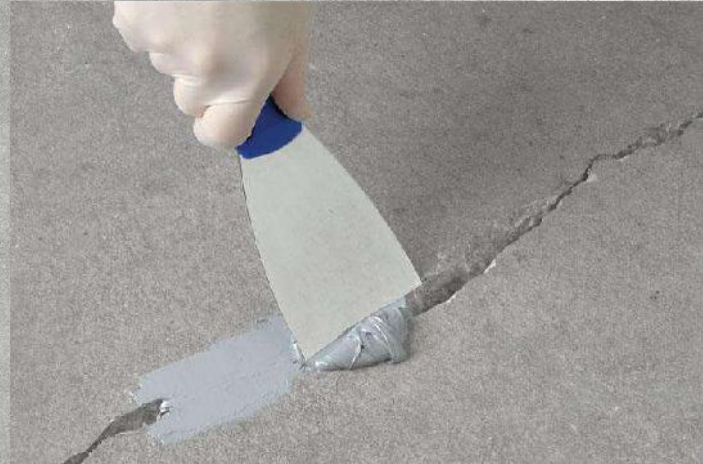


## Concrete Crack Repair



Structural Guide

## Limiting Values of Cracking

Having a crack width less than **0.1mm** is not considered an issue in the water retaining structures where the esthetic appearance is a concern.

Generally, the limiting value of the crack width for water retaining structures are **0.2mm**

For normal structures, crack width is limited to **0.3mm**. However, this value may be required to adjust depending on the exposure class.

Another concern of concrete cracks is the depth of the crack. The formation of cracks up to the reinforcements is the main issue with respect to the durability of the structure. Corrosion of reinforcements and rapid deterioration of the structure could experience with this.



## Why Concrete Crack

### Shrinkage Cracks

Thermal cracks - due to the heat of hydration

Thermal cracks - due to the change in temperature of the structures

Structural cracks

Cracking due to chemical reactions

## Concrete Crack Repair Methods

Epoxy Grout Injection

Polyurethane Injection

Stitching

Patching

Gravity Filling Methods

Drilling and Plugging Method

Flexible Sealing - Grooving and Sealing

Autogenous Healing

## Epoxy Grout Injection

Very low viscosity

Nonshrink

Grater bond to the steel than the cement

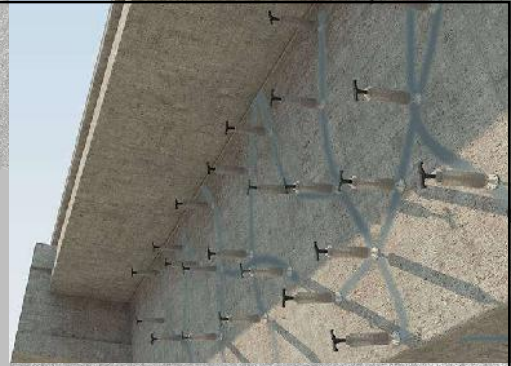
High bond to the concrete, high tensile capacity than normal concrete

Develop high compressive strength than the concrete

High shear bond strength

High chemical resistance

Epoxy grout is flowable and can be penetrated into very small cracks. Further, it will be applied with pressure allowing it to fill the whole crack. It is more suitable type of structural crack repairs.



## Polyurethane Injection

When there is a concern about material leaking, the polyurethane injection is suitable

It is not used to repair the structural cracks

The polyurethane expands about 2-40 times from its original volume. It is suitable for filling the voids in the concrete.

These elastomeric-fast setting forms are suitable for crack sealing in water retaining structures.

Polyurethane is very useful as it starts hardening within a few minutes. It reduces the movement of the material from the crack.

The elastomeric nature of the sealant allows the slight structural movements at the crack.

High injection pressure may be required to form to inject into fine cracks.





## Stitching

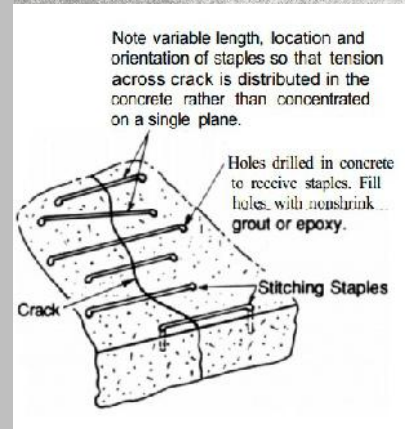
Stitching concrete crack repair is not as effective as the epoxy grout filling. It is a method that ties the two-part of concrete separated by the crack.

A steel bar is inserted into the concrete from either side not to allow the crack the widen.

It holds the two-segment of concrete together.

It may be suitable as a structural crack repair, However, in my opinion, it is advisable to select a method like epoxy grout injection when structure crack repair is required.

This method could be more suitable for no structural members such as brick walls.



## Patching

Patching is one of the simplest and easiest methods of concrete crack repair methods. It does not require complicated tools or high skilled person to do that. However, there should be technical personnel who is capable of following the product specification.

It is the method of applying the crack sealant on the surface of the crack. When the eustatic appearance is a concern, the sealant will be applied after cutting a groove in the concrete.

A "V" shape groove will be cut along the crack and it will be filled with the sealant.

Nonshrink construction grout is mostly used as the sealant. Its volume does not reduce when it hardens, gains strength very rapidly, the strength of the construction grout is about 50-60N/mm<sup>2</sup>.

Nonshrink construction grout can be applied as a past in the cracked area. It even can be applied to slab soffits and vertical surfaces.



## Gravity Filling Method

The concrete crack width of about 0.03 mm can even be sealed with this method.

It is required to use very low viscosity epoxy grout to do that.

Normal grout can not penetrate in the smaller width. They may seal the crack partially affecting the structural performance of the structure.

Since there is no pressure, attention shall be made to the efficiency of the system when a structural crack or crack in a water-retaining structure is sealed.

When there is uncertainty, it is always advisable to another method such as epoxy grout injection.



## Drilling and Plugging Method

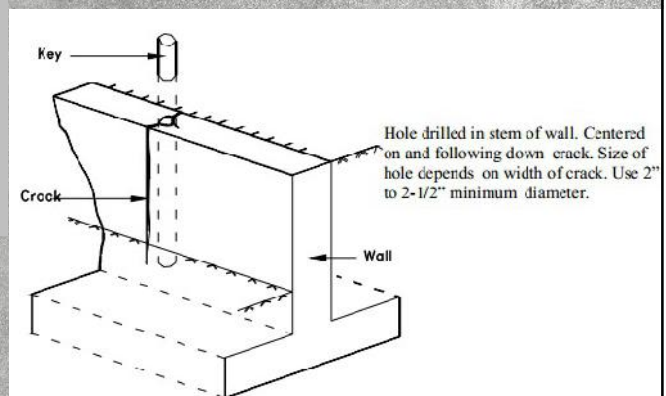
This method is suitable for cracks formed in nearly a straight line

Suitable for vertical cracks.

A hole or several holes can be drilled across the crack.

Then it can be filled with suitable non-shrink construction grout or epoxy grout.

Vertical cracks formed on the concrete walls can be treated with this method in most of the time.





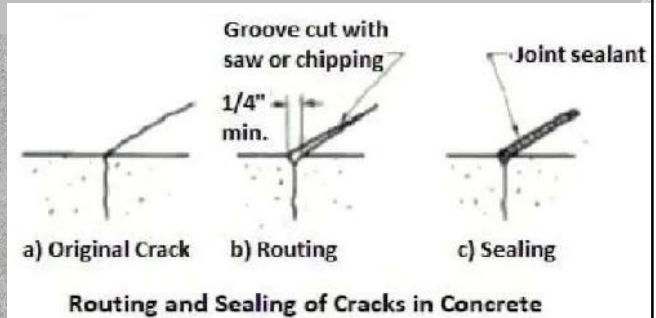
## Flexible Sealing - Grooving and Sealing

Concrete cracks that are not affected by the structural capacity, cracks in the brick walls, etc. can be sealed with grooving and sealing methods.

In addition, when there are cracks that formed due to the thermal effects, where continuous expansion and shrinkage occur, we may repair them with this method.

Firstly, it is required to cut a "V" shape groove along the crack. Then crack can be filled with the flexible sealant.

If there is a wider crack, and depending on the width of the crack, a backer rod may be inserted into the crack to minimize the use of the sealant.



## Autogenous Healing

Autogenous healing is the process of the formation of calcium carbonate [  $\text{CaCO}_3$  ] crystals.

$\text{Ca}^{2+}$  ions on the surface of the crack react with the water. They move through the crack and deposit. This is a rapid process.

Autogenous healing depends on the crack width. According to the British Standards, it is assumed that the cracks having a width less than 0.2mm will be healed automatically.

Autogenous healing is affected by the water pressure. However, the type of cement and type of water has no influence in forming Calcium Carbonate.

The formation of the Calcium Carbonate will be accelerated by the high temperature of concrete, rising pH of the water, and falling  $\text{CO}_2$  particles in the concrete.



## Secondary Method of Crack Repair

Adding Additional Reinforcements

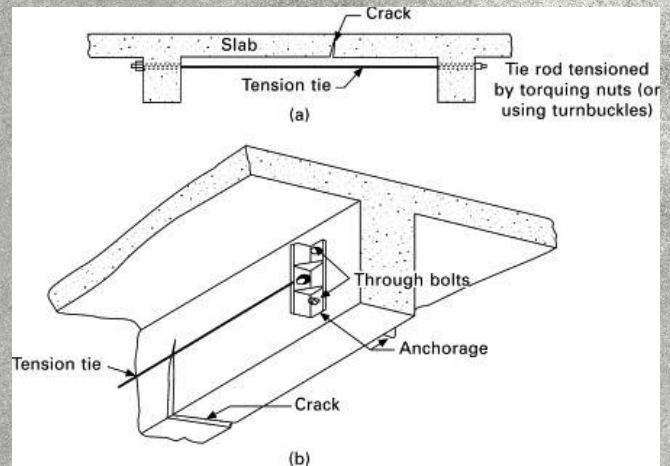
Prestressing

FRFP

Steel beam support

Increasing section

Provide additional supports



Thank you



**Structural Guide**

Civil & Structural Engineering Knowledge Base