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BRIDGE POLICY CIRCULAR

BPC2005/05

SUBJECT: USE OF STEEL FIBRE REINFORCED REACTIVE POWDER CONCRETE ('DUCTAL') IN RTA WORKS

No. Sketches Following	0	No. Appendix Sheets Following	0

Background

Reactive powder concrete (RPC) is an all fines concrete developing compressive strength in excess of 160MPa. When combined with steel fines, direct tensile strength in excess of 12MPa and a flexural strength in excess of 30MPa are possible. Prestressed concrete components made with RPC can be less than one third the maximum of conventional concrete and are of comparable mass to similar steel components.

RPC concrete also has extremely low porosity and permeability, high resistance to chloride and sulphate attack, and high bond strength for both pre-tensioned and un-tensioned reinforcement. The high bond strength reduces bond length for un-tensioned and pre-tensioned reinforcements, and also reduces the transfer length for pre-tensioned reinforcement.

Bouyges of France was the first to develop RPC as a construction material.

Over the past 5 years, the RTA, VSL Australia and UNSW have developed and tested procedures for the design and construction of bridges and related road structure from RPC. VSL developed a RPC using Australian concrete materials, marketed as 'Ductal'.

Until 2004, the only bridge structures built using RPC were pedestrian bridges. As part of the development work, in 2003 and 2004 the UNSW, RTA and VSL designed and constructed the first road bridge at Shepherds Creek, Valentine. This bridge used 'Ductal' in the pre-tensioned concrete beams and permanent formwork for the deck slabs.

Load testing of the bridge showed that the superstructure performed linear-elastically up to 1.5 times the serviceability load, and at this loading level there were no observable permanent effects.

When considered with additional testing at UNSW, the project demonstrates that:

1) Properly designed shear connectors will transmit very high shear forces;

2) Precast deck systems as thin as 80mm can be designed to resist a 140kN axle load with full shear transfer between supporting beams and precast panels;

3) The design method contained in the VSL design manual for 'Ductal' are suitable for use generally in RTA civil structures.

Australian Army tests show that 'Ductal' has very high blast resistance.

A specification for the use of 'Ductal' has been prepared.

Other Issues

At present, owing to the volume of work, and also owing to the high cementitious component, 'Ductal' is relatively expensive when compare to ordinary concretes. However, in cases where low mass and high durability are critical issues, 'Ductal' may be cost competitive.

As 'Ductal' is fibre reinforced, fine fibres are often apparent at the un-formed surface and usually this surface is not exposed. Where there is a risk of someone rubbing along the surface, a coating must be applied to prevent injury.

Other features of 'Ductal'

'Ductal' is highly resistant to blast and impact. As such, it is suitable for blast walls and noise walls impact risk is high.

Policy

Designers may use 'Ductal' in future RTA bridge works and noise walls. Design must be in accordance with the VSL design manual dated 19 March 2003 and the specification 'Ductal' works for bridges held by Manager, Bridge Specification & Rehabilitation.

Design for blast resistant structures must be based on VSL recommendations and must be reviewed by Manager, Bridge Policies, Standards & Records.

All project managers and designers for rehabilitation projects should consider 'Ductal' when evaluating options for strengthening or replacing superstructures.

Gordon Chirgwin
Manager Bridge Policies, Standards & Records
8 September 2005

Note: 'Ductal' is a registered trademark of VSL Australia.

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