

**Reinforcements at large openings**

Published Date: 09/11/2009

Large, precast, 'picture frame' panels are particularly susceptible to cracks at the corner of the opening, particularly if this is close to the corner of the panel.

These cracks are most likely to start at the corner and go at approx 45° as shown. The most common reason for these is due to handling stresses during demoulding, as well as racking during transport/handling.

To control corner cracks, bars should be detailed as shown across the corner of the opening.

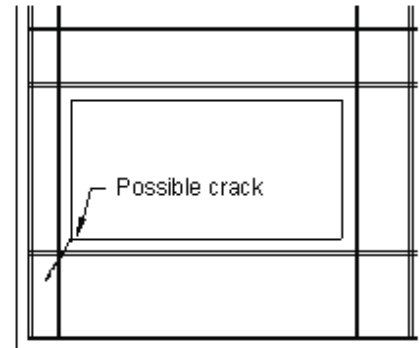
They should be at 45° as shown to be as efficient as possible in stopping the crack and at least an anchorage length each side of the crack position. The diameter should be assessed relative to the size of the panel, and is typically the same size as the bars trimming the opening elsewhere.

It is most important that the cover to the corner of the opening is the minimum allowed by the specification.

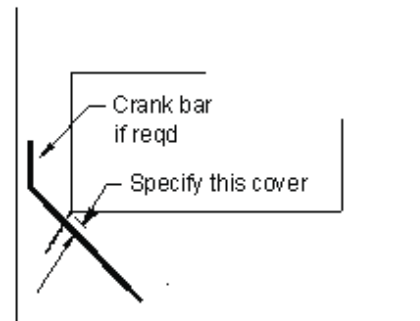
If the general horizontal or vertical bars do not have the required lap/anchorage beyond the opening then additional bars should be provided to compensate. A simple 'L' bar as shown will be sufficient in most cases. Such bars must never be detailed with the bend at the corner of the opening as this could burst out under load.

The diameter should be the same as the bar it laps onto, with an anchorage bend as required.

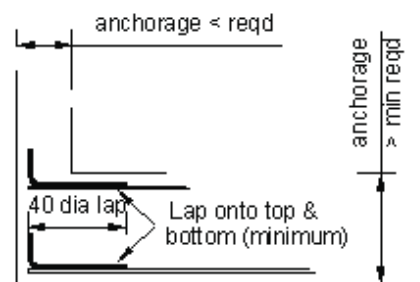
In general, unless there are special circumstances, the above bars would not be 'designed' and would not appear on a simple design calculation. They should however always be shown on drawings.



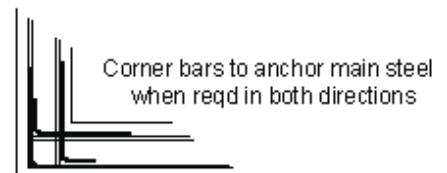
Design steel as per calcs  
(main bars only shown)



Corner bars to stop cracks  
(1 per face)



Corner bars to anchor main steel  
(1 per face)



Corner bars to anchor main steel  
when reqd in both directions