONS MUST BE TAKEN WHEN PLACING/SEALING EXTERIOR CONCRETE AFTER OCTOBER 1ST TO ALLOW AMPLE TIME (generally 28 days) FOR THE CONCRETE TO DRY BEFORE UNDERGOING FREEZE/THAW CYCLES. Contact your Cemstone Sales Representative for more information.

REAPPLYING SEALER
Since sealers eventually will degrade from environmental effects and no longer function as intended, concrete should be sealed on a regular basis in accordance with the sealer manufacturer’s instructions or as needed. Before applying any sealer, thoroughly clean by pressure washing with water. Allow at least 72 hours to dry before application.
DECORATIVE CONCRETE GUIDELINES

Decorative Concrete can incorporate: color, exposed aggregate finishes, specialty concrete toppings, and specialty concrete finishes. Concrete color is achieved with (1) integral color added at the ready mixed concrete plant, (2) color hardeners broadcast onto the surface of fresh concrete (3) antique form-release agents and/or (4) specialty concrete toppings. A combination of these processes can be used to expand the possibilities of decorative concrete design and to customize a particular look for an owner.

Cemstone’s 50 standard integral colors can be used to enhance most brick, siding, colored block and stone products to provide a continuation of a building’s interior or exterior color schemes. Now add the options of color hardeners, acid staining and specialty floor topping options, and your choices are endless!

When choosing colors from our color selector, keep in mind that the colors shown on paper are an approximation of the final concrete color. Concrete has a natural variation in appearance similar to marble, granite and wood. The natural color of various concrete materials, finishing practices, and/or curing and sealing will affect the color of the hardened concrete.

Test panels best represent in-place conditions. They are the method of ensuring that the final in-place concrete will not only be the correct color choice, but also the finish that will meet your owner’s expectations. Test panels should be reviewed no less than 28 days after placement. Test panels should be cast from a minimum load size of at least 3 cubic yards.

FINISHING *

Integral Color

All finishing should be conducted in accordance with the Portland Cement Association’s "Concrete Finisher's Guide." Contact your Cemstone Account Representative for more information.

Color Hardener

After initial finishing and when bleed water is no longer present, apply the color hardener. Color hardeners are placed in two separate applications, with 2/3 of the material used in the first application. The remaining 1/3 should be placed perpendicular to the first application.

* NOTE: Take precautions to protect the surrounding areas, adjoining surfaces, landscaping, etc. Use wood or magnesium floats to work the color hardener into the surface. Do NOT use steel trowels. Finish in accordance with the Portland Cement Association’s "Finishing Concrete with Color and Texture".

Stamping and Accent Colors

Method 1: Add accent color hardener in the color and quantity desired. Float the material into the surface, then proceed to stamp.

NOTE: A liquid form release must be used to prevent the concrete from sticking to the stamps.

Method 2: Add antiquing release powder without floating the material into the surface, then proceed to stamping. After the concrete has reached a strength where it can withstand washing (approximately 24 hours) sufficiently remove excess release powder with a soft bristled broom and a mild detergent.

DECORATIVE CURING

△ Begin IMMEDIATELY after final finishing
△ Concrete MUST be cured to provide a dense, durable surface.
△ Special care must be taken when curing decorative concrete to prevent efflorescence at the concrete surface.
△ Covering decorative concrete with plastic or sprinkling it with water is NOT recommended.
△ For surface treatments, overlays or other specialty products, consult with your manufacturer for any precautionary measures for decorative concrete.
△ Ensure that your curing method is compatible with the proposed concrete sealing program

DECORATIVE SEALING

△ Sealer should be applied whenever it's compatible with the other materials used in the concrete slab.

NOTE: The concrete surface must be thoroughly cleaned and dried prior to the application of sealer.
△ Follow the manufacturer’s recommendations for drying time before applying a concrete sealer.
△ Sealer may need to be re-applied when the color has lost its original appearance.
△ Ensure that your sealer is compatible with the implemented curing program.
## CURING & SEALING DECORATIVE CONCRETE OPTIONS

<table>
<thead>
<tr>
<th>CURING</th>
<th>SEALING</th>
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<tbody>
<tr>
<td><strong>ONE-COLOR INTERIOR</strong></td>
<td></td>
</tr>
<tr>
<td>CPC Cure and Seal WB</td>
<td>*CPC Cure and Seal Bright Seal WB</td>
</tr>
<tr>
<td>CPC Dissipating Cure</td>
<td></td>
</tr>
<tr>
<td><strong>MULTI-COLOR INTERIOR</strong></td>
<td></td>
</tr>
<tr>
<td>CPC Cure and Seal WB</td>
<td>*CPC Cure and Seal Bright Seal WB</td>
</tr>
<tr>
<td><strong>ONE-COLOR EXTERIOR</strong></td>
<td></td>
</tr>
<tr>
<td>*CPC Cure and Seal</td>
<td>*CPC Super Clear Coat or Diamond Glaze</td>
</tr>
<tr>
<td>CPC Cure and Seal WB</td>
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<td>CPC Dissipating Cure</td>
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</tr>
<tr>
<td>*CPC Cure and Seal WB</td>
<td>*CPC Super Clear Coat or Diamond Glaze</td>
</tr>
</tbody>
</table>

**Preferred Application Method:**
Airless Sprayer, Tip Size of 0.013 - 0.018" or Hand-Pump-up Sprayer with Back Rolling

- CPC Dissipating Cure is to be used as a cure ONLY when other SPECIAL final treatments are to be used such as urethane/epoxy coatings, siloxane/silanes or hardener/densifiers.

- Solvent based curing compounds will tend to have a darkening effect and will take longer to become uniform in color.

A test pour with various curing methods is recommended to ensure the desired results and to determine the time needed to achieve the appearance (see Manufacturer's recommendations for coverage rates). Please consult with a Cemstone Representative if wet curing with NCF Ultra-Cure blankets is desired.

Depending on desired results, CPC Siloxane or CPC Super Clear Coat can be applied as a sealer after 28 days (CPC Pigmented Siloxane is specially formulated waterproofing treatment with pigment added to help produce a uniform color on concrete).

It is NOT recommended to steel trowel colored concrete. This will cause discoloration.

### RECOMMENDATIONS TO ENSURE CONSISTENT COLOR:

- Use the same type and quality of Portland cement from load to load if available.
- Use the same amount of water from load to load.
- Use the same curing method throughout the project.
- Consistently follow the same finishing practices throughout the project. Place in consistent weather conditions as much as possible.
- Read the applicable manufacturer's technical data sheet to ensure thorough understanding of the product.
- See the manufacturer’s recommendations for coverage rates.
ACI 305  HOT WEATHER CONCRETING

HOT WEATHER IS ANY COMBINATION OF THE FOLLOWING CONDITIONS THAT TEND TO IMPAIR THE QUALITY OF FRESHLY MIXED CONCRETE BY ACCELERATING THE RATE OF MOISTURE LOSS AND RATE OF CEMENT HYDRATION, OR OTHERWISE CAUSING DETRIMENTAL RESULTS:

- High ambient temperature
- High concrete temperature
- Low relative humidity
- Solar radiation

THE FOLLOWING LIST OF PRACTICES AND MEASURES TO REDUCE OR AVOID THE POTENTIAL PROBLEMS OF HOT WEATHER CONCRETING ARE:

- Select concrete materials and proportions with satisfactory records in hot weather conditions.
- Cool the concrete.
- Use a concrete consistency that permits rapid placement and effective consolidation.
- Minimize the time to transport, place, consolidate, and finish the concrete.
- Plan the job to avoid adverse exposure of the concrete to the environment; schedule placing operations during times of the day or night when weather conditions are favorable.
- Protect the concrete from moisture loss during placing and curing periods; and
- Schedule a pre-placement conference to discuss the requirements of hot weather concreting.

POTENTIAL PROBLEMS FOR CONCRETE IN THE FRESHLY MIXED STATE ARE:

- Increased water demand.
- Increased rate of slump loss and corresponding tendency to add water at the job site.
- Increased rate of setting, resulting in a greater difficulty with handling, compacting and finishing and a greater risk of cold joints.
- Increased tendency for plastic shrinkage cracking.
- Increased difficulty in controlling entrained air content.

POTENTIAL DEFICIENCIES TO CONCRETE IN THE HARDENED STATE MAY INCLUDE:

- Use of cements with increased rate of hydration.
- Use of high-compressive-strength concrete, which requires higher cement contents.
- Design of thin concrete sections with correspondingly greater percentages of steel, which complicate placing and consolidation of concrete.
- Economic necessity to continue work in extremely hot weather; and
- Use of shrinkage-compensating cement.

HYDRATION STABILIZER ADMIXTURE USE AT HIGH TEMPERATURES

The following chart provides estimated hydration stabilizer dosages needed for additional working time based on the concrete temperature.

<table>
<thead>
<tr>
<th>Concrete Temperature</th>
<th>0.5-1 Hour</th>
<th>1-1.5 Hours</th>
<th>1.5-2 Hours</th>
<th>2.25 Hours</th>
<th>2.5-3 Hours</th>
<th>3-3.5 Hours</th>
<th>4-4.5 Hours</th>
<th>5-5.5 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>100°F - 109°F</td>
<td>5 oz./cwt</td>
<td>6 oz./cwt</td>
<td>7 oz./cwt</td>
<td>8 oz./cwt</td>
<td>9 oz./cwt</td>
<td>10 oz./cwt</td>
<td>11 oz./cwt</td>
<td>12 oz./cwt</td>
</tr>
<tr>
<td>90°F - 99°F</td>
<td>4 oz./cwt</td>
<td>5 oz./cwt</td>
<td>6 oz./cwt</td>
<td>7 oz./cwt</td>
<td>8 oz./cwt</td>
<td>9 oz./cwt</td>
<td>10 oz./cwt</td>
<td>11 oz./cwt</td>
</tr>
<tr>
<td>80°F - 89°F</td>
<td>3 oz./cwt</td>
<td>4 oz./cwt</td>
<td>5 oz./cwt</td>
<td>6 oz./cwt</td>
<td>7 oz./cwt</td>
<td>8 oz./cwt</td>
<td>9 oz./cwt</td>
<td>10 oz./cwt</td>
</tr>
<tr>
<td>70°F - 79°F</td>
<td>2 oz./cwt</td>
<td>3 oz./cwt</td>
<td>4 oz./cwt</td>
<td>5 oz./cwt</td>
<td>6 oz./cwt</td>
<td>7 oz./cwt</td>
<td>8 oz./cwt</td>
<td>9 oz./cwt</td>
</tr>
<tr>
<td>60°F - 69°F</td>
<td>1 oz./cwt</td>
<td>2 oz./cwt</td>
<td>3 oz./cwt</td>
<td>4 oz./cwt</td>
<td>5 oz./cwt</td>
<td>6 oz./cwt</td>
<td>7 oz./cwt</td>
<td>8 oz./cwt</td>
</tr>
</tbody>
</table>

CWT - 100 lb of Cementitious
If the evaporation rate exceeds 0.1 pounds per square foot per hour but is less than 0.2 pounds per square foot per hour, provide the following concrete evaporation protection.

1. Take special precautions to ensure that the forms and subgrade are sufficiently moist or protected to avoid lowering the water content at the pavement/subgrade interface. In hot weather conditions, moisten the subgrade the evening before operations.
2. Minimize solar heat by shading, or wetting, concrete chutes or other equipment that comes in contact with plastic concrete.
3. Use a fog spray to raise the relative humidity of the ambient air if there is a delay in immediately applying the curing compound.
4. Ensure that the time between placing and curing is minimized and eliminate delays.
5. Immediately apply an approved evaporation retarder to the concrete pavement and curbs or increase the surface cure application to 1.5 times the standard specified rate.
6. Use monofilament fibers to reduce the potential for plastic shrinkage.

If the evaporation rate is 0.2 pounds per square foot per hour or greater, take extreme precautions with the placement of concrete.

Source: ACI305 R-10

TO USE THIS CHART:
1. Enter with air temperature, move UP to relative humidity.
2. Move RIGHT to concrete temperature.
3. Move DOWN to wind velocity.
4. Move LEFT, read approximate rate of evaporation.

Use the on-line Evaporation Calculator Forecast Tool for current evaporation rates.
www.cemstone.com/concrete-evaporation-forecast.cfm
COLD WEATHER CONCRETE PRACTICES

During fall and winter seasons, we recommend having a cold weather concreting plan for every exterior concrete placement. It is your obligation to understand industry codes/standards and follow best practices. The American Concrete Institute 306 “Guide to Cold Weather Concreting” states that cold weather concreting exists when the air temperature has fallen to, or is expected to fall below 40°F during the protection period. The protection period is defined as the time required to prevent the in-situ concrete from being affected by exposure to cold weather. Concrete placed during cold weather must develop sufficient strength and durability to satisfy the intended service requirements when it is properly produced, placed, and protected. The necessary degree of protection increases as the ambient temperature decreases. A copy of ACI 306 is available for purchase upon request or at www.concrete.org.

The following information will help prevent cold weather STRUCTURAL concrete issues according to ACI 306:

- In dry conditions, it is critical to maintain concrete temperatures for at least the first 72 hours or until the concrete obtains a compressive strength of 500 psi with the use of thermal blankets, straw, etc.
- In wet conditions, it is critical to maintain concrete temperatures for at least the first week, or until the concrete obtains a compressive strength of 3500 psi with the use of thermal blankets, insulations, heated enclosures, etc.

DESIGN AND DURABILITY REQUIREMENTS

Exterior flatwork must be durable to withstand freeze/thaw surface defects. ACI 318-14 Chapter 19 “Design and Durability Requirements” recommends that exterior concrete be a minimum of 4500 psi, have a maximum water/cement ratio of 0.45 and have an air content of 6.0 ± 1.5% for ¾” or 1” aggregate for freezing and thawing in exposure class F2 & F3 for plain concrete. Many mix designs that meet DOT or municipal specifications do not meet the requirements to mitigate surface defects such as scaling. All concrete placed should be cured to maintain moisture and temperature for the first 7 days. After this initial curing period, the concrete needs to air-dry 30 days before being exposed to freeze/thaw cycles and deicers.

Deicing chemicals can cause concrete to deteriorate as the result of salt crystallization within the pores of both cement paste and aggregate, and they can also cause chemical changes to the cement paste. Concrete is more likely to experience surface defects after the winter season when the concrete does not achieve adequate strength and/or is not allowed to properly air-dry. If there is insufficient time for drying, boiled linseed oil could be applied to the surface which will let moisture out but keep water from entering the concrete.

Cemstone does not recommend the use of acrylic curing compounds and/or sealers within 30 days of freezing temperatures and throughout the winter months. Acrylic membranes do not allow the concrete to properly air-dry prior to freeze/thaw cycles.

During the cold weather concreting season, Cemstone heats mixing water and/or aggregates to keep concrete temperatures at or above 60°F at the time of batching. Cemstone warrants that the concrete will obtain the designed compressive strength and contain the designed air content at the point of delivery when it is strictly tested according to the corresponding ASTM procedure. Job site adjustments may be needed for slump and/or air content for project specification range compliance.

Cemstone will not be responsible for concrete failures due to improper cold weather plans, placing practices, incorrect mix design selection, protection, curing and/or maintenance. If you have any questions or concerns, please do not hesitate to call your Account Representative or Cemstone’s Engineering Services.
COLD WEATHER CONCRETE PRACTICES

ACI 306R - 10
COLD WEATHER CONCRETING

Cold weather exists when the air temperature has fallen to, or is expected to fall below 40°F (4°C) during protection period. The protection period is defined as the time required to prevent concrete from being affected by exposure to cold weather. Concrete placed during cold weather will develop sufficient strength and durability to satisfy the intended service requirements when it is properly produced, placed and protected. The necessary degree of protection increases as the ambient temperature decreases.

TOP 10 COLD WEATHER TIPS YOU NEED TO KNOW FOR STRUCTURAL CONCRETE

1) To prevent damage to the concrete due to early age freezing, when no external water is available, concrete should be protected until it obtains a minimum COMpressive STRENGTH OF 500 psi (for residential concrete this is typically two days after placement for concrete maintained at 50°F).

2) Concrete should not be allowed to freeze and thaw in a saturated condition before developing a COMpressive STRENGTH OF 3500 psi. New flatwork exposed to melting snow and freezing should be air entrained and protected from freezing until attaining at least 3500 psi.

3) FROZEN SUBGRADE can cause the concrete to freeze as well as cause soil expansion and contraction issues to arise in the spring. This can be reduced by using coarse grained soil above any frost susceptible soil.

4) MINIMIZE RAPID TEMPERATURE CHANGES, particularly before the concrete has developed sufficient strength to withstand thermal stresses which can cause cracking.

5) The use of HIGH EARLY MIX DESIGNS OR ACCELERATING CHEMICAL ADMIXTURES is recommended during cooler temperatures to increase the speed of hydration and mitigates free water from freezing. Avoid calcium chloride if the concrete contains steel reinforcement.

6) CYLINDERS must be cured according to ASTM C 31 which specifies initial curing within 60 to 80°F (cure boxes, blankets or other curing methods must be used in order to comply with ASTM specifications). ASTM C 31 also requires that cylinders must be initially cured in an environment free of evaporation and stored for not longer than 48 hours prior to being taken to the laboratory for final curing.

7) AVOID USING UNVENTED HEATERS: CARBON DIOXIDE from the heaters can cause soft, dusting floors when the concrete dries very quickly.

8) Allow ample time for BLEED WATER to dissipate before final finishing. Trapping bleed water in the concrete can cause higher water/cement ratios at the surface and may cause scaling and/or blistering.

9) PROPER CURING procedures must be followed immediately after finishing is completed.

10) MONITOR CONCRETE TEMPERATURES. Concrete corners and edges are vulnerable to freezing and usually more difficult to maintain the required temperature.

If you have any QUESTIONS, call your Cemstone Representative or reference the Cemstone Cold Weather Resource Guide.
Exterior concrete flatwork such as driveways, patios, loading docks, building entrances and walkways can greatly enhance the aesthetics and value of your property. Many factors play a role in sustaining the durability of your concrete. Cemstone proportions exterior concrete mix designs according to American Concrete Institute guidelines. Having the correct mix design alone, will not guarantee durability. It is also how the mix is produced, placed, finished, cured and then maintained that determines the quality and longevity of the concrete. Early-age protection of the concrete surface is critical, therefore curing should begin immediately after final finishing. Inadequate curing will result in a significant loss of surface strength and durability.

HOW TO MAINTAIN YOUR EXTERIOR CONCRETE

SEALING
Sealing helps maintain the appearance and durability of concrete. Sealers are designed to keep moisture and contaminants like deicing chemicals from being absorbed into the concrete. Since sealers will wear over time and no longer function as intended, concrete should be sealed on a regular basis. Reapply sealer per the manufacturer’s recommendations or as needed. You can spot check your concrete to determine when sealers need to be reapplied. When water no longer beads on the surface of the concrete, it is time to reseal.

PREVENTING FREEZE-THAW DAMAGE
Two key conditions must occur to create deteriorating freeze-thaw damage. The first condition is saturation of the concrete, and the second condition is freeze-thaw cycles. Without the combination of these conditions, damage will not occur.

The use of deicing chemicals often accelerates surface deterioration of concrete. This is especially true with new concretes which have not had ample amount of time for internal moisture to dry out. Deicing chemicals lower the freezing point of water and also allow water to saturate further into the concrete.

- Avoid using deicing chemicals on your concrete, especially for the first winter. Sand or traction grit can be used for traction.
- Promptly remove snow and ice accumulation manually from your concrete.

UNIFORM COLOR
Uniform appearance is created by following a uniform process during the installation. The subgrade should be a uniformly graded base material. All organic matter and clay soils should be removed from the subgrade. Make sure the mix design is the same for every pour and use a consistent water/cement ratio. Request to use the same brand of cement when matching existing concrete. Adding chloride accelerators may cause darkening. Over-finishing a surface or using different finishing techniques can change the appearance. The ambient conditions during placement as well as the curing method can also affect color.

PROTECTING YOUR INVESTMENT

- The best maintenance is the preventative kind. Preventative maintenance involves cleaning with a broom or rinsing to remove dirt and debris when weather permits. Make sure your concrete is sealed PRIOR to the first winter.
- Promptly remove snow and ice accumulation manually from your concrete.
- Avoid using de-icing chemicals on your concrete, especially for the first winter. Sand or traction grit can be used for traction.
- Remove stains immediately. While sealer will help to protect concrete from stain absorption, it’s still a good idea to remove oil, gasoline or other spills as soon as possible.
- Avoid using harsh acids for cleaning concrete. Use products designed for use on concrete.
- Fertilizers contain substances which chemically attack concrete. Promptly sweep off any fertilizer that is inadvertently cast on the concrete when spreading lawns.
- Channel water away from concrete surfaces by using properly located eaves and down-sprouts.
- Trees, bushes, and other plants roots can cause heaving or cracking if they are not properly spaced from the concrete. Be aware that vegetation droppings can stain the concrete.
CRACKING
Concrete expands and contracts with changes of moisture and temperature and deflects depending on load and support conditions. Cracks can occur due to the following:

- Plastic shrinkage cracks caused by high evaporation rates during placement
- Improper jointing
- Continuous external restraint
- Lack of isolation joints
- D-cracks from freezing and thawing
- Craze cracks from shrinkage of the dense paste layer at the surface
- Settlement cracks caused by inadequate subgrade

SCALING
Scaling is the localized flaking or peeling of a weakened concrete surface exposed to freezing and thawing. Light scaling does not expose the coarse aggregate. Moderate scaling exposes aggregate (1/8-inch to 3/8 inch deep).

HOW TO PREVENT SCALING:

- Concrete needs to have adequate air entrainment.
- Use correct timing for finishing operations: Finishing too early may results in trapping of the bleed water minimized surface air content which decreases the freeze/thaw durability.
- High evaporation rates caused by high temperatures, high winds and/or low relative humidity can cause premature drying of the surface.
- Do not use deicing chemicals, instead use sand or traction grit to provide traction on icy surfaces.
- Never leave fertilizers which contain ammonium sulfate or ammonium nitrate on the concrete.
- Concrete slabs should be constructed for proper drainage to prevent water from standing on the surface.
- Provide proper curing to ensure the chemical reaction of cement with water occurs.

MORTAR FLAKING
Mortar flaking is the dislodging of small sections of surface concrete, usually smaller than a dime, directly above coarse aggregate particles. Mortar flaking is typically very shallow in depth and consists of distinct delaminations (flakes) that occur directly over the coarse aggregate particles in the concrete. It is most common in exterior concrete exposed to freeze/thaw conditions but can occur any time rapid evaporation has occurred immediately after finishing.

HOW TO PREVENT MORTAR FLAKING
Mortar flaking typically occurs in concrete that was not properly cured immediately and for the following 7 days. Therefore addressing curing procedures is a must.

All concrete requires curing in order that the chemical reaction between the batch water and the cementitious materials can occur. This permits the mix to develop the strength and durability it is capable of. Curing techniques are those that trap water inside the concrete for a week or more or, like poly or wet burlap, that trap water against the exposed surface. While wet curing provides the best curing conditions, most exterior concrete surfaces are more practically cured by spraying on a liquid curing compound.

POP-OUTS
Because concrete is made from natural products it may have some natural imperfections. A pop-out is a cone-shaped cavity in a horizontal concrete surface left after an aggregate close to the surface has expanded and fractured. A pop-out can be caused by either a physical reaction or a chemical reaction.

Physical: A physical reaction is when a porous rock absorbs water and freezes, causing the rock to expand and fracture.

Chemical: An example of a chemical reaction is when alkalis in the cement react chemically with the silica found in some aggregates, a gel is formed which expands causing a small surface pop-out.

According to the Aggregate and Ready-Mix Association of Minnesota, one can expect some pop-outs per square yard depending on the type of aggregate used. Pop-outs do not in any way decrease the structural integrity of a concrete slab. Please see ARM’s “Understanding Concrete Pop-outs” for expectations.
## FIBERS

**DO NOT ADD BAGS OR BOXES TO THE LOAD.**
Mix for a minimum of 5 minutes or 70 revolutions after adding fibers.

### MICRO SYNTHETIC FIBERS
(Appearance: Fine)
Reduces potential of plastic shrinkage and settlement cracking.

<table>
<thead>
<tr>
<th>Company</th>
<th>Product Code(s)</th>
<th>Dosage Rate</th>
<th>Additional Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASF MonoFilament Fibers M100</td>
<td>20-M, 20-MNC</td>
<td>0.5 lb per yard</td>
<td>Add fibers BEFORE loading</td>
</tr>
<tr>
<td>BASF Fibrillated Fibers F100</td>
<td>20-F, 20-FNC</td>
<td>1.5 lbs per yard</td>
<td>Add fibers BEFORE loading</td>
</tr>
<tr>
<td>WR Grace *</td>
<td>Strux 90/40</td>
<td>1.5 lb bag</td>
<td>Add fibers AFTER loading</td>
</tr>
<tr>
<td>Forta *</td>
<td>Ferro F100</td>
<td>2.5 lb bag</td>
<td>Add fibers AFTER loading</td>
</tr>
<tr>
<td>Helix Fibers *</td>
<td>93HX, 93HXNC</td>
<td>45 lb bag</td>
<td>Add fibers AFTER loading</td>
</tr>
<tr>
<td>Bekaert *</td>
<td>Dramix 3D</td>
<td>44 lb bag</td>
<td>Add fibers AFTER loading</td>
</tr>
</tbody>
</table>

### MACRO SYNTHETIC FIBERS
(Appearance: Coarse)
Secondary reinforcement to control plastic shrinkage, temperature and settlement cracking.
Post Crack Control • Maintain Aggregate Interlock

<table>
<thead>
<tr>
<th>Company</th>
<th>Product Code(s)</th>
<th>Dosage Rate</th>
<th>Additional Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASF MAC Matrix</td>
<td>20-M470, 20-M470NC</td>
<td>5 lb bag</td>
<td>Add fibers AFTER loading</td>
</tr>
<tr>
<td>WR Grace *</td>
<td>Strux 90/40</td>
<td>5 lb bag</td>
<td>Add fibers AFTER loading</td>
</tr>
<tr>
<td>Forta *</td>
<td>Ferro F100</td>
<td>2.5 lb bag</td>
<td>Add fibers AFTER loading</td>
</tr>
<tr>
<td>Helix Fibers *</td>
<td>93HX, 93HXNC</td>
<td>45 lb bag</td>
<td>Add fibers AFTER loading</td>
</tr>
<tr>
<td>Bekaert *</td>
<td>Dramix 3D</td>
<td>44 lb bag</td>
<td>Add fibers AFTER loading</td>
</tr>
</tbody>
</table>

### STEEL FIBERS
Reinforcement for shrinkage, temperature and flexural reinforcement.

<table>
<thead>
<tr>
<th>Company</th>
<th>Product Code(s)</th>
<th>Dosage Rate</th>
<th>Additional Information</th>
</tr>
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<tbody>
<tr>
<td>Helix Fibers *</td>
<td>93HX, 93HXNC</td>
<td>45 lb bag</td>
<td>Add fibers AFTER loading</td>
</tr>
<tr>
<td>Bekaert *</td>
<td>Dramix 3D</td>
<td>44 lb bag</td>
<td>Add fibers AFTER loading</td>
</tr>
</tbody>
</table>

* Please allow 7 business days for shipping.
# FIBER CONVERSION FOR SLAB ON GROUND

**Source:** BASF Construction Chemicals LLC, Fiber Wizard

<table>
<thead>
<tr>
<th>SLAB DEPTH</th>
<th>SPECIFIED STEEL</th>
<th>FIBER OPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 inch</td>
<td>6 x 6 - 10 x 10 W1.4 Mesh</td>
<td>F100 - 1.5 lb./cyd</td>
</tr>
<tr>
<td>5 inch</td>
<td>6 x 6 - 10 x 10 W1.4 Mesh</td>
<td>F100 - 1.5 lb./cyd</td>
</tr>
<tr>
<td>4 inch</td>
<td>6 x 6 - 8 x 8 W2.1 Mesh</td>
<td>MAC Matrix - 2.0 lb./cyd</td>
</tr>
<tr>
<td>5 inch</td>
<td>6 x 6 - 8 x 8 W2.1 Mesh</td>
<td>MAC Matrix - 2.0 lb./cyd</td>
</tr>
<tr>
<td>4 inch</td>
<td>6 x 6 - 6 x 6 W2.9 Mesh</td>
<td>MAC Matrix - 3.5 lb./cyd</td>
</tr>
<tr>
<td>5 inch</td>
<td>6 x 6 - 6 x 6 W2.9 Mesh</td>
<td>MAC Matrix - 3.0 lb./cyd</td>
</tr>
<tr>
<td>4 inch</td>
<td>#3 Rebar 36 in OC EW</td>
<td>MAC Matrix - 3.0 lb./cyd</td>
</tr>
<tr>
<td>4 inch</td>
<td>#3 Rebar 30 in OC EW</td>
<td>MAC Matrix - 3.0 lb./cyd</td>
</tr>
<tr>
<td>4 inch</td>
<td>#3 Rebar 24 in OC EW</td>
<td>MAC Matrix - 3.2 lb./cyd</td>
</tr>
<tr>
<td>4 inch</td>
<td>#3 Rebar 18 in OC EW</td>
<td>MAC Matrix - 4.8 lb./cyd</td>
</tr>
<tr>
<td>4 inch</td>
<td>#4 Rebar 36 in OC EW</td>
<td>MAC Matrix - 4.1 lb./cyd</td>
</tr>
<tr>
<td>4 inch</td>
<td>#4 Rebar 30 in OC EW</td>
<td>MAC Matrix - 5.2 lb./cyd</td>
</tr>
<tr>
<td>4 inch</td>
<td>#4 Rebar 24 in OC EW</td>
<td>MAC Matrix - 6.8 lb./cyd</td>
</tr>
<tr>
<td>4 inch</td>
<td>#4 Rebar 18 in OC EW</td>
<td>Engineered Steel Fiber</td>
</tr>
<tr>
<td>5 inch</td>
<td>#3 Rebar 36 in OC EW</td>
<td>MAC Matrix - 3.0 lb./cyd</td>
</tr>
<tr>
<td>5 inch</td>
<td>#3 Rebar 30 in OC EW</td>
<td>MAC Matrix - 3.0 lb./cyd</td>
</tr>
<tr>
<td>5 inch</td>
<td>#3 Rebar 24 in OC EW</td>
<td>MAC Matrix - 3.0 lb./cyd</td>
</tr>
<tr>
<td>5 inch</td>
<td>#3 Rebar 18 in OC EW</td>
<td>MAC Matrix - 3.6 lb./cyd</td>
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<td>#3 Rebar 16 in OC EW</td>
<td>MAC Matrix - 4.2 lb./cyd</td>
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<td>5 inch</td>
<td>#3 Rebar 12 in OC EW</td>
<td>MAC Matrix - 6.0 lb./cyd</td>
</tr>
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<td>#4 Rebar 36 in OC EW</td>
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<tr>
<td>5 inch</td>
<td>#4 Rebar 30 in OC EW</td>
<td>MAC Matrix - 3.9 lb./cyd</td>
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<td>5 inch</td>
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<td>MAC Matrix - 5.2 lb./cyd</td>
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<tr>
<td>5 inch</td>
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<td>Engineered Steel Fiber</td>
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<td>6 inch</td>
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<td>6 inch</td>
<td>#4 Rebar 30 in OC EW</td>
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</tr>
<tr>
<td>6 inch</td>
<td>#4 Rebar 24 in OC EW</td>
<td>MAC Matrix - 4.1 lb./cyd</td>
</tr>
<tr>
<td>6 inch</td>
<td>#4 Rebar 18 in OC EW</td>
<td>MAC Matrix - 5.9 lb./cyd</td>
</tr>
</tbody>
</table>
CHEMICAL ADMIXTURES

AIR ENTRAINMENT ADMIXTURE (AEA):
Facilitate the development of a stable air void system within concrete that increases the durability of the concrete. Sufficient quantities and size of air bubbles results in increased resistance to deterioration from cyclic freezing and thawing exposure conditions. These products also improve workability and cohesiveness of concrete.

MID-RANGE WATER REDUCER (MRWR):
Improves concrete strength by reducing the water/cement ratio and enhances hydration. The most versatile of the plasticizers, it improves concrete performance with excellent early strength and rheology.

HIGH-RANGE WATER REDUCER (HRWR):
High range water reducers are used where well-dispersed particle suspension is required. These polymers are used as dispersants to avoid particle segregation and to improve the flow characteristics of the concrete. Their addition to concrete or mortar allows the reduction of the water/cement ratio and enables the production of self-consolidating concrete and high performance concrete.

VISCOSITY MODIFYING ADMIXTURE (VMA):
Developed for producing concrete with enhanced viscosity and controlled rheological properties. VMAs exhibit superior stability which increasing resistance to segregation during placement.

NON-CHLORIDE ACCELERATOR (NCA):
Formulated to accelerate time of setting and to increase early concrete strengths. NCA admixture does not contain calcium chloride which can cause corrosion of steel reinforcement.

HYDRATION STABILIZER ADMIXTURE (HSA):
Retards setting time by controlling the hydration of Portland cement and other cementitious materials during placing and finishing operations. HSAs are used for making more uniform and predictable high-performance concrete.

WORKABILITY RETAINING ADMIXTURE (WARA):
These are a new generation of polymers that provide slump retention in concrete without affecting setting times or early strength development. WARAs has revolutionized concrete delivery and consistency performance by keeping cement dispersed in fresh concrete which increases concrete workability time.

SHRINKAGE REDUCING ADMIXTURE (SRA):
Developed specifically to reduce drying shrinkage of concrete and mortar, and the potential for subsequent cracking.

ADDITIONAL PRODUCTS

EVAPORATION REDUCER:
Helps prevent the rapid drying of exposed plastic concrete when high rates of evaporation occur. Evaporation reducers do NOT replace proper curing procedures.

TRI-GRIP:
A synthetic aggregate mixed into acrylic sealers designed to create a non-slip surface.

PIGMENTED SILOXANE:
A specially formulated waterproofing sealer treatment with pigment added to help produce a uniform color on concrete.
RESOURCE GUIDE

Aggregate and Ready Mix Association of Minnesota
- Website: www.armofmn.com/resources

American Concrete Institute
- Website: www.concrete.org
- ACI-305 Hot Weather Concreting
- ACI-306 Cold Weather Concreting
- ACI-302 Guide for Concrete Floor and Slab Construction
- ACI-318 Building Code Requirements for Reinforced Concrete

ASTM International
- Website: www.astm.org
- ASTM C33 Standard Specification for Concrete Aggregates
- ASTM C31 Standard Practice for making and Curing Concrete Test Specimens in the Field

Concrete Network
- Website: www.concretenetwork.com
- The Concrete Network’s purpose is to educate homeowners, contractors, builders, and designers on popular concrete techniques and applications.

Minnesota Department of Transportation (MnDOT)
- Website: www.dot.state.mn.us

NRMCA CIP 12 – Hot Weather Concreting
- Readable PDF copy on Cemstone.com
- Available to purchase at www.NRMCA.org

NRMCA CIP 27 – Cold Weather Concreting
- Readable PDF copy on Cemstone.com
- Available to purchase at www.NRMCA.org

Portland Cement Association
- Website: www.cement.org

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