Report to the Residential Engineering Advisory Group

Condition of polythene DPM under cracks in concrete floor slabs

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8 August 2012

Background

On 2 August 2012, a group of researchers and floor levelling contractors toured past 12 houses scheduled for demolition in the Residential Red Zone to determine whether there were any opportunities for investigations or trials. Access was gained to the inside of approximately half of these houses.

Several properties were identified as being suitable for the investigation of the condition of the polythene DPM beneath the slab following cracking of the floors from lateral spreading of the ground on the property. Two of these properties [redacted] were selected for investigation of the DPM at a later date.

Investigation Undertaken

Cracks were evident in the floor slab of both properties ranging from very narrow (fractions of a millimetre) up to 30mm. At both properties the slab was generally in the order of 100mm thick. Neither slab had any reinforcing present. It was decided to check the condition of the DPM under the widest cracks first and if there was no apparent damage then it could be expected that there would be none beneath the narrower cracks.

To do the investigation, areas of approximately 500 mm square straddling the crack were cut with a concrete saw and the two halves of the slab were lifted out, exposing the DPM. The concrete cutting process also quite cleanly cut through the DPM, allowing it to be lifted out. Several photos are attached to show the cutting process and the details of the DPM and the fill beneath the DPM.

At one property when the panel was removed it exposed a possible taped joint in the DPM and so another panel adjacent to the first was also cut out to check the joint as well.

Results

A careful inspection of the DPM removed from the three locations in the two houses showed that there appeared to be no damage to the DPM caused by the cracking and opening of the floor slab for cracks up to 30mm wide. For cracks any wider than 30 mm it would be possible check the integrity of the DPM by inspection through the crack opening. All sections of DPM were brought back to BRANZ for closer inspection (once cleaned of silt and cutting slurry), where they were placed on a light-table. This showed that there were pin hole penetrations caused by workmen walking on the DPM once in place before pouring the concrete but there were no signs of reduction of the thickness caused by local stretching. It was figured that such a stretch would make the film more easily penetrable by the light.

The taped joint appeared to be reasonable sound still. The tape was not continuous but it may have pulled off the DPM locally as the saw cut through it.

The 30 mm wide crack at [redacted] formed because the concrete thickness had reduced to approximately 80 mm to accommodate a waste pipe from a hand basin, that was wrapped in a greased lagging (probably Densotape) and which sat only half of its depth into the hardfill. The local reduction in slab thickness had obviously been the greatest weakness in the slab as the house tried to stretch laterally.

The hardfill beneath the DPM was also inspected at each location. It was found that both houses had hardfill that comprised stones between 10 mm and 20 mm in diameter. There was no immediately obvious evidence of silt-sand penetration of the hardfill even though there was considerable ejecta around the outside of the houses. When the hardfill in the garage at [redacted] was excavated, wet silty sandy material was found in the stones at about 25mm depth. The stones were quite clean above this level, suggesting that the contamination was from ejecta below the slab. At both of the other locations no contamination was observed until about 100 mm below the underside of the slab.

There was no obvious indication that the stoney hardfill had compacted under the earthquake shaking. The stones appeared to be still hard against the underside of the slab. However, the houses had both obviously settled, which may have taken up any gap that would have opened through compaction of the stones.

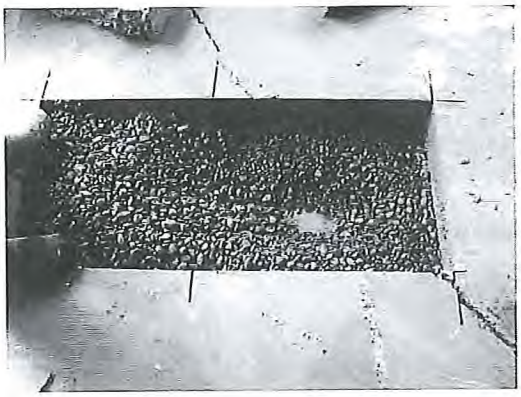
Conclusions

From this investigation it appears that the polythene DPMs can adequately accommodate crack openings up to 30 mm wide without tearing or weakening. None of the houses inspected in the week before had cracks wider than this. However, once the crack width extends beyond 30 mm it is possible to inspect its condition through the crack.

The hardfill was smaller than expected, having heard over recent months about 20/40 tailings being a commonly used hardfill, which are expected to be particles in the range of 20 mm to 40 mm. While the hardfill did not appear to have compacted in the earthquake this may have been masked by settlement of the house taking up the gap between the hardfill and the bottom of the slab.

Cutting second panel [redacted] dining area)

Taped joint exposed [redacted] dining area)



Water welled up to 100mm below the slab [redacted]

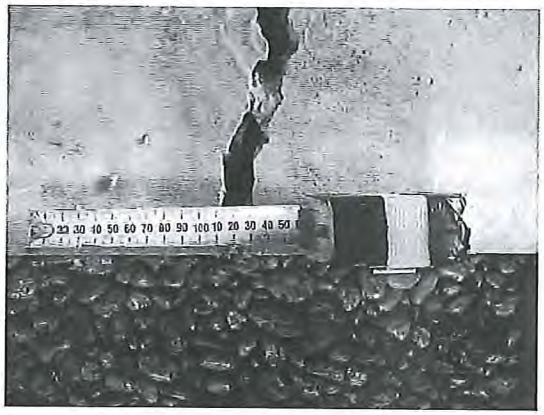
Panel in bathroom at [redacted]
(Crack had been filled with expanding foam)

Waste pipe beneath slab (Bathroom [redacted])

Hardfill at [redacted]

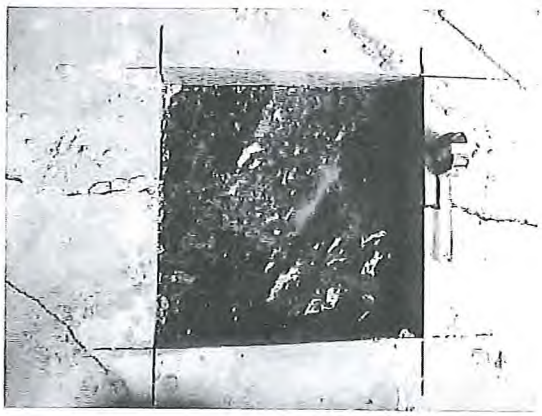
Photographs

[redacted] [redacted]



Cutting the garage floor [redacted]

Crack width and stone size [redacted] garage)



Hardfill contamination [redacted] garage)

Exposed DPM [redacted] dining area)

Reduction in slab thick filled with foam [redacted]

(Slab section is inverted for the photograph)