



MIX DESIGN FOR POLISHED CONCRETE

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The cement should be Portland cement, Type I, conforming to ASTM C 150, "Standard Specification for Portland Cement". The aggregate requirements should follow ASTM C33/C33M-18 standards for unit weight, size, etc. One of the strengths of diamond polished concrete is the range of aggregates that can be exposed, therefore a uniformly graded mix of not less than 3 aggregate sizes - fine, intermediate, and large - will yield the best visual quality. It should be understood that since aggregates are heavy and there is a cost for transporting aggregate from its source to the batch plant is a factor in the cost of the concrete, locally available aggregates are used to produce concrete. This is an important design consideration because, depending on the project location, there may be few, if any, opportunities for other aggregates to be used in the concrete mix. The mixing water needs to be free from injurious amounts of oils, acids, alkalis, organic materials. Basically, it needs to be potable water.

Avoid admixtures. The Portland Cement Association recommends that admixtures be kept to less than 1-2% of the total mix weight. Every time you add something to the mix, you are taking away from the portland cement, which is the only thing RetroPlate reacts with. Plasticizers, slag, fly ash, or other products replacing portions of the portland cement in the concrete mix is not recommended. If any of these are used, the total volume should not exceed 10% of the portland cement volume and should not be calcium chloride based.

The concrete should be engineered to reach a compressive strength of at least 4,000 psi (28 Mpa) at 28 days. The concrete should be mixed with the minimum slump necessary to afford proper consistency for efficient mixing, handling, placing and finishing. "Slump" is the consistency of the mix. Use as little water as possible in the mix, while still keeping it workable, the suggested water-to-cement (W/C) ratio is .45.

Do not use chemically reactive curing agents, or membrane curing agents such as acrylic compounds. The Concrete Polishing Association of America recommends evaporation control and wet curing concrete slabs according to ACI 308R-01: Guide to Curing Concrete (Reapproved 2008) without the use of topically applied curing compounds. While topically applied curing compounds may assist with curing during the first few days after concrete placement, they retard concrete drying in the weeks and months after curing and may cause the slab to be too wet when the time comes for diamond polishing or floor covering application.

The air content should be 5% as determined by ASTM C 173. No air entrainment is necessary on interior slabs and should not be added on a floor to be polished.

If color additives are to be used; the concrete should be at 45 days old before color is applied. Acetone and water based dyes, in particular require a low moisture level; a tolerance of no more than 3.5 pounds of moisture per square foot per 24 hours. If an integral color is included in the concrete mix, the minimum batch size should be 3 cubic yards.

EARTH SUBGRADE AND VAPOR BARRIER

Fine grading the Earth subgrade uniformly flat using a laser device is recommended as imperfections in the subgrade surface, such as rises and depressions, could cause variations in the thickness of the concrete which increases the possibility of cracking because of restricted movement. A uniformly flat subgrade surface reduces the potential of cracking because the concrete slab can expand and contract with minimal frictions. Cracks cannot be made invisible by the polishing contractor.

Moisture movement from earth subgrade through the concrete slab-on-grade to the concrete surface is a major problem in the flooring covering industry today, and can adversely affect a polished finish as well. A high-performance vapor barrier between the subgrade and the concrete is extremely important, a membrane that is rated Class A according to ASTM E1745 - 09 Standard Specification for Water Vapor Retarders Used in Contact with Solid or Granular Fill under Concrete Slabs that has the following properties should be used:

- Permeance: Not more than 0.1 perms (grains/sq.ft/hr/in-Hg) after conditioning testing according to Section 7.1 of ASTM E154-08a Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
- Thickness: Not less than 15 mils.
- Tensile Strength: Not less than 45lb/in.
- Puncture Resistance: 2200 grams.

CONCRETE PLACEMENT AND FINISHING

The floor should be as flat as possible - floor flatness tolerances should be an overall FF50 with and levelness of an FL30. The floor flatness and levelness should be tested within 8 hours after completion of the final troweling operation according to ASTM E1155 - 96(2008) Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers by an independent testing agency experienced with testing procedure and possessing the necessary equipment. The flatness, levelness, and finishing of the concrete are very important. Between flatness and levelness, the flatness is the most important. Additionally, a remedy for out-of-tolerance work should be specified. Making sure the floor finisher knows that the bare concrete will be the actual floor finish is vital. The floor should be finished tight without chatter marks or finishing marks. In addition to ACI standards, the following recommendations should be followed:

- After placement of the concrete mix, strike off the surface using a laser screed, then bull float at 90 degrees to the screed pull direction, vibrate and consolidate, and level to specified elevation. A 10 foot check rod is recommended, however, if not available bull floats should be 6 foot long; smaller bull floats may be used on sloping surfaces.
- When placing concrete mix at edges, use a 36 inch long metal or wood edged screed and run parallel with the formwork or edge after the initial screeding and before floating. Hand floating should be parallel to the edge and performed in 24 inch increments to avoid lifting or depressing the surface. Avoid pulling excessive amounts of the concrete mix to the edges by either not using hand tools more than 24 inches from the edge, or floating in a fan direction.
- When little or no bleed water is present and concrete mix has sufficiently hardened to support finishing equipment without causing imperfections in the surface, begin machine floating using pan trowels and make two passes.
- When machine floating edges, use pans and overrun the formed edge by 5 inches. For both walk-behind and riding equipment, make the first pass along the edge with the left side, or cutting side, of the equipment to pull down high spots of the surface. Make a second pass along the edge with the right side, or filling side, of the equipment to fill low spots in the surface.
- Steel trowel the surface in three passes without burning the surface or burning the aggregate (plastic trowel blades will prevent burning the aggregate).
- Lightly hand or machine tool edges construction joints and exercise care that the edges are not depressed or chattered along bulkheads, formed edges, columns, and pipe penetrations.
- Do not dust the finished surface with dry portland cement or sand to accelerate curing and drying.

CONTROL/EXPANSION JOINTS

Joints are put into concrete floors to keep cracks from being visible at the surface. They are not to keep the floor from cracking, as the floor will inevitably crack. Control joints also relieve stress caused by curling, cooling contraction and drying shrinkage. With proper spacing and timely installation, these joints help to control random cracking and curling. Joint spacing depends on the thickness of the slab, reinforcement used, cooling contraction, drying shrinkage potential and curing environment. The joint spacing needs to be determined by an engineer and based on the above items as well as the size of aggregate used in the mix.

Slab Thickness	Joint Spacing <i>(feet on center)</i>
4"	10'
6"	12'
8"	15'

Saw-cutting slabs as soon as possible after finishing using a saw blade that has a triangular arbor configuration to reduce edge raveling or dislodging aggregates at the following spacing to minimize slab curling and cracking. Since concrete shrinks during curing and drying in two directions, cracks are minimized when the area between contraction joints is as close to a square as possible.

PROTECTION

The concrete finishing specification should include damage and stain prevention requirements for the finished concrete slab.

The use of reinforced Kraft paper taped to itself with blue painters tape covered by OSB board or dry wall is recommended. Duct tape should never be used as the adhesive residue will stain the concrete. Never use plastic (visqueen) to cover the floor. Avoid Tyvek or similar products as they dye used may transfer to the slab. Other temporary floor protection products may also be used: **EZ Cover** (LEED Points), **Ram Board**, **Skudo**.

Please Note: This information is provided as a reference and guide for Mix Design for Polished Concrete, specific to the use of the RetroPlate Concrete Polishing System. The information provided herein is furnished as a service only, and does not replace field training by experienced, competent and authorized instructors. It is the responsibility of the reader to seek qualified instruction prior to utilizing any information contained in this guide.