MATERIALS

Aggregates
- Aggregates shall conform to the physical properties of ASTM C33 – class 4S or MDOT specifications for concrete.
- ASTM size #57 or #67 or MDOT size 6AA or 17A with MDOT 2NS should be specified in the mix design.

Portland Cement
- Portland cement shall conform to ASTM C150 – or ASTM C595 use the same source for each project.

Supplemental Cementitious Materials
- Fly ash shall conform to ASTM C618, slag cement shall conform to ASTM C989.

Chemical Admixtures
- Chemical admixtures shall conform to the requirements of ASTM C494.
- Air entraining admixtures shall conform to ASTM C260.

CONCRETE PROPERTIES AND PROPORTIONS OF MATERIALS

Compressive Strength and Water/Cement Ratio
- The minimum specified compressive strength (f’c) shall be 4000 psi (28 days) – ACI 332.
  - The maximum in-place water to cement (w/c) or water to cementitious ratio (w/cm) shall be 0.45.

Slump
- The maximum slump at the point of placement shall not exceed 4 inches.
- The maximum slump may be increased up to 7 inches by using a mid-range or high-range water reducing admixture.

Air Content
- Concrete shall be designed for a total air content, by volume, of 6.5% +/- 1.5%.

PREPARATION

Subgrade Preparation
- The subgrade shall be free of organic and unconsolidated material.
- Removal of unstable materials shall be to a minimum depth of 6 inches.
  - Replace with crushed stone, gravel, or sand - compacted to 95%.
  - Sub-base materials shall be a minimum of 4 inches in thickness compacted.
- In warm or hot weather, the sub-base shall be dampened prior to concrete placement.
- No standing water shall be present when concrete is placed.
- In no case shall a driveway be constructed on frozen subgrade/sub-base materials.

Drainage
- A minimum slope of 1/8 inch per foot shall be maintained for drainage and the subgrade shall be drained to daylight or to a drainage system.

CONCRETE THICKNESS
- The minimum concrete thickness for a driveway is 4 inches.
- When traffic will include delivery vehicles, the minimum concrete thickness shall be 5 inches.

BATCHING AND DELIVERY
- Concrete shall be batched, transported and discharged in accordance with ASTM C94.
- Any water addition on job after delivery should be documented on the concrete delivery tickets.

FINISHING
- It is recommended that at least one certified ACI flatwork finisher be involved in the finishing.
- Use of fly ash or slag cement will change the time of finishing.
- The recommended sequence for finishing includes strike-off, bull floating, edging, curing, jointing and texturing.
  - Do not perform finishing operations while bleed water is still visible.
  - Do not use steel trowels, fresnos or other tools that may seal the surface prematurely.
  - Do not sprinkle water onto the surface (blessing the concrete) to aid in finishing.
  - Edge the concrete around the perimeter (maximum radius = ½ inch) and at all tooled joints.
  - Using a stiff-bristle broom, apply a “broomed” texture.
  - NOTE: the use of an evaporation retarder is recommended on low humidity and/or windy days.
CURING
- Curing requires the maintenance of proper temperature and moisture in the concrete.
  - As the cement hydrates concrete gains strength.
- Curing shall begin within 30 minutes after texturing.
- Curing can be accomplished by covering the concrete with polyethylene, using spray on curing compounds or by continuous water application.
  - Curing by these methods must extend for a MINIMUM of three days.
  - NOTE: when using polyethylene, discoloration may occur.
- For residential construction, it is recommended that curing be accomplished by applying a product meeting ASTM C1315 within 30 minutes of texturing – apply uniform coverage according to the manufacturers’ recommendation.

JOINTING
Control Joints
- Shall be installed in both directions at intervals not exceeding two times the slab thickness.
  - i.e. 8 ft. for a 4 inch thick slab.
- Panels should be as square as possible and in no case shall the ratio of length to width exceed 1.5 to 1.
- Control joints shall have a minimum depth equal to ¼ the slab thickness.
  - i.e. 1 inch for a 4 inch thick slab.
- Control joints may be installed by pre-formed materials, hand tooling or by saw cutting.

Isolation Joints
- Isolation joints shall be installed at points of restraint to isolate freshly placed concrete from fixed objects.
  - i.e. existing structures.
- Isolation joints shall extend the full depth of the slab.

Saw Cutting – NOTE: the window for saw cutting is typically 8-12 hours, but will vary with weather and mix designs.

OPENING TO TRAFFIC
- The driveway/sidewalk may be opened to traffic following 7 days of curing, or sooner, when testing confirms that a compressive strength of 2500 psi is reached.

SEALING
- Sealers protect the concrete by minimizing water and deicing salt penetration.
- A penetrating sealer can be applied 30 days after initial placement and typically needs to be reapplied every three to five years. NOTE: if a curing compound meeting ASTM 1315 is used, it must be worn off or removed prior to applying the sealer.

COLD WEATHER CONCRETING – (ACI 306R-10 GUIDE TO COLD WEATHER CONCRETING)
Concrete matures at a slower rate during cool/cold weather conditions.
- Concrete shall not be placed on a frozen subgrade.
  - The subgrade temperature must be a minimum of 40°F.
- The contractor shall take measures to protect the concrete (i.e. straw/hay, insulating blankets, etc.) to maintain the required curing temperature of at least 50°F for a minimum of three days.
- To develop early strengths during cool/cold weather the mix may contain additional Type I cement, substitute Type III for Type I or contain an accelerator meeting ASTM C494.
- The use of fly ash and slag cement will slow the rate of hydration.

HOT WEATHER CONCRETING (ACI 305R-10 GUIDE TO HOT WEATHER CONCRETING)
Concrete hydrates faster as ambient temperatures increase.
- Caution should not be placed when the concrete temperature is above 90°F.
- Moisten the subgrade prior to placement (no standing water should be present).
- Place concrete when ambient temperatures are most favorable, i.e. early morning.
- The use of fly ash and slag cement will slow the rate of hydration.
- Set retarding admixtures meeting ASTM C494 may be used.
- To reduce the rate of evaporation from the surface resulting from low humidity, warm temperatures and moderate to high winds, the use of a evaporation retarding membrane is suggested.

SAFETY
- Provide Material Safety Data Sheets (MSDS) as requested.
- Avoid skin contact with fresh concrete by wearing gloves, boots, clothing and eye protection.

For more information, please visit our website at www.miconcrete.org