

**RECEIVED**

**23 JUL 2001**

# **Inner City Bypass Project Brisbane**

**4.5 Kilometres  
Links Hale Street at Paddington  
to  
Kingford Smith Drive at Hamilton**

**Client: Brisbane City Council**

**Superintendent: Sinclair Knight Merz**

**Contractor: Leighton Contractors**

**Design: Leighton's Design Team  
Contact: Mr. Iain Burgess**

**Engineers: Maunsell McIntrye  
Contact: Mr. John Hart**

**Concrete Supplier: CSR Construction Materials  
Contact: Mr. Todd McGurgan**

**Xypex Australia: Marketing Executive  
Contact: Ms. Maria Bobeldyk**

**Waterproofing Contractor: Xycrete  
Contact: Mr. Kevin Hill**

**Contents: Trial Information  
Project Works containing Xypex products**

- Landbridge**
- Inner Northern Busway Tunnel**
- RNA Tunnel**

**FACSIMILE**

To:	MMPL (ICB Site Office)		Sheet: 1 of
Attention:	Peter Kouparitsas	Fax No:	07 - 3872 2765
From:	Frank Collins	Copied to:	John Hart (ICB Site Office)
Date:	27 July, 2000	Ref No:	Fgc055
		Project No:	10206200.09
Subject:	<b>BICB – Xypex – Mix Trials and Slab Tests</b>		

Peter,

Further to my Draft DC 1690 sent by email Friday 21/7/00, & following discussion regarding the mix trials with Iain Burgess, LCPL are keen to conduct mix trials as well as producing trial cracked concrete slabs to test the effectiveness of Xypex for waterproofness. I have discussed this with John Connal and have the following suggestions:

1. The concrete mixes need to be essentially identical to the type of concrete mixes that CSR Readymix would use in this project for the concrete slabs in the Land Bridge and tunnel roof slabs. From the concrete mix trials we would be seeking clarification of the following information:
  - (i) Comparison concrete mixes with and without Xypex.
  - (ii) Measurement of the following fresh concrete properties (to Australian Standard AS1012): Initial slump and slump loss over 45 minutes, bleed, fresh density, air content, time to initial set, time to final set, compatibility with other chemical admixtures
  - (iii) Measurement of the following hardened concrete properties (to Australian Standard AS1012):
    - Compressive strength at 1, 3, 7, and 28 days
    - Drying shrinkage (to 56 days)
    - Water absorption
2. Waterproofness of cracked slabs

Testing the waterproofness of cracked slabs, made on-site and of similar proportions to the Land Bridge deck slab, will be a better indicator of the waterproofing properties of Xypex compared with testing of laboratory-size samples. The slabs are designed to crack under the action of restrained shrinkage.

It is proposed to make six (6 No.) slabs at the ICB site. It is proposed that the slabs are representative of the Land Bridge deck slab and are of dimension (at the cracked

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**FACSIMILE cont.**

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Subject: **BICB – Xypex – Mix Trials and Slab Tests**

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SHEET 2 OF

section) of 160 x 1000 x 3000 millimetres. A typical slab is shown in the attached Figure 1. The proposed slab types are as follows:

- (i) 3 No. slabs, with the configuration as shown in the attached figure, made with concrete containing no Xypex. The slabs are designed to generate cracking at mid-span under the action of restrained shrinkage. It is proposed that the cracked slabs are ponded with water on the top surface and the amount of water flow through the crack is monitored.
- (ii) 3 No. slabs, with the configuration as shown in the attached figure, made with concrete containing Xypex. The slabs are designed to generate cracking at mid-span under the action of restrained shrinkage. It is proposed that the cracked slabs are ponded with water on the top surface and the amount of water flow through the crack is monitored.

The slab configuration and method of ponding are outlined below.

Internal restraint is provided by the 1 metre anchorage length (at each end) of Y20 bars longitudinally cast into the slab. The central 1 metre portion of the bars are sheathed with smooth PVC electrical conduit to minimise the concrete to steel bond. The cross-section at the centre of the slab is reduced by casting in a removable angle section to create a groove suitable to act as a crack initiator. The slabs should be made and cured to the same methods that LCPL would implement for the construction of deck slabs made with and without Xypex. The slabs should be demoulded at 24 hours and placed (preferably) on roller supports (or on 2 layers of polythene plastic sheet on a smooth level surface). Following the period of curing, the slabs should be left exposed to drying conditions (& preferably sheltered from rain) to enable restrained shrinkage (& cracking) to occur. Cracks of different width can be generated by maintaining some of the slabs under drying conditions for longer duration of time.

Following cracking and prior to water ponding, the crack width should be measured at several locations at the top and side. A reservoir for ponding water should be set up on the top surface of the slab (e.g. – PVC pipe section sealed with silicone sealant) and a constant water head (e.g. – 50 millimetres) maintained for 7 days. The top of the reservoir should be covered to prevent evaporation. Water permeating through the crack from the down-stream concrete face should be collected in a tray and the quantity measured. The two types of concrete, with and without Xypex, can be ranked. If the concrete slab containing Xypex has not healed sufficiently and seepage continues the post-cracking treatment using Xypex concentrate should be implemented and assessed. Following completion of the test the cores should be drilled through the cracked section to assess the amount of healing that has occurred across the crack due to the action of Xypex.

**FACSIMILE cont.**

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Subject: **BICB – Xypex – Mix Trials and Slab Tests**

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SHEET 3 OF

I welcome your comments on this test programme. I believe there is a risk involved with not using a conventional waterproofing membrane and the effectiveness of Xypex, and potential side-effects with it's use, should be thoroughly assessed before we can approve it's use.

Regards

**Frank Collins**

Three structures on the ICB were sealed using Xypex Admixture concrete, the Inner Northern Busway tunnel at Normanby, the RNA tunnel under the RNA showgrounds and the Landbridge at York's Hollow.

The RNA tunnel was built using the cut and cover method. It consists of cast insitu walls covered with precast planks with and in-situ deck slab. The Landbridge used conventional T-Roff girders with a cast in-situ deck slab. On both structures, a waterproof membrane was specified to reduce leakage and prevent water from dripping onto the carriageway of the ICB.

The design life of structures on the ICB is 100 years. During investigations of the various membrane types, the longevity of the membrane on the landbridge and the RNA tunnels was questioned. On both structures, heavy equipment would be needed to place the soils and to install drainage and irrigation systems once the soil had been placed.

Both structures were to be covered in soil with a depth varying from 0.3m to 1.0m. This left the membrane for both structures exposed to potential damage from excavators, tent stakes and garden forks both during and after construction.

The use of a topping slab was considered on the RNA tunnel but rejected due to the difficulty in placing and ensuring no damage to the membrane during placement, as well as the extra expense.

A topping slab on the Landbridge would reduce the depth of soil available for the plants and trees due to the structural requirements that limited the depth of soil allowed.

A number of alternatives to a waterproof membrane were investigated. Xypex was identified as potentially a superior solution, which will fulfil long-term water proofing requirements including the ability to accommodate structural cracks. Xypex concrete had been successfully used on the South Bank Parking Structure without a waterproof membrane. There a 1m depth of fill, which has been planted in a similar manner to the landbridge, was placed over the slab. The average slab thickness was approximately 200mm. The parkland has a permanent irrigation system and the soil is constantly wet. Inspections of the structure showed no noticeable leakage. A number of commercial residential buildings built with Xypex and without a waterproof membrane that had similar gardens to South Bank were also inspected and no leakage found.

A series of trials were set up to determine the effectiveness in the autogenous seal healing properties of Xypex.

The results of the water flow tests show that Xypex can effectively seal small cracks up to 0.7mm. Xypex appears to reduce the flow in cracks wider than 0.7mm. In time these crack may self heal, however a proper repair as per the Xypex specification should be used.

The results of the physical concrete tests indicate that concrete with Xypex added shows no adverse reactions. Slump, consistency and set times were all within the normal limits of conventional concrete.

Xypex concrete was used first on the Landbridge and then on the RNA tunnel. The advantage of the Xypex concrete was seen during backfilling operations when full size trucks were used to replace the approximately 15,000m<sup>3</sup> of soils imported and compacted on top of the tunnel roof slab to form the basis for the pavement in the RNA. Drainage, sewerage and services were then reinstated. Once completed, the area was topped with asphalt to form a parking lot.



## Interim Report – Xypex Trials conducted August/September 2000.

### 1. Reason for the Trials

The design life of structures on the ICB is 100 years. During investigations of the various membrane types, the longevity of the membrane on the landbridge and the tunnels was questioned.

A number of alternatives to a waterproof membrane were investigated. Xypex has been identified as potentially a superior solution which will fulfil long term water proofing requirements including the ability to accommodate structural cracks. Xypex concrete had been successfully used on the South Bank Parking Structure without a waterproof membrane. There a 1m depth of fill, which has been planted in a similar manner to the landbridge, was placed over the slab. The average slab thickness was approximately 200mm. The parkland has a permanent irrigation system and the soil is constantly wet. Inspections of the structure showed no noticeable leakage. A number of commercial residential buildings built with Xypex and without a waterproof membrane that had similar gardens to South Bank were also inspected and no leakage found.

MMPL proposed a series of trials to prove the Xypex system for this particular project for use in the Landbridge, RNA tunnel and the Normanby Tunnels.

### 2. MMPL Trial Specifications

Concrete test requirements were as follows:

- (i) Measurement of the following fresh concrete properties (to Australian Standard AS1012): Initial slump and slump loss over 45 minutes, bleed, fresh density, air content, time to initial set, time to final set, compatibility with other chemical admixtures
- (ii) Measurement of the following hardened concrete properties (to Australian Standard AS1012):
  - Compressive strength at 1, 3, 7, and 28 days
  - Drying shrinkage (to 56 days)
  - Water absorption

Testing the waterproofness of cracked slabs, made on-site and similar proportions to the Land Bridge deck slab, was proposed as a better

indicator of the waterproofing properties of Xypex than testing of laboratory-size samples.

MMPL proposed that 3 slabs be made at the ICB site. The slabs were to be representative of the Land Bridge and RNA tunnel deck slabs and have a dimension (at the cracked section) of 160 x 1000 x 3000 millimetres. A typical slab is shown in the attached drawings. The slabs were designed to crack at mid-span under the action of restrained shrinkage.

A 0.5 metre anchorage length (at each end) of Y20 bars longitudinally cast into the slab provided internal restraint. The central 2-metre portion of the bars were sheathed with smooth PVC electrical conduit to minimise the concrete to steel bond. An angle section was cast in to create a groove suitable to act as a crack initiator and reduce the cross section of the slab to 160mm.

Once cracks developed, a reservoir consisting of a 500mm high, 300mm-diameter cylinder was to be sealed onto the top of the cracks, and the rate of flow through the cracks monitored.

Following completion of the test the cores will be drilled through the cracked section to assess the amount of healing that has occurred across the crack due to the action of Xypex.

### 3. Sample Preparation

The slabs were made and cured to the same methods that would be implemented for the construction of deck slabs. Following the period of curing, the slabs were left exposed to drying conditions (sheltered from rain) to enable restrained shrinkage (& cracking) to occur.

After two weeks no cracks had formed. The slabs were then placed on timbers directly under the crack inducers, in order to induce a crack, this was unsuccessful. An attempt to crack the slabs with a sledgehammer was unsuccessful. Slab 1 was rocked over a timber to produce an impact, and a hairline crack was approximately 0.1 – 0.25mm formed. The crack increased in size over the following week to 0.7mm

At the end of three weeks, an excavator was used to break slabs 2 and 3 producing large cracks of the order of 0.6 – 0.9mm. These cracks also increased in size to 0.9mm to 1.2mm. Cracks were measured on the left hand face, the right hand face, and adjacent to the edge of the cylinders.



Slab No.	LHS	RHS	Centre 1	Centre 2
Slab 1	0.85	0.4 + 0.35 (two cracks)	0.6	0.7
Slab 2	0.7	1.1	0.9	0.8
Slab 3	1.1	0.9	1.2	1.3

Cracks greater than 0.7mm are larger than what Xypex claim they can effectively seal through autogenous self-healing alone without further Xypex repair procedures. They were flexural cracks, which taper down, at the bottom of the slab as opposed to shrinkage cracks, which would be of similar size throughout the slab. The flow path of the water through the flexural cracks produced differs from the shrinkage cracks in that the flow was more horizontal than vertical. The length of the flow path is similar and the head of up to 500mm is of a similar nature to what can be expected in the field. Photos 5 to 9 show the approximate crack sizes and shape.

At this stage the cylinders were sealed onto the slabs using silicone and tested for leakage.

### 3. Results

On filling the cylinders with water, it was noted that the water was not flowing along the crack, but was simply flowing out the crack under the silicone. We increased the width of the silicone seal around the cylinders over the crack to 75mm, to force the water to flow through the crack.

The cylinders were filled with water and monitoring began on all three slabs. The cylinders were monitored approximately hourly for the first day, thereafter at least twice per day. The cylinders were re-filled when there was approximately less than 20mm of water left in the bottom. On a number of occasions, the cylinders ran completely empty, particularly overnight on the first two days. Thereafter, the flow had decreased enough that filling was only necessary either in the morning or late afternoon.

Figures 1 –3 show the results of the trials up to 13/09/2000. At that stage, we believed that although the flow rate had decreased, we would not effectively seal the cracks in slabs 2 and 3. The crack size was monitored during the trial, there was an increase in the size of the cracks in the early morning when compared to those measured in the afternoon,

indicating that the cracks were affected by the thermal movement of the slabs.

Slab No.	Morning (7:30AM)	Afternoon (3:00 PM)
1	0.85mm	0.7mm
2	1.1mm	1.0mm
3	1.2mm	1.1mm

The tests were stopped on Slabs 2 and 3 and the cylinders were removed and the Xypex repair procedure followed. The tests continued on Slab 1 until the 20/09/2000. Figure 4 shows the results including the last week of testing. The flow rate in slab 1 decreased to a negligible amount.

The Xypex specification for the admixture calls for a thorough inspection of the surface for shrinkage cracks within 48 hours of the initial set. Any cracks found are to be treated with a Xypex concentrate solution. In line with this specification, the cracks on slabs 2 and 3 were ground back, and a Xypex concentrate slurry applied to the crack in accordance with the Xypex Specification. Photos 10 to 12 show the repair operation. The cracks were then cured for 4 days. To date there are no visible cracks on the repair. The repairs will be tested along similar lines to the initial tests

Attached are the concrete test results. The slump, slump loss and initial set time are all within practical limits.

The strength tests show consistent higher concrete strengths when compared to a typical 40Mpa concrete mix.

The results of the drying shrinkage test initially indicated that a high shrinkage strain expected, however, the current results indicate a drying shrinkage of the order of 800 microstrain at 56 days is likely. This is approximately 150 microstrain higher than the average reported by CSR over the last six months for the standard N40 mix. This is contrary to the Xypex literature and shrinkage test results for Xypex concrete used on other contracts around Brisbane. Further shrinkage tests on standard N40 mix and an N40 with Xypex have been performed. The test results are still outstanding.

#### 4. Conclusions

The results of the physical concrete tests indicate that concrete with Xypex added shows no adverse reactions. Slump, consistency and set times were all within the normal limits of conventional concrete.

The results of the water flow tests show that Xypex can effectively seal small cracks up to 0.7mm. Xypex appears to reduce the flow in cracks wider than 0.7mm. In time these crack may self heal, however a proper repair as per the Xypex specification should be used.

The Xypex specification calls for a thorough inspection of the slab within 48 hour after pouring the concrete. All cracks are to be treated with a Xypex concentrate repair. This process should eliminate the large cracks that were tested in the trial.

The Xypex specification calls for the degree of crack control to be "moderate to strong" when implementing Clause 9.4.3.4 of AS3600 and requires a minimum of 1% (0.25% per layer in each direction) which is expected to limit the crack width to less than 0.4mm. With these requirements met, it can reasonably be expected that any cracks from shrinkage and creep that occur after the deck has been covered will be less than 0.7mm and thus would autogenously self heal.

## 5. Recommendations

Xypex concrete is recommended to replace waterproof membranes in the INB Tunnel, the Landbridge and the RNA Tunnel subject to the following conditions:

- (i) The Xypex dosage rate in the concrete is as per manufactures specification
- (ii) The Xypex specification is strictly adhered to in regards to batching, placing, compaction and curing.
- (iii) The crack control steel as per AS3600 Clause 9.4.3.4 is included in the design.
- (iv) A thorough inspection of the deck is carried out within 48 hrs and all cracks repaired in accordance with the Xypex specification.

## 6. Attachments

Drawing of Trial slab reinforcing layout.

MMPL DC No. 2471 – Comments on Leighton Xypex Report

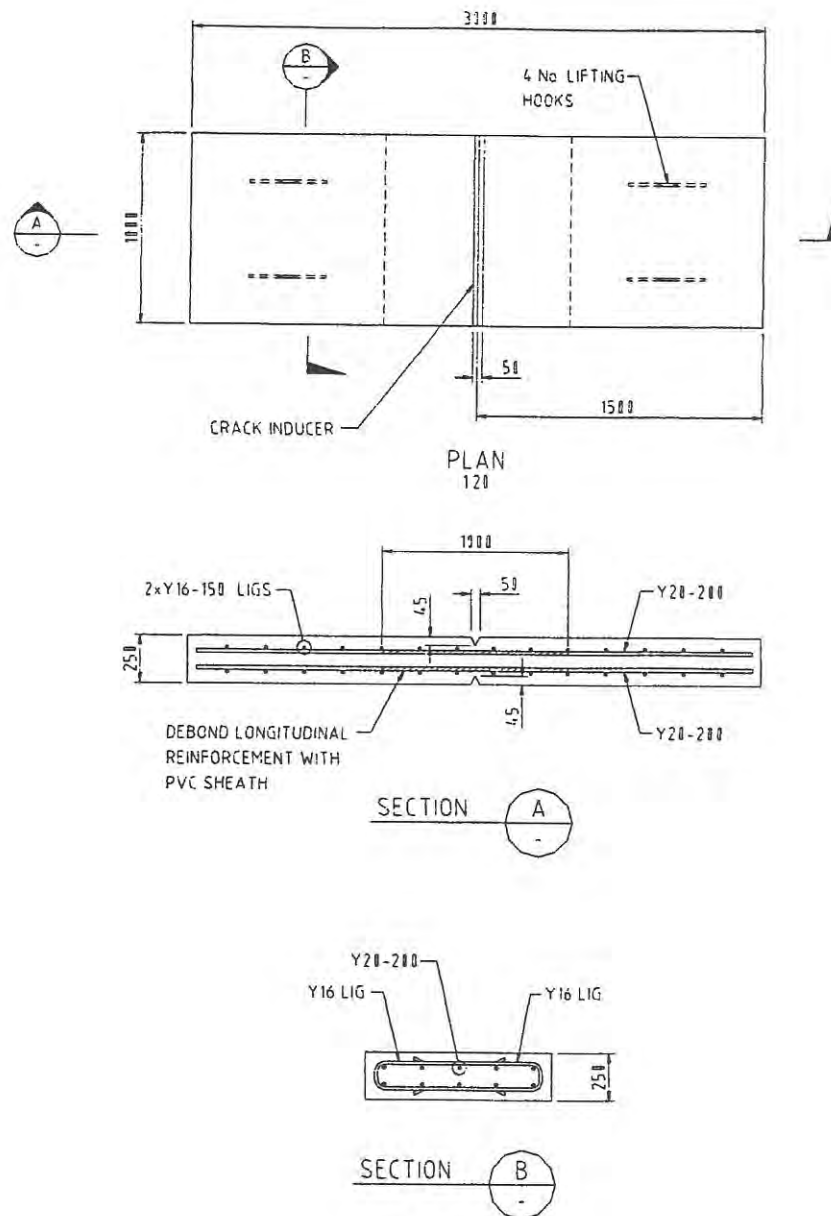
Xypex Standard Concrete Waterproofing Specifications – Xypex Admix C-1000NF / C-2000NF

Xypex Procedure for Supervision of Xypex Admix Pours

Xypex – Introduction to Xypex Waterproofing by Crystallisation

CSR Report on Xypex Concrete Trial – 23/09/2000

CSR Batch Record – Xypex Concrete S40MXYP



**Figure 1**      **Proposed Restrained Slab Configuration for Xypex Testing**





## CERTIFICATE OF MIX DESIGN

Date: 24 May, 2000  
 Client: Leighton Contractors Ptv. Ltd.  
 Contract: Inner City Bypass  
 Attention: James Hamilton  
 Facsimile: 07 3872 2700

We are pleased to submit for your approval, the following details of the concrete mix we propose for use to the above, from our despatch depot at Albion and Geebung.

### MATERIALS

Material	No	Supplier	Works, Quarry, Pit	Specification
Type GP Cement	1	QCL	Bulwer Island	AS3972
Fly Ash	2	Pozzolanic	Tarong	AS3582.1
20mm Aggregate	3	CSR Readymix	Petrie	AS2758.1
10mm Aggregate	4	CSR Readymix	Petrie	AS2758.1
Coarse Sand	5	CSR Readymix	Tivoli	AS2758.1
Fine Sand	6	CSR Readymix	Oxley Creek	AS2758.1
Not in use	7	-	-	-
Not in use	8	-	-	-
Water Reducer	9	WR GRACE	Archerfield	AS1478/79
Air Entrainer	10	WR GRACE	Archerfield	AS1478/79
Not in use	11	-	-	-

### MIX DESIGN

Mix Description	Slump (mm)	Mass of Materials (kg/m3)								Admix. (mL/m3)		
		1	2	3	4	5	6	7	8	9	10	11
N20/20 - N202GMRS	80	180	80	770	350	550	400			1560	100	-
N25/20 - N252GMRS	80	205	85	770	350	530	380			1740	100	-
* N32/20 - N322GMRS	80	225	95	780	350	520	370			1890	100	-
N40/20 - N402GMRS	80	260	110	780	360	500	350			2220	0	-
N50/20 - N502GMRS	80	320	140	810	360	460	300	-	-	2760	0	-

Comments: Coarse and fine sand moisture contents are at 6% and 8% respectively (subject to change).  
 Above figures, including the Aggregate, and Admixture combinations and quantities, are subject to change to ensure compliance with AS3902 and AS1379 requirements.  
 Water Reducer (Wre) dose will vary to control set time properties.

Yours Faithfully,

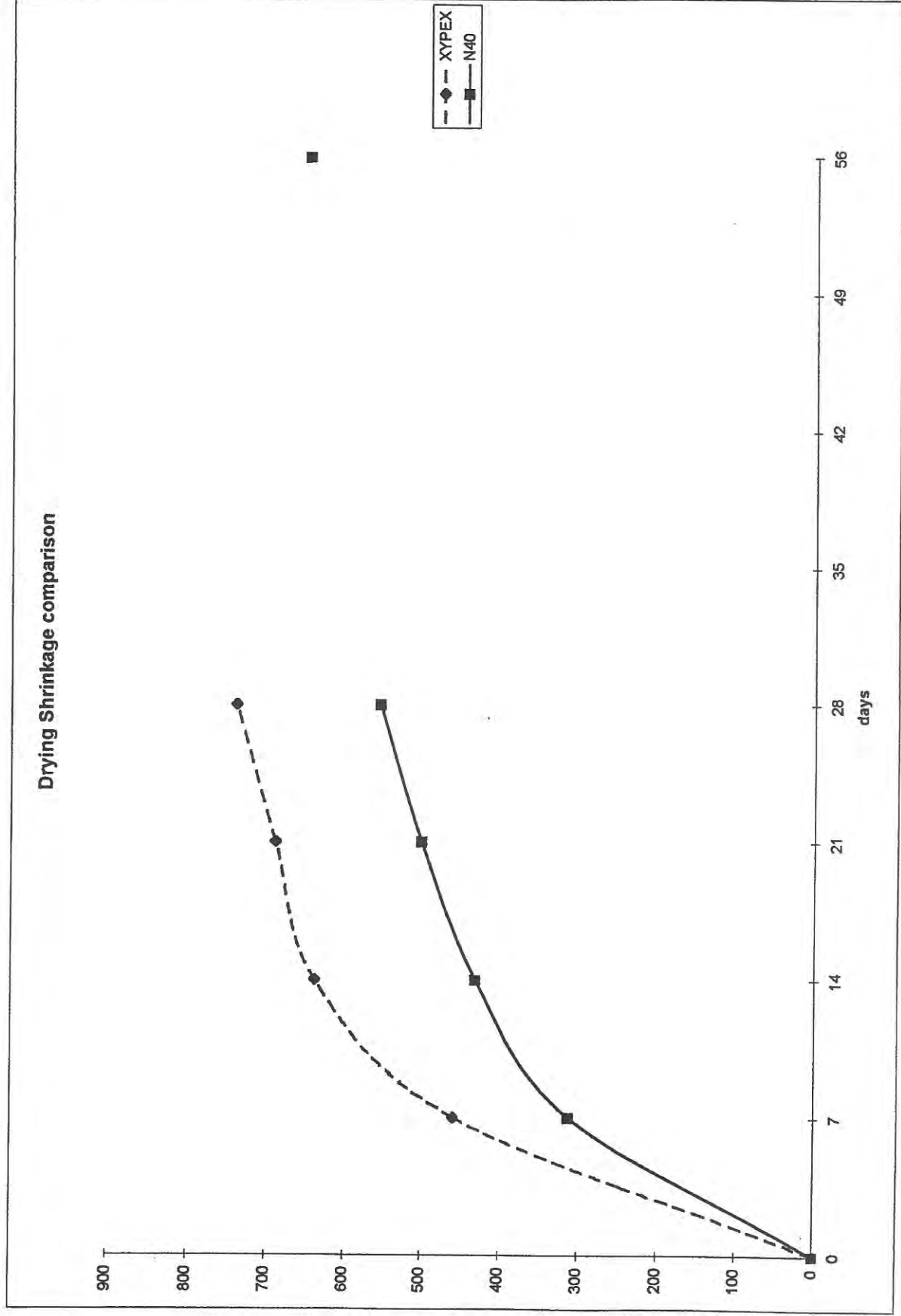
  
 Todd McGurgan  
 CSR Readymix Concrete

*The information contained on this document is for the sole purpose and use of the client as listed above, and must not be divulged to any third party without the express written permission of CSR Construction Materials*

Reproduction of CSR Readymix Batch Ticket for Xypex trials

Selection:	Date MONDAY, 14-Aug-00 only												
Sequence:	Ticket 17052137 only, Shipping plant number 3 only												
	Weights report												
Ticket number	Plant No.	Truck No.	Batch	Mix Design	Slump	Hot Water	Amount	Design	Actual	Variance Unit Percent	Mix code		
Plant 03 Crosby Road													
17052137		67	01 of 01	S40MRXYP	80		03.00	03.00	03.00	0	0.00%	380ppe01	
				PET 20				002370	002380	10	0.42%		
				PET 10				001071	001050	-21	-1.96%		
				TIVCS				001491	001500	9	0.60%		
				OXCFSW				001020	001040	20	1.96%		
				BULGP				000801	000806	5	0.62%		
				TARFA				000339	000348	9	2.65%		
				WR				003420	003400	-20	-0.58%		
				WATER				000200	000192	-8	-4.00%		
				XYPEX				Added at plant by Xypex					
			Measured slump		80								
			Available water from materials				182	litres					
			Batch water				200	litres					
			Slump stand				50	litres					
			On-site				40	litres					
			TOTAL WATER				472	litres					
			Total cementitious				1154						
			W/C ratio =				0.41	compared with 0.42 design estimated					

Trial#1graph Chart 1



CSE OVER 12 mth period  
xypex 1 test





Readymix  
Concrete

# CONCRETE TESTING SERVICES

DATE 14/8/00



Tests were carried out by the following registered Concrete Laboratory  
BRISBANE TEL (07) 5546 6935

FIRST LOAD CONCRETE DOCKET No. 17052137

JOB SITE / LOCATION: XYPEX LEIGHTONS ICB				
FIELD TEST SHEET NUMBERS: 233444				
ON SITE	OFF SITE	WAITING	TRAVEL	A/HRS
13:35	15:30			
HRS		HRS		HRS
ESTABLISHMENT COST: \$				
OTHER SERVICES:				
NAME: OAS WEST.				
SIGNATURE: [Signature]				
TEST DETAILS				
C.C.C.T.R.	CAST ONLY	TEST ONLY	SLUMP ONLY	
12		1		
QTY	QTY	QTY	QTY	

FORM 10A

C40RMX265

Limited ACN 000 001 276



## Concrete Delivery Docket

Control No  
USE ONLY

335975

DOCKET No. 17052137

### WARNING WORK SAFELY WITH CONCRETE

Why you should take care

- When hardened concrete products are cut, drilled, sawed, routed, chased, sanded, broken up or ground, silica dust may be released. Breathing silica dust over time may lead to lung diseases including bronchitis, silicosis and lung cancer.
- Freshly mixed concrete may irritate eyes and skin and may cause dermatitis.
- Protect yourself against breathing dust or getting it in your eyes, and against skin contact.
- When cutting, drilling, sawing, routing, chasing, sanding, breaking up or grinding hardened concrete products:
  - Use suitable dust extraction equipment
  - Wear protective clothing
  - Wear a P2 dust mask (AS/NZS 1715/1716) and eye protection (AS/NZS 1337)
- When working with freshly mixed concrete:
  - Wear protective clothing, gloves (AS 2161) and eye protection (AS/NZS 1337)
- First Aid
  - Eyes and Skin - wash with plenty of water.
  - Dust breathed in - move straight to fresh air.
- Clean up every day
  - Wash your work clothes often - it's best not to put them in the same wash with other clothes.
  - When working in an enclosed area wet and sweep OR dry-vacuum all dust, collect solid waste and put all in a covered container - wear all protective gear.
  - Follow local authority requirements for getting rid of waste.

For Readymix® Premixed Concrete Material Safety Data Sheet for details - call 1-800-807668 for copies.

Ver 6 18/1/95

This sale is subject to CSR Construction Materials Terms and Conditions of Sale. Whilst your attention is particularly drawn to the selected clauses printed on the reverse side of this delivery docket, please note that all Terms and Conditions of sale do apply.

Customer Signature .....

#### Waiting Time

On Site

Finished Pour

Waiting Time

Customer Signature:

..... Minutes

#### Water Added

Batch + Moisture

Slump Stand

On Site

Customers Request

Max. Water

Customer Signature:

.....

#### CASH SALE ONLY

Received the sum of: \$

Cash ☒ Cheque ☐ Credit Card ☐

Received by: .....

Customer No.	Customer Name			Customer Order No.	Job No	Plant No	Date
335975	LEIGHTON CONTRACTORS PTY LTD			T B A	79	3	14-Aug-00
Order No.	Delivery Address			Truck	Km / Zone		
330701	HERSTON GILCHRIST AV DATE AT MAIN SITE			67	5		
Load m3	Progressive m3	Ordered m3	Strength	Agg	Mix Description	Actual Slump	Design Slump
1.00	3.00	3.00	S40 20MM MATH ROADS XYPEX CONC				80.00
Unit Price \$/m³	Other Charges			EXTRA PRODUCTS			
Total this Load	Progress Total			Description	Quantity	UOM	Unit Price
Waiting Time (this load)	Total Due \$			SUR-XYPEX40	3.00	M3	
				NO MIN CART	1.00	MTR	
				Dosed with Xypex admix C1000NF			
Customer Service ph	131100	Qty Delivered	Qty Dumped	On Distance	Payment Code		

Pink - Signature Copy Blue - Customer's Copy



23 SEP 2000



00008694

CSR Limited ACN 000 001 276. PO Box 1143, Milton, Qld 4064 Australia  
Telephone (07) 3364 2831 International +61 7 3364 2831  
Facsimile (07) 3364 2926 International +61 7 3364 2926

To: **Iain Burgess** From: **Todd McGurgan**  
Company: **LEIGHTON CONTRACTORS Pty Ltd. - Inner City Bypass**  
Fax Number: **07 3872 2700** Reference:  
Date: **23<sup>rd</sup> September 2000** Pages inc. cover: **23**  
Subject: **Report on XYPEX concrete trial**

---

Iain,

please find below a summary of the concrete performance measured on the XYPEX concrete trial on your project 14<sup>th</sup> August 2000.

Mix supplied	S40MRXYP + standard dose of additives
XYPEX	added at plant by XYPEX personnel
Water cement ratio	0.42
slump measured	80mm @ 30 minutes
2 <sup>nd</sup> slump measured	65mm @ 60 minutes
concrete temp.	28°C
air temp.	24°C
Bleed	minimal
initial set	normal (checked @ 2 hours)
final set	normal (checked @ 4 hours 20 minutes)

notes:

- The mix appeared to be more pasty than the normal 40MPa concrete. This would have contributed to the low amount of bleed. If low bleed is to be expected, the use of an Aliphatic Alcohol to control evaporation of surface moisture would be necessary.
- The slump loss measured may have been contributed to the amount of water added to the rear of the load on-site, as apposed to being part of the initial mix water. This will need to be monitored on site, as part of our normal concrete monitoring. Additional set retarding admixtures may be required to reduce slump loss. This will need to be confirmed through XYPEX.



**Client:** XYPEX AUSTRALIA  
ATTN: MARIA BOBELBYK  
PO BOX 228  
NORTHGATE QLD  
**Project:** LEIGHTONS- I.C.B. (TRIAL)

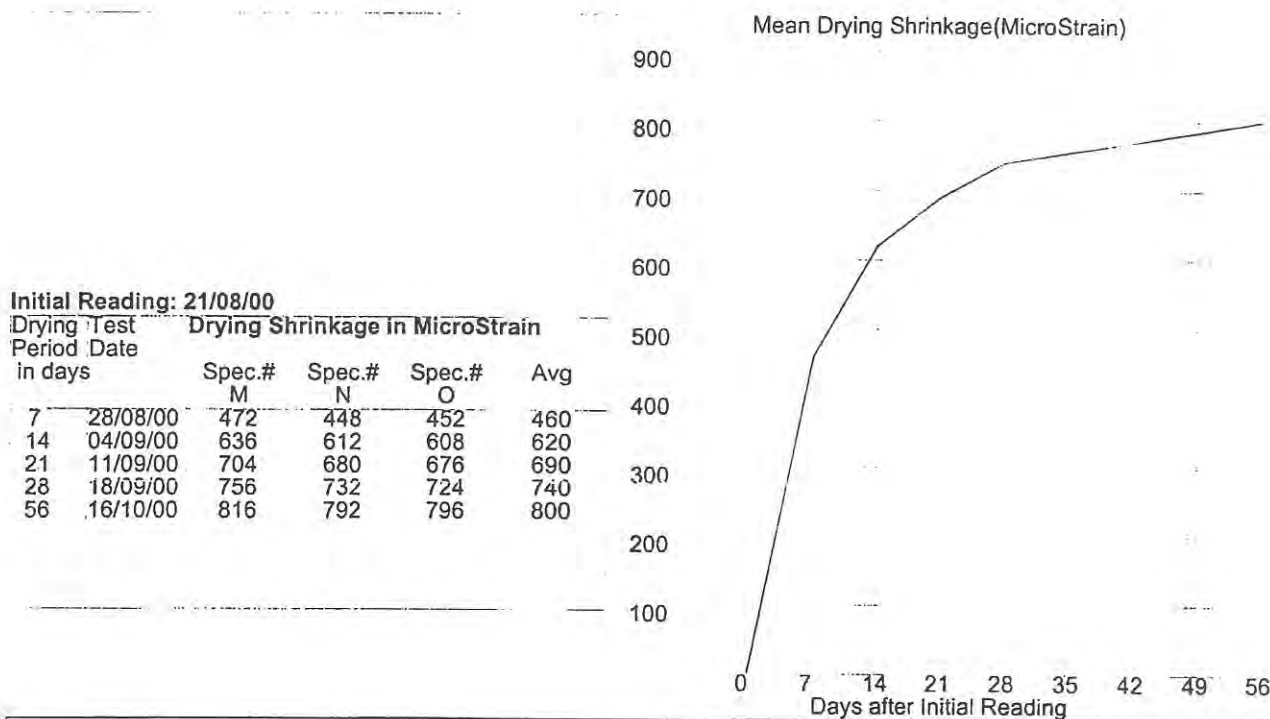
**Addendum to**  
**Report No:** 20005141  
**Date:** 25/10/00  
**Sample Date:** 14/08/00

## CONCRETE SHRINKAGE REPORT

We advise that the sampling and slump were carried out in accordance with AS 1012.1 and AS 1012.3 as appropriate and moulding, curing, and measurement in accordance with AS 1012.13 unless otherwise stated in notes.

Plant	Sample No.	Mix Design	Delivery Docket	Sample Time	Initial Cure Hrs	Actual Slump	Despatch Date/Time	Cond Rec'd	Demoûld Date/Time	Received Date/Time
ALB	233444	S40/20/80 S40MPa	17052137	14:10	20	80	15/08/00 10:00	Sat'd	15/08/00 10:00	15/08/00 10:00

Location: XYPEX TRIAL



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Accreditation 1559

Authorised Signatory: S.G. HUNT

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## CERTIFICATE OF MIX DESIGN (XYPEX concrete)

**Date:** 13 December, 2000 ~~2 November, 2000~~  
**Client:** Leighton Contractors Pty. Ltd.  
**Contract:** Inner City Bypass  
**Attention:** James Hamilton  
**Facsimile:** 07 3872 2700

We are pleased to submit for your approval, the following details of the concrete mix we propose for use to the above, from our despatch depot at Albion and Geebung.

### MATERIALS

Material	No	Supplier	Works, Quarry, Pit	Specification
Type GP Cement	1	QCL	Bulwer Island	AS3972
Fly Ash	2	Pozzolanic	Tarong	AS3582.1
20mm Aggregate	3	CSR Readymix	Petrie	AS2758.1
10mm Aggregate	4	CSR Readymix	Petrie	AS2758.1
Coarse Sand	5	CSR Readymix	Tivoli	AS2758.1
Fine Sand	6	CSR Readymix	Oxley Creek	AS2758.1
7mm Aggregate	7	CSR Readymix	Petrie	AS2758.1
Free water - design	8	B.C.C	-	-
Water Reducer - GWR	9	WR GRACE	Archerfield	AS1478/79
Air Entrainer	10	WR GRACE	Archerfield	AS1478/79
Superplasticizer - D19	11	WR GRACE	Archerfield	AS1478/79

### MIX DESIGN

Mix Description	Slump (mm)	Mass of Materials (kg/m <sup>3</sup> )								Admix. (mL/m <sup>3</sup> )		
		1	2	3	4	5	6	7	8	9	10	11
S40/20 - S40MRXYP	80	260	110	780	360	500	350	-	165	1110	0	0
N40/10 - N401GMRS	80	285	95	-	1000	600	320	-	165	1140	0	0

**Comments:** Coarse and fine sand moisture contents are at 6% and 8% respectively (subject to change).  
 Above figures, including the Aggregate, and Admixture combinations and quantities, are subject to change to ensure compliance with AS3902 and AS1379 requirements.  
 Water Reducer (Wrr) dose will vary to control set time properties.  
 XYPEX to be added @ dose rate nominated and controlled by XYPEX.

Yours Faithfully,

Todd McGurgan  
 CSR Readymix Concrete

*The information contained on this document is for the sole purpose and use of the client as listed above and must not be divulged to any third party without the*

# CERTIFICATE OF MIX DESIGN

## (XYPEX concrete)

**Date:** 2 November, 2000  
**Client:** Leighton Contractors Pty. Ltd.  
**Contract:** Inner City Bypass  
**Attention:** James Hamilton  
**Facsimile:** 07 3872 2700

We are pleased to submit for your approval, the following details of the concrete mix we propose for use to the above, from our despatch depot at Albion and Geebung.

### MATERIALS

Material	No	Supplier Specification	Works, Quarry, Pit
Type GP Cement	1	QCL AS3972	Bulwer Island
Fly Ash	2	Pozzolan AS3582.1	Tarong
20mm Aggregate	3	CSR Readymix AS2758.1	Petrie
10mm Aggregate	4	CSR Readymix AS2758.1	Petrie
Coarse Sand	5	CSR Readymix AS2758.1	Tivoli
Fine Sand	6	CSR Readymix AS2758.1	Oxley Creek
7mm Aggregate	7	CSR Readymix AS2758.1	Petrie
Free water - design	8	B.C.C	-
Water Reducer - GWR	9	WR GRACE AS1478/79	Archerfield
Air Entrainer	10	WR GRACE AS1478/79	Archerfield
Superplasticizer - D19	11	WR GRACE AS1478/79	Archerfield

### MIX DESIGN

Mix Description	Slump (mm)		Mass of Materials (kg/m3)							
			Admix. (mL/m3)							
			1	2	3	4	5	6	7	8 9
	10	11								
S40/20 - S40MRXYP	80	260	110	780	360	500	350	-		165
	1110	0	0							
N40/10 - N401GMRS	80	285	95	-	1000	600	320	-		165
	1140	0	0							

**Comments:** Coarse and fine sand moisture contents are at 6% and 8% respectively (subject to change).  
 Above figures, including the Aggregate, and Admixture combinations and quantities, are subject to change to ensure compliance with AS3902 and AS1379 requirements.  
 Water Reducer (Wrrr) dose will vary to control set time properties.





## CERTIFICATE OF MIX DESIGN (XYPEX concrete)

**Date:** 2 November, 2000 ~~November, 2000~~  
**Client:** Leighton Contractors Pty. Ltd.  
**Contract:** Inner City Bypass  
**Attention:** James Hamilton  
**Facsimile:** 07 3872 2700

We are pleased to submit for your approval, the following details of the concrete mix we propose for use to the above, from our despatch depot at Albion and Geebung.

### MATERIALS

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Type GP Cement	1	QCL	Bulwer Island	AS3972
Fly Ash	2	Pozzolanic	Tarong	AS3582.1
20mm Aggregate	3	CSR Readymix	Petrie	AS2758.1
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7mm Aggregate	7	CSR Readymix	Petrie	AS2758.1
Free water - design	8	B.C.C	-	-
Water Reducer - GWR	9	WR GRACE	Archerfield	AS1478/79
Air Entrainer	10	WR GRACE	Archerfield	AS1478/79
Superplasticizer - D19	11	WR GRACE	Archerfield	AS1478/79

### MIX DESIGN

Mix Description	Slump (mm)	Mass of Materials (kg/m <sup>3</sup> )								Admix. (mL/m <sup>3</sup> )		
		1	2	3	4	5	6	7	8	9	10	11
S40/20 - S40MRXYP	80	260	110	780	360	500	350	-	165	1110	0	0
N40/10 - N401GMRS	80	285	95	-	1000	600	320	-	165	1140	0	0

**Comments:** Coarse and fine sand moisture contents are at 6% and 8% respectively (subject to change).  
 Above figures, including the Aggregate, and Admixture combinations and quantities, are subject to change to ensure compliance with AS3902 and AS1379 requirements.  
 Water Reducer (Wre) dose will vary to control set time properties.  
 XYPEX to be added @ dose rate nominated and controlled by XYPEX.

Yours Faithfully,

Todd McGurgan  
 CSR Readymix Concrete

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## CERTIFICATE OF MIX DESIGN (XYPEX concrete)

**Date:** 7 March, 2001 ~~2 November, 2000~~  
**Client:** Leighton Contractors Pty. Ltd.  
**Contract:** Inner City Bypass  
**Attention:** James Hamilton  
**Facsimile:** 07 3872 2700

We are pleased to submit for your approval, the following details of the concrete mix we propose for use to the above, from our despatch depot at Albion and Geebung.

### MATERIALS

Material	No	Supplier	Works, Quarry, Pit	Specification
Type GP Cement	1	QCL	Bulwer Island	AS3972
Fly Ash	2	Pozzolanic	Tarong	AS3582.1
20mm Aggregate	3	CSR Readymix	Petrie	AS2758.1
10mm Aggregate	4	CSR Readymix	Petrie	AS2758.1
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Fine Sand	6	CSR Readymix	Oxley Creek	AS2758.1
7mm Aggregate	7	CSR Readymix	Petrie	AS2758.1
Free water - design	8	B.C.C	-	-
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Air Entrainer	10	WR GRACE	Archerfield	AS1478/79
Superplasticizer - D19	11	WR GRACE	Archerfield	AS1478/79

### MIX DESIGN

Mix Description	Slump (mm)	Mass of Materials (kg/m <sup>3</sup> )								Admix. (mL/m <sup>3</sup> )		
		1	2	3	4	5	6	7	8	9	10	11
S40/20 - S40MRXYP	80	260	110	780	360	500	350	-	165	1110	0	0
N40/10 - N401GMRS	80	285	95	-	1000	600	320	-	165	1140	0	0

**Comments:** Coarse and fine sand moisture contents are at 6% and 8% respectively (subject to change).  
 Above figures, including the Aggregate, and Admixture combinations and quantities, are subject to change to ensure compliance with AS3902 and AS1379 requirements.  
 Water Reducer (Wre) dose will vary to control set time properties.  
 XYPEX to be added @ dose rate nominated and controlled by XYPEX.

Yours Faithfully,

Todd McGurgan  
 CSR Readymix Concrete

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---

**Compressive strength comparison:**

age	S40MRXYP (MPa)	typical N402GMRS (MPa)
24 hours	8.2	7.3
72 hours	26.5	20
7 days	34.5	30
28 days	53	48.5


**Drying Shrinkage comparison:**

	(microstrain)	(microstrain)
7 days	460	313
14 days	640	432
21 days	690	502
28 days	740	556
56 days	TBC	650

Estimated 56 day shrinkage for XYPEX mix = 800

Please don't hesitate to call for any further information.

Regards

  
Todd McGurgan  
Projects coordinator  
mobile: 0419 474 782  
e-mail: TMcGurgan@csr.com.au  
CSR Readymix Concrete



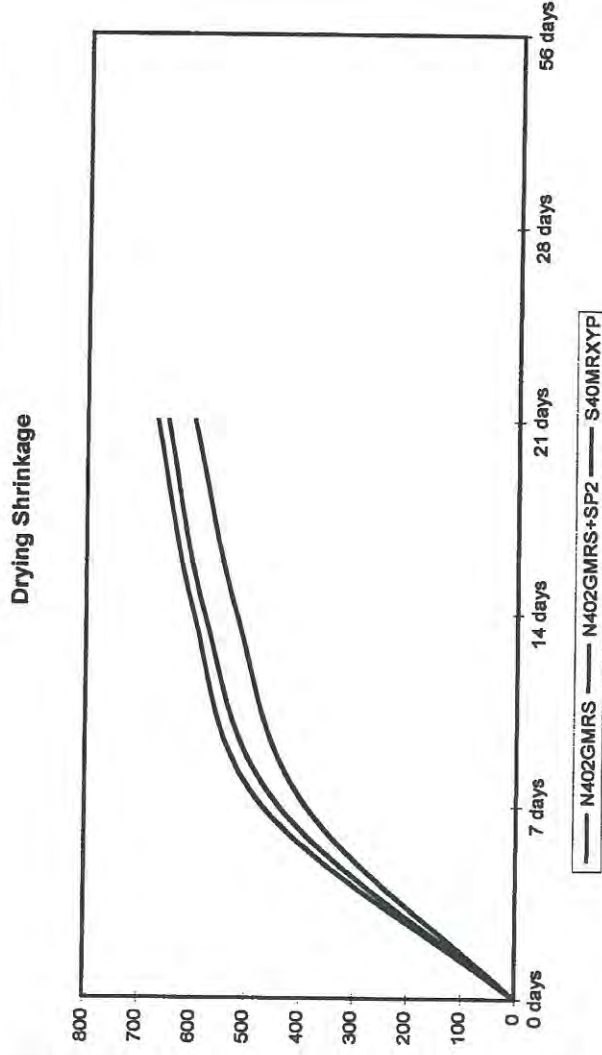
Shrinkage trial - Leighton ICB

date poured: 14/9/00

		Compressive	
Mix	N402GMRS	N402GMRS+SP2	S40MRXYP
slump	70	110	80
W/C ratio	0.46	0.37	0.41
7 day compression	35	33	32
28 day compression	55.5	53	48.5

		Drying Shrinkage	
	N402GMRS	N402GMRS+SP2	S40MRXYP
0 days	0	0	0
7 days	470	390	440
14 days	600	520	580
21 days	670	600	650
28 days			
56 days			

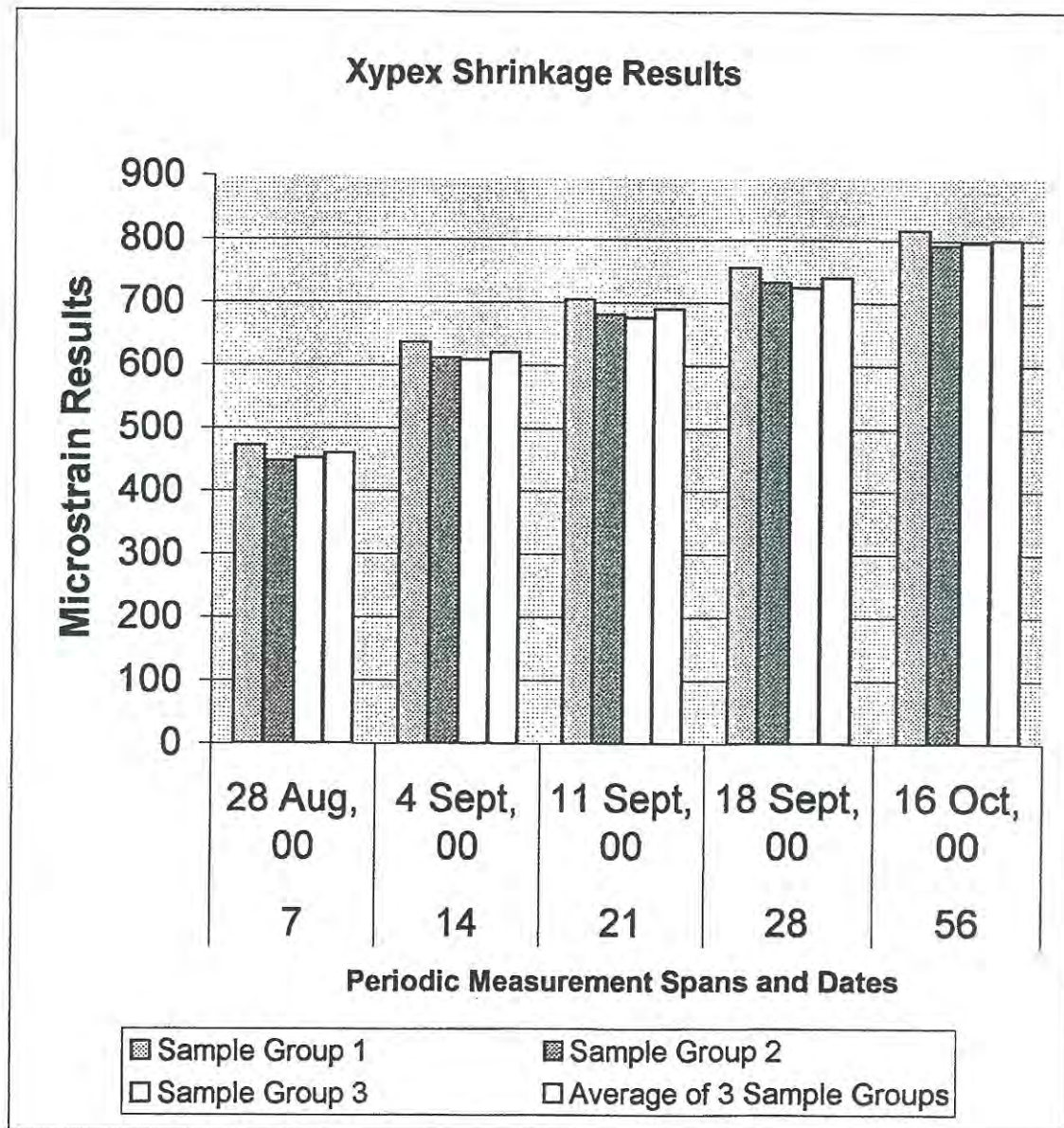
Sample Number	243200	243203	243206
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**Xypex Shrinkage Results  
Inner City Bypass Trials**

<b>Drying Period In Days</b>	<b>Initial Read: 21 Aug, 00 Test Date</b>	<b>Spec 1</b>	<b>Spec 2</b>	<b>Spec 3</b>	<b>Average</b>
7	28 Aug, 00	472	448	452	460
14	4 Sept, 00	636	612	608	620
21	11 Sept, 00	704	680	676	690
28	18 Sept, 00	756	732	724	740
56	16 Oct, 00	816	792	796	800



Carried out Aug 2000



### Test Results - Inner City Bypass Trials

Drying Period In Days			Cast Shrinkage Bars		Shrinkage Results		Shrinkage Results		Mix Design	
Test Date: 14 Sept, 00 Initial Read: 21 Sept, 00			Average		Average		Average		Typical	
			Xypex Mix		Xypex Mix		CSR Typical		S40MRXYP - C1000NF	
7	28 Sept, 00	440							GP Cement - 260kg	GP Cement - 260kg
14	5 Oct, 00	580							Fly Ash - 110 kg	Fly Ash - 110 kg
28	12 Oct, 00	650							Xypex C1000 @ 0.8 %	Xypex C1000 @ 0.8 %
56	12 Nov, 00									
									Water Reducer dosage	Water Reducer dosage
									300ml per 100kg	300ml per 100kg
									cementitious content	cementitious content
									Water/Cement	Water/Cement
									Ratio 0.42	Ratio 0.42

**Comparison Shrinkage Results**  
Xypex 40MPA - Typical CSR 40MPA

Periodic Measurements & Dates	Xypex Mix (Microstrain)	CSR Typical Mix (Microstrain)
7	~450	~500
14	~550	~600
28	~650	~700
56	~750	~800

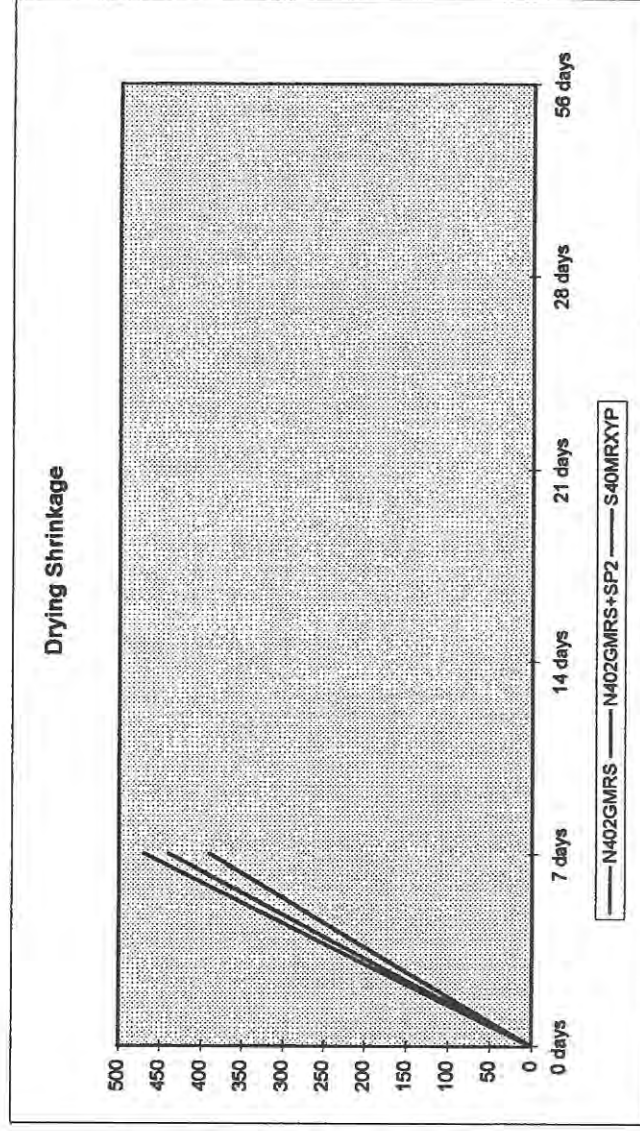
Trials carried out Sept 2000

Shrinkage trial - Leighton ICB

date pored: 14/9/00

Compressive	
Mix	N402GMRS N402GMRS+SP2 S40MRXYP
slump	80 70 110
W/C ratio	0.46 0.41 0.37
7 day compression	30 32 33
28 day compression	

Drying Shrinkage	
N402GMRS	N402GMRS+SP2 S40MRXYP
0 days	0 0 390
7 days	470 0 440
14 days	
21 days	
28 days	
56 days	

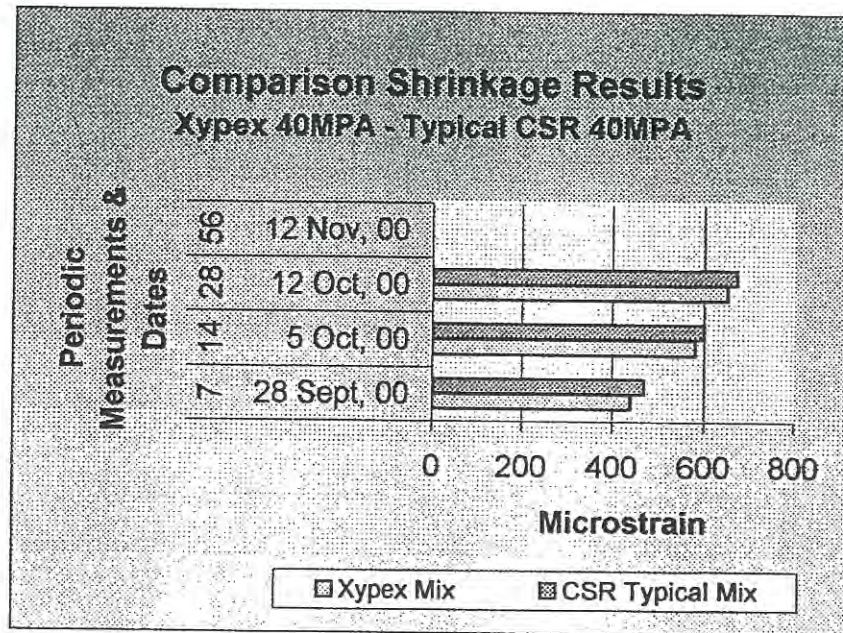




# Test Results - Inner City Bypass Trials

## Microstrain/Shrinkage Results

Drying Period In Days	Cast Shrinkage Bars Test Date: 14 Sept, 00 Initial Read: 21 Sept, 00	Shrinkage Results Average Xypex Mix	Shrinkage Results Average CSR Typical
7	28 Sept, 00	440	470
14	5 Oct, 00	580	600
28	12 Oct, 00	650	670
56	12 Nov, 00		



### Mix Design Xypex Admix S40MRXYP - C1000NF

GP Cement - 260kg  
Fly Ash - 110 kg  
Xypex C1000 @ 0.8 %

Water Reducer dosage  
300ml per 100kg  
cementitious content

Water/Cement  
Ratio 0.42

### Mix Design Typical N402GMRS

GP Cement - 260kg  
Fly Ash - 110 kg

Water Reducer dosage  
300ml per 100kg  
cementitious content

Water/Cement  
Ratio 0.42

Trials carried out Sept 2000



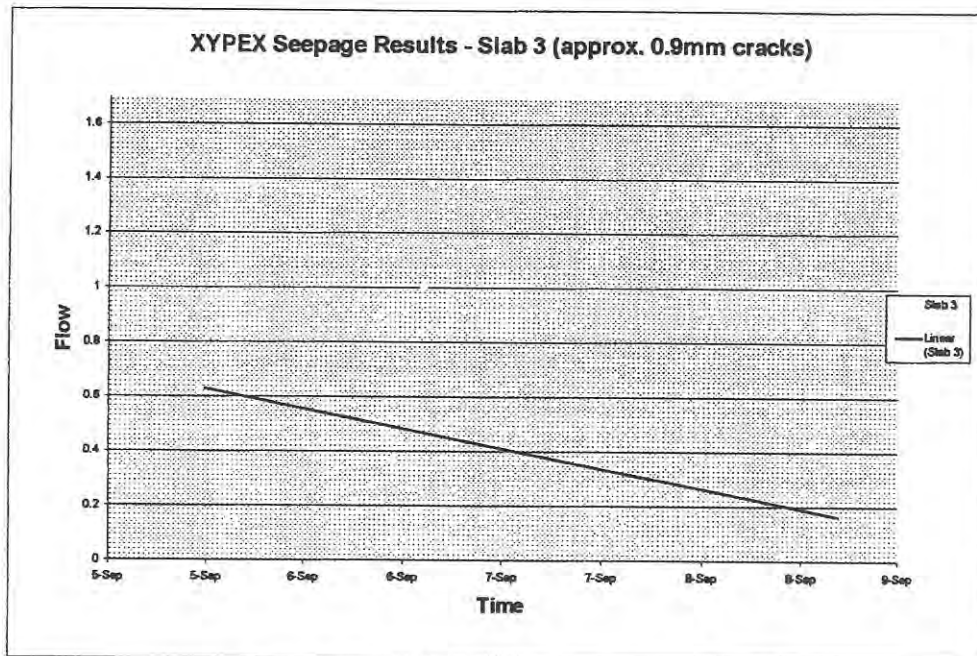


Figure 3 - Seepage Results - Slab 3

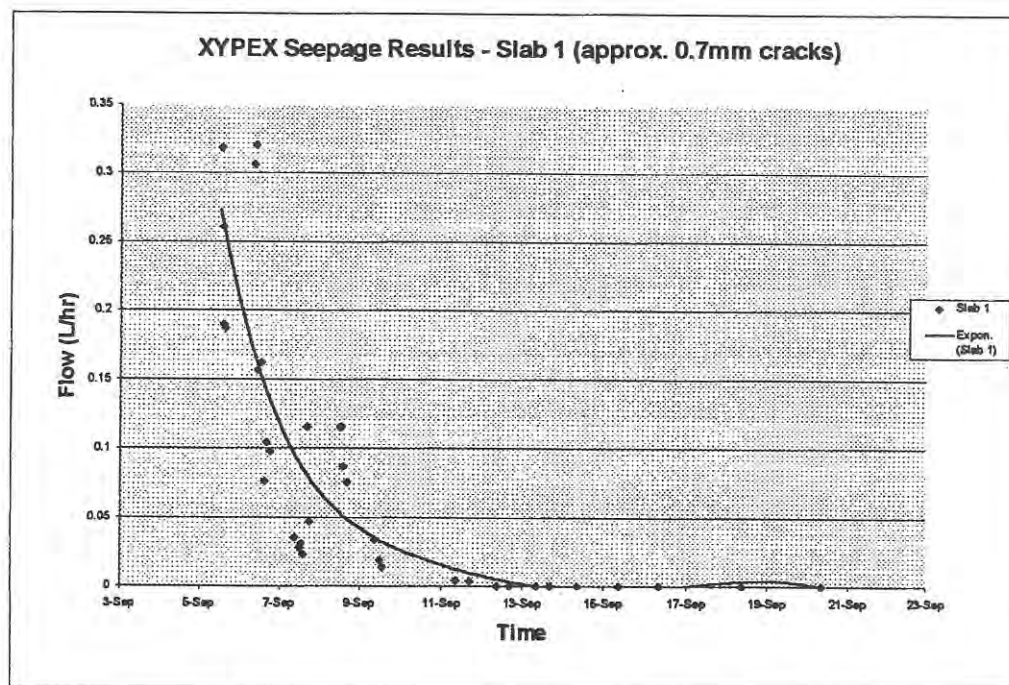


Figure 4 – Extended time base Seepage Results - Slab 1

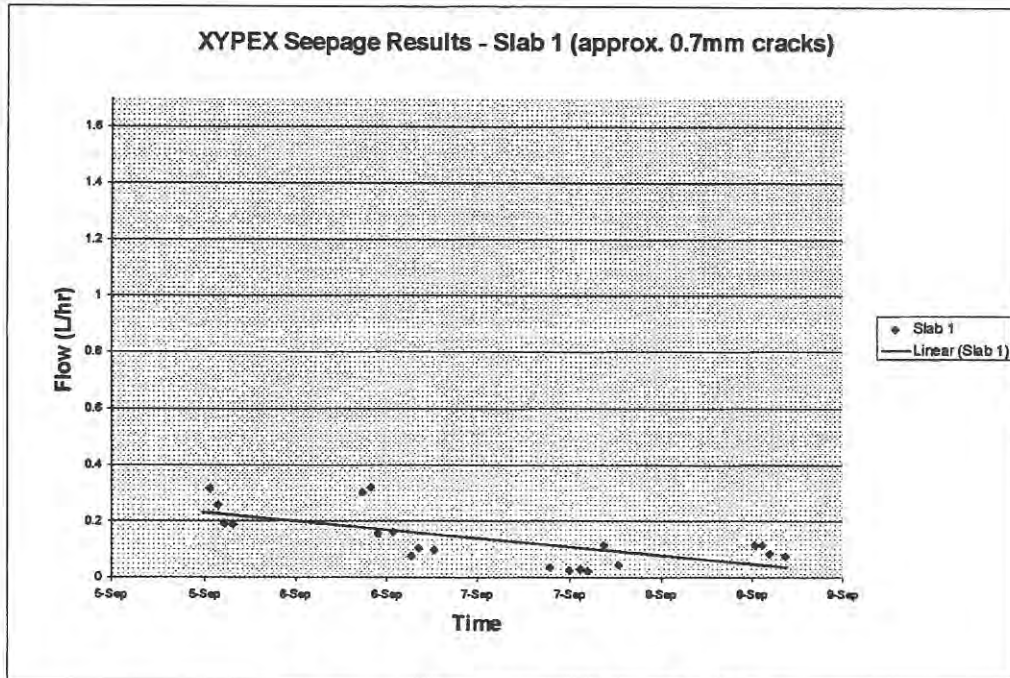


Figure 1 – Seepage Results – Slab 1

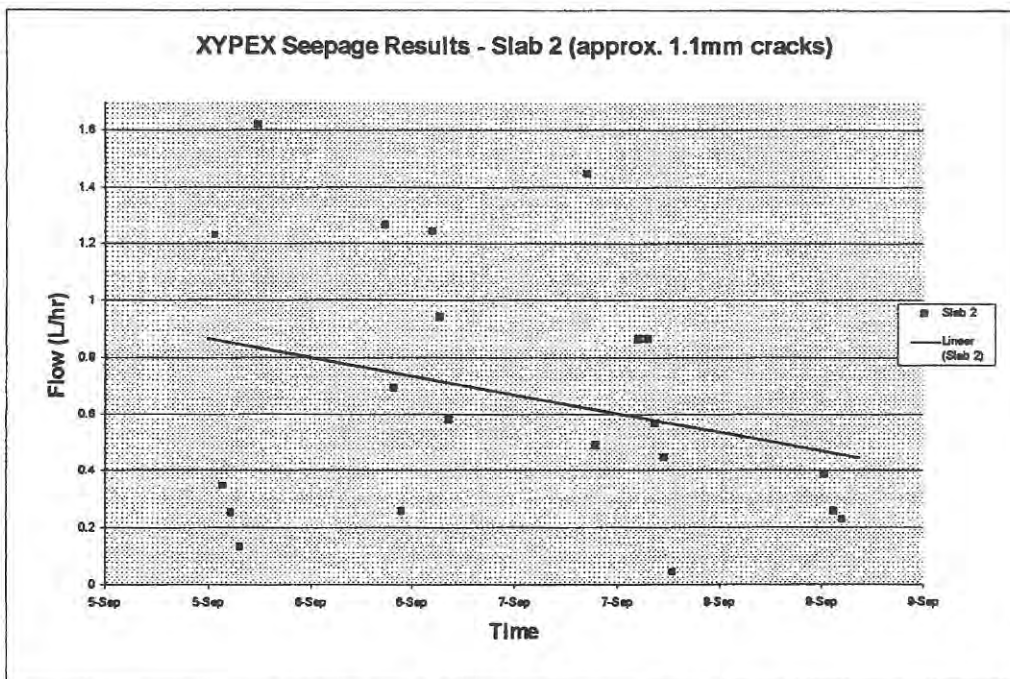


Figure 2 – Seepage Results – Slab 2

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A.C.N.: 000 001 276

RF0015(9/97)



**Client:** XYPEX AUSTRALIA  
ATTN: MARIA BOBELBYK  
PO BOX 228  
NORTHGATE QLD 4013  
  
**Project:** LEIGHTONS- I.C.B. (TRIAL)

**FINAL REPORT**  
**Date :** 11/09/00  
**Report No. :** 20005141  
**Page :** 1 of 1  
**Sample Date :** 14/08/00

## Construction Materials Laboratory

# CONCRETE TEST CERTIFICATE

### Slump, Compressive Strength, Flexural, Indirect Tensile

We advise that the sampling, slump, moulding, curing and testing were carried out in accordance with AS1012 parts 1,3,1.8,1.8.2,9 and 12.1 unless otherwise stated in remarks or notes. All densities SSD unless otherwise stated in remarks.

Batch Details							Specimen Details										
Sample No.	Truck No.	Mix Description F'c/Agg./Slump MPa/mm/mm	Delivery Docket No.	Batch Time	Sample Time	Actual Slump (mm)	T y p e	C o m p a c t	F l e x u r a l	C a p	Date Tested	Curing Int/Std hrs/days	Dimensions Avg. Dia. (mm) Height (mm)	Age days	Strength (MPa)	Mass per Unit Vol. (kg/m3)	
233444A	67	S40/20/80 S40MPa	17052137	13:36	14:10	80	C	E	N	S	15/8/00	20/0	100.1	200	1	8.4	2480
233444B							C	E	N	S	15/8/00	20/0	100.0	200	1	8.0	2460
233444C							C	E	N	S	15/8/00	20/0	99.9	200	1	8.4	2480
233444D							C	E	N	S	17/8/00	20/2	99.9	200	3	27.0	2480
233444E							C	E	N	S	17/8/00	20/2	100.0	200	3	26.0	2480
233444F							C	E	N	S	17/8/00	20/2	99.9	200	3	27.0	2460
233444G							C	E	N	S	21/8/00	20/6	100.2	200	7	34.5	2460
233444H							C	E	N	S	21/8/00	20/6	100.2	200	7	35.5	2480
233444I							C	E	N	S	21/8/00	20/6	99.9	200	7	33.5	2480
233444J							C	E	N	S	11/9/00	20/27	99.9	199	28	53.0	2500
233444K							C	E	N	S	11/9/00	20/27	100.2	199	28	53.0	2500
233444L							C	E	N	S	11/9/00	20/27	99.9	200	28	52.5	2500

Plant: ALB  
Location: XYPEX TRIAL

Notes 1. Type: C=Compressive; F=Flexural; I=Indirect Tensile  
2. Compaction: R=Rodding; E=Vibration; A=Ramming  
3. Fracture: N=Normal; S=Shear; A=Abnormal; C=Cap Failure

4. Cap Types: S=Sulphur; R=Rubber  
5. Zone: Tropical  
Other Remarks: External vibration not in accordance with AS1012.8



Accreditation 1559

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Qld. 4818  
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PO BOX 617  
BEENLEIGH QLD 4207  
ph.: 07 5546 6935  
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A.C.N.: 000 001 276

RF0015(9/97)



RECEIVED  
24 AUG 2000  
BY: .....

Client: XYPEX AUSTRALIA  
ATTN: MARIA BOBELBYK  
PO BOX 228  
NORTHGATE QLD 4013

INTERIM REPORT

Date : 21/08/00

Report No. :20005141

Page : 1 of 1

Sample Date : 14-08-00

Project: LEIGHTONS- I.C.B. (TRIAL)

## CONCRETE TEST CERTIFICATE

Slump, Compressive Strength, Flexural, Indirect Tensile

We advise that the sampling, slump, moulding, curing and testing were carried out in accordance with AS1012 parts 1,3,1.8,1.8.2,9, and 12.1 unless otherwise stated in remarks or notes. All densities SSD unless otherwise stated in remarks.

Batch Details							Specimen Details									
Sample No.	Truck No.	Mix Description F'c/Agg./Slump MPa/mm/mm	Delivery Docket No.	Batch Time	Sample Time	Actual Slump (mm)	T y p e	C o m p	F l e x	C a p	Date Tested	Curing Int/Std hrs/days	Dimensions : Avg.Dia. (mm)    Height (mm)	Age days	Strength (MPa)	Mass per Unit Vol. (kg/m3)
233444/A	67	S40/20/80 S40MPa	17052137	13:36	14:10	80	C	E	N	S	15/8/00	20/0	100.1    200	1	8.4	2480
233444/B							C	E	N	S	15/8/00	20/0	100.0    200	1	8.0	2460
233444/C							C	E	N	S	15/8/00	20/0	99.9    200	1	8.4	2480
233444/D							C	E	N	S	17/8/00	20/2	99.9    200	3	27.0	2480
233444/E							C	E	N	S	17/8/00	20/2	100.0    200	3	26.0	2480
233444/F							C	E	N	S	17/8/00	20/2	99.9    200	3	27.0	2460
233444/G							C	E	N	S	21/8/00	20/6	100.2    200	7	34.5	2460
233444/H							C	E	N	S	21/8/00	20/6	100.2    200	7	35.5	2480
233444/I							C	E	N	S	21/8/00	20/6	99.9    200	7	33.5	2480

Plant: ALB  
Location: XYPEX TRIAL

Notes 1. Type: C = Compressive F = Flexural I = Indirect Tensile  
2. Compaction: R=Rodding; E=Vibration; A=Ramming;  
3. Fracture: N=Normal; S=Shear; A=Abnormal; C=Cap Failure.

4. Cap Types: S = Sulphur; R = Rubber  
5. Zone: Tropical  
Other Remarks: External vibration not in accordance with AS1012.8



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Approved Signatory: S.G.HUNT

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RF0015(9/97)



**Client:** XYPEX AUSTRALIA  
ATTN: MARIA BOBELBYK  
PO BOX 228  
NORTHGATE QLD 4013  
  
**Project:** LEIGHTONS- I.C.B. (TRIAL)

**INTERIM REPORT**  
**Date :** 18/08/00  
**Report No. :** 20005141  
**Page :** 1 of 1  
**Sample Date :** 14-08-00

## CONCRETE TEST CERTIFICATE

Slump, Compressive Strength, Flexural, Indirect Tensile

We advise that the sampling, slump, moulding, curing and testing were carried out in accordance with AS1012 parts 1,3,1,8,1,8,2,9, and 12,1 unless otherwise stated in remarks or notes. All densities SSD unless otherwise stated in remarks.

Batch Details							Specimen Details										
Sample No.	Truck No.	Mix Description F'c/Agg./Slump MPa/mm/mm	Delivery Docket No.	Batch Time	Sample Time	Actual Slump (mm)	T y p e	C o m p	F l e x	I n d i r e c t	Date Tested	Curing Int/Std hrs/days	Dimensions : Avg.Dia. Height (mm) (mm)	Age days	Strength (MPa)	Mass per Unit Vol. (kg/m3)	
233444/A	67	S40/20/80 S40MPa	17052137	13:36	14:10	80	C	E	N	S	15/8/00	20/0	100.1	200	1	8.4	2480
233444/B							C	E	N	S	15/8/00	20/0	100.0	200	1	8.0	2460
233444/C							C	E	N	S	15/8/00	20/0	99.9	200	1	8.4	2480
233444/D							C	E	N	S	17/8/00	20/2	99.9	200	3	27.0	2480
233444/E							C	E	N	S	17/8/00	20/2	100.0	200	3	26.0	2480
233444/F							C	E	N	S	17/8/00	20/2	99.9	200	3	27.0	2460

Plant: ALB  
Location: XYPEX TRIAL

Notes 1. Type: C = Compressive F = Flexural I = Indirect Tensile  
2. Compaction: R=Rodding; E=Vibration; A=Ramming;  
3. Fracture: N=Normal; S=Shear; A=Abnormal; C=Cap Failure.

4. Cap Types: S = Sulphur; R = Rubber  
5. Zone: Tropical  
Other Remarks: External vibration not in accordance with AS1012.8



Accreditation 1559

This Laboratory is accredited by the National Association of Testing Authorities, Australia. The tests reported herein have been performed in accordance with its terms of accreditation. This document shall not be reproduced except in full

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RF0015(9/97)



Client: XYPEX AUSTRALIA  
ATTN: MARIA BOBELBYK  
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NORTHGATE QLD 4013

# INTERIM REPORT

Date : 16/08/00

Report No. :20005141

Page : 1 of 1

Sample Date : 14-08-00

Project: LEIGHTONS- I.C.B. (TRIAL)

## CONCRETE TEST CERTIFICATE

### Slump, Compressive Strength, Flexural, Indirect Tensile

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233444/C							C	E	N	S	15/8/00	20/0	99.9	200	1	8.4	2480

Plant: ALB  
Location: XYPEX TRIAL

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