A Milestone for Belfast

Unprecedented in scale, design and diversity, the £320 million retail centre is one of Europe’s largest urban regeneration projects and a milestone in the revitalisation of Belfast city centre.

Many of the world’s major cities sit on estuarial floodplains, for good historic and socio-economic reasons, and Belfast in Northern Ireland is no exception. But a strategically excellent location is no guarantee of its suitability for large scale construction, as examples such as the flooding of New Orleans in 2005 demonstrate. There may be little risk of hurricanes or storm surges battering Belfast, but its geography has its own unique drawbacks, as the team building the vast Victoria Square development found out, constructing a three storey deep basement for underground car park and retail.

Sleech is the local term for soft estuarine quasi-thixotropic deposits that underlie both banks of the River Lagan in the heart of the city. Up to the end of the 19th century the entire centre of the city was supported on a forest of timber piles, most of which are still performing their original function. But 19th century engineers never attempted to build deep basements, certainly not on the Victoria Square scale.

Victoria Square comprises 75,000m² of retail space, including a flagship House of Fraser store, two-level food court, a restaurant terrace, 106 apartments and an eight-screen Odeon cinema, over a two-level basement car park for 1000 cars (Northern Ireland’s largest underground car park).

Basement Challenges

The basement footprint is 21,500m². Designer Benaim’s solution was 4,000t of ‘high modulus sheet piles’ – basically two standard piles welded together and stiffened by universal beam sections welded on to the outer side – around the entire perimeter, driven down 22m to the sand and gravel. This perimeter wall cut off most of the water flow across the site. Some 3m of made ground above the sleech was then excavated and steeply inclined ground anchors installed to stabilise the wall. In all, 240,000m³ of material had to be excavated to get down to formation level, 10m below ground level and 8m below the effective water table.

Such a high water table means that once the dewatering pumps are turned off, the basement will try to float. So the main purpose of the more than 1,300 piles installed by an FK Lowry/Stent joint venture is to hold the building down, via friction between the piles and the subsoil. Where strutting was planned and piling from formation level impractical, 180 bored piles, each measuring 759mm in diameter, were installed from ground level 30m down, with the upper 10m cut away once formation level was reached. Over most of the site, however, 600mm diameter CFA piles 20m deep were the order of the day, and 1,200 were installed in total.
Benefits of PUDLO

The benefits of using PUDLO soon became apparent. With the amount of sleech around the basement it was imperative to use an additive that was both corrosion-resistant and capable of withstanding hydrostatic pressure. PUDLO is BBA approved and CE Mark Certificated. Manufactured under ISO 9001 quality procedures, it is easy to specify and use and can dramatically save construction time and materials without compromising on watertightness.

The project demonstrates how structures can be designed to BS 8110 rather than BS 8007, thus saving on structural steelwork, in addition to the membrane material costs and construction time savings, and are watertight, even in site conditions as challenging as Victoria Square.

The showpiece glass dome space is the heart of the project with floating platforms linking all levels of circulation. The 37m diameter dome rises to 45m above lower ground level and comprises 635 triangular panes of glass. It is an intentional set-piece and has become an iconic image on Belfast's skyline. Victoria Square won a large number of awards after it was completed including Best Regeneration Project at the Belfast Awards 2008 and Commercial Property Development of the Year 2008 at the Property Awards.