CASE STUDY M1 Slab Replacement Project

Roadtek QLD

Antoun Civil Engineering (Aust) Pty Ltd
Volumetric Concrete Australia Pty Ltd
CTS Rapid Set Cement Pty Ltd

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ANTOUN CIVIL ENGINEERING (AUST) PTY LTD FOR ROADTEK QLD

INTRODUCTION

The M1 in Brisbane, Queensland, Australia, is the key route between Tugun near the New South Wales-Queensland border to the Sunshine Coast hinterland via the following corridors:

- Pacific Motorway between Tugun and Eight Mile Plains
- Gateway Motorway between Eight Mile Plains and Bald Hills
- Bruce Highway between Bald Hills and Cooroy

The Pacific Highway continues on south from the M1 into New South Wales, while the Bruce Highway continues further north from the M1 up the Queensland coast. Both of these roads and the M1 itself are part of the line of route of National Highway 1, although M1 signage is used for that part of the corridor. Since its completion, the M1 has saved Queensland motorists countless hours and millions of dollars, reduced air, noise and water pollution and made travelling faster and safer for everyone.

Currently, Roadtek is upgrading the M1 motorway including asphalt re-sheeting of on/off ramps and vegetation maintenance whilst also rehabilitating slab sections which have fallen below substandard conditions due to heavy trafficking.

This particular case study is in reference to various sections of pavement with slab dimensions of approximate length of 4.2m and an overall width of 3.6m. The slab section are located at various locations- Yatala North bound, Yatala South bound and Pimpama Northbound.

Due to the nature of the works, Roadtek directly engaged Antoun Civil Engineering in conjunction with Volumetric Concrete Australia to rehabilitate these sections of pavement to be ready for trafficking at 04:00 EST.

THE PROJECT

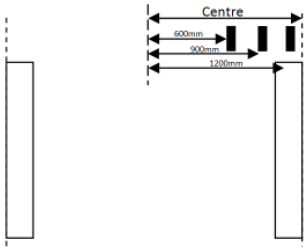
Requirements/ Specifications

There were a total of 22 slabs on the project. Some slabs were adjacent to each other, with others in independent locations. Each slab had the approximate dimensions of 4.2m and an overall width of 3.6m and an approximate average depth of 250mm. The slabs were located in various lanes, some in the slow lane (lane 1) with others in lane 2 and 3.
The scope of works required saw cutting the previous night. During any one shift ACE had to then demolish and replace up to a maximum of 3 slab sections within an eight hour timeframe including all establishment and demobilisation.

Initially demolition would take place and concrete sections would be placed into steel bodied trucks for carting and disposal. The existing lean mix is then to be swept free of any remaining debris.

The existing adjacent slab faces parallel to the flow of traffic were then to be drilled using a 16mm diameter drill bit, 300mm deep. The slabs perpendicular to the flow of traffic had to be receive a 38mm dia hole 225mm deep into the existing adjacent slab faces.

Faces of all adjacent slabs then had to receive a coat of emulsion after which each hole must be doweled using a 900mm long, R12 bar, chemset at a depth of 300mm and a 450mm long galvanised N32 dowel chemset at a depth of 225mm. Exposed N32 dowels had to be then also painted with the same material as the faces of all adjacent slabs.



R12 bars had a spacing of 900mm C/C with the N32 dowels at a spacing of 300mm C/C- Total of 3 beneath each wheel path at either end of the slab.

A plastic bond breaker was then to be installed spanning the full length and width of the slab to be replaced. Any additional plastic is to be cut away with all additional plastic lapped.

Reinforcement mesh (SL82) is then to be placed, lapped and tied at 250mm with a clear cover of min 50mm from all adjoining faces, N36 dowels etc. This was required as the aforementioned slabs are classified as a 'repair' as opposed to a 'new pavement'.

Finally, concrete was then to be installed as per best practice, with no radius on the adjoining edges and a tine finish across the carriage way (as it is a 'repair'. If new pavement- tine longitudinally). Post saw cutting was then to commence as soon as practically possible (usually the following shift) with all joints saw cut.

The works

Mobilization onsite was at 20:30 EST with traffic control closing the slow and adjacent 2 lanes- one being for the buffer between site personnel and the motoring public on the four lane carriage way.

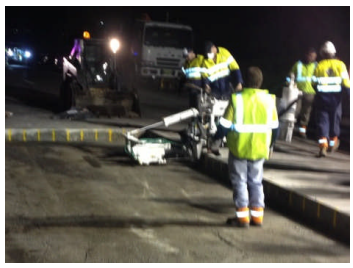
The plant and equipment was convoyed strategically due to restrictions in both time and work zone area.

Demolition took place using the efficient, clean method of lifting plates with concrete screws for each sawn panel section. Slabs were drilled post demolition and lifted (as opposed to jack hammered) out and placed using a 20t pneumatic excavator. This was in an effort to reduce debris and avoid damage to the other surrounding slabs. Removed slab sections were placed directly into steel bodied trucks for carting and disposal offsite.

The existing lean mix was then swept free of all foreign materials and debris and inspected by both managerial staff and the client representative. Any cracks in the existing lean mix were noted on the relevant Inspection Test Plan (ITP).

Demobilization of all plant and equipment occurred during dowel and steel installation. The concrete mixer was then parked in position ready to dispense the concrete when required.

The existing adjacent slab faces parallel to the flow of traffic were drilled using a 2 gang *Minnich Drill*®. This drill was implored to drill 16mm diameter hole, 300mm deep in less than 10 seconds per hole with no form of heavy manual handling.



A second *Minnich Drill*® was then used to drill 38mm diameter hole in the existing adjacent slab faces across the carriage way with 3 dowels at each end of the slab beneath the wheel path.

Faces of all adjacent slabs then received a coat of rapid setting paintable emulsion after which each hole was doweled using a 900mm long, R12 bar, chemset at a depth of 300mm and a 450mm long galvanized N32 dowel chemset at a depth of 225mm. Exposed N32 dowels were then also painted with the same material as the faces of all adjacent slabs.

R12 bars were installed at 900mm C/C. N32 dowels installed at 300mm C/C- Total of 3 beneath each wheel path at either end of the slab.

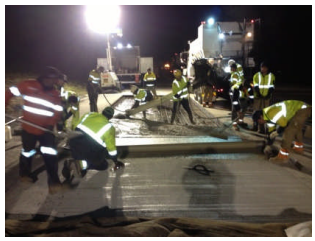
A plastic bond breaker was then installed spanning the full length and width of the slab to be replaced. Any additional plastic was cut away with all additional plastic lapped at a rate of 600mm per joint. Joints were taped in place.

Reinforcement mesh (SL82) was then placed, lapped and tied at 250mm with a clear cover of min 50mm from all adjoining faces, N36 dowels etc.

Concrete was then installed as per best practice using specialized trucks and a unique cement- CTS Rapid Set Cement. No radiuses were installed on the adjoining edges and a tine finish across the carriage way was put into place. Post saw cutting was to commence as soon as practically possible with all joints saw cut.

Upon finishing of the slab, curing compound, damp hessian (overlapped by 300mm) and 2µm black buildings plastic was laid over the slab completed in order to aid in the curing process. Slabs were ready for trafficking by 3am- 1 hour prior to what has been specified by authorities.

During any one shift, Antoun Civil Engineering (ACE) in conjunction with Volumetric Concrete Australia (VCA) replaced up to a total of seven slabs within an eight hour timeframe including all establishments, saw cutting (post installation) and demobilization- an impressive result.



Below is a summary of the shift where ACE & VCA completed a 7 slab replacement.

Works	Start Time	Finish Time
Drilling of lifting plates & plate installation	8:05pm	8:30pm
Demolition	8:15pm	10:15pm
Dowel drilling	8:55pm	10:45pm
Base preparation, emulsion, plastic, reinforcement & shutter	10:25pm	10:50pm
Concrete installation (first 4 slabs)	10:50pm	11:42pm
Clean out and Reload 2 trucks	11:00pm	12:30am
Concrete installation (final 3 slabs)	1:50am	2:25am
Curing, Demobilization	2:25am	3:00am
Saw cutting of new slab	3:00am	3:30am
Final clean up	3:30am	4:00am

***Table 1: Summary of times taken during key milestones during 7 slab replacement shift**

Once the concrete slab had what we believed to be sufficient curing time, saw cutting commenced. The client representative requested that only the transverse cuts be installed.

RESULTS

Five to ten compressive cylinders samples were taken during concrete installation on various shifts. Table 2 below summarizes the results to date.

Also, during the course of the works, Inspection Test Plans (ITP's) were completed. This is a crucial part of our Quality Assurance system. However, due to site conditions and recommendations, the specification changed in terms of dowel spacing and type on four different occasions.

The results proved to be excellent with an opening strength of 24MPa prior to allowing traffic on the carriage way.

Slab I.D. by Dates poured	3 hrs (MPa)	6 hrs (MPa)	24 hrs (MPa)	Location comments and notes
20-21/06/2013	27.6	38.0	42.5	Yatala Northbound before exit 38, 9.6m^3 poured, 4 sections in 1 long pour lane 2.
23-24/06/2013	25.5	31.0	39.2	Yatala Northbound before exit 38, 14.8m^3 poured, 4 separate slabs, lane 1 - 2 slabs and lane 2 - 2 slabs.
24-25/6/2013	18.5	26.5	38.5	Yatala Southbound after entry 38, 11.4m^3, 3 slabs, lane 1 – 2 slabs and lane 2 – 1 slab
25-26/6/2013	24.2	28.5	36.5	Pimpama Northbound after entry 49 (camel hump), 24.0m^3 poured, 7 slabs lane 1*
27-28/6/2013	21.5	27.5	36.5	Pimpama Northbound after entry 49 (camel hump), 12.3m^3 poured, 3 slabs lane 2
28-29/6/2013	21.0	28.0	39.5	Yatala Southbound near exit 38, 2 slabs in lane 3, 7.9m^3 poured.

Table 2: Test results to date

LIMITATIONS & DISCUSSION

Antoun Civil Engineering and Volumetric Concrete Australia had to overcome some situations. These included but were not limited to:

1. Inclement weather
2. Delayed start by traffic control- 21:20 EST
3. Steel mesh installation
4. Change in specifications

The above points can be mitigated/ eliminated via the following:

1. During the inclement weather, sand bags were installed to the high side of the slab. Marquees were then used during the works until initial set was achieved <20min.
2. Traffic control was implemented on time during every shift except one. The delay was caused due to works on the opposing direction causing a buildup of traffic and preventing the traffic control crew from reaching the desired location. Alternative route will be used if this is the case if available.
3. We believe that steel mesh was required to compensate for the low opening strengths gained using conventional Portland cement. As CTS Rapid Setting Cement can achieve much higher compressive results, we believe this is not required. This translates into a significant cost saving to the client both in terms of materials required and labor required for the installation. This coupled with the time saved during the installation will in turn mean that more slab sections can be replaced in any one shift. This then also provides further savings in terms of traffic control, day makers, supervisors and most importantly delays to the general public. This specification detail will need to be reviewed and approved by Roadtek engineers (ENT).
4. Specification to be finalized and approved prior to project commencement. Please also refer to note 3 above.

CONCLUSION

The M1 slab replacement project was without doubt a great success. The client was impressed with the methodology, trouble shooting and the results obtained on the finished product. The project was completed on time and to budget. This would not have been possible without Volumetric Concrete Australia and the technology and cement implored from CTS Rapid Set Cement. A total of 22 slabs were replaced across 6 shifts varying from 8 hours per shift to as little as 6 hours per shift.