

“Permaban has been involved with formwork manufacture since 1983 and developed AlphaJoint, which in 2002 won the SED Concrete Innovation Award, creating a number of industry innovations.”

Joint armoured and load transfer

Following its development in 1999, the Diamond Dowel has revolutionised and simplified the traditional method of providing load transfer between adjacent slabs using dowels.

RODNEY ARNOLD, PERMABAN LTD

Traditional round dowels for both slabs on ground and suspended slabs have been the most common method for providing load transfer across floor slab joints. Most engineers appreciate that using round dowels allows shrinkage contraction in one direction only. Round dowels do not permit any lateral movement of the slab, resulting in the slab ‘locking’ and cracking across the corners.

Dowel development programme

The Diamond Dowel development programme included the development of extensive computer programs to analyse the optimum shape of dowel plate as a finite plate element on an elastic foundation. Analyses demonstrated that the stresses for the Diamond Dowel reduce signifi-

Figure 1: The Diamond Dowel sleeve is fixed to the timber formwork just prior to pouring the concrete.

Photos: Permaban Ltd.



cantly beyond the first 25mm of the dowel past the joint and beyond this the stress tails off to zero at the rear of the dowel only 100mm from the joint face. Therefore, this analysis would suggest that for every dowel bar that has been traditionally used, 66% of its length has not served any purpose or provided any benefit.

The Diamond Dowel and its counterpart, Alpha Dowel, provide superior load transfer across the joint compared with round dowels and allow two-way lateral movement which round dowels do not. Apart from the obvious technical benefits, there are several fixing benefits and these are as follows:

- The Diamond Dowel sleeve is fixed to the timber formwork just prior to pouring the concrete (see Figure 1).
- After casting the concrete the timber formwork is removed leaving the Diamond Dowel sleeve firmly cast into the concrete (see Figure 2). As there are no dowels protruding (which present a trip hazard) the

Figure 2: How many sites have been doing it since 1999.



Figure 3: How some sites still do it in 2005.

contractor can make sure the sub-base is properly levelled and compacted right up to the slab edge. As can be seen in Figure 3, unless the bars are straightened prior to the adjacent pour, the two slabs will become effectively locked together by the dowel bars. Even with the dowel bars fixed correctly the slab will still lock, as shown in Figure 4.

- Just before concreting commences, the Diamond Dowel plate is inserted into the slot in the Diamond Dowel. In this way, superior load transfer and two-way lateral movement are achieved; yet no vertical movement is allowed due to the thin, hard plastic Diamond Dowel sleeve. The original development programme demonstrated that the sleeve material was equally as important as the dowel in ensuring no vertical movement and showed that whatever the dowel shape, be it Diamond Dowel or traditional round or square dowels, thick, soft plastic sleeves should not be used as they deform under load from trucks passing across the joint allowing differential vertical movement. Research has shown that joint arris degradation will commence with vertical movement as low as 0.1mm.

Joint armoured and load transfer

In the late 1990s the major distribution facility developers began changing their profile from selling on their develop-

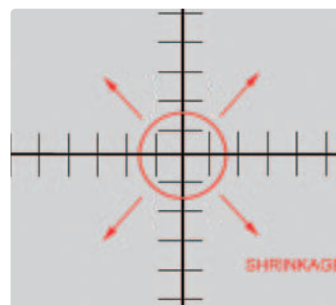


Figure 4 left: Traditional round dowel bars actually lock up the slab especially where circled.

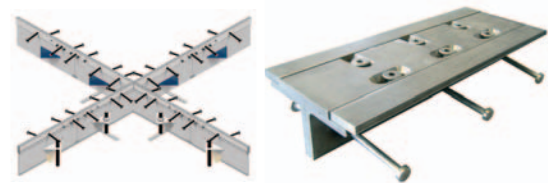


Figure 5 above left: AlphaJoint ‘leave in place’ formwork providing 2 × 10mm-wide flat steel strips to provide the joint arris armouring with Diamond Dowels providing the load transfer.

Figure 6 above right: Joint section for post-tensioned floor slab.



ments to one of retaining ownership, which they then leased out. This led to an awareness of how much joint repair was costing the building owner, which, in turn, led to a demand for better methods of joint armouring and load transfer.

Permaban has been involved with formwork manufacture since 1983 and in 2001 developed AlphaJoint, which in 2002 won the SED Concrete Innovation Award, creating a number of industry innovations such as:

- 10mm-wide double metal strips (see Figure 5) employing engineering grade steel so that the top surface of the joint is very flat and the edges sharp
- load transfer by discontinuous Diamond or Alpha Dowels which allow two-way opening in the horizontal plain but do not allow differential vertical movement across the joint (research had shown that joint degradation would commence with vertical movement as low as 0.1mm)
- precision fixing by fully adjustable Alphafix eliminates on-site welding of joint sections.

Case study

AlphaJoint has established itself as a superior system for joint armouring and load transfer for both ground-bearing and suspended slabs on ground, employing either mesh/bar reinforcement or steel fibres. However, Permaban recently produced the joint section (see Figure 6) for what is claimed as the first post-tensioned floor slab in Europe installed using the Somero laser screed. Stanford Flooring Ltd installed the distribution centre facility of some 65,000m² for William Morrison Supermarkets plc in Kettering, Northamptonshire as a complete design-and-construct package and of the 65,000m² some 44,000m² was post-tensioned. Main contractor was Carrillion and Balvac provided the MK4 unbonded post-tensioning sys-

tem to Stanford. Design engineers were Sprigg Little Partnership in conjunction with Peter Matthews.

The slab was designed with additional reinforcement around the edges and two different joints were required to accommodate joints between post-tensioned slabs and for connection between post-tensioned slabs and the dock leveller slab. The stainless steel joint provided was designed to allow the post-tensioning cables to pass underneath and was held in position for installation by Permaban Alphafix, which provided good rigidity and allowed accurate adjustment for height and level across the joint. This was critical on an overall joint width of 150mm, as can be seen in Figure 7. Figures 8–10 illustrate modern methods of load transfer. While post-tensioned slabs are rare in Europe, they are common in Australia and Permaban was able to consider the adaptations to their AlphaJoint to accommodate the post-tensioning cables which have been made by their associate company in Brisbane for the Australian market.

Concluding remarks

Since AlphaJoint's introduction in 2002 its use has expanded throughout the world. Demand since 2002 has increased approximately 25% per annum with manufacturing plants being established in UK, Belgium, Spain, Australia, New Zealand and the USA.

To complement the AlphaJoint, lighter section BetaJoint systems are available for medium- and light-duty situations. However, the reader should not be misled by claims that products of a light gauge material will offer the same degree of joint aris armouring as the 10 × 50mm-thick steel.

Figure 7 far left top: Stainless steel joint allowing post-tensioning cables to pass underneath being held in position by Permaban Alphafix.

Figure 8 far left: AlphaFix securing the joint in position with the unbonded cables being installed by passing them under the joint.

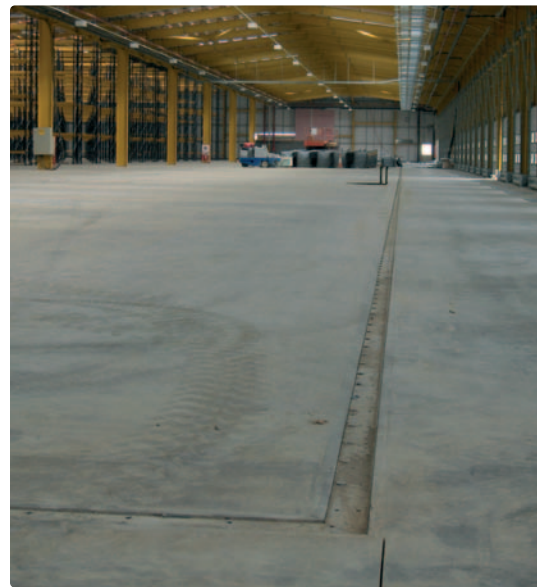


Figure 9: The joint is designed to have a plate installed into the recess in the top of the joint once the post-tensioning has completed and the joint has opened up to its designed maximum of up to 40mm.

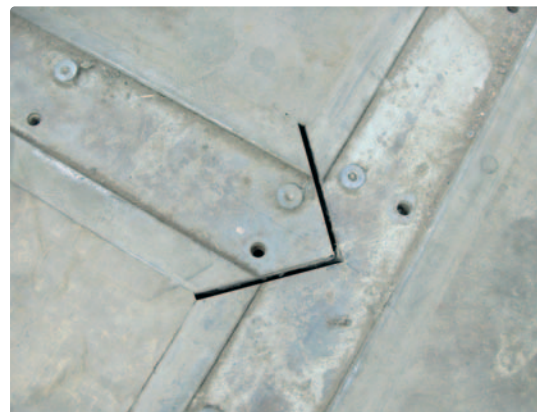


Figure 10: A 90° joint junction and the neat detailing and finish achieved by the installers.