

Bringing the power to Manchester

The Woodhead Tunnel was built in 1953. It was no longer required for its original use and needed upgrading by National Grid in order to be able to install 2 x 400kV lines passing through. The installation of these lines is essential for the security of electricity supplies to Manchester. The use of the Woodhead Tunnel for this purpose will also avoid running pylons over this rugged, yet sensitive and beautiful part of Britain.

ANDREW MACKENZIE, PERMABAN

The Woodhead Tunnel project is managed by Electricity Alliance – East (EAE), a grouping of National Grid and Balfour Beatty, who appointed Balfour Beatty Civil Engineering Limited (BBCEL) for the civil engineering and concrete part of the works.

The new cables will be installed onto supports using a bespoke Tescorp cable installation machine. This requires a solid concrete base in order to operate.

Couldwell Concrete Floors (CCF) was appointed by BBCEL to install the concrete floor in the 5km tunnel and consulted Permaban regarding the permanent formwork required.

The width of the tunnel is 7.4m and at the edges BBCEL has created two open concrete drainage channels. The 230mm slab was required to be poured in two very long strips with falls from the centre to the level of the drainage channels. On the centreline of the sub-base is a 300mm-thick (500mm-wide) in-situ concrete protection layer, which already existed to protect the old precast ducting below.

Conditions working in a long tunnel like this make it imperative to design the work to be as straightforward as possible. Thus, permanent formwork avoided the need for the stripping and cleaning operation as well as avoiding damage to the concrete edges.

After consultation with Permaban, CCF conducted trials to evaluate the options available. A modified Beta Strip 200 was selected as the optimum permanent formwork for the 230mm deep unreinforced C35/40 concrete slab.

The Beta Strip design was modified by Permaban to suit CCF's needs to use two welded stiffening strips (upper and lower) with multiple holes suitable for the AlphaFoot post (studding) to pass through and be located and levelled with two flanged nuts – one above and one below the upper stiffener. The use of multiple holes gave maximum flexibility of location for the three AlphaFeet per 3m Special Beta Strip 200 rail.

Normally, Beta Strip is fixed together with joiner plates. However, to simplify the operation and reduce the number of components, fixing of the rails end to end was done by laps and three short welded M8 studs. The rails fitted together neatly over these and three M8 nuts were put in place.

CCF decided to fix the Permaban Special Beta Strip formwork to the concrete protection by shot-fired fixings. Planning meetings and trials were held between CCF,



(Photos: Couldwell Concrete Flooring Ltd.)



Permaban and Avantifix in Wakefield and in the tunnel itself. It was found that by suitably selecting the thickness of the metal comprising the base of the foot it could be fixed by shot-firing the fixing through the plate itself and into the concrete without needing to locate specific holes in the foot itself (see Figure 1). This gave great flexibility of location for firing and was important because the concrete below had not been installed for this purpose and did have some irregularities (see Figure 2).

Beta Strip had been assessed by EAE and found to be suitable for installation so close to such high-voltage cables.

Deliveries by Permaban were carefully co-ordinated on specially hired trucks with HIAB-type off-lifts. The

Figure 1 top: Beta Strip fixed in place – note the feet are fixed onto the concrete substrate by nails shot-fired through the foot plate.

Figure 2 above: Beta Strip fixed in place in location where the concrete substrate was very low. The feet were fixed onto the substrate by shot-fired nails through both the foot plate and the wooden spacer.



Figure 3 above: Addition of superplasticiser to the concrete immediately before entering the tunnel from the western end.

Figure 4 below: Concrete placement underway. Note the outside of the Beta Strip formwork is a smooth flat face.

tunnel itself was considered a confined space and the traffic subject to a one-way system as well as a stringent safety regime for all site works and personnel. The Special Beta Strip bundles were placed along the tunnel at suitable intervals and the CCF formwork team started setting up several days ahead of the start of the concrete work on 12 October 2009.

The concrete was supplied by CEMEX from its Huddersfield plant. The agreed supply rate was 260m³/day at 30m³/hour. In view of the remote location and timings involved and because the effect of superplasticiser does begin to reduce after an hour or so, CEMEX provided technicians to add carefully controlled amounts of superplasticiser before the trucks entered the tunnel to give a consistent S3 consistence (see Figure 3). The concrete was compacted and screeded using a ‘magic-screed’ (can

be seen, although not actually being used, in Figure 4). CCF produced the surface with a brushed-texture finish.

One side of the tunnel had to be concreted first as this has inspection chambers and was not favourable to running over with laden concrete trucks.

Unusually, all the feet, stiffeners and levelling mechanism were cast into the first side. This was in order to leave a totally flat face for side two and thus avoid damage by (and damage to) the concrete truck tyres. It had the other advantage of making it much easier to fix the Miothene foam required at the joint to create a longitudinal debonded expansion joint along the centreline.

The tunnel length is just under 5km so a large (35,000m²) floor has been created high in The Pennines and helping to secure future power supply for the Manchester area. ■

(Photo: Balfour Beatty Civil Engineering Ltd.)

