



Tunneling

Reference Details:

Owner Dublin Corporation, City, England +++ **Design** Haswell, Geo Design, City, England +++ **Main Contractor** Nishimatsu Construction, City, England

DSI Units DSI UK, Southam, England
DSI Services Launch Audit - Fairview Park: R51L Hollow Bar Spiles (Approx. 3000m) together with a range of drill bits, including: hardened cross cut bits, carbide button drill bits; TBM Shove Frames: Strand Anchors (standard), Multi-Stage Strand Anchors, Packers, Stressing Services; Lay-By Enlargements and Cross-over Tunnels: 5,000 No. active and passive x 32mm Prestressing Steel Rock Bolts, Grout Packers and Tubing. Stressing equipment and Torque Wrenches; permanent Lining, Side-wall Plinths: 5,000 No.20mm Formtie Assemblies (20mm bar, sleeve, water plate and wingnut)



Dublin Port Tunnel

The booming economy in Ireland has led to increases in traffic volumes throughout the country, but these have become particularly acute in Dublin causing major congestion problems throughout the city.

To ease congestion, the Dublin Port Tunnel was commissioned to provide a road link from the M1 Motorway in the north of Dublin City to the sea port, where the new road is intended to take the bulk of freight traffic direct from the sea port on to the Motorway Network (M1 and M50).

The project comprises of a twin bore tunnel (diameter 11.8m), to accommodate both north and southbound carriageways, over a length of 2.6km with an additional 1.9km of cut and cover tunnel at the northern approach.

DYWIDAG Products Supplied

DSI UK supplied products to four major areas within the tunnel project, as follows:

- Self-Drilling Hollow Bar Spiles -Launch Adit, Fairview Park This section of the tunnel was in difficult ground, featuring broken rock (hard limestone) overlaid by boulder clay. The launch adit was constructed as an extension to the turnaround chamber used by the TBM (Tunnel Boring Machine). The launch adit enabled the TBM to be reassembled, following turnaround, to its operating configuration (length = 100m) prior to boring for the start of the northbound drive. The two drilling methods used for the installation of the inclined Spiles were:

- Strand Anchors and Multi-Stage Strand Anchors - TBM Shove Frames The strand anchors were used to restrain the shove frames at both ends of the tunnels during launching (Collins Avenue and Fairview Park). The shove frame at the Fairview Park end of the southbound tunnel required some specialist anchors as the ground conditions varied between the crown level and invert level of the tunnel.

The ground conditions at the crown were weak ground requiring 15m bond lengths, this could only be achieved through the use of DYWIDAG Multi-Stage Anchors. At the lower levels, conventional DYWIDAG Strand anchors were sufficient.

- Simultaneous drill and grout (in conjunction with a stuffing box at the mouth of the borehole)
- Water flush drilling, followed by subsequent grout injection through the bore of the bar.

The process of grout injection ensured localised consolidation of the ground, which increased the structural support within the crown of the tunnel.

- Prestressing Steel Rock Bolts with Grout Packers - Lay-by Enlargements, Cross-Over Tunnels. Following the boring of both tunnels, there was a considerable package of rock bolting required, for roof and rib (sidewall) support, in the secondary stage of tunnelling works comprising of:
 - Lay-by enlargements (4 pcs. at 50 m each). The lay-by enlargements comprise of localised enlargement of the tunnel bore to provide parking spaces, outside of the main carriageway, for broken down vehicles.
 - Cross passages between the tunnel bores (at every 250m centres), to provide escape routes for motorists (in case of fire), as well as access for service and maintenance crews. In addition, there are also two vehicle cross passages.

The key technical feature of the rock bolts was that they had to provide a locked-in prestress once grouted. This prestress is essential to mobilise friction between the bedding planes of the rock, to provide continuity within the rock mass, for arch support of the roof.

The method employed for installation of the prestressed and grouted bolts involved a 1.0m grouted point anchorage at the top of the borehole. This was achieved through the use of grout inflated packers (also supplied by DSI UK), placed at 1.0m from the top of the bolt, and then grouting the point anchorage. The rock bolt was then prestressed to 150 kN. The prestress ensured that the rock bolts actively load the bedding planes within the rock. Following prestressing, a secondary grout was injected, to provide full column bonding over the length of the bolt.

In addition to the active rock bolts, passive bolts were required for roof support in the temporary construction adits as well as the sidewall niches for electrical installations and fire hydrants

Following installation of the anchors, DSI UK provided a crew of stressing technicians to proof test the anchors and then lock-off each anchor at the required working load.

- Formtie System -Permanent Tunnel Lining Plinths (Both Tunnels)

Following the construction of the primary segmental lining through both tunnels, a permanent (waterproofed) concrete lining was required over the full length of each tunnel. The permanent concrete lining required a cast concrete plinth, formed at invert level, on both sides of the two tunnels. The formwork for the concrete plinths was restrained using 20mm removable DYWIDAG Formties, anchored into the segmental lining of the tunnel using expansion shells. The front shutter was stiffened with a standard waler beam detail, held in place with DYWIDAG Waler Plates and Wingnuts.

The official opening of the tunnel is scheduled for summer 2005.