CONCRETE

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Is that concrete floor dry yet?

Fresh concrete contains significiant water which evaporates over time. Installing floor coverings on the floor slab before it's dry is a recipe for disaster, so how do you know if it's dry enough?

Figure 1: Flooring hygrometer installed on concrete slab.

Table 1: Maximum acceptable values of relative humidity in concrete prior to installation of floor covering.

Floor covering	Flooring hygrometer reading	Humidity probe reading (at 40% of slab depth)
Carpet	70%	85%
PVC	70%	90%
Timber strip	65%	80%

Even a modest domestic floor slab may contain up to 1,000 litres of excess water, added purely to allow the concrete to flow. This water is released as vapour through its top surface over time. Installing a moisture-sensitive floor covering too soon will damage it – carpets can grow mould or rot, timber-strip and parquetry flooring can warp and cup, and low-permeability coverings, such as vinyl, can bubble and delaminate.

Reported floor-covering failures have increased in recent years due to fast-track construction schedules and the reduced use of more tolerant solvent-based flooring adhesives for environmental reasons.

Allow enough drying time

The best solution is simply to allow the concrete to dry naturally to equilibrium with its surroundings. An old rule of thumb suggests a month of drying time for every 25 mm of slab thickness, so several months delay needs to be factored into the construction process before considering installing floor coverings. The actual rate of drying will depend on the concrete composition, relative humidity of the surrounding environment, and the air temperature and flow across the slab's surface.

Drying is assisted by closing in the slab as quickly as possible to protect it from the rain, while still maintaining adequate ventilation. Fans to circulate air may be helpful but attempts

How to measure slab drying

A 'flooring hygrometer' is the most common technique used in New Zealand to check moisture content or vapour transmission rate. This consists of a tensioned synthetic hair hygrometer and associated indicator dial, mounted in an insulated PVC box (Figure 1). The hygrometer is sealed to the floor, trapping any water vapour that diffuses from the slab. After about 16 hours, the vapour pressure in the hygrometer chamber equalises with that in the near surface of the concrete and a humidity reading can be taken. Readings at several different positions should be taken for small (<100 m^2) floor slabs. On larger slabs this can be extended to one measurement per 100 m^2 of area.

Hygrometers are quick, convenient and inexpensive, but only give useful results if the surface concrete is in equilibrium with the ambient building conditions (hasn't been force dried or recently subjected to rain or washing).

Direct measurement of humidity at depth within the slab, by inserting a probe into a drilled and sleeved hole, gives a truer indication of the slab drying. This has long been used in Europe and is becoming increasingly popular here as probes become available with integrated displays, eliminating the need for ancillary data loggers to interpret the results. Some units are cheap enough to be regarded as disposable items left permanently embedded in the floor.

Other measurement techniques used include handheld electrical resistance or impedance meters, which can be useful for comparative survey readings across large areas. However, unreliable correlation with absolute moisture conditions within the slab mean they shouldn't be relied on for 'go/no-go' decisions regarding floor covering installation.

American technical literature often references the 'anhydrous calcium chloride' test, which uses a water-absorbent chemical in a dome sealed to the concrete surface to measure vapour transmission rates in units of mass per area per day. This method suffers from similar technical limitations to the flooring hygrometer, with the additional problem that it is a one-shot test that requires access to a sensitive balance to perform.

Lastly, there is the well-known qualitative field test where a large polythene sheet is taped tightly to the concrete and left for at least 16 hours. The accumulation of condensation is a sure sign that the slab needs to be allowed to dry further. No moisture does not mean the slab is acceptably dry. Testing with a more sophisticated measurement technique is needed to confirm this.

to aggressively dry the concrete with heaters or dehumidifiers are generally unsuccessful. Such force-drying only affects the top few millimetres of the concrete, leading to misleadingly low moisture measurements.

Concrete design can help

Where drying times are crucial, optimise the concrete mix design by using low water-to-cement ratios with chemical admixtures providing the necessary plasticity. Curing should preferably be achieved by covering with polythene sheeting. This retains the mixing water without adding any additional moisture. Curing compounds should be avoided.

Moisture migration systems

Sometimes waiting for the slab to dry completely isn't practical because of time constraints, or a damaged or absent damp-proof membrane. Surface-applied moisture mitigation systems can reduce the vapour transmission rates to acceptable levels but the decision to rely on such a system should be made carefully. Always get the system supplier to provide a written warranty covering any damage to the floor covering if the system fails.

The most effective mitigation systems include purpose-designed epoxy coatings, which can cope with most vapour transmission rates. Non-reemulsifying acrylics are generally restricted to solving less severe moisture problems, but also help isolate the applied flooring material from the pH rising effects of soluble alkalis leached from the concrete. Dense copolymer modified cementitious overlays serve a similar function.

The least costly mitigation treatments are often reactive penetrants based on sodium or potassium silicates. These work by chemically reacting with the calcium hydroxide in the concrete and forming additional cementing material that reduces surface porosity. Achieving a successful result depends on a number of factors, including adequate penetration of the concrete which normally necessitates shot-blasting of the surface. Conversely, over-generous application can result in an unstable surface film. Consequently they should be used with extreme caution for this purpose.