

# DRIVEWAY & SIDEWALK

## DESIGN AND PLACEMENT GUIDELINES



## MATERIALS

### Aggregates

- ▶ Aggregates shall conform to the physical properties of ASTM C33 class D (formerly 4S) or MDOT specifications for concrete aggregates.
- ▶ 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.

### Supplemental Cementitious Materials

- ▶ Slag cement shall conform to ASTM C989. Coal ash (fly ash) shall conform to ASTM C618.

### 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)
  - ▶ The maximum in-place water to cement (w/c) or water to cementitious ratio (w/cm) shall be 0.45 or less.
  - ▶ NOTE: The minimum recommended cementitious content is 564 lbs.

### 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 uncompacted material.
- ▶ Removal of unstable materials shall be to a minimum depth of 6 inches.
  - ▶ Replace with crushed stone, gravel, or sand - compacted to 95% (TMD) Density.
  - ▶ Sub-base materials shall be a minimum of 4 inches in thickness compacted.
- ▶ If the sub-base is dry, it shall be dampened prior to concrete placement.
- ▶ No standing water shall be present when concrete is placed.
- ▶ In no case shall concrete be placed on frozen subgrade/sub-base materials.

### Drainage

- ▶ A minimum slope of 1/8 inch per foot (1-2%) shall be maintained for drainage and the subgrade shall be drained to daylight or to a drainage system.

## CONCRETE THICKNESS

- ▶ The minimum concrete thickness recommended 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 site 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 (bleeding the concrete) to aid in finishing.
  - ▶ Edge the concrete around the perimeter (maximum radius = 1/2 inch) and at all tooled joints.
  - ▶ Using a stiff-bristle broom, apply a "broomed" texture.
  - ▶ **NOTE: the use of an evaporation retarder is highly recommended on low humidity and/or windy days and the use of a finishing aid, either integral or topical is beneficial with Type 1L cements**



## CURING

- ▶ Curing requires the maintenance of proper temperature and moisture in the concrete.
  - ▶ As the cement hydrates concrete gains strength.
- ▶ Curing shall begin immediately after final finish.
- ▶ 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 C309 immediately after final finish – Apply uniform coverage according to the manufacturers' recommendation. (150-200sft/gal)

## 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. (Example: 8' x 8' panels)
- ▶ Control joints shall have a minimum depth equal to  $\frac{1}{4}$  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, walls, foundations, etc.
- ▶ Isolation joints shall extend the full depth of the slab.

**Saw Cutting** – NOTE: the window for saw cutting is typically 8-12 hours after placement, but can 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 3000 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 C309 is used, it must be worn off or removed prior to applying the sealer.

## COLD WEATHER CONCRETING

### (ACI 306R 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 day.
- ▶ To develop early strengths during cool/cold weather the mix may contain additional Type IL cement, substitute Type III for Type IL, or contain an accelerator meeting ASTM C494.
- ▶ The use of supplementary cementitious materials such as harvested ash and slag cement will slow the rate of hydration.

## HOT WEATHER CONCRETING

### (ACI 305R GUIDE TO HOT WEATHER CONCRETING)

- ▶ Concrete hydrates faster as ambient temperatures increase.
- ▶ The maximum concrete temperature at time of placement is recommended to be  $\leq 95^\circ\text{F}$ , unless specified.
- ▶ If the subgrade is dry, it should be moistened prior to placement. (no standing water should be present)
- ▶ Place concrete when ambient temperatures are most favorable, i.e. early morning.
- ▶ The use of supplementary cementitious materials such as slag cement and harvested ash 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 an evaporation retarding membrane is recommended followed by immediate curing methods after finish. NOTE: the use of a finishing aid, either integral or topical, may be beneficial with IL cements

## SAFETY

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