

PLASTIC SETTLEMENT Cracking

WHAT ARE PLASTIC SETTLEMENT CRACKS?

Plastic settlement cracks are so-called because they form while the concrete is still plastic, ie has not set. The settling concrete is restrained and cracks form at the surface. They may become visible very early, ie while finishing is proceeding, but are often not noticed until some hours after placement. They are distinguished from plastic shrinkage cracks by their distinct pattern which typically mirrors the pattern of the restraining elements such as the reinforcement.

The cracks occur while the concrete is plastic and frequently while bleed water is still rising and covers the surface. They tend to roughly follow the restraining element, eg reinforcing bars, or changes in the concrete section. They can be quite wide at the surface, tend to extend only to the reinforcement or other restraining element and taper in width to that location. In exposed situations this may increase the risk of corrosion of the reinforcement and pose a threat to durability. Cracks may develop further, due to subsequent drying shrinkage, leading to possible cracking through the full depth of the concrete member.

WHAT CAUSES PLASTIC SETTLEMENT CRACKS?

After it is placed, concrete bleeds, ie the solids settle down and the mix water rises up to the surface. If there is no restraint this merely produces a slight lowering of the concrete surface. However, if the concrete is locally restrained from settling (eg by a reinforcing bar, duct or insert) while the adjacent concrete continues to settle, there is the potential for a crack to form over the restraining element **Figure 1**. It may also lead to a void under the restraining element and where this is reinforcement it may affect the local bond.



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The amount of settlement tends to be proportional to the depth of concrete, ie the deeper the section the greater the settlement. At changes of section, eg at a beam/slab junction, the different amount of settlement can lead to cracks forming at the surface **Figure 2**.

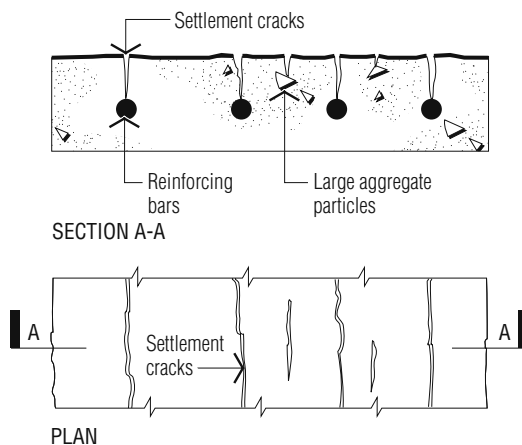


Figure 1: Settlement cracking

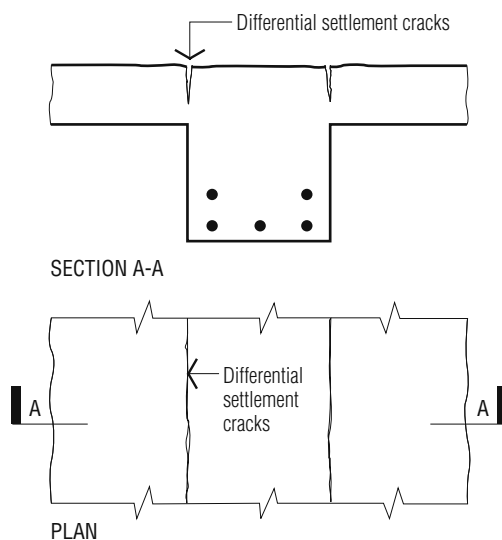


Figure 2: Differential settlement cracking

PRACTICES TO MINIMISE THE RISK OF PLASTIC SETTLEMENT CRACKING

Concrete

- Use mixes with lower bleeding characteristics, eg lower slump and more cohesive mixes
- Increase the ratio of cover to reinforcing bar diameter, ie by increasing the cover or decreasing the size of the bars.

Avoiding the use of retarding admixtures is sometimes suggested as a way of minimising plastic settlement cracking, but in hot weather the benefits of their use outweigh the disadvantages.

Construction

- Wet the subgrade before placing concrete to avoid excessive water loss from the base of the concrete
- Set all formwork accurately and rigidly so that it will not move during concrete placement
- Place concrete in deep sections first (including columns) and let it settle prior to placing and compacting the top layers (ensuring that the two layers blend together)
- Fully compact the concrete
- Cure the concrete promptly and properly.

REPAIR OF PLASTIC SETTLEMENT CRACKS

In pre-hardened concrete The most effective repair is to close the cracks shortly after formation by re-vibration and reworking the surface while the concrete is still plastic. Careful timing is essential to ensure the concrete re-liquefies under the action of the vibrator so that the cracks are fully closed. Re-vibrate too soon and cracks may reform; too late and the bond to the reinforcement may be damaged. Mechanical re-trowelling of the surface may be sufficient to close the cracks and compact the concrete around the reinforcement provided the cover is not too great, but the best result is where this is combined with some form of vibration.

Caution needs to be exercised in the use of re-trowelling alone since it may just form a skin (which can fracture with subsequent shrinkage, thermal or traffic impacts) over the cracks but not close them. If used it must be done as soon as the cracks become evident.

Note: Additional working of the surface may change the colour and texture of the surface in that area.

In hardened concrete After the concrete has hardened, plastic settlement cracks may be chased out and filled using a suitable proprietary material. It is almost impossible to camouflage the plastic settlement cracking, the object being simply to ensure that the durability and the wear characteristics of the surface are not impaired.

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FURTHER INFORMATION

CCAA Data Sheets:

Hot Weather Concreting

Plastic Settlement Cracking

Early Age Concrete Shrinkage

Download from www.concrete.net.au.

Guide to Concrete Construction (T41/HB64) Cement and Concrete Association of Australia and Standards Australia, 2002.

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