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An Industry Association Statement

For Successful Exterior Concrete Flatwork

For purposes of this statement, exterior concrete flatwork might be a residential driveway, a sidewalk or a patio.

Successful exterior concrete flatwork, with minimal maintenance:

- carries the traffic for which it was designed;
- survives in the natural and man-made environments where it was built; and
- remains aesthetically pleasing to its owner.

The process of constructing exterior concrete flatwork is a complex set of activities, which requires professional skill and an extensive understanding of concrete, the primary construction material being used. Often, several people are involved. For assurance of a successful outcome, the construction activities must be managed. Concrete flatwork construction must be planned, organized, directed and controlled.

A concrete flatwork owner has the pride of knowing that it is the best flatwork available, but must be aware that even the best is not indestructible. With minimal maintenance, the concrete flatwork can provide maximum satisfaction. If ignored, concrete flatwork may suffer from neglect or abuse, and not perform to the best of its ability.

1. **Definitions**

1a. ACI - American Concrete Institute.

1b. ASTM - American Society for Testing and Materials.

1c. Ready mix producer - the producer, or the producer's driver, quality control technician or sales agent.

1d. Informed person - one who knows enough about concrete to determine what will be fit for his or her particular purpose. Anyone who hires him or herself, or his or her company out, to order, receive, place, finish or control concrete for another individual or company will be considered an informed person.

1e. Uninformed person - one who does not know enough about concrete to determine what concrete will be fit for his or her particular purpose. An uninformed person may be a homeowner, a builder, a developer or an agent for any of those persons.

1f. Air entrainment - microscopic air bubbles intentionally incorporated in concrete during mixing, usually by use of a surface-active agent; typically between 10 and 1000 micrometers in diameter and spherical or nearly so.

1g. Batching - weighing or volumetrically measuring and introducing into the mixer the ingredients for a batch of concrete.

1h. Compressive strength - the measured maximum resistance of a concrete specimen to axial compressive loading; expressed as force per unit cross sectional area, such as pounds per square inch (psi); or the specified resistance used in design calculations.

1i. Curing - the maintenance of a satisfactory moisture content and temperature in concrete during its early stages so that desired properties may develop.

1j. Flatwork concrete - a general term applicable to concrete floors and slabs that requires finishing operations.

1k. Scaling - localized flaking or peeling away of the near-surface portion of hardened concrete.

2. **Concrete, the material**

2a. All concrete is not the same. As with other construction materials, such as wood or paint, some concrete is designed for interior purposes, while some is designed for exterior purposes. Like other construction materials, concrete designed for interior use may deteriorate early if exposed to exterior, weathering conditions.

2b. As with other construction materials there is inexpensive concrete, moderately priced concrete and higher priced concrete, the prices varying according to normal market pressures of supply and demand and the cost of additives or special ingredients used in the concrete.

2c. The concrete mix should be designed and proportioned to achieve a strength of 4500 psi at 28 days with a maximum 0.45 water-cementitious materials (w/cm) ratio. This is consistent with the Ohio Building Code Table 1904.2.2(1), requirements for special exposure conditions, for concrete exposed to freezing and thawing in a moist condition or to deicing chemicals. If supplementary cementitious materials are used (fly ash or ground granulated blast furnace slag), the maximum percent by weight should not exceed 30%. Aggregates used in the concrete mixture should be approved by the Ohio Department of Transportation (ODOT).

3. **Planning and organizing the work**

3a. It is the responsibility of the person in charge of the planning and organizing for a concrete construction project to determine what concrete should be used for that project, whether he or she will batch the material themselves or purchase it from a ready mix producer.

3b. If the person responsible for the planning and organizing of the concrete construction work does not know which concrete should be used for each particular purpose, i.e. is an uninformed person, then it is that person's responsibility to seek advice.

3c. If the ready mix producer is responding to the request of an uninformed buyer, it is the responsibility of the ready mix producer to recommend, produce and deliver a concrete which is fit for the particular purpose, for which it was ordered.

3d. If the ready mix producer receives an order from an informed buyer, then it is the producer's responsibility to produce and deliver the concrete as ordered.

3e. Concrete in the truck, in its fresh, unhardened state, is a perishable product with a very short shelf life (generally 60 to 90 minutes from the time the water and cement were mixed together.) ASTM C-94 *Standard Specification for Ready Mixed Concrete*, paragraph 11. 7, in pertinent part, says "Discharge of the concrete shall be completed within 1 1/2 hours, or before the drum has revolved 300 revolutions, whichever comes first, after the introduction of the mixing water to the cement and aggregates or the introduction of the cement to the aggregates."

3f. It is the responsibility of the ready mix producer to produce and deliver the concrete in a fresh unhardened state, properly proportioned of approved materials, thoroughly mixed, at the design consistency, and with ample shelf life remaining for it to be discharged and placed in a reasonable period of time.

3g. If the person taking delivery of the concrete is informed, it is that person's responsibility to verify that the concrete received is the material which was ordered, and that it has not been altered or damaged and that, at the time of delivery, its shelf life has not been excessively consumed.

3h. If the person taking delivery of the concrete is uninformed, then he or she is responsible for making that fact known to the ready mix producer, and then it is the responsibility of the ready mix producer to affirm that the material delivered is fit for the particular purpose for which it was ordered and for which it is to be used, and that the concrete has not been altered from its design, or damaged, and that it has ample shelf life remaining for it to be discharged and placed in a reasonable period of time; and it is the responsibility of the ready mix producer to so advise the person taking delivery of this affirmation.

3i. The delivery ticket accompanying each load of concrete should provide sufficient information to describe the contents of the load and the time when it was batched.

(Refer to *Guidelines for Durable*, paragraphs, 1a through d, 2a through e, 3a through d, and 4a)

4. Directing the work

4a. The person in charge of placing and finishing should be an informed person.

4b. If the person taking delivery of the concrete is informed, and if that person orders an alteration of the concrete prior to discharge, or causes the concrete to remain in the truck such that its shelf life is expended prior to complete discharge, placing and finishing, it is the responsibility of the ready mix producer to record these facts and advise the person taking the delivery that these facts are being recorded.

4c. It is the responsibility of the person in charge of the placing and finishing of the concrete on a concrete construction project to direct those operations, such that the concrete is not altered or mishandled during those operations, which will prevent or compromise the concrete's ability to perform its intended purpose.

4d. If the person taking delivery of the concrete is uninformed, then he or she is responsible for making that fact known to the ready mix producer, and then if job conditions make it necessary to alter the concrete prior to discharge, or cause the concrete to remain in the truck such that its shelf life will be expended prior to complete discharge, placing and finishing, it is the responsibility of the ready mix producer to inform the person taking delivery, of these facts, and of the possible results of using the concrete after it has been altered or its shelf life has been expended; and it is the responsibility of the ready mix producer to record these facts, advise the person taking delivery that these facts are being recorded, including the fact that the person taking delivery was informed of the facts and possible results.

4e. Any concrete, which is still in the truck when the shelf life has been exhausted, may no longer be fit for the particular purpose, and should not be included in the project work for which it was intended.

(Refer to *Guidelines for Durable*, paragraphs 4a through d, and 5a through e.)

5. Control of the finished work

5a. The person in charge of controlling the finished concrete's environment should be an informed person.

5b. After the concrete has been finished, it is the responsibility of the person in charge of controlling the concrete's environment while the concrete is maturing, ie: the contractor, owner or owner's agent, to install controls to insure that the finished concrete is not damaged or abused during the maturing period, thus preventing or compromising the concrete's ability to perform its intended purpose.

5c. Freshly finished concrete must be protected with a high relative humidity internally, and suitable temperature for a sufficient number of days, for the concrete to reach maturity, such that it can perform and endure on its own.

5d. The practice of controlling the concrete's internal relative humidity and temperature is commonly called curing.

5e. During that time it is maturing, the concrete must not be subjected to freezing temperatures, and must not be subjected to pedestrian or vehicular traffic. Properly mixed, placed, and finished concrete also requires proper curing. This involves preventing loss of moisture from the concrete and maintaining a temperature in the concrete of 40° to 90° F (4° to 32° C) - suitable for maturing of concrete. Favorable curing conditions should be maintained as long as practical. Three to five days are considered minimum requirements for summer conditions. In the winter, favorable curing conditions should be maintained even longer.

(Refer to *Guidelines for Durable*, paragraphs 5e and 6a through e)

6. **Owner's Responsibilities**

6a. After the concrete has gained strength through a proper and sufficient curing period, the concrete flatwork may be opened to traffic. This does not mean that the flatwork has fully matured, nor does it mean that it is immediately capable of withstanding harsh environmental assaults by man or nature.

6b. Newly cured concrete should have a proper amount of time to air dry before being sealed to deter water from becoming trapped in the surface pores.

6c. The informed person(s) that planned, organized, directed and controlled the concrete flatwork's construction is responsible for providing the owner with suitable instructions for proper protection, use and maintenance of the new flatwork.

(Refer to *Guidelines for Durable*, paragraphs 6e, and 7a through c)

(Refer to *Take Care of Your Concrete Surfaces*)