GEOTECHNICAL CONSULTANTS INC.

Concrete Facts Every Building Owner and Contractor Must Know

Water intrusion and moisture related problems cost building owners more than $11 billion every year including $100 million in problem floor covering installations. Since the early 1990s, there has been a huge and growing increase in the frequency of moisture related issues due in part to fast track construction, lower VOCs in adhesives, and less-breathable floor coverings that sometimes form a better vapor retarder than the actual vapor retarder.

Moisture problems specifically related to concrete floors typically become evident due to floor covering adhesive breakdown, covering debondment, blisters, mold and mildew growth, wood flooring buckling, substrate cracks reflecting through bonded floor coverings, and underlayment expansion that ruptures the flooring.

Preventing and Solving Water Problems

Most contractors and building owners recognize that proper management of moisture and relative humidity is important during construction and concrete placement but proper moisture management must begin during the building design and pre-construction phase and continue throughout the building's useful life.

Pre-construction:

1. **Build moisture prevention measures into design specifications.**

   Prevention is the first step in solving moisture problems. To minimize the potential for excessive moisture and alkalinity from reaching the concrete slab surface, strong design specifications that clearly define moisture protection measures from external sources on the top and bottom of the slab should be incorporated early in the design process.

   In addition, specifications should address properties that relate to concrete slab performance as a substrate for flooring, not just compressive strength and also include appropriate

Adhesive Degradation – Due to excessive moisture and a high pH in the concrete surface, the adhesive under this sheet vinyl has re-emulsified and lost most of its holding strength.

weather-specific concrete mixes, acceptable concrete drying and curing methods, weather protection during the construction phase, and suitable use and frequency of testing.

2. **Determine proper vapor retarder specifications to restrict moisture flow.**

   Vapor retarders are sheet materials used under concrete slabs on ground to restrict the flow of moisture vapor from the sub-grade into and through the concrete slab. It's best if designers specify the likely types of floor covering on concrete slabs so that the appropriate perfo-mance-based water vapor retarders can be determined during the design and budgeting phase.

3. **Develop a realistic schedule that allows for adequate concrete drying.**

   Concrete drying can't be rushed, at least not without tradeoffs that may have undesirable long term consequences. General contractors can gather input on materials selection, concrete mixes, finishing techniques, environmental protection, and construction processes during the design phase from engineers, testing experts and trade contractors so that concrete slabs and structural elements are allowed the necessary time to dry while still keeping to the desired schedule.

Microbial Growth – Excessive moisture trapped under floor finishes can create conditions for mold and mildew to grow.

Wood Expansion – Wood flooring glued directly to a damp concrete floor slab absorbed moisture from the slab, expanded, and buckled.

Vapor retarders used under concrete slabs on ground restrict the flow of moisture vapor from the sub-grade into and through the slab.

During Construction:

4. **Relative humidity (RH) testing provides essential concrete moisture knowledge.**

   The amount of moisture within the concrete slab—not just on the surface—typically must not exceed 75%. Unlike traditional surface-based testing methods, relative humidity (RH) testing measures the amount of moisture within the slab. In-situ probes are placed in holes drilled in the hardened concrete to measure the moisture content at a depth proven to give the best indicator of the moisture level that the slab would have if the slab were to have the surface sealed at that point.

Section 10.2 of ASTM F2170-02 establishes the RH testing depth requirement at 40% for a slab drying from one side and 20% if from two sides. The hardened concrete's internal relative

humidity at precisely these depths using in-situ probes provides the best indicator of a final relative humidity level if the slab were to be sealed and allowed to equilibrate at that time.

5. **Provide weather protection during construction.**

   If there are no overhangs at building eaves, and weather-stripping and sealant joints around openings are not properly installed, rainwater will penetrate the building envelope and resaturate the concrete.

6. **Turn on HVAC and dehumidifier systems as soon as possible.**

   To make certain that conditions are suitable prior to floor covering installation, as soon as possible during building construction, turn on HVAC and dehumidifier systems to provide air movement and help remove excess moisture from the air as the concrete dries. Supplemental dehumidification equipment will likely be necessary during concrete drying in order to remove all the excess moisture that is released. Testing standards require that both a concrete slab and the air space above the slab be at service conditions with HVAC systems operating for at least 48 hours before beginning RH testing.

7. **Concrete alkalinity and moisture can be highly destructive to floor covering adhesives.**

   Because newer, lower-VOC floor covering adhesives are sensitive to both high pH and high moisture conditions (concrete is very alkaline), it is more important than ever to make certain that concrete conditions are suitable for installation and the flooring manufacturer's specifications are followed.

After Construction:

8. **Concrete can regain moisture – be vigilant about leaks and humidity.**

   Concrete is a hygroscopic material – it gives up and takes on moisture, especially after being covered with flooring or sealants. Like the majority of building materials, temperature and humidity have an impact on the internal moisture levels in concrete even after is has been deemed "dry" and finished with a flooring sealant. Regular monitoring of building systems for water leaks and high humidity conditions can uncover concrete moisture conditions in the early stages when remediation is less costly.

Alkalinity is the most destructive water problem. Tests of adhesives commonly used for bonding floor finish to concrete slabs indicate that they lose a large portion of their dry bond strength when the concrete becomes damp. This is possibly due to chemical degradation of the adhesive at the junction of the adhesive and the concrete, and may be caused by a reaction, in the presence of water, between alkali in the cement and the resin in the adhesive.

9. **Address exterior drainage problems immediately.**

   After construction is complete, water that collects around the base of a building can cause problems along the interior or perimeter. Water can saturate concrete walls or flow along joints and cracks, leading to mold, mildew, and flooring failures.

10. **Use proper cleaning and maintenance practices.**

    Maintenance of modern floor coverings is critical to ensuring their long-term appearance and function. Floor maintenance staff must use proper chemicals at the correct rate with approved equipment to ensure adequate cleaning without damage from excessive water. Improper maintenance such as inadequate floor polish, frequent stripping, or excessive cleaning may cause water to migrate into concrete at floor covering joints and cause moisture-related problems.

Poor exterior drainage allows water accumulation at the base of an exterior wall and infiltration of water under the interior floor slab that can saturate floor coverings around the interior perimeter of the building.

In summary, proper concrete design and specifications, good communication between all parties from design throughout construction, proper concrete curing and drying, verification by testing, and appropriate property maintenance practices will help limit the potential for moisture related problems and flooring failures.

Contact GCI's Jim Rosebrock or Bob Hiles at 614.895.1400 for technical details and specific strategies for your concrete work.

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