

*VSL PT to reduce joints and maintenance cost.*



▲ The extension increases the stockroom by over 16,500 m<sup>2</sup>

Pilkington (Australia) Limited, a major Australian producer of glass, recently extended its existing float glass plant at Ingleburn, NSW, Australia.

The extension increases the stockroom by over 16,500 m<sup>2</sup>, provides a new laminating facility and adds heavy duty external pavements.

Boulderstone Hornbrook Pty Ltd was successful in winning the head contract on a design and construct basis in conjunction with Consulting Engineers, Hardcastle & Richards Pty Ltd.

### Scope of works performed

- Post-tensioning works
- Design subcontract to fully design and detail all 26,000 m<sup>2</sup> of post-tensioned concrete slabs on grade.

Continual floor slab joint maintenance is the major source of cost and delay to the owners and operators of industrial slabs on grade.

Both Pilkington (Australia) and Hardcastle & Richards were well aware that maintenance costs over the life of the slab could be even more significant than the initial costs of construction and that it was necessary to adopt a life-cycle approach to the evaluation and selection of floor slab systems.

The best strategy was to simply minimise the total length of jointing in the slab and to use a higher quality of jointing for those that remain. Reduction of jointing is achieved by casting larger individual areas. VSL post-tensioning was then used to axially compress the large slab areas and control shrinkage cracking as well as the stresses due to applied loads. VSL carried out all the post-tensioning works

as well as a design subcontract to fully design and detail all 26,000 m<sup>2</sup> of post-tensioned concrete slabs on grade.

### Minimisation of Joints

Various methods have been proposed and used to cast large areas and hence eliminate joints. They generally rely upon a high content of steel reinforcement or fibres intended to limit any individual crack to a width calculated to be sufficiently small that the business activities of the building owner will not be impaired. This approach is



▲ Preparation of post-tensioning of the floor

somewhat Reactive – the slab designer calculates the inevitable tensile stresses in the concrete, appreciates that the concrete will suffer cracking and then designs a steel component to limit what is, essentially, the damage.

By comparison, post-tensioning is the only "proactive" approach. It has the ability to compress the concrete section to a greater stress level than the applied loads will create in tension. Hence concrete cracking damage is wholly obviated. There is nothing "reactive" in a post-tensioned slab.

The VSL approach to post-tensioning the slabs on grade was adopted because of its capacity to greatly reduce potential future maintenance costs. The VSL slabs on grade were cast in large individual slabs, some of which exceeded 2,100 m<sup>2</sup>. Hence most of the joints, which would have been required in a more conventional system, were eliminated. Since problems during the life of the structure invariably occur at joints, the risk of future problems was greatly reduced.

### Slabs Loads and Thicknesses

Most of the internal VSL slabs at the Pilkington site were 170 mm thick. These slabs carried a

variety of static and mobile loads caused by storage and moving plant. Whilst some loads were caused by familiar plant such as forklifts (up to 33.5 tons all up) and storage pallets, others, such as the Balduin Transporter, with its small wheels and 35 tons all up weight, are unique to the glass industry and had been observed to be punishing on the original reinforced concrete slabs used in the construction of the original plant some years ago. Specialist glass storage racks, such as "A" Frames and Lahti Stillages introduced a variety of concentrated loads similar to racking effects as well as uniformly distributed loads.

Heavy duty VSL slabs were 240 mm thick and carried loads similar to internal slabs but also allowed for high repetitions of forklifts with all up weight of 77 tons. Fatigue considerations were critical to the design and external slabs were additionally designed to accommodate the effects of linear and non-linear temperature distribution through the depth of the slab due to daily heating from the sun.

### Construction

The slabs were axially post-tensioned by tendons running in both directions and located at the centroid of the slab.

#### OWNER

Pilkington (Australia) Pty Ltd.

#### CONTRACTOR

Baulderstone Hornibrook Pty Ltd.

#### CONSULTING

Hardcastle & Richard Pty Ltd.

#### PT DESIGN

VSL Prestressing (Aust.) Pty Ltd.

#### PT CONTRACTOR

VSL Prestressing (Aust.) Pty Ltd.

The slab was cast on a suitable foundation with a thin sliding layer of sand and plastic membranes. There was an edge thickening to accommodate anchorage. The early application of some initial prestress served to control initial shrinkage cracking because the entire slab contracts under the prestress by sliding. Final prestress application was designed to ensure that the slab would remain permanently in a state of compression, even under the most adverse combination of applied wheel or post loads and temperature effects.

In some locations however, the design ensured that the maximum tensile stresses in the bottom of the slab would not exceed the tension resisting capacity of the concrete section being the total of prestress and the flexural tensile strength of the concrete.

Construction was staged to allow gradual relocation of Pilkington plant and equipment and the final concrete was cast early in 1995.

▼ 26,000 m<sup>2</sup> of post-tensioned concrete slabs on grade completed.



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