Waterproofing of concrete underpinned basements

With building land at a premium in the UK, it makes perfect sense to extend buildings below ground level. But excavating a basement comes with various challenges in terms of waterproofing and it is essential to understand how to deal with these issues professionally. ***Mike Dunn*** *of* ***Triton Systems*** *explains the different systems available to the waterproofing designer and their specific applications.*

Above: A clear example of 'lime' leaching from the dry pack between the underpinning and the existing foundations.

Waterproofing designers face various challenges when dealing with a basement or semi-basement which is to be excavated to provide additional levels of accommodation, or where stabilisation of the structure above is required in order to fully realise the potential for making new living space where no basement or cellar existed previously.

The very nature of the underpinning process – the installation of concrete 'pins' in an alternating pattern in concert with removal of the existing floor and the careful excavation of spoil – does not lend itself to many of the forms of waterproof protection that might usually be specified. A basement waterproofing designer would normally have access to a number of different options, in order to satisfy the requirements of the end user, while addressing the issues of type of construction, buildability, maintainability and repairability, all as laid out in BS 8102:2009[1]. The presence of underpinning reduces those options but does not remove the responsibility that the designer has to produce a reliable and feasible design.

Waterproofing options

Many concrete basements can be built using external Type A membranes or barriers and/or Type B integral protection. The alternating formation pattern of the concrete 'pins' means it is almost impossible to reliably install a Type A external membrane when underpinning is being carried out. The underpinning process introduces a lot of 'cold' vertical joints between the concrete 'pins' which are difficult to seal. The poured concrete at these joints might not always be fully compacted, increasing the risk of water percolating through. Thus, the sheer number of joints and junctions negates the benefit of any water-resisting admixture in

> Cavity drain systems are unique in that they are the only ones that can be tested before and after installation, unlike other methods which have to wait for the right conditions to occur before they prove themselves.

the concrete itself.

The use of crystallising cement coatings can improve the resistance of joints if the faces become accessible as the excavation work proceeds, but this will not provide sufficient protection to allow the basement to become a habitable space. This generally leaves internal Type A cementitious systems or Type C cavity drain membrane systems (Figure 1). Internally applied cementitious systems can be prone to cracking over the multiple joints and areas of stress concentration present and, although there are elastic versions of the products available, they are very reliant on surface preparation. As a consequence, they are often used to slow down water ingress and to deal with the threat of 'free lime' leaching from the dry pack between the existing structure and the new retaining walls, but not as the sole form of protection. Their use can also be limited if the construction is such that the new floor slab is not fully tied to the walls. In such instances, floatation could occur if hydrostatic pressure were to build up under the floor, which could result in movement, cracking and water leakage.

Reliable option

The remaining and most reliable option is to consider using a Type C cavity drain membrane system (Figure 2). A cavity drain system will manage away water ingress without the risk of increasing hydrostatic pressure while also providing a dry internal surface which can be finished with lining systems that can be quickly installed, thereby reducing waiting times and helping to maintain a programme of works. The cavity drain system comprises a drainage membrane fixed to the walls (typically 8mm thick), a floor perimeter drainage channel, preferably set into a rebate already formed within the depth of the slab, leading to a sump and pumps with battery backup and alarm. The floor is overlaid with a deeper (20mm) section membrane that is sealed to the wall. Figure 3 shows a typical layout. The preparatory works required are much less onerous than for a cementitious system but substrates must still be sound and capable of supporting the membrane and care is still required to ensure that the ingress of 'free lime' is restricted by using a sealer over the dry pack area and by ensuring that an anti-lime dressing is applied over the new concrete walls and floor. The cavity drain system can be accessed for maintenance and inspection via ports fitted to the drainage channel, particularly important in these situations as the 'free lime' can clog the channel and pumps if not monitored and dealt with.

A typical Type C structural waterproofing system using cavity drain membranes on the walls and floor in an underpinned multi-level domestic basement.

Unique systems

Cavity drain systems are unique in that they are the only ones that can be tested before and after installation, unlike other methods that have to wait for the right conditions to occur before they prove themselves. Consideration to the following must be given when installing a cavity drain system as the principal form of waterproofing, whether underpinning has been used, or not:

- Flood test: Does water that reaches the floor move around the drainage channel rebate and onward to the chosen sump location, unimpeded with no

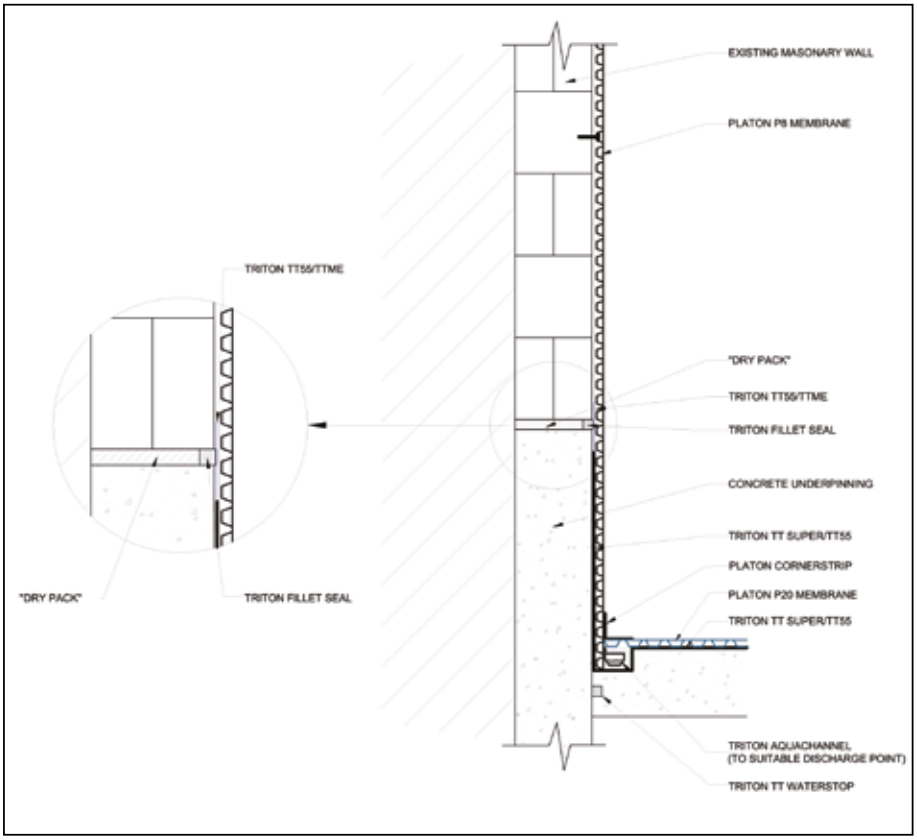

Figure 3: Diagrammatic layout of typical Type C cavity drain system.

obstructions or high spots? Is the floor slab sufficiently level to avoid puddling which might otherwise threaten the floor membrane? Has this performance been maintained after installation?

- Sumps and pumps: Are the sump pumps adequate for the potential water ingress and can they and the rest of the drainage system be maintained long term? Do the pumps, battery backup and alarm operate properly and reliably when tested (more than once)?
- Installer: Is the installer experienced in using a cavity drain system? Is he able to offer design input? If not, a specialist designer should be considered, preferably one who is registered with the Property Care Association Waterproofing Design Specialist register and who holds the Certificated Surveyor in Structural Waterproofing (CSSW) qualification. ■

References:

1. BRITISH STANDARDS INSTITUTION, BS 8102. *Code of practice for protection of below ground structures against water from the ground.* BSI, London, 2009.

The installation of a 20mm-deep cavity drain membrane to the floor in an underpinned basement. An 8mm-deep cavity drain membrane has been installed to walls.