c. Air. Exterior concrete should have at least 5 percent total air entrainment.

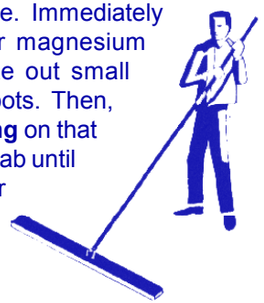
4. Placing

a. Tests. Standard tests generally are not made on residential work, but slump, air content, and temperature should be checked.

b. Addition of Water. Don't add water to the mix unless absolutely necessary. If water is needed to adjust the slump within the limits of **3-b**, it should be added before discharging any concrete. Once discharge begins water should not be added. When water is added, put it all in at once, then run the mixer for 30 revolutions at mixing speed. Record the amount of water added. If it becomes necessary to increase the slump beyond the 5 inch limit using water per **3-b**, a superplasticizing chemical admixture (meeting ASTM C-494 standards) should be used. The superplasticizer should be added to the mixer and thoroughly mixed for a minimum of five minutes before discharging the concrete.

c. Filling the Forms. Chute, wheel or shovel the concrete directly to its final position. Don't dump it in large piles and then flow, drag or rake it the rest of the way.

d. Leveling. Screed (strike-off) to level the surface. Immediately use a wood or magnesium bullfloat to take out small high and low spots. Then, **stop everything** on that portion of the slab until bleed water (water sheen) disappears from surface.



5. Finishing

a. When to Finish. Immediately after all the bleed water is gone it is the proper time to broom *OR* float surface *once* and edge. If hand tooling, cut control joints before edging.

b. Final Finish. A broom finish is recommended - particularly on driveways, walks, etc. Where a smooth finish is desired (patios, etc.), a wood hand float finish should be used. Machine floating and/or troweling is not recommended.

CAUTION! Overworking/overfinishing the surface of an exterior concrete slab is time consuming, expensive and potentially damaging. Overworking/overfinishing tends to bring too much fine material to the surface causing it to weaken. Overworking/overfinishing also may destroy the entrained air void system at the surface where it is most important. Avoid swirl finishes. Never use a steel trowel on concrete exposed to weather. The most durable surface results when finishing operations are minimized.

c. Joints. Contraction (crack control) joints must be located and properly constructed to control cracking of the concrete flatwork. The joints may be hand tooled or sawed to a depth of at least 1/4 the thickness of the slab and spaced in both directions to a maximum length of 12 feet. Recommended spacing per slab thickness is provided below:

Thickness of Slab	Nominal Space Between Joints
3.5 inches	8 feet
4 inches	10 feet
5 inches or more	12 feet

All panels are to be sized as square as possible with the length to width not exceeding 1.25. Contraction joints must be straight and continuous; not staggered or offset unless an isolation joint is constructed. When contraction joints are sawed, sawing should be done promptly after the concrete has hardened sufficiently to permit sawing without raveling. Delayed sawing may result in uncontrolled cracking,

d. Curing. Apply curing as soon after finishing as it can be done without marring the surface.

6. Curing

a. Need for Curing. Curing is one of the most important steps in concrete construction and, regrettably, one of the most neglected. **Effective curing is absolutely essential for surface durability.** Fresh concrete must be kept warm and moist until the mixing water combines chemically with the cement. This chemical reaction hardens the concrete and gives it strength. It takes 28 days for concrete to reach its design strength at normal temperatures. However, eighty (80) percent of the potential strength is developed within the first seven days and therefore is critical to adequately cure (maintain moisture) the concrete. Early drying of the concrete will create a weakened surface. Low-strength exterior concrete does not perform well when subjected to frequent freezing and thawing. It is difficult to apply too much curing, but applying too little or none is asking for trouble.

b. Curing in Warm Weather. The most effective method to cure fresh concrete is to keep it continuously wet for seven days, which can be accomplished by covering with plastic. As an alternative, curing can be accomplished with a liquid membrane meeting (ASTM C-309 standards) which is sprayed on the surface of a slab immediately after finishing. **Curing compound must be applied according to the manufacturer's instructions.** For example, many manufacturers specify a coverage of not more than 200 square feet per gallon (twice as thick as most house paints are applied).

c. Curing in Cold Weather. It is absolutely essential that fresh concrete be kept from freezing for at least the first week after it is placed. In very cold weather, membrane curing will not keep the concrete warm enough. The suggested method is to use curing blankets or a thick layer of straw sandwiched between two layers of plastic sheeting (black sheeting preferred).

d. What Not to Use. Avoid any curing compound that lets the surface dry in a short time. Rapid drying stops the hardening process causing a weak surface that is likely to scale. For slabs placed in the fall in cold weather areas, use blankets or plastic sheeting instead of curing compound. Curing compound may trap excess water in the slab after the initial curing period.

e. Drying. Newly placed outdoor concrete not only needs time to cure, but it also needs time to dry in warm air. Concrete placed in the spring, summer or early fall has a decided advantage over concrete that has not had time to dry out when cold weather begins. A new slab should be allowed two months of temperatures above 40°F (one for curing and another to dry out) before hard freezes are expected.

7. Tips To Owners

a. First Winter. Owners should be advised to not use salt or other deicers during the first winter, especially if concrete was placed after September 15th and was not air dried and sealed. We suggest the use of sand instead to improve traction.

b. Safe Use of Deicers. Deicers containing salt and/or calcium chloride should be generally safe for use on a quality concrete pavement **after the first winter**. Never use any deicer that contains either ammonium sulfate or ammonium nitrate (fertilizers). Anyone who buys a deicer under a brand name should read the label to see what it contains.

c. Sealers. Water-repellent coatings and sealers can help prevent damage from freeze/thaw cycles and salting. They deter water from getting into the surface pores. Some sealers will cause darkening of the slab. Newly cured concrete should have a period of air-drying before being sealed. Use of a conventional curing compound followed two months later by a conventional sealer is recommended rather than the popular misconception of a one step application. Most quality concrete sealer applications are effective for about a two-year period. Refer to the manufacturer's instructions for re-application.

For more information, contact your local ready mixed concrete producer.

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GUIDELINES FOR DURABLE

• DRIVEWAYS
• CARPORTS
• PATIOS • WALKS

•The Right Concrete Mix

•Placing and Finishing

•Joints Correctly Spaced

•Curing for Durability

For quality concrete around the home, we recommend . . .

1. Planning

a. Thickness. 3½ to 4 inches is generally enough. Unless heavy trucks will park on it regularly, a thicker pavement is merely an excess of material.

b. Base. Compacted earth is entirely adequate as a base for residential concrete. There is no need to bring in sand, gravel, or stone unless it is specified or necessary for drainage or uniformity.

c. Reinforcement. Wire mesh is not necessary in residential slabs. Synthetic fibers may be used to control early-age cracking.

d. Drainage. Surface of the finished slab should slope at least 1/8 inch per foot. A slope of 1/4 inch per foot will provide better assurance that surface won't pond water.

2. Preparation

a. Excavating. Be sure to take out all organic matter - sludge, leaves, tree roots, wood, etc. Don't dig deeper than needed.

b. Compaction. The entire soil area on which concrete is to be placed must be compacted uniformly and evenly so the slab won't settle and won't vary in thickness.

c. Forms. Stake securely and slope forms in accordance with 1-d above. Scrape loose base away from forms so edges will be at least full thickness. A 3½ inch slab can be formed with 2 x 4 lumber.

d. Isolation. Before concrete is delivered, install premolded joint material wherever the new concrete slab would contact buildings, steps, walls, existing slabs, etc. The joint material keeps the new concrete slab separated from existing slabs or structures to permit vertical and horizontal movement of the slab. Joint material must extend the full depth of the slab.

e. Moistening. Shortly before placing concrete, dampen the forms and the subgrade. Don't make the subgrade so wet that it's muddy.

3. Specifications for Concrete

a. For exterior flatwork, air entrained concrete with a minimum cement content of 611 lbs/cy (6.5 bags) and a maximum water/cementitous materials ratio of 0.45.

b. Slump. Most specifications permit a maximum slump of 5 inches for non-reinforced concrete slabs. The slump may be increased by using chemical admixtures. If increased slump is desired to ease placement, a chemical admixture should be used instead of water.