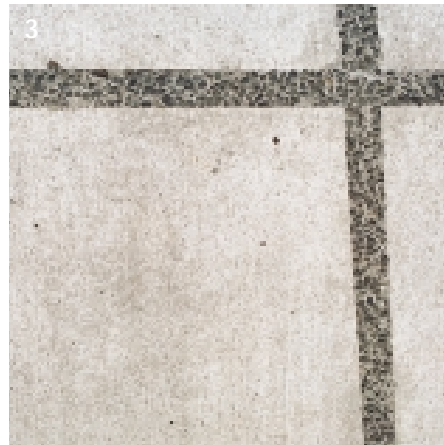
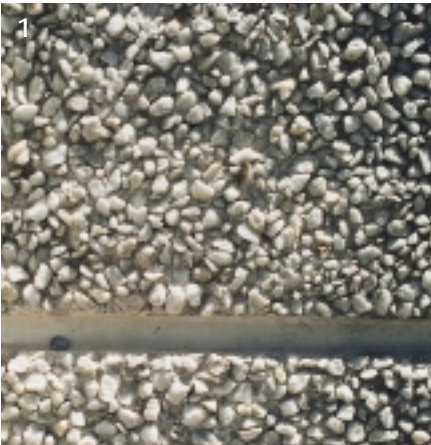


Exposed aggregate

the endless interplay of texture, pattern and form

1. Wall panel from a Christchurch polytechnic building which uses bands of exposed quartz aggregate and fair faced concrete to achieve an attractive texture.
2. Grey and quartz stone mix exposed aggregate courtyard at the Christchurch hospital.
3. Broom finish concrete courtyard with exposed aggregate contrast.
4. Exposed aggregate path using white and black stone where the darker side has been treated with a hydrochloric acid wash.

Exposed aggregate is the name given to concrete in which the top layer of the concrete has been removed to expose the aggregate. The result can be an attractive, low maintenance, non-slip surface.



The large range of aggregate colours, sizes, and shapes, combined with the possibility of adding colour to the concrete, mean that designers have the option of creating their own original masterpiece.

In this article we explore some of the effects that have been achieved with exposed aggregate, and the methods of achieving a good quality exposed aggregate surface. Although exposed aggregate finishes have also been used on many cladding panels for buildings, we will focus on floors.

Achieving Good Results

A good result comes from a combination of knowledge and experience. Consequently, we look at the materials, then how to expose aggregates, and then how to avoid common mistakes.

The Materials

The colours, shape and size of the aggregates can be used to create unique surface texture and appearance. White, black, brown, green and grey are common colours of aggregates used. It is best to talk to your local Ready Mix plant to discover the options available in your area.

Combinations of colours, either mixed together or in separate panels, are often used to good effect. The size of the stone and the shape (round or crushed) will affect the end result.

When selecting the desired aggregate, some points to consider include:

Grading - is the distribution of particle sizes in a batch. Most normal concrete mixes use continuously graded aggregates (i.e. a balanced mix of small, medium and larger aggregates). These mixes can however lead to non-uniform distribution of aggregates when exposed. To achieve a uniform exposure, the intermediate sizes are often omitted using what is referred to as gap graded aggregates. To achieve acceptable workability and consistent exposure, a specifically designed concrete mix should be used.

Shape - The shape, round or crushed, will impact on the appearance and skid resistance of the finished floor. When flat or elongated aggregates are selected, it may be necessary to use a seeded surface technique (refer explanation later) as these aggregates can both significantly reduce the workability and strength of the mix.

AAR - Alkali aggregate reaction is an expansive reaction that can occur with some aggregates. The expansion of the aggregates can lead to cracking of the concrete. CCANZ report number TR03 provides a detailed explanation of this process, and lists aggregates that are potentially reactive.

Abrasion resistance - As the aggregates are exposed, it is important that they can handle the wear and tear associated with the intended use of the floor.

The Matrix

If the mix is not to be tinted with pigments, you will find that the colour of the sand will dictate the overall impression of matrix colour. For a large project it is advisable to stockpile sand and aggregates from a single source to avoid colour variation.

The colour of the cement also affects the colour of the matrix. For more consistent colour, it is advisable to stick with one supplier and cement type.

Adding the Aggregates

Aggregates are normally added using one of three methods:

- Integral mix;
- Topping mix;
- Seeded surface.

For the integral mix, which is the most common method, the aggregates are added to the mix at the batching plant. The concrete is placed, vibrated, screeded and bullfloated to ensure a 2mm cover of cement paste over the aggregates.

In a topping mix, the coloured aggregate is only placed in the upper (topping) layer. The base slab is typically finished 25-40 mm below the finish level and the bleed water allowed to evaporate. The topping is placed and consolidated to ensure bonding. A surface retarder is sometimes used on the base slab to extend working times and improve adhesion.

In some instances, the aggregates are introduced after the bleed water has evaporated. The selected stones are evenly sprinkled over the surface and fully embedded by tamping and repeatedly working the surface with wood floats. This method is known as seeding the surface.

Exposing the Aggregates

Washing

The most common method of exposing the aggregates is the wash off method. When the concrete has stiffened sufficiently to allow the support of a person with only 2mm deep foot prints, it is time to begin removing the surface cement paste. A medium bristle broom and a continuous water spray are used. The surface should not be over broomed as this can result in dislodging the stones, and the mixing of water into the underlying cement paste can weaken the surface.

Spray-on retarders are typically used to prolong the available working time and to give a consistent and predetermined depth of exposure. These chemicals are applied with a back pack sprayer, typically with a long spray boom to reach the centre of the slab.

After curing, a mild acid wash (5% hydrochloric acid) is applied to remove a very thin layer of cement paste that may



5. An attractive stair detail using fairface concrete risers with exposed aggregate treads.



6. Pattern created using steel stencils laid out prior to abrasion blasting. Photo courtesy of C&CAA.

be dulling the appearance of the exposed aggregate. The surface is then thoroughly washed, and sealer applied if desired.

Abrasive blasting

Abrasive blasting is another method of exposing the aggregates. This process is conducted on hardened concrete. The depth of abrasion is dependent upon the abrasive used, and the effort exerted. The aggregates exposed tend to be dulled by the abrasion. Some striking effects can be achieved by using steel templates, which mask some of the slab resulting in a combination of surface textures. (see figure 6).

What Can go Wrong?

A less than desirable end finish with an exposed aggregate floor is most often associated with lack of attention to detail. Some, fortunately not overly common, problems include:

Inconsistent aggregate exposure

Potential causes include:

- Use of a concrete mix with continuously graded aggregates;
- Inconsistent vibration (refer below);
- Inconsistent application of surface retarder.

Inconsistent vibration

Inconsistent vibration creates dense and less dense areas. The surface retardant will penetrate more deeply into poorly consolidated concrete, meaning a greater exposure of the aggregate.

Footprints

If during the screeding process footprints are created, it is important that these are filled with concrete, rather than pushing cement paste into the depression. These footprints become obvious as patches with poor aggregate exposure if the latter technique is used. **C**

Additional references on this topic include

- CCAA Briefing 02- Exposed- Aggregate Finishes For Flatwork - available from the Cement and Concrete Association of Australia web site- www.concrete.net.au*
- IB 11 Coloured Aggregates, CCANZ, though a little dated, as first produced in 1987*
- IB 18 Architectural Surface Finishes, CCANZ*
- TM 01 Architectural Concrete Cladding*

Te Kura Kaupapa Maori O Te Whanau Tahī

Exposed aggregate concrete patterns were used in a number of pedestrian areas around this new Maori language school in Christchurch.

The layout of the buildings designed by Opus International Consultants forms a large circular courtyard. Within the courtyard are three large circles symbolising the baskets of knowledge of Maori folklore. Patterns within these were designed by Gwen Rolleston and Taipari Mahanga, teachers at the school. They represent the three stages of growth from seed to young plant to the fully developed plant. Similar details have been

repeated in other paved areas adjacent to the school library and staff room.

The landscape site works were detailed by John Marsh, Landscape Architect and built by Higgs Builders Ltd.

Patterns were formed with a combination of Kaiapoi Brown/Grey 10-20mm pebbles from North End Sand Supplies, Kaiapoi and Oamaru Shingle Supplies 10-19mm washed white marble. The latter was mixed with white sand and cement. The aggregates were used throughout the mix which incorporates retardants enabling the surface to be washed clean as it set.

