



MICHIGAN CONCRETE ASSOCIATION SIX STAR DRIVEWAY PROGRAM

Mix Design and Placement Requirements

FORWARD

A MCA Six Star Driveway is intended for passenger car and light truck use. The subgrade must be properly compacted and remain stable. The MCA Six Star Driveway specification is not applicable when heavy loading and/or unstable soils are anticipated.

1.0 MATERIALS

This document and those listed below cover material and construction requirements for the MCA Six Star Driveway.

- ✓ American Society for Testing and Materials C94-00, *Standard Specification for Ready Mixed Concrete*
- ✓ American Concrete Institute *Guide to Residential Cast-in-Place Concrete Construction* (ACI 332)
- ✓ American Concrete Institute *Guide for Concrete Floor and Slab Construction* (ACI 302)

1.1 Aggregates

Coarse aggregates shall conform to ASTM C33-01, Class Designation 5S (i.e. MDOT 6AA). The coarse aggregate shall have a nominal maximum size equal to or greater than $\frac{3}{4}$ inch.

Fine aggregates shall conform to ASTM C33-01 'Fine Aggregate' and shall have no more than 3.0% loss by washing.

1.2 Cement

Portland cement shall conform to ASTM C150-00. Use one brand of cement for each MCA Six Star Driveway project. Incorporating different brands of cement may result in color and/or strength variations in the finished product.

1.3 Chemical Admixtures

Chemical admixtures shall conform to the requirements of ASTM C494-99. Air entraining admixtures shall conform to ASTM C260-00.

1.4 Fiber Reinforcement (optional)

Fiber reinforcement shall consist of 100 percent virgin polypropylene or nylon fibers with no reprocessed olefin materials. The size and gradation of the fibers shall be selected for optimum performance based on the mix design. Fibers shall be added to the mix per the manufacturer's recommendations. Fiber reinforcement shall conform to ASTM C1116-00.

2.0 CONCRETE PROPERTIES AND PROPORTIONS OF MATERIALS

2.1 Compressive Strength and Water/Cement Ratio

The minimum specified compressive strength (f_c) shall be 4000 psi at 28 days. The maximum in-place water to cement ratio shall be 0.45. The minimum quantity of cement shall be 564 lbs. per cubic yard.

2.2 Slump

When using a Type A water-reducing admixture, the slump at the point of placement shall not exceed 4 inches. If concrete is proportioned using a mid-range water-reducing admixture, the slump shall not exceed 6 inches.

2.3 Air Content

Concrete shall be proportioned with an air-entraining admixture to produce a total air content of 6.5% \pm 1.5% by volume.

2.4 Aggregate Proportioning

The minimum ratio of coarse aggregate to fine aggregate shall be 55% to 45%.

3.0 PREPARATION

3.1 Subgrade Preparation

The subgrade shall be free of black dirt, vegetation, roots, stumps, wood, and other loose unstable materials. Soft areas shall be excavated, filled with suitable material, and compacted. Clay and other unstable materials are not acceptable subgrade materials. Removal of unsuitable materials shall be to a minimum depth of 6 inches. Replace unsuitable materials with crushed stone, gravel, or compacted sand. Controlled density fill materials, such as flowable fill, can be used to correct sub base deficiencies.

Sub base materials shall be a minimum of 4 inches in thickness.

Compact the sub base with a vibrating tamping plate or heavy roller to a uniform, firm, and unyielding condition. In warm or hot weather, the sub base shall be dampened prior to concrete placement. No standing water shall be present when the concrete is placed.

In no case shall a MCA Six Star Driveway be constructed on frozen or saturated subgrade/sub base materials.

3.2 Drainage

Provide drainage to allow water to flow away from the driveway and the house. A minimum slope of 1/8 inch per foot shall be maintained unless special conditions indicate otherwise.

4.0 READY MIXED CONCRETE

4.1 Ready Mix Plant

A ready mix plant supplying concrete to a MCA Six Star Driveway project shall sign the 'Concrete Producer Agreement', be certified by the National Ready Mixed Concrete Association (NRMCA) and be a participating member of the Michigan Concrete Association.

4.2 Mix Design

Special mix designs have been developed for this application and must be ordered as the Six Star Driveway mix. Conformance to the mix design can be verified by requesting the batch weights from the Ready Mixed Concrete supplier.

4.3 Testing

Any testing performed on the plastic or hardened concrete shall be performed by a Level I or Level II concrete technician certified by the Michigan Concrete Association. All tests shall be performed in strict compliance with ASTM standards.

The Ready Mix Concrete supplier will verify conformance of the plastic and hardened properties of the concrete as specified in this document.

5.0 CONCRETE THICKNESS

The minimum concrete thickness for a MCA Six Star Driveway is 4 inches. When traffic will include delivery vehicles, the minimum concrete thickness shall be 5 inches.

6.0 PLACEMENT

Concrete shall be placed with a minimum of handling and manipulation. Concrete must be discharged within 90 minutes or before 300 revolutions of the drum, whichever comes first, after the introduction of the mix water to the cement and aggregates.

7.0 FINISHING

At least one MCA/ACI Certified Flatwork Finisher shall be actively involved with the finishing process. The certified finisher must sign the concrete delivery tickets. For additional information on required training, contact the Michigan Concrete Association.

Do not over-work the surface or perform finishing operations while bleed water is still visible. Do not use steel trowels, fresnos or other tools that will seal the concrete surface prematurely preventing the evaporation of bleed water.

Edge the concrete around the perimeter of the driveway and at all tooled joints. Edging shall produce a maximum radius of ½ inch. The rounded edge will reduce the probability of chipping at the edge of the concrete.

Using a concrete broom, apply a “broomed” finish.

8.0 JOINTING

8.1 Control Joints

Control joints shall be installed at intervals not to exceed 10 feet in either direction (for a concrete thickness of 4 inches) and no more than 12 feet for a concrete thickness of 5 inches. Panels should be as square as possible, and in no case shall the ratio of length to width, or width to length, exceed 1.5 to 1. Driveways with widths of 12 feet and greater shall have a control joint longitudinally down the center.

Control joints shall have a minimum depth of 1 inch for 4 inch thick slabs, and 1¼ inch for 5 inch thick slabs.

Control joints may be installed by tooling during the finishing process, or by sawing. Sawing must be performed as soon as the concrete can be sawed without raveling/spalling and within 24 hours.

8.2 Isolation Joints

Isolation joints are to be installed at lines or points of restraint and to isolate freshly placed, plastic concrete from fixed objects. Isolation joints shall be installed at the junction of the driveway with sidewalks, streets, curbs, adjacent buildings, drainage structures and fence posts.

Isolation joints shall extend the full depth of the pavement. Preformed joint material shall be a minimum of 3/8 inch thick and consist of bituminous-impregnated vegetable and mineral fiberboard material. The top of the joint material shall be recessed ¼ inch below the top of the driveway surface.

See ACI 332 for additional detail.

9.0 REINFORCING STEEL

Reinforcing steel is not required in driveway slabs except under special circumstances. Reinforcement is required around depressions, openings, pipe trenches, and other re-entrant points. See ACI 332 for details on installation.

10.0 CURING AND SEALING

Curing requires the maintenance of proper temperature and moisture in the concrete for a defined period of time. Curing shall begin immediately after the final finishing operation. Any delay can affect the durability of the concrete.

10.1 Concrete Temperature

The concrete temperature shall be maintained between 50 and 90 degrees for at least 3 days following placement. When the anticipated mean daily temperature will be less than 60 degrees F for 3 consecutive days, the concrete temperature shall be maintained at a minimum of 50 degrees F for at least 5 days following placement.

10.2 Curing

Maintaining moisture in the concrete shall be accomplished by applying a membrane forming curing compound (minimum solids content of 25%) meeting the requirements of ASTM C309-98. A low-pressure sprayer, roller, or brush may apply the compound. Apply in strict accordance with the manufacturer's recommendations. Application of the compound shall begin as soon as the final finishing operation is completed.

10.3 Sealing

Apply a silane (minimum 20% solids) or siloxane sealer (minimum 10% solids) when the sheen of the curing compound disappears and the surface will no longer repel water (typically within 1-12 months of placement). A sealer minimizes moisture and deicing salt penetration into the surface of the concrete. Apply in strict accordance with the manufacturer's recommendations. Compatibility of the sealer with ASTM C309 membrane curing compounds shall be verified prior to application.

11.0 OPENING TO TRAFFIC

The driveway can be opened to traffic following 7 days of curing.

12.0 COLD WEATHER CONCRETING

Concrete matures at a slower rate during cool/cold weather. Extended setting times, slower bleeding rates, and slower strength development occur during such conditions.

As a result, a MCA Six Star Driveway shall be installed only after seasonal weight restrictions have been locally removed. A MCA Six Star Driveway shall not be installed after October 15 due to the slower rate of hydration.

Concrete shall not be placed on a frozen subgrade. The subgrade must be at least 40 degrees F before concrete is placed. Caution must be exercised to avoid placing warm concrete on a cold subgrade. Finishing and cracking problems can result from significant temperature differences between concrete and subgrade.

The contractor shall take measures to protect the concrete and maintain the required curing temperature in cool/cold weather conditions.

If a set accelerator is used, care must be exercised to avoid discoloration. Accelerators shall conform to ASTM C494-99, type C or type E.

13.0 HOT WEATHER CONCRETING

Concrete placed in warm/hot weather has reduced setting times, higher water demand for equivalent workability, and increased tendency for the formation of plastic shrinkage cracking.

A MCA Six Star Driveway can be successfully placed in hot weather if certain precautions are taken. Caution should be exercised when placing concrete at ambient temperatures above 90 degrees F. Moisten the subgrade prior to placement, preferably the night before. No standing water should be present when the concrete is placed. Place concrete when ambient temperatures are most favorable, generally in the early morning. Set retarding admixtures may be used to offset the effects of hot weather.

If ambient conditions indicate low humidity, moderate-to-high winds, and warm temperatures, the contractor may use a vapor retarding membrane during the finishing process to inhibit the formation of plastic shrinkage cracks or crazing.

Because of the rapid hydration of cement during hot weather, the contractor shall be prepared to start the curing process immediately following the final finishing operation.

The concrete producer shall take measures to assure that the maximum water to cement ratio of 0.45 is not exceeded due to the higher water demand normally observed during hot weather production.

14.0 SAFETY

Provide Material Safety Data Sheets as required. Avoid contact between the plastic concrete and skin with appropriate clothing and gloves. If concrete does contact skin, wash the skin thoroughly. Wear eye protection during placement of plastic concrete.