ptNEWS
Newsletter 2 - 2011

President's Report

There are signs of recovery and improved activity in the Post-tensioning industry around Australia. We may be entering a period of optimistic growth after a long financial slow down.

Developers in the country have renewed confidence and PTIA Members are seeing new projects coming on stream each month.

The year ahead appears to be a positive one particularly for those associated with building projects. PTIA continues to drive forward with its policies and projects, seeking assistance from members in areas where their expertise is useful to the Institute's members.

Sustainability

PTIA is committed to fostering a reduction in greenhouse gas emissions and an overall reduction in global warming from the construction industry. In building construction, post-tensioning offers substantial improvements because of the reduced volumes of concrete and reinforcing steel required. Unfortunately, this aspect isn't recognised in current rating schemes used in Australia.

Current rating tools from the Green Building Council give credit points where the Portland cement content in concrete is reduced through using supplementary cementitious materials by 30% and 40%. It doesn't recognise that Portland cement content used in a building can also be reduced by using less concrete overall, as is the case with post-tensioned structures.

PTIA is organising PT Industry Information Forums and invites discussion on various topics. Our first forum will address the issue of sustainable building construction. General industry forums and specific forums for consulting engineers are planned. Comments on the aspects people and organisations would like discussed are welcome. Please send suggestions to info@ptia.org.au.

Another area PTIA continues to strive for improvement in is training. We see the need for training at site level, and also at design and implementation levels.

After many years of hard work and considerable financial investment, PTIA is pleased to announce operative training is now available across Australia for mono strand, multi strand and stressed bar post-tensioning. Training is recognised as elective units within CPC31108 Certificate III in Steel Fixing.

PTIA has a submission before the Construction and Property Services Industry Skills Council recommending a Certificate III in Post-Tensioning rather than including PT in the Certificate III in Steel Fixing. A favourable initial response has been received.

Training in these units is now available through PTIA, or CSTC in Queensland (see the article in this issue). From 1 July, PTIA will also be offering a one-day course in PT for engineers, project managers, safety officers, union officials and work-experience students. This course will include an option to complete the "Construction Industry Induction" course earning the White Card.

Our website will be upgraded soon to include details of these courses and how to apply for them. Enquiries? Please email us at info@ptia.org.au.

When is comes to design of post-tensioning there seems to be a shortage of structural engineers with detailing experience in PT. PTIA will introduce this year, training sessions to assist structural engineers with particular emphasis on economical PT designs and practical detailing.

Michael O'Neill
President

PTIA to hold industry forums

PTIA is planning a series of industry forums to present and discuss topical issues related to post-tensioning. One of these forums will be directed to consulting engineers to present and consider aspect of the revised AS3600 and its impact on PT designs. Another will be aimed at a wider industry audience to examine aspects of sustainability and post-tensioning.

These events will commence in Sydney in May and June, with the intention to repeat them in other states subsequently.

PTIA members interested in participating in these events, or wishing to raise topics for discussion, should email PTIA on ptia.org.au .

Charlestown Square Redevelopment

Location: *Charlestown NSW*
Client: *GPT Group*
Contractor: *Bovis Lend Lease*
Post-tensioning contractor: *Structural Systems Limited*
Post-tensioning strand supplier: *OneSteel Limited*
Consultant: *Taylor Thomson Whitting*

The $350M Charlestown Square Redevelopment has resulted in one of the largest shopping centres in the Hunter Region and incorporates new community facilities and a civic piazza. Energy efficient measures have been introduced in the form of a solar thermal cooling plant, a large co-generation plant, green areas and water and energy efficiency measures. The concrete mix for the PT floor slabs incorporated 25% fly ash (a natural waste product in the Hunter) with no significant problems in regards to anchor failures.

Post-tensioned band beams and slabs were used for the extension of the shopping centre which covered a built area of about 200m by 200m. A typical grid of 8.7m by 10.8m was adopted for most of the new retail and car parking floors.

Innovative techniques were used in the design of the structure for mine subsidence which resulted in substantial savings in both cost and construction time. 3D models of the super-structure, sub-structure and subgrade material were prepared to enable a precise analysis of the effects of the predicted mine subsidence, earthquake, post-tensioning and concrete shrinkage. Permanent building joints were located approximately 100m apart and the 3D models were used to locate areas of high tension in the floor plates. This resulted in an economical and conventional PT design that allowed for the effects of mine subsidence.

"...This resulted in an economical and conventional PT design that allowed for the effects of mine subsidence."

A key driver of the design was the need for the Centre to remain trading through the 30 months of construction. Several of the PT decks were designed to support the full weight of the 'wet' deck above resulting in no back-propping being required and the early opening of car parking areas. Careful attention was paid to the design of new car park areas to provide an improved experience for the shoppers. One such detail was to avoid a patchwork of top stressing pockets by forming a continuous 75mm deep rebate in the top of the slab where live anchors were located. The Redevelopment of Charlestown Square was opened for trading in November 2010.

Most of these topics are not peculiar to post-tensioned concrete pavements, but are included for completeness.

Geotechnical Investigation, Site Selection and Subgrade

A geotechnical engineer needs to be involved in the site investigation, and in the quality assurance and certification of the project. This also applies to reinforced concrete slabs.

Internal Pavements: Before or After the Roof?

Construction of internal slabs under roof and with walls to shield from weather yields the following benefits and reduced risks:

- usually improves the critical path for the project;
- removes possibility of rain, hail or similar damage to the subgrade and especially the fresh concrete surface;
- allows better quality and tolerance of finish including burnished finish;
- removes differential concrete drying due to sunlight exposure, which improves consistency during placing and compaction and improves consistency of finish.

Unless there is a compelling reason to do otherwise, internal concrete pavements should be constructed under roof. Adequate ventilation and release of vehicle fumes must be planned for.

This also applies to reinforced concrete slabs.

Subgrade shaping and water damage

The final cut of the subgrade is normally undertaken just before the sand layer is placed.

If the roof is complete before the final cut of the subgrade, this will largely eliminate risk of water damage to the final subgrade shape. Subgrade shape must take into account the required sand layer thickness; any deviance should err on the side of a slight increase in the thickness of the sand layer.

In accordance with the geotechnical report, the subgrade must be protected from rain, stormwater or similar damage. If water does affect the subgrade, geotechnical advice must be promptly sought and complied with. This also applies to reinforced concrete slabs.

In Ground Services and Compaction of Backfill

Geotechnical advice must be sought and complied with for all fill including backfilling of service trenches. This also applies to reinforced concrete slabs.

Superflat?

At an early stage of procurement, the degree of flatness and the acceptance criteria must be specified.

External pavements generally do not need superflat tolerances, and external pavements and pavements used by road trucks only do not require superflat tolerances. Internal pavements are often specified as superflat in case of future lease to a tenant who desires same. This also applies to reinforced concrete slabs.

Sand Layer and Equivalent Materials

Permission for any substitution must be sought from the party responsible for the design, but many projects have successfully used crusher dust instead of sand for post-tensioned concrete pavements.

Surface level tolerances are critical to achieving correct slab thickness, especially as most slabs are poured to a level or a slope. A check survey must be undertaken before each pour. This also applies to reinforced concrete slabs. Refer notes in accompanying article about friction and number of layers of polythene.

Joints and Maximum Slab Size

In order to maximize the cost effectiveness of the PT system, tendon lengths should be as long as practically possible. On the other hand longer slabs/tendons incur larger duct friction loss and more subgrade friction which leads to more strands being required to achieve the same P/A or load capacity.

Experience and current industry capability suggest pour sizes of between 1500 and 2500 m2 can readily be undertaken without too much difficulty. Larger pours up to almost 6000 m2 have also been successfully achieved using PT.

Edge Formwork – Timber or Proprietary Steel?

Edge and internal blockout formwork is usually generic timber or proprietary permanent steel forms.

Proprietary steel forms are available with proprietary support systems. For movement joints they can incorporate a built-in edge protection for the slab. Proprietary permanent steel forms are detailed to accommodate the post-tensioning anchorages, the manufacturers are accustomed to this.

Temporary edge forms must be stripped in time to allow initial stressing, this can be as early as the evening of the pour, to help counteract early shrinkage cracking.

Reinforced concrete pavements have a much larger total length of joints required, this makes it expensive to armour their joints, and this causes higher maintenance costs.

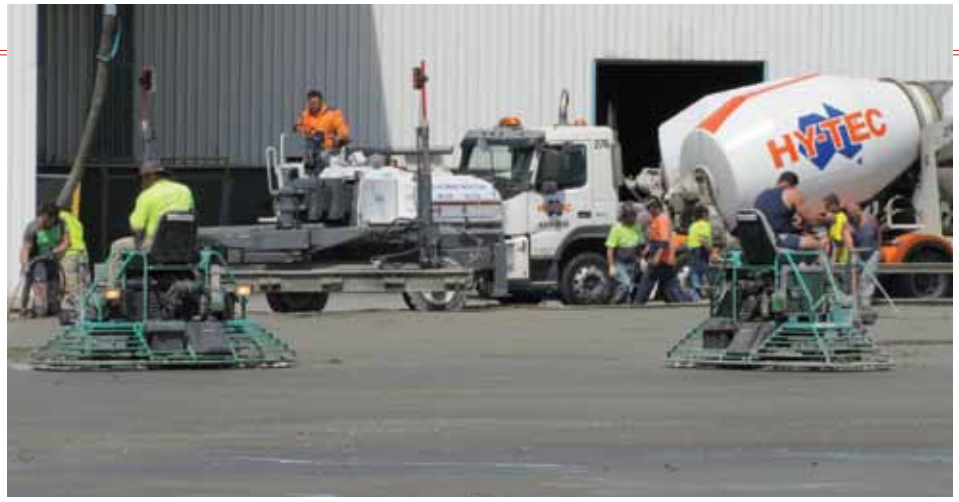
Reinforcement and Accessories

Reinforcement, especially mesh, must be chaired and supported independently of the post-tensioning. If the mesh is not properly chaired and supported, an area of mesh will concentrate the load from several concretors on post-tensioning chairs that are not designed for this load.

All chairs (for reinforcement and for post-tensioning) must be either placed on 'tin lids' or incorporate load spreading bases, such that they do not puncture the plastic or sink into the sand layer.

Dowels & Post-Tensioning Couplers for Construction Joints

Construction joints require post-tensioning couplers to ensure continuity of prestress across the completed slab. In addition, starter reinforcement should be detailed to control local cracking.



Dowels and Joint Covers for Movement Joints

Dowels are required to share load across the joint, these dowels can be round or square steel rods and need to be provided with sleeved covers to allow movement both perpendicular and parallel to the joint.

Standard dowel systems for reinforced concrete slabs are usually not suitable for post-tensioned concrete pavement movement joints, because the wider spaced joints mean larger movements need to be allowed for. A range of suitable products are available from specialist suppliers. Both construction and movement joints are usually thickened, to accommodate the post-tensioning anchorages and usually to provide sufficient strength of the reinforced concrete section parallel to the edge.

Edge Protection for Movement Joints

Historically joint maintenance is a major cost item for pavements of all types, and post-tensioned concrete pavements offer the major benefit of a large reduction in total length of movement joint (MJ). On some projects, most of the movement joints can be located under the racking, further reducing the length exposed to traffic.

Edge protection for internal slabs is done using steel edge angles (black or hot dip galvanised) or epoxy joint systems, which may be proprietary or generic.

Edge protection must be considered as part of the design, and carefully co-ordinated with the required finish and acceptable opening at the movement joints. Edge angles may incorporate a cover plate, the width of which can be adjusted to provide less gap. Hot dip galvanised angles tend to bow, but if fabricated and galvanised in 3m lengths this is controllable and provides for installation tolerance and adjustment.

Epoxy joint systems offer the opportunity to create the epoxy edges after the slabs have undergone a significant part of their shrinkage, so offering a smaller gap. This needs to be carefully evaluated so any thermal expansion can still occur, although this is usually very small for internal slabs.

For slabs trafficked by road trucks, edges of movement joints are coved, the joint sealed to protect against ingress of water, stones or other materials; no edge angles are required. The sealant and installation details need to accommodate the likely gap movements (wider spaced joints mean more movement) and often a periodic (say 2 – 5 year cycle) maintenance replacement strategy is appropriate.

Post-Tensioning

See article in ptNEWS Newsletter 1-2011 titled Post-Tensioned Slab on Ground Design Notes

Pre-pour Engineering Inspection – 'Restraint, restraint, restraint'

The author's experience is that ensuring the slab is free to shrink and move is critical to its performance and to avoid cracking or other restraint damage, and must be a main focus of trade work and of pre-pour inspection. Sources of restraint include:

Inadequate sand thickness – even multiple layers of plastic are inadequate separation between a foundation and the post-tensioned pavement.

Formwork blockouts around columns – these must be released on afternoon or evening of the pour.

Services such a hydrant stand pipes. Any soffit shape that does not have a very gentle slope (about 1 in 20).

Reinforcement tied into walls at edges, or similar (e.g. drainage pits must be isolated from the slab).

Concrete Supply, Placing, Compaction and Finishing

Screeding Large Area Pours

Machines such as Somero screeds have become widely available and standard practice for internal slabs and superflat slabs. They enable a large saving in labour numbers, but experienced operators are essential.

They are often used even where superflat tolerances are not required. Portable aluminium runways are used to bridge over the post-tensioning tendons.

Placing Large Area Pours

Most concrete is pumped. Where there is sufficient headroom, boom pumps with sufficient reach provide the advantage of placing the concrete as near as practical to its final position, with no pump lines to handle.

Pre-mix Concrete Supply to Large Area Pours

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

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Training and assessment of post-tensioning operatives – nationally endorsed qualification

PTIA is most pleased to advise that its Skills Training units are now nationally recognised as elective units within CPC31108 Certificate III in Steel Fixing.

The three elective units are:

- CPCCSF3002A Carry out Mono Strand Post-tensioning
- CPCCSF3003A Carry out Multi Strand Post-tensioning
- CPCCSF3004A Carry out Stress Bar Post-tensioning

For operatives holding a current PTIA Skills Card or with four years or more experience working as a PT operative, they may apply for a Recognition of Prior Learning (RPL) assessment.

"...operatives holding a current PTIA Skills Card or with four years or more experience working as a PT operative...may apply for a Recognition of Prior Learning (RPL) assessment"

For operatives who are new or who have less than four years experience working as a PT operative, they will need to undertake the full training and assessment course for each elective unit.

Training courses and RPL assessments are offered by PTIA in all states expect Queensland. For these courses and assessments contact B Parkinson by email on bradp@structural.com.au. In Queensland, PTIA has an arrangement with CSTC, a Registered Training Organisation, who provide these training courses and assessments. For operatives in Queensland, contact CSTC by telephone on 07 3373 8888.

Training courses will be scheduled on demand and when the minimum class size of 12 has been achieved. For RPL assessments, a time will be arranged for an assessor to visit the sites where the operative is working.

"...operatives who are new or who have less than four years experience working as a PT operative... will need to undertake the full training and assessment course for each elective unit."

Short course in PT for engineers, project managers, safety offices and others working with PT

PTIA is also finalising a one-day course in PT suitable for people working with PT such as, consulting engineers, project managers, safety offices, union officials, students undertaking work experience. The course will also include an option to complete the Construction Industry Induction course, earning the White Card. This course will be available from July 2011 and will be scheduled on demand and when the minimum class size of 12 has been achieved.

Enquiries about this course should be sent by email to info@ptia.org.au

Fees for courses and assessments provided through PTIA are shown in the table below:

Course	Non- Member fee	PTIA Member fee
Skills Training & Assessment course: • Mono Strand (CPCCSF3002A) • Multi Strand (CPCCSF3003A) • Stress Bar (CPCCSF3004A)	 $1,100.00 $1,100.00 $1,100.00	 $550.00 $550.00 $550.00
RPL assessment	$935.00	$467.50
Short course in PT including White Card (from July 2011)	$484.00	$242.00

NATSPEC// Construction Information

PTIA Co-operation with NATSPEC

The PTIA Technical Committee, in co-operation with NATSPEC, recently updated the NATSPEC Concrete Post-tensioned Specification.

Following the review by NATSPEC's independent committee, NATSPEC have adopted a revised Concrete Post-tensioned Specification.

The PTIA recommends the use of the NATSPEC Concrete Post-tensioned Specification.

Finishing Large Area Pours

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

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.

References: "Guide to Concrete Construction" published by Cement Concrete and Aggregates Australia.

Author's note: this publication contains a wealth of practical tried and tested advice on a wide range of concrete matters.

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
Ancon Building Products
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
Parsons Brinkerhoff
SCP Consulting Pty Ltd
Taylor Thomson Whitting

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