CONCRETE Advice

Drying times for concrete slabs

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Concrete has an inherent quantity of water within the mix from the time of batching, typically about 200 litres per cubic metre. The majority of this water is not required to hydrate the cement but is needed to improve the consistence or workability of the concrete to ease handling and placing. The water that is not chemically combined or held by capillary action within the concrete's pore structure is free to evaporate i.e. dry.

1 Drying or curing

Drying is a different process to curing. Curing is the process of preventing the loss of moisture from the young concrete whilst maintaining a satisfactory temperature regime.

The purpose of minimising moisture loss is to maintain a high level of hydration of the cement in the surface layer of the concrete and thus improve durability.

2 Influencing factors

There are many factors that affect the drying time of concrete slabs including:

- Type of cement.
- Type and amount of aggregate.
- Water content.
- Thickness of the slab.
- Curing and drying conditions.
- Moisture condition required.
- Drying from one or two sides.

Use of power-float and power-trowel finishing methods can further delay drying as the surface is densified by the re-working process.

3 Guidance

BS 8204-1[1] suggests that under good drying conditions concrete bases of 150mm thickness, drying from one face, will take more than one year to dry. The often quoted 'rule of thumb' of 1 day per mm thickness refers to cementitious levelling screeds and not concrete.

The Swedish Council for Building Research[2] describes a method to estimate drying times for concrete slabs. Correction factors make it possible to allow for deviations from a set of base conditions. The purpose of the calculation is to enable the estimation of a minimum drying time for concrete slabs during the planning stage. It can be useful for general planning but should not be relied upon to determine precise drying times due to variability of actual concrete composition and site conditions.

Factors used in this calculation include:

- Slab thickness.
- Drying temperature.
- Relative humidity of the air.
- Drying from one or two sides.
- Water/cement ratio.

Other interpretations of this method have been developed[3,4,5] along with a computer program[6].

The standard drying time is initially based on the water/cement ratio and the target RH of the concrete, as per Table 1.

RH %	w/c ratio			
	0.4	0.5	0.6	0.7
85	50 days	90 days	135 days	180 days
90	20 days	45 days	65 days	95 days

Table 1. Standard drying time

These RH values are from an in-hole humidity meter; 85% in-hole humidity is approximately equivalent to 75% RH when using the BS 8201[7] or BS 8203[8] enclosed surface method and 4% moisture content when using the electrical impedance method.

Drying from both sides (such as with a suspended slab) is quicker than drying from one side (such as a ground supported slab). Table 2 provides correction factors.

Drying condition	w/c ratio			
	0.4	0.5	0.6	0.7
1-sided	2.0	2.3	2.6	3.2
2-sided	1.0	1.0	1.0	1.0

Table 2. One or two sided drying correction factor

The thickness of the slab will have an effect on the drying time. Table 3 provides correction factors.

Thickness mm	w/c ratio			
	0.4	0.5	0.6	0.7
100	0.4	0.4	0.4	0.4
150	0.8	0.8	0.8	0.7
180	1.0	1.0	1.0	1.0
200	1.1	1.1	1.1	1.2
250	1.3	1.4	1.5	1.8

Table 3. Slab thickness correction factor

The ambient temperature and humidity during drying also affect the drying time, the lower the RH and the higher the temperature, the shorter the drying period. Table 4 provides the correction factors.

Variations in curing conditions (including: dry, rain, and high moisture) are also covered in the original Swedish Council for Building Research and some of the interpretations but for simplification they have been omitted in this summary.

RH %	Temperature °C			
	10	18	25	30
35	1.2	0.8	0.7	0.6
50	1.2	0.9	0.7	0.6
60	1.3	1.0	0.8	0.7
70	1.4	1.1	0.8	0.7
80	1.7	1.2	1.0	0.9

Table 4. Ambient temperature and relative humidity correction factor

4 Examples

As an example, if 85% in-hole RH is required, the drying time for a 150mm thick concrete slab with a water/cement ratio of 0.5, drying from one side only in ambient conditions of 10°C and 60% RH, would be 215 days (90 days from Table 1, x 2.3 from Table 2, x 0.8 from Table 3 and x 1.3 from Table 4).

Similarly, if 85% in-depth RH is required the drying time for a 200mm thick concrete slab with a water/cement ratio of 0.4, drying from both sides in ambient conditions of 18°C and 60% RH would be 55 days (50 days from Table 1, x 1.0 from Table 2, x 1.1 from Table 3 and x 1.0 from Table 4).

5 The effect of curing

Effective curing, whilst delaying the onset of drying, produces a less permeable concrete by allowing more hydration products to form. These hydration products reduce the size of the capillary pores and can lead to capillary discontinuity (see Table 5). Whilst this reduces the rate of drying it can also reduce the moisture emission rate to less than that required for moisture sensitive finishes i.e. the moisture is trapped inside the concrete and cannot escape via the capillary pores.

Water/Cement ratio	Curing time required for capillary discontinuity
0.40	3 days
0.45	7 days
0.50	14 days
0.60	6 months
0.70	1 year
Over 0.70	Not achievable

Table 5. Curing time required for capillary discontinuity

The application of spray applied curing membranes provide extended curing times and hence reduced permeability as they may takes weeks or months to degrade and wear off the surface. However, they are generally not recommended where shorter drying times are required as they delay the start of drying. In such situations curing with plastic sheeting is generally preferred.

The use of a water-resisting admixture can also create capillary discontinuity and permit the early application of moisture sensitive coatings.

Note that these guidelines refer to the times for the original water of the fresh concrete to dry out. They are not applicable to drying out of water applied to already hardened concrete such as in the case of flooding.

It should also be noted that proprietary concretes are available to produce early drying concrete slabs.

References

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Further reading

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