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**1.0** Darjit originated from making paper fiber out of old newspapers, and mixing it with the waste product from our local clay mine in the Far North of New Zealand. That was in the late 90ies. It's an adventure into the wonderful uses of recycled paper fiber.

We had been building with insitu adobe and found that the addition of paper pulp made our bricks much better (better surface finish, more tensile strength, and aerated. Then we were introduced to paperclay, and I learned about papercrete as it was being used in the USA. All this at around the same time as the clay mine asked me to find a way of using their waste product, they make 260 liquid tons per week of waste they call tailings. I took the gearbox of my friends rotary slasher (brush hog) and bolted it into a 44 gallon drum, powered it with his tractor and we made paperclay and papercrete, we were interested in alternative building material. Once I started experimenting with the mine tailings I soon had a material that was so nice to work with, I got hooked into making sculptures with it, my artist friends asked how did you make those and what did you make it with. People started wanting it and wanting to know how to use it so I started teaching workshops on making and using it, and we gave it a name,, Darjit, named after my Mum Dhaj.

Darjit started out as a recipe dictated by the materials that needed recycling in that geographic area. Due to the internet I was getting inquiries from several different countries as to how to purchase it, shipping it wasn't going to be an environmentally sustainable option. So I would travel overseas to teach workshop on how to make it with the local materials available in that area, then the techniques of making sculptures with it.

Darjit changed from being a recipe to a way of thinking or a goal, how do we take the cultural waste products that need recycling and make an architectural sculpting compound that is strong, permanent and wonderful to use, that we can make artwork or art houses with. In California we use paper from the recycle centers, rock dust( the waste product from gravel mining, or the dust they wash out of sand in sand mining, we add some powdered clay to get the workability we want and water based paint from the hazardous waste dump (as a binder, plasticizer and water resisting agent)

**Creating an outdoor living space**

I designed and built a series of garden walls and outdoor living spaces, using darjit, which also incorporate my love of designing decorative steel gates. These walls incorporate materials often sourced from land fills.

There is a lot of scope for the use of darjit when creating "interactive walls." The walls can curve and flow, sculpting natural ponds and water features, as well as seating areas, fire pits and plantings. Most of the walls I make are a series of curves, which can frame a garden area, or boundary.

### **Making Darjit**

Darjit is made from paper, clay and silica powder( the fine dust or waste product from mining operations). Any paper can be used – but it is best to avoid brown paper bags and cardboard boxes as they are harder to break down if you want a smooth, sculpting medium.

The same is true of the clay. Darjit can be made with a variety of clay like substances. If you have a particular clay in your area – try it out.

Soak the paper overnight at least, two –three days is best Approx 80% water to 20% paper, you can use newspapers, telephone books, glossy mags, junk mail, old office paper, shredded paper, old tax records.

*If in doubt use less paper.*

*You need to get it right first time because it is difficult to add more paper later.*

*You can add more water any time.*

*Soaked paper is mixed/broken down with the drill and plaster mixing paddle.*

*Hold the drill with loose hands – but be careful it can be unwieldy.*

*Regularly untangle paper from the paddle.*

*Feel free to stop and start – settling helps break down the paper sludge.*

*Once paper is broken down into a sludge add clay*

**2 – 3 parts paper**

**1 part clay\***

*\*A good proportion for the "clay" component is 60% silica powder (mining waste) and 40% clay. Too much clay will cause cracking from shrinkage, not enough and you won't get that wonderful buttery, clay like sculptability*

*Please note the clay particles help break down the paper and vice versa.*

*Once it has been mixed to a smooth consistency, pour out onto a draining surface and leave overnight. A shade cloth is good – but any semi porous material that holds in all the solid matter and lets the water drain through is good.*

## **2.0 Darjit Making equipment**

A large steel tank, 100-400 gallons, with rotary slasher or brush hog gearbox bolted in facing up from the bottom so the blade is in the tank. The driveshaft can be then driven by PTO on a tractor or welded to the axle of an old car or truck. It wants a drainage valve welded into the bottom of the tank, no smaller than 2inch, 3-4inch is better.

You can make smaller batches in a 50 gallon plastic barrel, or steel oil drum, the wheelie bins used for trash and recycling work great.

A plaster mixing drill and paddle are used to break down the paper and mix in the clay and silica, once again, it's the RPM (rev's per minute) that are important 300-800 RPM

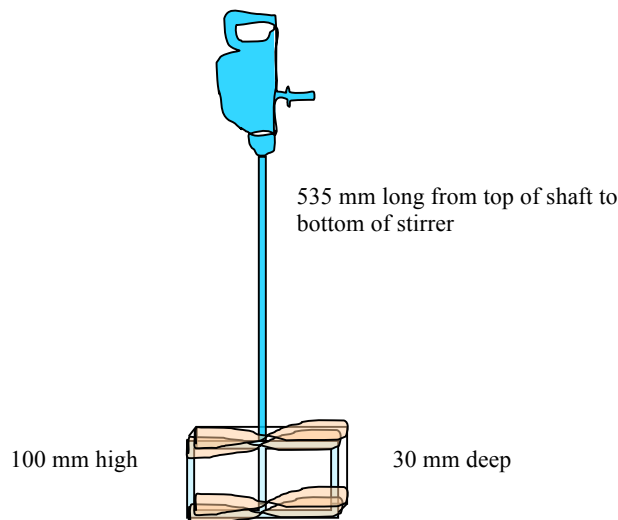
It is best to soak the paper longer when using the drill method.

## Making sculpture, walls, columns etc.

### 2.1 Equipment

- *Linesmens* pliers, *square ends* (with large cutting circle) - use these to make your wire ties, tacks. Consider filing off the sharp edges of the jaws of the piers if you have trouble with the wire ties breaking before they get tight enough.
- Long nose pliers – use these to form and shape the lath and chicken wire with twisting, pulling and pushing
- Wire cutters –shears for cutting the wire mesh .
- Leather gloves – or prickle proof gardening gloves. If you like to take your gloves off a lot – looser leather ones are best. If you don't take off your gloves and like a tight glove the garden ones are best.
- Surgical gloves – not optional for handling the Darjit once it has been mixed with cement. Note – find the tightest ones possible to get the best finish on the surface of the Darjit for your top coat.
- Buckets –for mixing
- Drill
  - revs per minute (RPM) are the main consideration 300-800 RPM
  - A high torque plaster mixing drill is best. Rotary hammer drills often have a drill setting and a low RPM that make them suitable. Any drill in the RPM range of 300-800 will work
  - variable speed does not mean the drill has low RPM
- Drill bit/paddle – see picture below with dimensions
  - Specialised plaster mixer

Note: cement mixers don't do a good job of mixing sculpting compounds.



### 3.0 Armature

Darjit can be used like clay and moulded to make objects.

But it comes into its own as a plaster coat to use on top of preformed armature.

Armature can be made using a wide variety of objects but the materials you use for the armature need to reflect the scale of the piece – ie it needs to be strong enough to support the final size.

### 3.1 Components

Choices here include:

- Rebar – very strong – plus there are different diameters to choose from
- *Square welded mesh 18 gage, 13mm/1/2inch hole size* – looks a bit like chicken wire – but has squares instead of hexagons. Is stronger than chicken wire
- Expanded Metal Lath (lath, or stucco lath) has the best shaping, workability and reasonable strength, 2.5 lb per sheet is the gauge that is shapeable.
- Chicken Wire (Hexagonal Wire Mesh) – is very easy to roll and fold but not very strong, 13mm/ ½ inchhole size
- Polystyrene – can be carved and shaped to form a plastering surface
- Plastic tubing/Chairs/buckets and other existing objects
- Wood – *see note below.*

There are a couple of ways to secure these things together.

- Welding – useful for work with rebar
- *Rebar tie wire*
- *Metal wire loops*
- *Electrical zip ties*

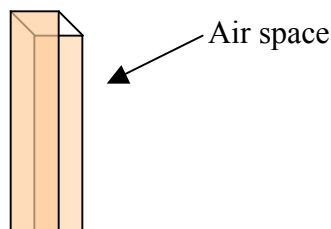
Don't be precious – experiment, and redo.

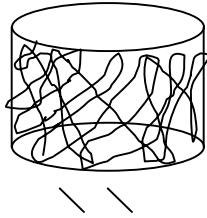
Don't let armature limit you. Why use a chair as a base if you are going to disregard its shape, or not build on it?

Make sure you measure as you go along. Scale can get out of whack very quickly. If you make a mistake – undo it and start again – that way the error does not compound. It is best just to tack things in place until you have your final form – so they can be changed quickly/easily, but be sure to fully tie it before plastering.

*It is best to use metal, plastic, stabile material as the base for your armature.*

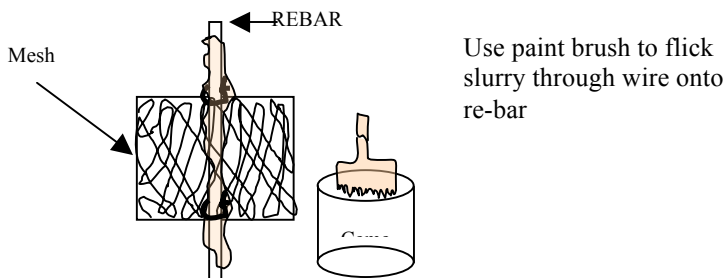
*If using wood for armature you will need to leave an air space around the wood as wood swells and shrinks with moisture and will crack the plaster.*





### 3.2 Rebar (reinforcing bar)

Use rebar when you need to create a stronger skeleton .  
 The steel in rebar won't rust if it is coated in cement.  
 You can use cement slurry to protect it if required – see below.



There are a variety of rebar benders available, vise's work well too.  
 If you don't have a rebar bender, find something really strong to wedge it in.  
 A storm water drain grill works well – as does a sturdy bike rack.  
 Use body weight and gravity to shape.  
 Be careful not to destroy other people's property.

When making curves do it incrementally, lots of small bends .  
 Rebar can be retrofitted to the outside of armature – it will be covered up with Darjit later.

Welding is the strongest way to join rebar – however it can be joined using ties/tacks.  
 To join using tacks - loop it around twice and twist it gently.

**Then pivot the pliers using the the rebar or another object to pull it tight.** This way you aren't tightening with the twisting action (as this may break the tie).  
 You can also use the shape of the rebar to add strength.

### 3.3 Expanded metal lath

Lath is by far the most versatile mesh to work with, it has much more structural strength than Chicken wire and is much easier to shape than Hardware wire cloth. It makes a large range of shapes, has smaller holes size so you can do a 1 coat finish if you want very thin shapes, like dogs ears, leaves etc.

### 3.4 **Hardware-wire Cloth (HWWC) Square welded mesh**

Good when you need structure not so easy to shape. Things like columns chairs walls. Gauge is significant. 18 or 19 gauge is good, lighter gauges are easy to shape but don't have the same strength.

### 3.5 **Chicken Wire**

Chicken Wire mesh (CW) does not provide much structural support.

It can be strengthened by rolling and folding it.

Minimize the amount of cutting as this further weakens the wire.

Always cut more chicken wire than you think you will need as when you work it - it will get scrunched and compressed.

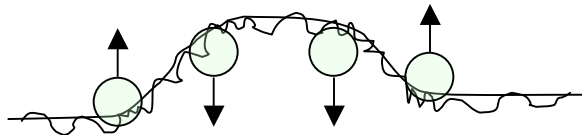
CW will become more rigid when it is stretched.

It stretches easily on one plane – but not the other.

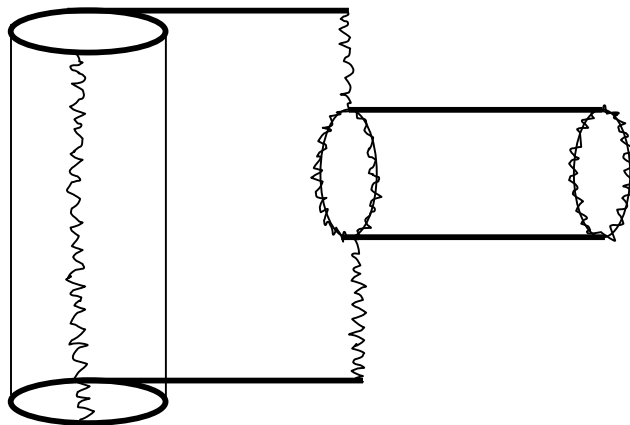
You can twist CW to join onto itself rather than using tacks.

Twisting can also be used to firm up the CW. Use long nose pliers to pull up and twist pimples.

Twist CW using your long nose pliers to create fullness eg



Please note CW rolls better one way than the other for forming tubes that you want to put a curve in.



Rolling this way is not as good. The CW tends to fold and seems unable to hold the tubular form as it is manipulated.

Rolling this way allows the CW to hold its tubular form when carefully handled.

## 4.0 Basic Armature Shapes

The tube is a versatile shape when making armature (underlying structure).

You can form HWWC into a tube to use as a base for your piece – or as a pillar for your wall!

You can form CW tubes to add structure and form to that base.

You can use a series of them to build something up. For example to make a beer belly – rather than just using one coil roll of CW – use three to provide strength.

Please note it is best to accentuate characteristics of your sculpted object eg for a face make a big chin and nose and brow. It is easier to flatten things later than it is to pull them out after.

Try to minimize double handling by tacking stuff in place. Make your manipulations and then tie down all together. The tacks you make for the CW will secure the HWWC at the same time.

### 4.1 Column/Pillar

Form a large tube with hardware-wire. Fold it over at the top and bottom to provide strength. If you are intending to sculpt the pillar you may need to provide additional support for this.

To provide a relief base:

Roll chicken wire into a tube (as detailed in previous section).

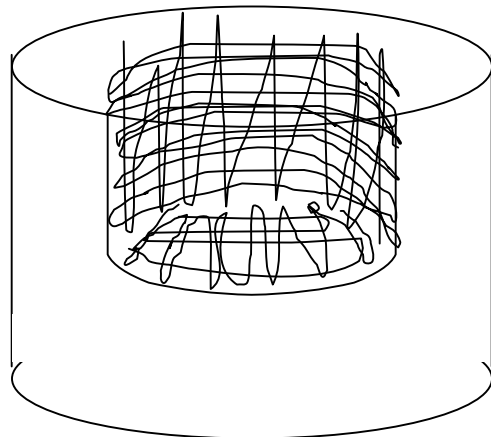
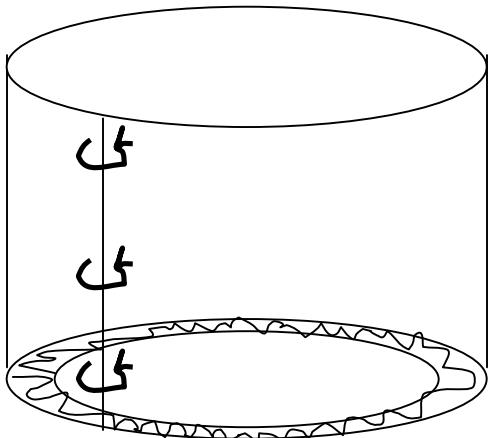
Roll around pillar

Secure in place with metal ties.

### 4.2 Chair

To make a chair with hardware-wire.

- Form a large tube with the wire. Roll wire under at bottom & top to provide strength.
- Use your hand/a hammer/what ever to carefully force one side in to create a “seat”.
- Note a seat should be approx 450 wide x 450 deep x 450 from the floor



## 5.0 The Mix

### 5.1 Making Darjit with drill and paddle

Darjit is made from paper and clay. Any paper can be used – *but it is best to avoid brown paper bags and cardboard boxes* if you can as they are harder to break down. Use paper that's needs recycling paper – ideally locally sourced.

The same is true of the clay. Darjit can be made with a variety of clay like substances. If you have a particular clay in your area – try it out.

#### 5.1.1 The Paper Mix

<b>Approx 80% water</b> <b>&lt;20% paper</b>
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*If in doubt use less paper.*

*If in doubt use less paper because it is difficult to add more paper later. You can add more water any time.*

*Soak paper for a couple of days then mix it up with the drill paddle.*

*Hold the drill with loose hands.*

*Regularly untangle paper from the paddle.*

*Feel free to stop and start – settling helps break down the paper sludge.*

#### 5.1.2 The Clay Mix

*Once paper has been soaked and mixed and broken down into a sludge add clay*

<b>2 – 3 parts paper</b> <b>1 part clay</b>
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*It is best to source local clay. It may need sifting if it has lumps, stone etc. If it is powdery mix it right into the paper pulp, if not mix it with water until it is buttery before adding to the paper pulp. Note – the clay particles help break down the paper and vice versa.*

*A good proportion is 60% silica powder(mining waste) 40% clay, Too much clay and you get more shrinkage, not enough and it isn't good to work with, wants to be clay like/buttery.*

*Once it is mixed to a smooth consistency, pour out on a draining surface and leave overnight, shade cloth is good.*

### 5.2 Stabilising Darjit

Once the Darjit has been made using clay and paper you will need to add sand and cement (to reduce shrinkage and dusting). Please note you don't have to. You can use Darjit as is – but its applications are limited and is not weather or water proof.

The recipes from here depend on whether:  
you are making a bottom coat  
a top coat  
covering a whole wall  
sculpting something relatively small

- Harder and stronger = heavier (more cement and sand)
- Weaker = lighter more tactile and insulating (more paper)

If there will be fire involved:

- don't use acrylic paint in the mix
- In extreme heat situations use high density refractory cement
- use polypropylene fibers to make it lighter and expansion and contraction from heating and cooling. These just melt away and leave holes. You can get this from the cement suppliers.

### 5.2.1 Under-coat recipe

1 and 1/2 parts Darjit 1 parts cement 1 part sand 10% by volume waterbase paint (acrylic adhesive) Water to consistency
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### 5.2.2 Finish-coat recipe

1 and 1/2 parts Darjit 1 part cement 1 part sand .You can leave the sand out of the finish coat if you want a smoother finish 10% by volume acrylic paint (min 5% max 15%)* Water to consistency
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*\*Acrylic Paint*

*Provides a bit of color as well as adhesive properties.*

*Only use paint that has been recycled - if you can help it ie don't go and buy new paint for this - save the planet etc. Can chuck multiple cans in there if color doesn't matter - especially if it is going to be painted or oxidized later.*

This mix should be relatively dry – to provide better sculpting properties. Use more or less water to adjust consistency .

## **RECIPES**

Darjit can be applied directly out of the bag for a 100% recycled environmentally friendly material. As an interior plaster, it is prone to shrinking and dusting, and needs to be applied in layers 5mm or less thick. We recommend the addition of cement and/or acrylic adhesive, to control shrinking and dusting. You will need to add some water to the Darjit, as the Darjit in bags is quite dry.

### **Interior Plaster:**

You can use Darjit with no additives if you plan for the shrinkage (plaster in layers no more than 1/4in, (5mill) thick ). That is my preferred way. To add cement is just to control shrinkage 7-9 parts darjit, 1 part cement, or oxides can be used for color.

### **Building light weight outdoor garden sculptures:**

3 parts darjit, 1 part cement, 10% acrylic adhesive or recycled acrylic paint.

### **For a harder mix with a grainy finish texture that cures faster:**

2 parts darjit, 2 parts sand, 2 parts cement.

### **Paving or flooring mix:**

1/2 part darjit, 2 parts fine plasterers sand, 2 parts cement, 10% acrylic adhesive, or recycled acrylic paint

### **High strength plaster for exterior use and wet areas:**

2 parts fine plasterers sand, 2 parts cement, 1/2 part darjit, 1 small handful Polypropylene fibers per 20 liter bucket, 15% acrylic adhesive.

As a conditioner for sand/cement plaster add 5-10% darjit to your sand cement mix for a smooth, buttery, malleable mix that holds well to all types of mesh or wire armature.

### **To mix:**

Use a heavy duty low speed drill, between 500 and 850 revs per minute, with a plasterers paddle, or can be mixed in a concrete mixer

To hand mix smaller amounts, use the 'tarp method', by adding all the ingredients on top of a small tarpaulin, keep folding it back on itself, and scrunching it with your feet.

**MAKE SURE IT IS WELL MIXED!**

## **APPLICATION**

For plastering dry porous surfaces like concrete, earth buildings, ferro cement etc, apply a concrete or PVA sealer, or wet the surface well with water before plastering.

For exterior sculpture, experiment with wetness/dryness of mix. Dryer for free form sculpture, wetter for casting in molds or plastering on a mesh base.

## 6.0 Technique Notes

- A more liquid mix is better for walls and large surfaces.
- Approx 6 hours working time per coat.
- Use flexible trowel (Aluminum flashing or flexible plastic) to “finish off” a piece. Try & keep tools clean – as once Darjit has dried on it won’t finish as well.
- Use a small flexible trowel to get undulations.
- Use sponge trowel to get texture
- To make a corner use 2 trowels at a right angle to each other.
- You can use anything to make an impression eg rubber stamps, wood blocks, plants, leaves. When using leaves it’s good to select ones with big veins.

Cement is alkaline and most things (plants) don’t favor alkaline environments to live in. To balance the ph consider use peat moss. This can be seeded with spores and as it washes away it will leave holes for the plants and other to grow in. You can also use a variety of mixes on the same wall/structure – this allows for different growing “zones”.

### 6.1 How to plaster

#### 6.1.1 Bottom coat

Apply in one smooth movement – wriggling your hand as you go or make little *flat pancakes* of plaster and apply one at a time – ensuring it is *gently* squished in place. Please note – do not handle the plaster too much or it will fall off or be *forced through the mesh*.

#### 6.1.2 Top coat

Slap/throw wet plaster onto dry plaster. This gets rid of any air trapped between. This connection needs to be maintained at all costs – so don’t play with the top coat too much. Support the unset plaster while you are making shapes so you don’t compromise that join. Shapes should be added not just reduced eg form face with individual components ie lips chin etc. Not just add big blob and then carve out bits.

You can do preliminary work while the plaster is still relatively wet – and then come back for the more detailed/extreme work once it has dried out a bit. When it has fully set you can do reductionist work with carving tools.

#### 6.1.3 Big surfaces

Use quite a wet mix for easy spreading. Try and do the whole thing at once – or at least be mindful of the cold joints.

### **6.1.4 Mosaics, Mixed media**

You can embed lots of stuff in Darjit. Its best to attach objects straight away when plaster workable. However when embedding don't just rely on the stickability of plaster – also build some structural support – ie bezel things in.

For larger objects you may need to wait a while for the plaster to dry out a bit – if the plaster is too wet it will be too soft and the item will fall off.

Rule of thumb – don't over work it.

Metal, plastic, glass, cable, chain, rope etc (say L shaped aluminum) can be added with one part of L under plaster and the other bit sticking out.

To get depth for eyes – drive a hole through the plaster to/through the armature and then set the eyes on to get shadow or depth behind eyes.

### **6.1.5 Lighting**

*Make sure you run wires etc before plastering*

*If you are considering adding lights/ water later build a hose pipe into your armature for running water or wiring for lights etc later.*

## **7.0 Coatings**

*Mixed with regular grey cement it (Darjit) will dry to an oyster white. For a bone white colour use white cement.*

*For a range of colours, mix in oxides or water based paints (all colours will lighten when dry). For a marbled affect mix the cement in thoroughly and then fold in the oxides. Keep experimenting until you get the desired effect.*

*DARJIT! does not need to be painted, but can be. It can be clear coated for wet or high use areas, or waxed for a natural non toxic sealer.*

### **7.1 Painting**

Acrylic paint can be added while mixing the top coat – this acts as a glue. This changes the color of the mix.

It can also be “rubbed in” while the top coat is still wet.

If you want to paint it – it is best to wait until it is completely dry – 2 weeks to one month – depending on conditions. Use a paint system that's good for concrete products.

### **7.2 Oxides**

Oxides can be added to the mix or used on top of the plaster while it is still wet. Do not use when drying or dry.

**50% Oxide** (comes in various colors)

**50% Cement** (to stabilize the Oxide that would otherwise dust off)

**Small amount of water** to mix it together.

Consistency can be like cake icing or runnier - depending on your preference.

You don't need much. Mix smaller amounts at a time.

It can be added to the Darjit mix or applied after.

It must be applied while the sculpture is still wet.

Oxide can be applied using a brush, your fingers (with gloves), or a squirt bottle.

It then needs to be worked into the surface - using a trowel or by hand.

You can mix colors together on the work to get a monochrome finish or leave loosely mixed to get a "painting" type finish.

- Use your hands if you want an even finish.
- Use a trowel if you want it to stay variegated.

The Oxide layer is contributing to the strength of the piece because of the cement content.

### **7.3 Waterproofing**

Use bitumen or other concrete sealers.

Use clear concrete sealers to get shiny or matt finishes as required.





