The use of lockable dowels at temporary movement joints

(Photo: Children's Health Partnership.)

Construction on the post-tensioned concrete frame of the Royal Children's Hospital, Melbourne.

In Australia, Bovis Lend Lease has installed over 5000 lockable dowels in the post-tensioned concrete frame of the new Royal Children's Hospital in Melbourne. Use of these dowels at temporary movement joints has replaced the need for pour strips and for slabs to be propped, improving site access and allowing services such as cabling, fire-suppression systems and wastewater pipes to be installed without delay. Annabelle Wilson of Ancon Building Products reports.

The new Royal Children's Hospital is the largest hospital redevelopment to be undertaken by the state of Victoria and one of the largest hospital projects in Australia. The project is being delivered under the state's Partnerships Victoria framework by the CHP consortium, which comprises international public partnerships as sponsors, Bovis Lend Lease as contractor, Spotless Group as facilities manager and architects Billard Leece, Bates Smart and HKS (US).

The project will create a 165,000m² hospital facility on seven floors, with an additional 75,000m² of car-parking space on three basement levels. The project will employ up to 2200 construction workers at its peak in the coming months and the concrete structure will use some 280,000m² of formwork.

Accommodating concrete shrinkage

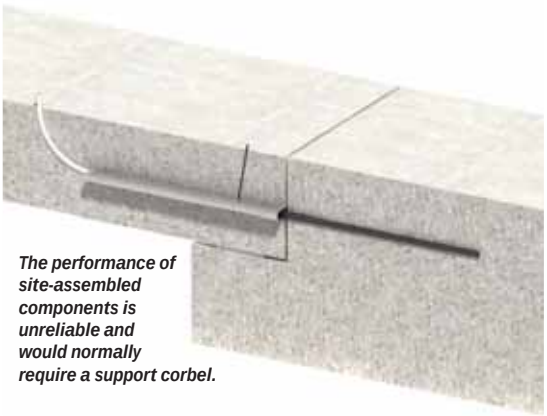
A key design consideration in a post-tensioned concrete structure, where long uninterrupted spans are to be achieved, is the accommodation of normal concrete shrinkage. This is achieved either through the construction of temporary movement joints or by leaving 'pour strips' in the slab; the joint or strip is then filled, typically after 60–120 days, once movement has stabilised to provide the desired continuity in the concrete.

Although commonly used, pour strips are not ideal as they require the slabs to be propped from below. This restricts site access and can delay the installation of building services until the props are removed. Pour strips also create an unnecessary trip hazard for site workers, use additional formwork and leave the soffit face marked.

Traditionally, the construction of temporary movement joints has also been problematic. The diagram below illustrates a typical detail where a carbon steel reinforcing bar is located in a length of galvanised ducting to allow movement at a joint. Once shrinkage has stabilised, grout is pumped through a tube into the unseen ducting below, locking the bar in position to prevent further movement taking place. Unlike a proven dowel system, reinforcement bar does not transfer shear load and a support corbel is required below the slab. It is widely accepted that the performance achieved by these site-assembled components is inconsistent and unreliable. Corbels also require additional time, formwork and concrete to construct.

It was issues with the traditional construction methods, such as those outlined above, which led to the development of the lockable dowel. Although a relatively new concept to the European post-tensioned concrete industry, lockable dowels have been used with great success in Australia since 2007. Their use continues to increase as their benefits over pour strips and corbel-supported movement joints become more widely recognised.

On the new Royal Children's Hospital development, use of the lockable dowel was able to eliminate site delays caused by slab propping and simplify the detailing and construction of the temporary movement joints.



The performance of site-assembled components is unreliable and would normally require a support corbel.

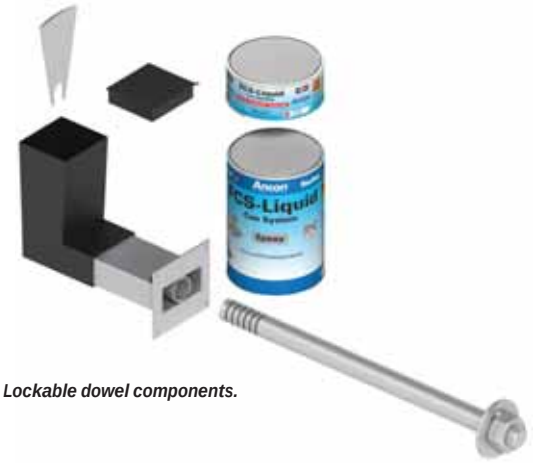
Ancon lockable dowels installed at temporary movement joints on the new Royal Children's Hospital, Melbourne.

Lockable dowels

Dowels transfer load across joints in concrete and are used with a sleeve component where movement is required. Ancon furthered this principle by engineering a shear load connector, which could be locked after an initial phase of movement.

The lockable dowel comprises a stainless steel dowel, a box-section sleeve with an L-shaped void former, a locking plate and 1.5 litres of a two-part epoxy resin. One end of the dowel component is threaded with a nut and washer for additional anchorage and the other features a series of grooves to accept the locking plate.

The dowel and sleeve components allow shrinkage of the concrete to take place; the box-section sleeve allows lateral, longitudinal and some rotational movement to occur in this initial stage.



Lockable dowel components.

After a predetermined time period, generally 60–120 days, when movement has stabilised and the joint has been filled, the dowel is locked in position with the plate and the resin. The void former allows inspection of the dowel before the joint is locked.

The fan-shaped locking plate, which allows the dowel to be locked in any position in the sleeve, is inserted around one of the grooves on the dowel before the controlled amount of epoxy resin is inserted from the top of the slab. The void former is topped with cementitious material to complete the installation.

When locked, the dowel continues to transfer vertical load but further movement is prevented from taking place.

Improving site access

Post-tensioning can create long, clear spans but normal concrete shrinkage must be accommodated.

Lockable dowels at temporary movement joints can be used to replace pour strips, thereby improving site access and allowing the installation of overhead building services without delay. These dowels also simplify the formwork design at these joints, by eliminating the need for support corbels.

Upon opening in 2011, Melbourne's new Royal Children's Hospital will provide a purpose-built facility for the care of children. Eighty-five per cent of rooms are designed for single occupancy to provide privacy for patients and their families, and the majority will have views of parkland, courtyards or gardens. ●

Aerial photos of the construction site.

(Photos: Children's Health Partnership.)