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Subject:

Update - Core samples collected from Monash University Car Park, VIC

Date	Description	Party
23/02/2006	Preliminary Report	G.Kao, G.Jackson, A.Dudesin
09/03/2006	1 st Draft Report	G.Kao, G.Jackson, A.Dudesin
16/03/2006	Final Report	G.Kao, G.Jackson, A Dudesin

TABLE OF CONTENT

TEST SUMMARY	.....	3
BACKGROUND	.....	4
TEST RESULTS	.....	5
Sample 2	.....	6
Sample 2A	.....	10
Sample 4	.....	13
Sample 5	.....	16
CONCLUSION	.....	19

TEST SUMMARY:

Four core samples obtained from Monash University car park were tested for crack healing under low water pressure (300mm water head). The deck design incorporates significant drainage falls that will ensure that the water depth will never approach the 300mm that has been used in this testing, indeed it is unlikely that even a modest 50mm inundation is experienced.

The selected test condition was taken as representing extreme conditions, relative to site conditions, to simulate constant low water pressure and wetting, which are considered as conditions of exposure to enhance both Xypex crystallisation and autogenous healing. Furthermore it is considered that crack healing at this head of water would clearly indicate that the less onerous site conditions would not result in leakage.

Details on visual examination on the cracks in the cores, believed to be plastic settlement cracking, and condition of the reinforcing steel in the cores were recorded and summarised as follow:

- ✓ Visual examination on the core samples prior to any testing have shown no corrosion at reinforcement even though the crack has gone passed through the level of reinforcing steel.
- ✓ Under the test condition, two of the four samples (Sample 2A & Sample 4) have achieved no leaking within a week, whereas others have shown significant reduction on leaking after first week of testing; Sample 2 has shown no leaking and dampness after 4 weeks of testing.
- ✓ The major part of the crack healing process has been attributed to Xypex crystallisation where constant moisture provides driving force to reactivate the Xypex reaction between Xypex chemicals and cement hydration by-products, hence forming Xypex crystals to block the passage of crack and stop the leaking.
- ✓ All the test core samples are still subjected to a constant low water pressure; further updates will be made on Sample 5

BACKGROUND

A copy of preliminary report issued by ANCON was provided on 01/02/06 as a reference material (dated 31/01/06). Core samples from the Monash University Car Park were received on 27/01/06 from Xypex Melbourne office. Locations of the core sample were mapped out as shown in red circle in Fig 1 (engineering drawing sourced from the attachment in the ANCON's report). They were labelled as Sample 2, Sample 2A, Sample 4 and Sample 5. Digital photos were taken on all samples prior to any testing for crack healing. Crack width on the surface and at the reinforcement steel were estimated and recorded in Table 1.

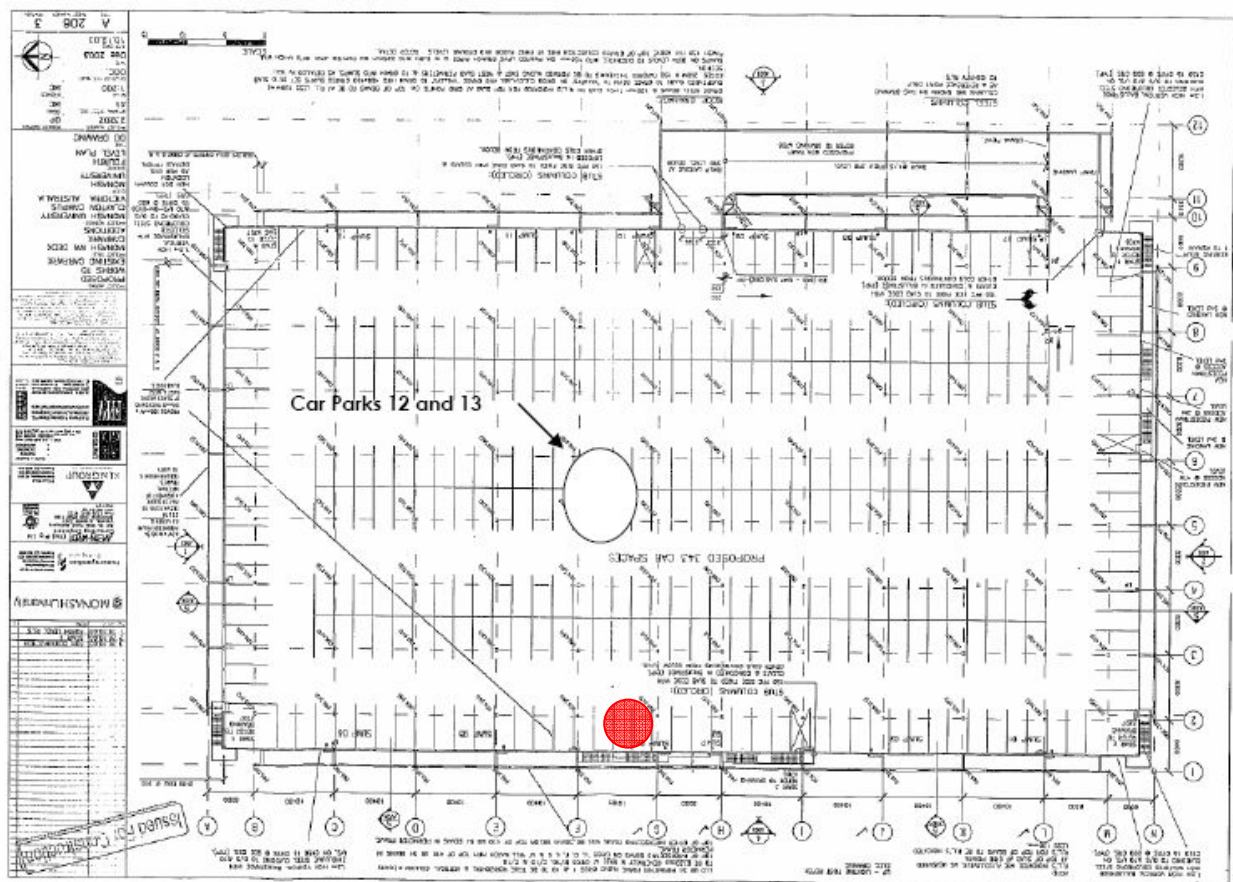



Fig 1. Locations of the core sample

A length of 350mm PVC pipe with diameter of 65mm was attached to the top surface of sample using membrane bonding agent. After the curing of the bonding agent has completed, all samples were subjected to 300mm constant water head and monitored regularly.

Table 1. Preliminary Testing Information

	Sample 2	Sample 2A	Sample 4	Sample 5
Concrete Cover (mm)	50mm	50mm	40mm	40mm
Crack Width (~mm)				
Surface	0.10	0.10	0.10	0.10
Reinforcement	0.20	0.30	0.30	0.30
Bottom	Yes (all the way through)	No (2/3 of way from surface)	No (4/5 of way from surface)	Yes (all the way through)
Signs of Corrosion at Reinforcement prior to testing	No	No	No	No
Setup				

TESTING RESULTS:




Observations on the progress of leaking on four core samples were recorded and summarised as follow



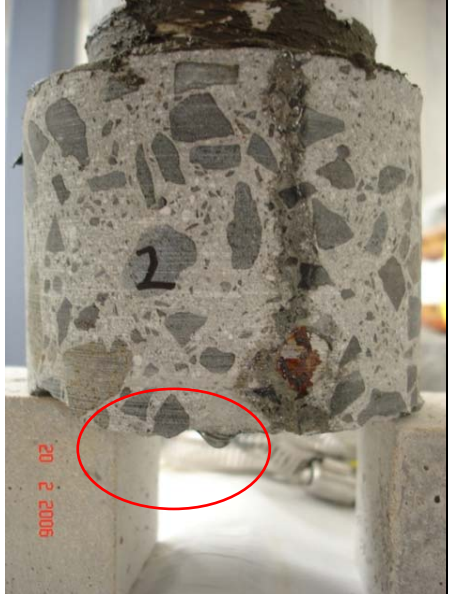



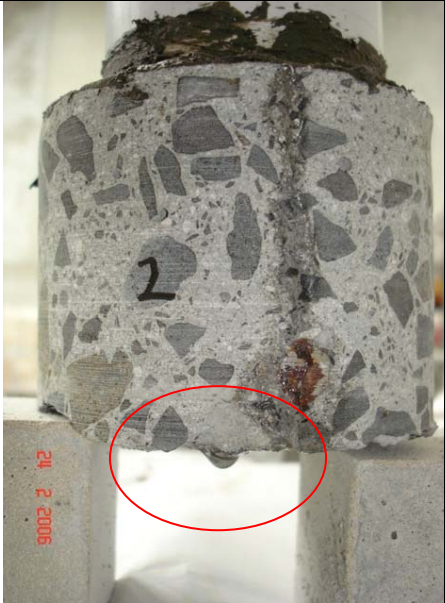



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Sample 2	Side A	Side B	Reinforcement
Elapsed Time (days)			
0 min	 A vertical cross-section of a concrete sample. The top surface is dark and appears to be covered in a thick, dark material. The concrete matrix is light grey with numerous dark grey aggregate particles. A black handwritten number '2' is visible on the left side. A red date stamp '16 2 2006' is visible on the left edge.	 A vertical cross-section of a concrete sample, similar to Side A. It shows a light grey concrete matrix with dark grey aggregate. A black handwritten number '2' is visible on the right side. A red date stamp '16 2 2006' is visible on the right edge.	 A circular cross-section of a concrete sample. The surface is light grey with some darker spots. A black handwritten number '2' is visible on the right side. A red date stamp '16 2 2006' is visible on the bottom right edge.

<p>5 min</p>			<p>Note:</p> <ul style="list-style-type: none"> * Leaking from both sides of the crack was observed; * Dampness was observed along the crack from top (surface), through the reinforcement steel bar and to the bottom of the core sample; * Dripping from both sides of the crack was observed as shown in red circle on the left
<p>4 days</p>			<p>Note:</p> <ul style="list-style-type: none"> * Leaking from both sides has significantly reduced after 4 days; * Dripping from Side A continued after 4 days; * Dripping from Side B stopped after 4 days. * Dampness was still notable along the crack and bottom of the core sample

<p>8 days</p>			<p><u>Note:</u></p> <ul style="list-style-type: none"> * Dripping was notable after 8 days (on side A); * Dampness has significantly reduced on the Side B
<p>16 days</p>			<p><u>Note:</u></p> <ul style="list-style-type: none"> * No dripping was observed on both sides of the crack (Side A & Side B); * dampness was still notable at bottom of core sample (Side A ONLY) * No dampness on Side B.







29 days








Note:

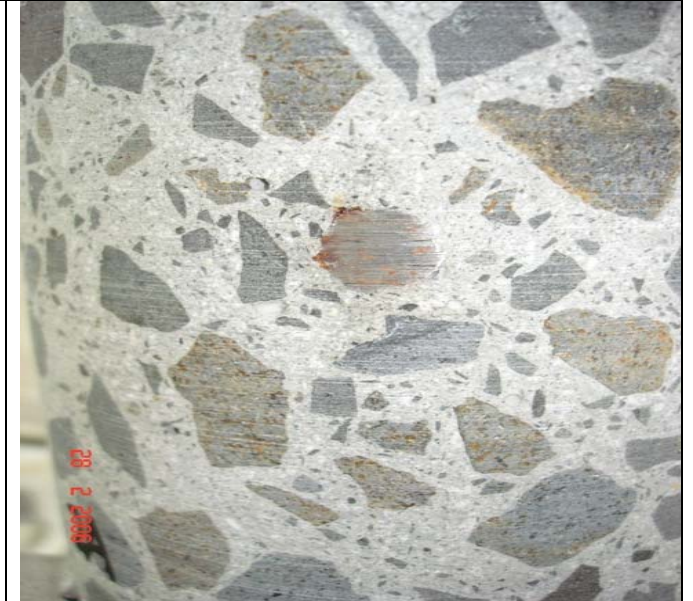
* No leaking & Dampness could be observed on both sides of the crack and also the bottom of the core sample, as shown above.





* The core sample remains dry





Sample 2A	Side A	Side B	Reinforcement
Elapsed Time (days)			
0 min	 A cylindrical concrete specimen with aggregate, labeled '2A' in black marker. A vertical crack is visible. A red date stamp '13 2 2006' is on the left.	 A cylindrical concrete specimen with aggregate, labeled '2A' in black marker. A vertical crack is visible. A red date stamp '13 2 2006' is on the right.	 A cylindrical concrete specimen with aggregate, labeled '2A' in black marker. A vertical crack is visible. A red date stamp '9 2 2006' is on the left.
5 min	 A cylindrical concrete specimen with aggregate, labeled '2A' in black marker. A vertical crack is visible. A red date stamp '13 2 2006' is on the left.	 A cylindrical concrete specimen with aggregate, labeled '2A' in black marker. A vertical crack is visible. A red date stamp '13 2 2006' is on the right.	 A close-up view of the reinforcement bar in the concrete, showing a circular cross-section. A red date stamp '14 2 2006' is in the bottom right.

4 days	 A cylindrical concrete specimen with aggregate visible. A vertical crack runs down the center. A red circular mark is visible on the left side. A red date stamp '17 2 2006' is on the right edge.	 A cylindrical concrete specimen with aggregate visible. A vertical crack runs down the center. A red circular mark is visible on the left side. A red date stamp '17 2 2006' is on the left edge. The label '2A' is visible on the right side.	<p>Note:</p> <ul style="list-style-type: none"> * At first five minutes, leaking was observed along the crack on both sides and also at reinforcement steel; * Leaking has significantly reduced after 4 days; * Leaking has stopped after 8 days; no signs of dampness were notable at both reinforcement steel and crack after 8 days; * No leaking and dampness were found after 16 days
8 days	 A cylindrical concrete specimen with aggregate visible. A vertical crack runs down the center. A red circular mark is visible on the left side. A red date stamp '20 2 2006' is on the left edge. The label '2A' is visible on the left side.	 A cylindrical concrete specimen with aggregate visible. A vertical crack runs down the center. A red circular mark is visible on the left side. A red date stamp '20 2 2006' is on the right edge. The label '2A' is visible on the right side.	 A close-up view of the concrete specimen showing the aggregate and the red circular mark. A red date stamp '20 2 2006' is visible in the bottom right corner.

16 days



Sample 4	Side A	Side B	Reinforcement
Elapsed Time (days)			
0 min	 A cylindrical concrete specimen with aggregate, showing a vertical crack. A red date stamp '9 2 2006' is visible on the right edge.		 A cylindrical concrete specimen with aggregate, showing a vertical crack. A red date stamp '9 2 2006' is visible on the left edge.
5 min	 The same concrete specimen as at 0 min, showing the crack and some darkening at the bottom. A red date stamp '9 2 2006' is visible on the right edge.	 The same concrete specimen as at 0 min, showing the crack and some darkening at the bottom. A red date stamp '10 2 2006' is visible on the left edge.	<p>Note:</p> <p>* Leaking on both side of the crack was observed;</p>






<p>4 days</p>			<p><u>Note:</u></p> <ul style="list-style-type: none"> * Leaking has significantly reduced after 4 days; * dampness along the crack on the Side A was notable; * Dry moisture stains (marked in red circle) on the Side B was noticed at 4th day of testing; however, dampness along the crack on the Side B was still notable
<p>8 days</p>			<p><u>Note:</u></p> <ul style="list-style-type: none"> * Leaking has stopped after 8 days; * No dampness has observed along the crack on both sides of the crack after 8 days; * Dry moisture stains have observed on both sides of the crack (marked in red circles)





16 days







Note:

- * Core sample remains dry;
- * No leaking and dampness have observed after 16 days of testing.
- * Dry moisture stains are still notable after 16 days

Sample 5	Side A	Side B	Reinforcement
Elapsed Time (days)			
0 min	 A vertical concrete sample with aggregate visible. A vertical crack runs down the center. A black number '5' is handwritten on the right side. A red date stamp '16 2 2006' is at the bottom left.	 A vertical concrete sample with aggregate visible. A vertical crack runs down the center. A black number '5' is handwritten on the left side. A red date stamp '16 2 2006' is at the bottom left.	 A circular cross-section of the concrete sample. A horizontal crack runs across the middle. A black number '5' is handwritten on the right side. A red date stamp '16 2 2006' is at the bottom right.
5 min	 A vertical concrete sample with aggregate visible. A vertical crack runs down the center. A black number '5' is handwritten on the right side. A red date stamp '16 2 2006' is at the bottom left. A red circle highlights a dark, wet area at the bottom of the crack.	 A vertical concrete sample with aggregate visible. A vertical crack runs down the center. A black number '5' is handwritten on the left side. A red date stamp '16 2 2006' is at the bottom left. A red circle highlights a dark, wet area at the bottom of the crack.	<p>Note:</p> <p>* Leaking was observed along both sides of the crack; dripping was found on both sides of the crack</p>

<p>4 days</p>			<p><u>Note:</u></p> <ul style="list-style-type: none"> * Leaking has significantly reduced after 4 days * Dripping from Side A stopped after 4 days; dampness was notable * Dripping from Side B has slowed down after 4 days
<p>8 days</p>			<p><u>Note:</u></p> <ul style="list-style-type: none"> * Leaking has significantly reduced after 4 days; * Dampness was increased on Side A of the crack * Dripping from Side B was still notable

<p>16 days</p>			<p>Note:</p> <ul style="list-style-type: none"> * Large amount of corrosion by-products have been observed on the Side A of the crack * Dampness on Side A has reduced * Leaking from Side B of the core has reduced * Dripping from Side B has significantly reduced
<p>29 days</p>			<p>Note:</p> <ul style="list-style-type: none"> * Large amount of corrosion by-products remain on the steel reinforcement after 29 days; * Dripping from Side B is still notable

CONCLUSION:

- ✓ Visual examination on the core samples prior to any testing have shown no corrosion at reinforcement even though the crack has passed through the level of reinforcing steel.
- ✓ Under the test condition, two of the four samples (Sample 2A & Sample 4) have achieved no leaking within a week, whereas others have shown significant reduction on leaking after first week of testing;
- ✓ Sample 2 has shown no leaking and dampness after 4 weeks of testing.
- ✓ The experimental results show that the supplied core samples (3 out of 4) with cracks have been sealed under the test conditions.