

CONCRETE INDUSTRY BEST PRACTICE RECOMMENDATIONS

THE IMPORTANCE OF CURING CONCRETE & MORTARS

After the addition of water, concrete stiffens and sets fairly quickly at say 23°C in about 3-4 hours. This is followed by its slow hardening by it gaining strength over the next 28 days.

After setting, most grades of concretes, mortars and grouts typically take twenty four hours to reach about 26% of their ultimate strengths and hardness. It takes 28 days to reach about 85% of their ultimate strength and hardness.

It is important to realise that these cement-bound building materials including those that are through coloured with colouring pigments can only attain their full potential ultimate strength and durability over this time span if their mixing water is prevented from evaporating - at *all* stages of their processing or application on site. You may care to request, read and study Ability's publication 'How To Reduce Cracking & Shrinkage Movement In Concrete' which outlines the importance of keeping the mix water within the concrete.

Good, durable, coloured or plain concrete is made with:

- ★ a relatively low water content compared with the cement or cementitious binder content.
- ★ The lower the water:cement ratio in concrete, the higher its strength at all ages.
- ★ the immediate adoption of suitable procedures after the concrete is placed prior to it setting to prevent water loss from it. This can be done by spraying liquid moisture evaporation retardant

called Aliphatic Alcohol over it whilst carrying out the finishing operations, and then importantly, just prior to it setting, adopting a suitable method of curing it.

- ★ These are items that can ensure the retention of the mix water in the concrete over a 28 day or longer period.

If concrete is to have a minimum amount of shrinkage cracking, high surface hardness, wear resistance, longevity, and high mechanical strengths, the **slow** chemical hardening and gluing/binding reactions (hydration) **after** setting between the cement and mixing water **must** proceed **to the fullest possible extent**.

This cannot happen if there is early *loss* of water from concrete, mortar or grout, all of which harden slowly after they set. Subsequent wetting will be of some help, but it is far better to adopt suitable procedures that prevent evaporation of the mix water from concrete **prior to** it setting and **after** setting, by using Aliphatic Alcohol and a proper curing regime for as long as possible.

CURING PROCEDURE:

This *procedure* adopted for cement bound materials after they set as specified by architects, landscape architects, and engineers, and carried out by concreters and plasterers is known as 'curing', and its importance in producing good, hard, wear-resistant and durable concrete would be difficult to exaggerate.

Ideally, a suitable curing procedure should be *continuous* for greater than a month. The

earliest start, as soon as the concrete has set – **within** about 3-3½ hours at 23°C after fresh wet plastic concrete is placed and finished for a *minimum* duration of seven days, and to gain the highest strength – preferably 28 days should always be attempted. Curing, as is also the procedure of concrete **compaction** by a vibration procedure to remove air bubbles which reduce strength and increase the chances of concrete cracking is now **mandatory** for the placement and site-processing of all concrete specified according to the important Australian Standard AS3600-2007 'Concrete Structures'.

Preventing the evaporation of and keeping the original mixing water **in** newly placed and set concrete and all cement bound materials is an important factor in eliminating surface dusting and minimizing shrinkage cracking. This is because, as the hardening reaction proceeds, shrinkage increases as the rate of drying is reduced.

Curing gives fresh concrete time to adjust to shrinkage forces induced by the relatively slow but continuous hydration of cement and the occurrence of visual cracking can be made to be minimal – especially if joints in the concrete are saw cut at 1½ metre centres to ⅓ its depth within about 8 hours of placement.

AVOID STRENGTH LOSS:

If concrete surfaces exposed to air dry out, up to 40% of the concrete's **mechanical strengths** can be **lost** and a considerable amount of cracking can occur. Also a thin volume at the concrete's surface will usually be weak to a depth of 1mm-5mm and have very poor resistance to wear. It can be dusty as well, ie the set and hardened concrete can have a weak dusting surface - hardly having any strength at all.

A good method of retaining the mix water in concrete **prior to the concrete setting** is to spray on a moisture retaining film of Aliphatic Alcohol. This is a very effective moisture loss retardant to stop plastic cracking but is NOT a curing compound.

Concrete can be effectively cured – **immediately after it sets** by either of the following:

METHODS OF CURING:

The three principal methods used for curing nowadays are:

1. Applying by brushing or spraying, a liquid low-moisture vapour permeability, film-forming, non-aqueous, solvent solution **curing compound** - such as Ability's 'Duro Seel' Clear - on to the placed and newly set concrete.

Curing compounds should conform to Australian Standard AS 3799-1990 "Liquid Membrane-Forming Curing Compounds for Concrete". This method of curing is efficient and lasts for **at least 28** days.

2. The covering over the area of flexible sheets of 200µm thick polythene or water vapour-impermeable building paper.

To work effectively, these should be suitably lapped and held down over the concrete for the total curing period.

3. by 'ponding' water on the surface, and by hanging wet hessian cloth onto vertical faces and keeping the cloth constantly wet.

The applied non-wax based 'Duro Seel' Clear curing compound (which forms a coating of very low moisture vapour permeability) must be applied – usually one uniform liberal coat directly to the freshly finished 'green' concrete surface *on the same day as placement* – **immediately** the set has occurred or if the application of the coating doesn't disturb or mar the surface, slightly **before** the concrete has set.

This time period is typically about 3-3½ hours, after discharge and placement of the concrete from the transit mixer at average ambient temperature of 23°C, and a relative humidity (RH) of 50%. This time can be *less* in hotter weather and *longer* in colder weather.

ADDITIONAL SEALING:

Later, in a day or two, a second coat of 'Duro Seel' Clear may be applied if required for additional 'sealing' protection.

For the purpose of curing, 'Duro Seel' Clear is simply and easily applied in a single coat by brush, broom, knapsack or other suitable spray equipment at the *specific* coverage rate of 5m²/litre. NOTE: It is counter productive in achieving effective curing, and its beneficial results, to spread a curing compound out further than the recommended application coverage rate.

In certain cases other brands/types of curing compounds may later have to be deliberately removed as they may affect the bond of other surface treatments or finishes carried out by some after trades.

For example a water-based vinyl floor tile adhesive applied to a wax-based curing compound may not stick properly.

On windy days lapped moisture retaining sheets laid over concrete are often blown aside, yet it is on such days that concrete or cement rendering most needs to be protected from mix-water evaporation.

To ensure effective curing, careful attention must be paid to adequately securing the sheets or, with the selection and application of a liquid curing compound, coating **all exposed** surfaces of the concrete adequately and uniformly.

COLOURED CONCRETE & WALL RENDERS:

Curing is important for **all** concrete – including integrally coloured concrete - obtained by adding pigments into the mix - particularly for concrete floors and pavements, and for trowel applied cement renders, where a hard, long-lasting low shrinkage, crack-free, high adhesion, long-term coating material with a non-dusting and abrasion-resistant surface is required.

‘FULTONE MORTAR 8’:

✿ You may care to check out details for Ability’s ‘FULTONE MORTAR 8’ product – a strong, low shrink, lightweight (1670/m³), sound deadening, and thermally insulative mortar, dry mix (just mix into the recommended proportion of water) product. ‘FULTONE MORTAR 8’ is made available in **any** colour for rendering external or internal walls, a concrete repair material, and as a trowel applied wear resistant coating onto floors, pavements and flat roofs – none of which will require painting to decorate them.

Curing is a **most** important procedure for all concrete and mortar work carried out in summer and **on all days with low humidity air throughout the year**, particularly where freshly finished concrete/mortar work is exposed to strong evaporative forces - such as days having strong direct sunshine, and when hot or cold drying winds blow over the placed concrete.

BLENDED Vs GENERAL PURPOSE CEMENTS:

The proper curing of all exposed concrete surfaces is considered by most concrete technologists to be **imperative** when Australian **blended** Portland cements

(Type GB General Blended) are used to make concrete and mortars instead of pure Portland cement (Type GP - General Purpose). Check which type has been ordered or, for bagged cement, you can check the type which is printed on the bags.

GB cements which contain pozzolanic material are, at the same temperature and environmental conditions, **slower** to harden and gain strength after setting. As a result, they can permit more rapid moisture loss from freshly placed concretes/mortars under a given amount of evaporative force and possibly never reach a specified strength in a given time. Unless they are cured properly, many problems with lack of concrete quality and durability can therefore occur! Preventing moisture loss from all cement bound materials – particularly when using GB cements is considered to be most important.

An important aspect of efficient curing is that it should be **continuous** - for up to 28 days or more.

Please refer to a copy of the Australian Standard ‘CONCRETE STRUCTURES’ AS 3600-2007 available at libraries or, your personal copy may be purchased from the *Standards Australia* organisation in your capital city.

AVOID REPAIRS:

REMEMBER: "Every dollar spent on the proper curing of concrete can save \$200 on remedial repair systems for that concrete", a statement quoted by Mr Bruce Lee at a Concrete Institute of Australia (CIA) seminar on ‘Curing & Cracking Of Concrete’ 16/02/00 (still applies), Holmesglen Conference Centre, Melbourne.

PLASTIC CRACKING:

In direct sunshine and/or in very hot weather, to avoid cracking **before** the concrete sets, the spraying on of ALIPHATIC ALCOHOL - an easy to use moisture evaporation retardant can be an effective method of avoiding plastic cracking. This reduces evaporation of water from the concrete prior to it setting. It may need to be done **SEVERAL** times whilst finishing by trowelling, floating and brooming.

Please note that Aliphatic Alcohol forms a non-permanent evaporative film but not a coating and is therefore **NOT** a curing compound, and will not cure the concrete.

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