

Waterproofing Your Concrete in Numerous Applications

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Concrete is the number one building material in the world because it is strong, durable, and can provide a safe and comfortable environment in which to live and work. Many structures, such as our homes and businesses, have concrete as the foundation, floor, and wall elements. Over their lifetime, these elements can be exposed to rain or ground water. Because concrete is adsorptive, porous, and susceptible to cracking, any water that penetrates through concrete acts as a carrier for deleterious materials that can lead to premature deterioration, thus shortening the element's service life. In addition, the living environment can be compromised from water penetration which can cause damage to its contents, and lead to high humidity levels, mold, and mildew affecting our well-being and comfort.

How do we defend our homes and businesses, particularly the concrete floors and walls from water damage? Fortunately, there are steps to manage the infiltration of water to help keep our structures dry.

Managing Water Infiltration

Above grade - the first line of defense against water infiltration is diverting rainwater away from structures by sloping the finished-grade or abutting pavement away from the structure.

Below grade – the use of externally-applied coatings or membranes, with drain boards, against the outer side of poured concrete or block walls in combination with appropriate drain tile, and vapor barriers beneath concrete floors can effectively repel and pipe unwanted water off into swales, ravines, or storm sewers.

Using a Quality Concrete Mixture – under normal conditions, good quality uncracked concrete will not permit the passage of water. Good quality concrete starts with a baseline mixture that has a low water content. For concrete that is only in contact with water where low permeability is required, the ACI 318 Building Code stipulates a minimum compressive strength of 4,000 psi (28 MPa) and a maximum water-cementitious materials ratio (w/cm) of 0.5, with no limit on the amount of supplementary cementitious materials (SCMs) that can be used. The permeability of concrete can be further reduced to enhance its “waterproofing” performance.

Concrete with “Waterproof” Performance

“Waterproof” concrete can be obtained by: i) reducing the total amount of water used in the mixture; ii) using SCMs such as fly ash, slag cement, natural pozzolans (calcined

clay), high-reactive metakaolin, and silica fume; and iii) adding integral waterproofing admixtures.

To facilitate concrete placement, consolidation and finishing in concretes with relatively low water content, water-reducing admixtures – normal, mid-range, high-range – may be required. The Master Builders Solutions brand offers a wide range of water-reducing admixtures, including the MasterPolyheed® family of mid-range water-reducing admixtures and the MasterGlenium® family of high-range water-reducing admixtures. Fly ash, slag cement and natural pozzolans are cost-effective SCMs that can be used to reduce concrete permeability. However, their availability may be limited in some areas. High-reactive metakaolin and silica fume, including Master Builders Solutions MasterLife® SF 100 product, provide significant reductions in permeability, thus enhancing the overall durability of concrete.

To further inhibit water infiltration, an integral waterproofing admixture, such as Master Builders Solutions MasterLife 300 series of crystalline capillary waterproofing admixtures, react in concrete in the presence of moisture to form insoluble crystalline products that fill fine pores and help to seal hairline cracks. Their ability to seal hairline cracks has led to increased acceptance of these crystalline capillary-based waterproofing admixtures and their wide use in various concrete applications.

An often-overlooked factor is that concrete, even high-quality concrete, can crack beyond the hairline cracks that crystalline capillary admixtures can help seal, and thus allow water penetration and leakage if exposed to water. A major cause of concrete cracking is drying shrinkage, but cracking can also occur if other potential durability issues, including corrosion of steel reinforcement, are not addressed. To minimize cracking due to drying shrinkage, Master Builders Solutions recommends the use of either a shrinkage-reducing or crack-reducing admixture such as MasterLife SRA 035 admixture or MasterLife CRA 007 admixture, depending on the application. In steel reinforced structures exposed to chlorides in service, the use of a MasterLife CI series corrosion-inhibiting admixture is recommended to minimize corrosion cracking potential.

Summary

There are multiple options to consider for waterproofing concrete structures as has been described. Each of the options available have performance limitations. When designing and building a watertight concrete structure, the most effective waterproofing strategy is to use a combination of external water-repelling barriers and integral waterproofing of the concrete, in addition to providing proper drainage for water. This systems approach will help ensure a dry, comfortable structure and avoid inevitable, time-consuming, and costly options to remedy leakages after the fact.