ptNEWS

Newsletter 2 - 2012

Post-Tensioning Institute of Australia Limited

President's Report

Welcome to another edition of the PTIA newsletter. With this issue I would like to update members on issues PTIA is working on at the moment.

Sustainability issues relating to post-tensioned construction

PT undoubtedly reduces materials, labour and other aspects of a building during construction, but it does not receive the credits it should be awarded when it comes to sustainability rating of buildings. The PTIA board and interested parties in PTIA are moving to attempt to correct this inequity.

PTIA has engaged specialists company Engineered Material Solutions Pty Ltd (EMS) to develop a framework for evaluation of sustainability benefits of PT in building construction with a view to have PT more favourably assessed.

We have requested EMS proceed with a three phase project for PTIA.

- Look at where post-tensioning is now positioned within the sustainability framework and where it might be reassessed.
- Liaise and interact with the Green Building Council of Australia and other parties in the sustainability areas to look at where we might be able to move forward.
- Look into design modelling and positioning of PT in Green Star and other environmental specifications.

For this project work a team lead by Board Member and Technical Director Andrew Castle is handling the PTIA end of discussions. Any assistance members can give to Mr Castle would be greatly appreciated.

We will report on progress we do make in this regard in future newsletters.

You will find an abridged version of "Optimising Building Design for Sustainability using High Performance Concrete" by Jenkins, Baweja and Portella in this newsletter.

PTIA Guidance Notes

We are now focused on developing technical and operational information for PT design and construction.

A new series of Guidance Notes will be published and can be downloaded from the PTIA website.

The first in this series are:

- Barricade construction suitable for mono strand stressing.
- Safe stressing procedures for mono strand post-tensioning.
- Safe stressing for multi strand post-tensioning.
- Process for forming new penetration through post-tensioning slabs.

Future categories will address PT design aspects and revision of some PT concrete specifications.

CCAA/PTIA Joint Working Group

PTIA and Cement Concrete & Aggregates Australia formed a joint working group in 2011.

This group in currently examining PT Concrete Strength specification and Bond Strength in relationship to compressive strength of the concrete. A topic the group will also look into is the PT concrete specification in relation to Green Star requirements.

The Institute continues to gain strength and is actively seeking new members who may contribute to and benefit from the services we do with to offer.

Members are encouraged to seek out interested parties who may want to join the Institute and put them in touch with us.

Michael O'Neill, President


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Safe Stressing – Multi Strand System

New PTIA Technical Publications

PTIA is developing a series of Guidance Notes which will provide technical, safety and operational information in relation to Post-tensioning. The first of these – Safe Stressing Mono-strand Post-tensioning, Safe Stressing Multi Strand System, Barricade Construction for Mono-strand Stressing – can be found on our website. New publications will be added progressively to the website.

Contents

Westfield Fountain Gate Project

Location: *Narre Warren, Fountain Gate Shopping Centre, Victoria*
Client: *Westfield*
Contractor: *Caelli Constructions*
Post-tensioning contractor: *Australian Post Tensioning*

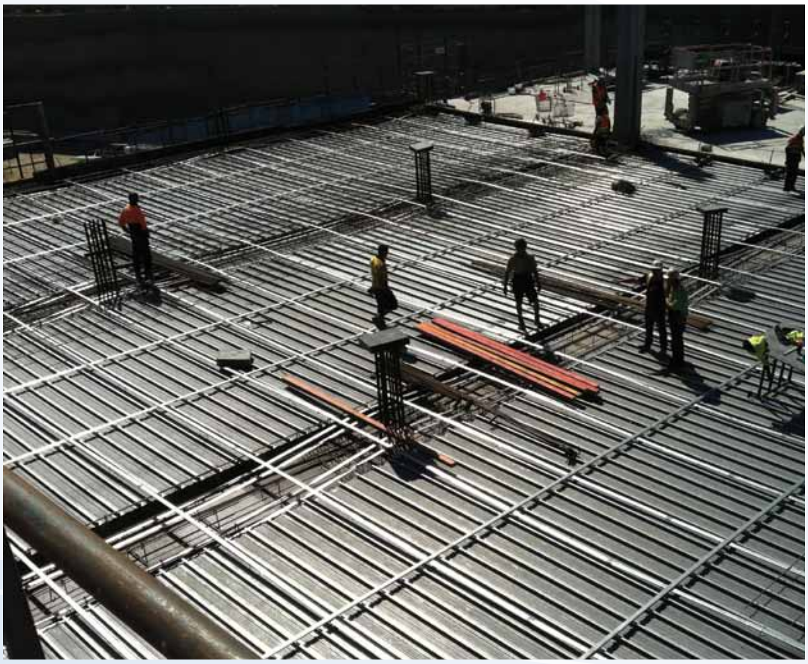
Westfield Fountain Gate, as one of Melbourne's largest retail shopping centres, underwent a massive 60,000 square metre extension to its retail space and car park

The centre is undergoing a major redevelopment to meet the needs of a growing population. It will feature an enhanced fashion offering, an exciting new 'market' food precinct and a look to rival Melbourne's most stylish shopping destinations. The revamped Westfield Fountain Gate is on track to open to the Public on Thursday 17 May 2012.

As the post-tensioning contractor on the project, AusPT's involvement consisted of three levels of suspended post-tensioned floors for various retail and car park occupancy.

The entire extension consisted of 84 concrete pours. In total, 351 tonnes of OneSteel 12.7mm diameter strand was installed. Each pour took an average of two days to complete with a labour force of 4-6 men per pour. With thanks to AusPT, Caelli Constructions and V & G Concrete the structure was handed over earlier than forecast completion date.

"The entire extension consisted of 84 concrete pours."



Due to a flawless delivery of the project, Westfield is an extremely satisfied client.

Optimising Building Design for Sustainability using High Performance Concrete

Doug Jenkins[1], Daksh Baweja[2] and Joanne Portella[3]

1.Principal, Interactive Design Services;
2. Associate Professor, University of Technology, Sydney;
3.Specialist Consultant, DMC Advisory, Melbourne

1. Introduction

This is a summary of a paper presented at the Concrete 2011 Conference which examined the effect of concrete strength and construction systems on the design of a typical flat slab structure, comparing different strength grades used with both reinforced and post-tensioned in-situ concrete construction.

The paper arose from the need to reduce CO_2 emissions in all parts of the building cycle, which has seen a push to use reduced cement contents in concretes and an increased use of supplementary cementitious materials in building construction. The roles of supplementary cementitious materials on concrete performance, whilst well understood, are not clearly defined in a sustainability context in building construction. In addition, a new Australian Standard for General Purpose and Blended Cements has recently been published with additional constituents allowed for in the broad definition of GP cement and other cement categories, and The Green Building Council of Australia has recently published a proposed revised concrete materials credit that will in future form part of its published Green Star specification for residential and commercial buildings. Both of these initiatives focus on the reduction of cement content, rather than total material requirements and related emissions.

Whilst these developments are welcomed, there has been little examination of the potential interaction between cement content, binder composition, binder content, concrete strength, other mechanical and serviceability properties of concrete, required constructional properties and the total material usage in typical building structures. The paper examined the opportunities for improved sustainability through the use of high performance concrete combined with post-tensioning in building construction, considering the use of existing typical designs, and modified designs optimised for higher strength grades or other critical concrete performance parameters. These alternatives were compared for impact on life-cycle resource requirements, CO_2 emissions, durability, and constructability, within the context of current Australian building design and construction practice. The paper found that post-tensioned construction used in conjunction with high strength concrete offered the potential for significant reductions in CO_2 emissions, compared with systems with a lower nominal cement content.

2. Details of study

Key design features of the structure studied were as follows:

- Three x four span flat slab building floor structure supported on square columns,
- Span arrangement: 4 x 7.5m longitudinal, 7.5 m, 9.0 m, 7.5 m transverse,
- 2.5 x 2.5 m drop panels over 400 mm square columns,
- Design to AS 3600 and loading to AS 1170.1 with 3 kPa live load,
- Typical Sydney shrinkage and creep parameters, and
- Exposure Classification A2 as defined in AS3600 Section 4 on Design for Durability

Two alternative structural configurations were considered as follows:

- Type 1 – Reinforced concrete flat slab.
- Type 2 - Post-tensioned concrete flat slab.

The following concrete mixes were evaluated in this study:

A. Reference case: 25 MPa characteristic compressive strength using Portland cement alone,
B. Typical current standard structural concrete; strength of 25 MPa incorporating SCMs,
C. Typical prestressed concrete with strength of 40 MPa required for post-tensioned construction.
D. Typical high strength concrete having a characteristic compressive strength of 65 MPa,
E. High SCM concrete having a characteristic compressive strength of 40 MPa.

3. Analysis and Design Procedures

3.1 Structural Analysis

The structures were designed to the simplified method given in AS 3600, and checked using the equivalent frame method, following the procedures given in Warner et. al. Prestressing strand was provided to balance approximately 85% of the structure self-weight, and was checked to ensure compliance with the Code requirements for the Ultimate and Serviceability Limit States. Slab deflections were checked with a non-linear finite element analysis, using a moment-curvature relationship taking account of cracking, tension stiffening, loss of tension stiffening, creep and shrinkage.

3.2 Concrete Emissions Analysis

Component emission factors used to calculate embodied energy of concrete were taken from other studies conducted on concrete materials. Concrete mix emissions for alternative mix designs A to E were calculated using predetermined concrete emission factors for each of the concrete constituents. An allowance of 5% of the Portland Cement content as mineral additions and or minor additional constituents was made for the purpose of these calculations, though the recently published new edition of AS3972 (General Purpose and Blended Cement) has increased this allowance to 7.5%.

4. Conclusions

The following conclusions were drawn from the study:-

The use of high strength concrete can result in efficient solutions for sustainable construction on building projects using both reinforced concrete design and post-tensioned concrete design. The use of post-tensioning allowed much greater potential for reduction in concrete and steel quantities, providing significant reductions in CO_2 emissions, compared with both the base case and high SCM reinforced concrete designs..

Tools are available to determine with reasonable accuracy the embodied energy involved in producing and supplying a cubic metre of concrete.

Supplementary cementitious materials can be efficiently used to produce concretes that have appropriate design and construction characteristics required for building projects.

The simple reduction of Portland cement content in a concrete mix, by whatever means, will not necessarily result in an efficient design and thus in an efficient environmental outcome.

The analysis showed that using higher strength concretes having more Portland cement than would be used on other design options resulted in more efficient design options with respect to favourable environmental outcomes, both through the reduction in the total volume of concrete and a reduction in total steel quantities.

The use of a high SCM content in association with a prestressed, post-tensioned design may require changes to current construction practices, particularly at the stage of initial stressing, and the choice of optimum system will require review of the effects on the construction programme and cost, as well as direct materials emissions and costs.

For floor slabs in the span range examined in this study or greater, the use of a relatively high strength, high SCM concrete, in conjunction with post-tensioning, is likely to result in substantially greater reductions in total emissions than can be achieved by focussing on reduction of cement content alone.

In addition to the reduction in CO_2 emissions, the use of a post-tensioned concrete design for slabs in this span range also had other benefits including reduced construction depth, greatly reduced long term deflections and reduced flexural cracking, which should also be taken into account in the choice of structural system.

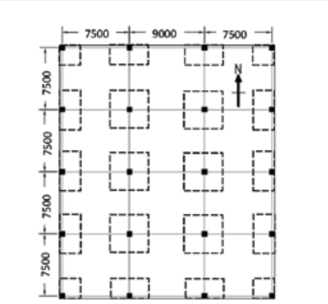


Figure 1, Flat Slab Layout

Planning should include mackup concrete supply, setup location(s) for pumps, pour directions, access and egress of concrete and other trucks, and ventilation for internal slabs.

Finishing Large Area Pours

Finishes for internal slabs such as burnished (sometimes colloquially called 'burnt') are functionally and aesthetically attractive to clients.

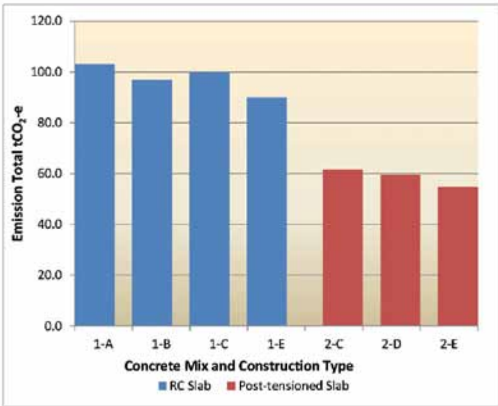


Figure 2: Embodied Energy (CO_2 Emissions) Derived from The Design and Concrete Materials Related Analyses

Protection against Plastic Shrinkage Cracking

The concrete must be protected, during its plastic phase, against premature drying and plastic shrinkage cracking. Plastic shrinkage cracking tends to occur where the evaporation rate exceeds the bleed rate, and is dependent on temperature, wind speed, relative humidity and concrete bleed.

Application of aliphatic alcohol is an easy method to reduce evaporation and prevent plastic shrinkage cracking. It must be applied after the last screed pass, which requires a wand with at least the same reach as the screeding method. This also applies to reinforced concrete slabs.

Curing Concrete

Curing must commence immediately the finishing is complete and there is no bleed water remaining.

Curing will likely need to be applied afternoon, evening or night, and progressively as areas become due.

The practice of applying curing compound at start of normal working hours the day after the pour is likely to be too late in most weather conditions. This also applies to reinforced concrete slabs.

Non-conformances and Unplanned Pour Breaks

The author has experienced non-conformances such as unintentional placement of completely unsuitable concrete. In general the best practice is to 'bite the bullet' and dig out the affected concrete whilst it is still fresh and as soon as possible. This minimise the age difference and differential shrinkage of concrete. This solution is also the fastest.

Even with a backup concrete plant, backup equipment on site, and foresight, unplanned construction joints may be required. Engineering advice must be sought. This also applies to reinforced concrete slabs.

Slab Sawing for Guidance Systems for Automated Forklifts

In the absence of engineering advice, sawcutting of slabs, e.g. for installing guidance systems for forklifts, must not be permitted.

These systems need to be conceived, co-ordinated and designed for in advance. This also applies to reinforced concrete slabs.

Australian Post-tensioning
New Corporate member

Australian Post-Tensioning Pty. Ltd. was established in July 2010. We operate predominantly in Victoria and have expanded our business to South Australia. The business provides post-tensioning engineering, design, supply and remedial services.

It specialises in the structural and civil sectors within the Construction Industry and provides solutions across a wide range of post-tensioning activities. In a 20 month period we have listed 60 projects and have successfully completed 35 of these projects with no lost time injuries, no environmental issues and extremely satisfied clients.

Australian Post-Tensioning employees have several years' experience in the Post-tensioning Industry. Each employee's level of experience is varied and is vital to the success to AusPT. We run an in-house design team comprising engineers and draftsmen. As well as dedicated on site employees, we also pride ourselves in our Occupational Health and Safety, and are establishing a solid OH & S system and committee.

Certificate III in post-tensioning

CPSIC is currently seeking stakeholder feedback regarding the proposed Units of Competency for a new Certificate III in Post-tensioning. It is hoped that this qualification will be finalised and approved in the coming months.

Once this qualification has been approved, to achieve this qualification the candidate must demonstrate competency in 18 units consisting of 12 core units and six elective units shown below.

Core units	
CPCCCM1012A	Work effectively and sustainably in the construction industry
CPCCCM1014A	Conduct workplace communication
CPCCCM1015A	Carry out measurements and calculations
CPCCCM2001A	Read and interpret plans and specifications
CPCCCM2004A	Handle construction materials
CPCCCM2010A	Work safely at heights
CPCCCM2005A	Use construction tools and equipment
CPCCOHS2001A	Apply OHS requirements, policies and procedures in the construction industry
CPCCSF2002A	Use steelfixing tools and equipment
CPCCSF3002A	Carry out monostrand post-tensioning
CPCCSF3003A	Carry out multistrand post-tensioning
CPCCSF3004A	Carry out stressbar post-tensioning

Elective units	
CPCCCO3026A	Carry out repair and rectification of concrete
CPCCCM2008A	Erect and dismantle restricted height scaffolding
CPCCCM3001B	Operate elevated work platforms
CPCCCO2014A	Carry out concrete work
CPCCSF2005A	Arc weld reinforcement steel
CPCCSF2007A	Splice and anchor using mechanical methods
CPCPCM2033A	Weld using arc welding equipment
CPCPCM4001A	Carry out work based risk control processes
RIICFW302A	Install temporary and permanent rock anchors
RIIOHS202A	Enter and work in confined spaces

Training Course Schedule

Enquiries and applications for all courses should be directed to:
PTIA at info@ptia.org.au

Courses will be run on demand when a minimum of 12 people have registered. Details are shown on the PTIA web site.

Enquiries and applications for all courses should be directed to PTIA at ptia.org.au

Course	Non- Member fee	PTIA Member fee
Skills Training & Assessment course		
• Mono Strand (CPCCSF3002A)	$1,100.00	$550.00
• Multi Strand (CPCCSF3003A)	$1,100.00	$550.00
• Stress Bar (CPCCSF3004A)	$1,100.00	$550.00
RPL assessment	$935.00	$467.50
Short course in PT including White Card	$484.00	$242.00

Skills Training & Assessment courses will be conducted in –

- Melbourne between 11 & 15 June 2012
- Sydney between 13 & 17 August 2012

A minimum of twelve people is required to conduct a course.

Member Companies

Corporate Members

Australian Post-Tensioning Pty Ltd
Australian Prestressing Services Pty Ltd (founding member)
Structural Systems Pty Ltd (founding member)
VSL Australia Pty Ltd (founding member)

Associate Members – suppliers

Ajax Foundry Pty Ltd
Ancon Building Products
Haggie Reid Pty Ltd
Holcim (Australia) Pty Ltd
OneSteel Wire Pty Ltd
Refobar Australia
Severs Technical Systems Pty Ltd

Associate Members – consulting engineers

ABC Consultants
Arup
Bornhorst + Ward Pty Ltd
Costin Roe Consulting Pty Ltd
Hyder Consulting Pty Ltd
McVeigh Consultants Pty Ltd
Parsons Brinkerhoff
SCP Consulting Pty Ltd
Taylor Thomson Whitting

"ENSURING EXCELLENCE AND ACCREDITATION FOR THE POST-TENSIONING INDUSTRY"

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