ptNEWS

Newsletter 3 - 2010

POST-TENSIONING INSTITUTE OF AUSTRALIA LIMITED

PTIA Web Site Upgraded

PTIA web site – www.ptia.org.au – has recently been upgraded and updated. This upgrade provides management tools to make changes and additions more easily.

The next stage of the upgrade will provide for a more complete listing of all PTIA and other courses and events, and this will also be more easily kept up to date. Courses and Events have been removed from this Newsletter as readers will be able to obtain more up to date information from the web site in future.

President's Report

This newsletter has an emphasis on aspects of prestress design. One of PTIA's platforms for improvement in the industry is the emphasis on safe and economical design for the PT industry. PTIA members are expected to be at the forefront of upholding the highest standards in this regard.

The new AS3600 has been introduced and there are implications for PT structures as detailed in our report on page 3.

The PTIA Technical committee has been looking into any specific changes that may occur in our industry as a result of the new code and any comments from the industry would be welcomed by the Technical committee.

We have recently redesigned, upgraded and updated our website. This new site will give us more opportunities to distribute data to members. A second stage development in August will enable us to keep you up to date with courses and seminars. Members are asked to check their company information and links on the site and advise us of any changes required.

PTIA site training programs are continuing and we have now signed a national agreement with CSTC to strengthen our national training image.

CSTC is a Registered Training Organisation, so all training will now be nationally recognised.

Brad Parkinson from Structural Systems is coordinating the training program. Please contact Brad for information – BradP@structural.com.au. We are seeking official recognition of our training program from WorkCover and other authorities, and expect to make some progress in this area in the coming months.

PTIA is also conducting a number of seminars in conjunction with Concrete Institute state branches, with seminars in Melbourne and Hobart recently completed. Presentations from past seminars will be shown on our web site.

The post-tensioning industry continues to slowly recover in Australia where we are seeing strong activity in the southern states and some more projects coming up in the northern area. The year 2010 will continue to be tough for all and it is in these times that support for and by PTIA will improve the industry.

Michael O'Neill,
President

Project Report

University of Sydney – Faculty of Law Building

Location: *Sydney, NSW*
Client: *University of Sydney*
Contractor: *Baulderstone*
Post-tensioning contractor: *Structural Systems Limited*
Consultant: *Taylor Thompson Whitting*

Top: Podium with light tower and faculty building.
Above: The Law Library.
Right: The Law Faculty Building

The Faculty of Law and the University made the decision to return the faculty to the campus from its previous home amongst the law precinct in the city. The client had a need to distinguish this law faculty from other schools and it therefore required a design that was iconic, unique and appropriate for its environment.

An international design competition was held which was won by leading architectural firm FJMT. Taylor Thomson Whitting (TTW) won the structural and civil engineering design components. The project was procured under a traditional tender with the design team fully documenting the project. Baulderstone won the main contract and they engaged Structural Systems to install the post tensioning.

The Faculty of Law building comprises teaching spaces both above a podium in the triangular building and below where they are easily accessible from Eastern Avenue. Academic offices occupy the linear building adjacent to Victoria Park which is separated into a north and south tower by a four storey cable stayed bridge . The Law Library is situated below the podium and a glazed tower extends from its reading room through the podium. Occupying the lower 2 levels below the library of the excavated building is car parking for the university. The building forms part of an integrated public space connecting Victoria Park to the university's new pedestrian precinct.

Given the unusual design and geometry of the buildings and a need to keep structural depths and excavation to a minimum a post tensioned floor system was adopted throughout. Due to the irregular shapes of some of the floors the design, documentation and the construction was very complex. Post tensioning ducts, in some areas, overlapped each other in three different directions.

The library, with its open floor plan and being situated below the sloped podium, called for a structure that was shallow, free of columns and a profile that could follow the external terrain. The library roof structure was designed as cranked post tensioned beams, which span 20 metres, with the post tensioning cables overlapping where the structure changes direction. Again, a post tensioned structure was adopted to maximise headroom in the library.

The faculty bridge is a four storey cable stayed structure with post tensioned floors and structural steel rods and columns. Transfer of load of the bridge from temporary support to the permanent supports required the bridge to be hydraulically jacked to ensure floor tolerances were maintained and a smooth transfer of load.

The law faculty have been occupying the new building for over a year and it has been very well received by the users.

AS 3600-2009 Changes which affect PT design

This article describes some of the key changes in the new edition of AS3600 **Concrete Structures** published in December 2009 that affect the design of post-tensioned floors. The current BCA 2010 still references the previous edition of AS3600 however it is expected the next issue of the BCA in May 2011 will reference AS300 – 2009.

Fire Resistance

The changes in Section 5 of AS3600 – 2009 **Design for Fire Resistance** are based on the Eurocode and did not appear in the draft of the Standard. Clause 5.5.2 **Structural adequacy for slabs** has a new requirement of minimum slab thickness for the structural adequacy for flat slabs and flat plates which requires a 200mm minimum slab thickness to achieve a fire resistance period (FRP) of 90 to 240 minutes. However for **Structural adequacy** there is no minimum slab thickness requirement for "solid or hollow-core slabs supported on beams or walls".

Designers will need to assess which category banded slabs fit into and specify appropriate slab thicknesses. For further background refer to the paper by Kelly and Purkiss *Reinforced concrete structures in fire: a review of current rules* in The Structural Engineer 7 October 2008.

There is also a new requirement in AS3600 – 2009 just for flat slabs and flat plates for at least 20% of the total top reinforcement in each direction to be continuous over the full span and placed in the column strip. The concrete cover requirements in AS3600 – 2009 remain basically unchanged.

These new requirements will make a significant change to the design of two-way post-tensioned slabs. However there are errors in the section for fire resistance for columns so there may be amendments issued to Section 5 in the near future.

Pattern Loadings

The requirements for pattern loadings have been moved from the **Methods of Structural Analysis** section to Section 2. Clause 2.4.4 requires variable arrangements of live load to be considered, regardless of the method of analysis used.

Crack Control

The new Clause 9.4.2 **Crack control for flexure in prestressed slabs** has reduced the minimum bar spacing for crack control reinforcement from 500mm to the lesser of 300mm or 2 times the slab thickness.

Shrinkage, Cracking & Restraint: What comes First?

The Concrete Institute of Australia recently held a national seminar on ***'Shrinkage, Cracking, & Restraint: What Comes First'***. This series of seminars was proudly supported by the Post-tensioning Institute of Australia (PTIA), Cement Concrete and Aggregates Australia as well as Engineers Australia. The PTIA provided various speakers to enlighten the audience on the effects associated with post-tensioning and what recommendations can be put in place to optimize designs and construction of PT floors.

The range of topics presented was:

Design of individual PT structural elements

- Careful approach must be taken by the post-tensioning designer at tender stage to highlight the potential problems that may arise when combining post-tensioning with other structural elements.
- Consultants and Builders need to consider the advice given by post-tensioning contractors and work together to achieve a feasible solution.
- The post-tensioning designer must take into consideration the commercial expectations of the builder.
- Minimum levels of post-tensioning (P/A) and reinforcement affecting the degree of crack control for shrinkage and temperature.
- Shrinkage limits & restraint.

CONT/ PG 4

Adnec Capital Gate Tower – Abu-Dhabi

The 35 floor Adnec Capital Gate is the latest in a line of iconic buildings to be completed in the capital of the U.A.E. Abu-Dhabi.

It has a built up area of 50,000 m^2. The building leans at 18 degrees, nearly five times more than the leaning Tower of Pisa. The building is balanced with a series of post-tensioned bars in the raft and vertical multi-strand cables in the core.

The Post-Tensioning was supplied and installed by VSL Middle East.

SHRINKAGE CONT/...

Restraint by vertical elements leading to cracks in floor systems

- Consideration of retention systems and how it may impact the performance of the post-tensioned slab
- Location of shear walls and cores and the need to possibly introduce permanent/temporary movement joints
- Are there block walls on the project and if so what connection detail must be considered?
- All of the above items need careful detailing and accurate construction methods for this system to be effective

Implications for watertight concrete slabs

- Emphasise that "watertight" slabs does not mean "waterproof". Reliance on the post-tensioning alone will not provide the solution. Additional top mesh and waterproof membranes need to be considered where possible
- It is often the case when the client perceives the slab to be waterproof with no additional work to assist in its performance
- Minimising restraint is critical in achieving a watertight slab
- Correct curing techniques to eliminate early age and plastic shrinkage cracking

The future?

- Consulting Engineers need to understand and consider restraint
- Movement joints (temporary/permanent) need to be considered at architectural concept stage
- Codes need to consider what PT / Reinforcement proportions are required (after restraint)
- The PT industry needs to understand what is important in "mix design" to minimise early shrinkage
- Is a limit on 56 day shrinkage relevant?
- Who takes responsibility for early cracking?

The following points summarise some of the key issues to be considered when designing post-tensioned floors for restraint. This is only a guide and it is up to the interpretation of the designer to produce a design that is fit for purpose:

- Slabs shall be designed for moderate degree of crack control in the primary direction. This may be between 1.0MPa and 1.4MPa. The secondary direction may be designed for 1.0MPa. Watertight slabs require a high degree of crack control (say 2.0MPa)
- Typical nominal shrinkage limits are between 700 and 800 microstrain
- Be aware of geometry of slab and make allowances for any obvious changes in geometry
- Introduce movement joints when the slab length exceeds 50m
- Isolate restraining elements only when required
- Assist the client when deciding on details for movement and isolation joints. This is particularly important because the costs associated with these works are not identified early by those who are unaware of PT designed structures
- If the designer is using passive reinforcement and allowing the slab to restrain then the reinforcement allowances are very important when tendering
- Consideration must be given when the concrete supplier is adding in admixtures and other constituents (i.e. fly ash, accelerants and retardants)

MEMBER COMPANIES

Corporate Members

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
Haggie Reid Pty Ltd
Holcim (Australia) Pty Ltd
OneSteel Wire Pty Ltd
Refobar Australia
Sanwa Pty Ltd
Severs Technical Systems Pty Ltd
Usha Martin Australia 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
SCP Consulting Pty Ltd
Taylor Thomson Whitting

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