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Artikel: A1 (M) Hatfield Tunnel, full scale research of anchored sheet pile wall (UK)

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3. A1 (M) Hatfield Tunnel, Full Scale Research of Anchored Sheet Pile Wall (UK)

Client:	*Herfordshire County Council*
Main Contractors and Research Management:	*Tarmac Construction Ltd. Wolverhampton*
Contract Completion:	*December 1986*
Research Organisations:	*Tarmac Construction Ltd. Cementation Research Ltd. Transport and Road Research Laboratory (Dep. of Transport) Hatfield Polytechnic Science and Engineering Research Council*

A major part of the A1(M) Hatfield Project consists of a dual three-lane motorway within a 1200 metre long tunnel (Fig. 1) designed as a two bay portal frame in reinforced concrete (82,000 m^3). The tunnel was constructed by the «cut and cover» technique within a narrow site corridor flanked by the heavily trafficked A1 trunk road, extensive services and closely adjoining property. The temporary works comprises over 2 km of sheet pile retaining wall (3200 tonnes) restrained by prestressed strand ground anchors of up to 60 tonne capacity. The soil conditions were mainly glacial deposits of sand and gravel overlying boulder clay (Fig. 2).

After contract award, the Contractor recognised that the extent and repetitive nature of the temporary works provided an opportunity to verify the design predictions by monitoring the performance of the anchored wall at full scale. They accordingly initiated and managed a collaborative study of the wall and anchorage system over a ten month period.

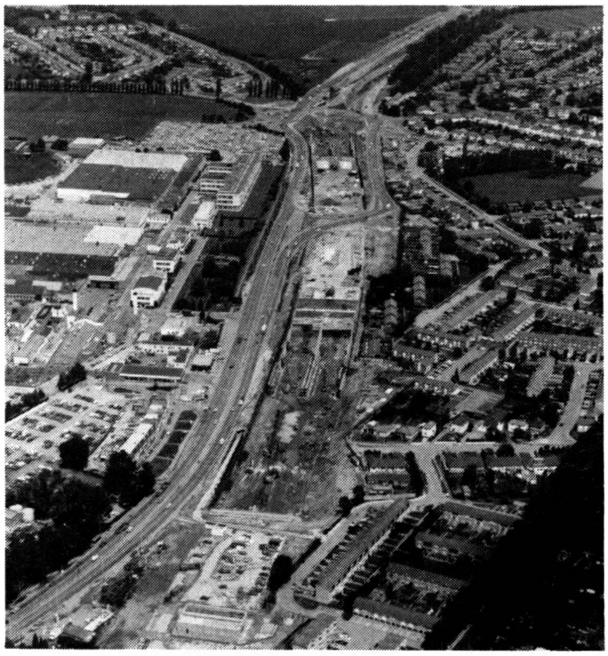

Fig. 1 Aerial View of Tunnel Construction

The specific aims of the research were to provide further understanding of soil-structure interaction, to assess the relevance of factors applied in current design procedures, and to increase knowledge of ground anchor behaviour. The aims were achieved through measurement of ground movement, pile bending strains, ground anchor strains and loads, and by a comparison of observed behaviour with the design predictions.

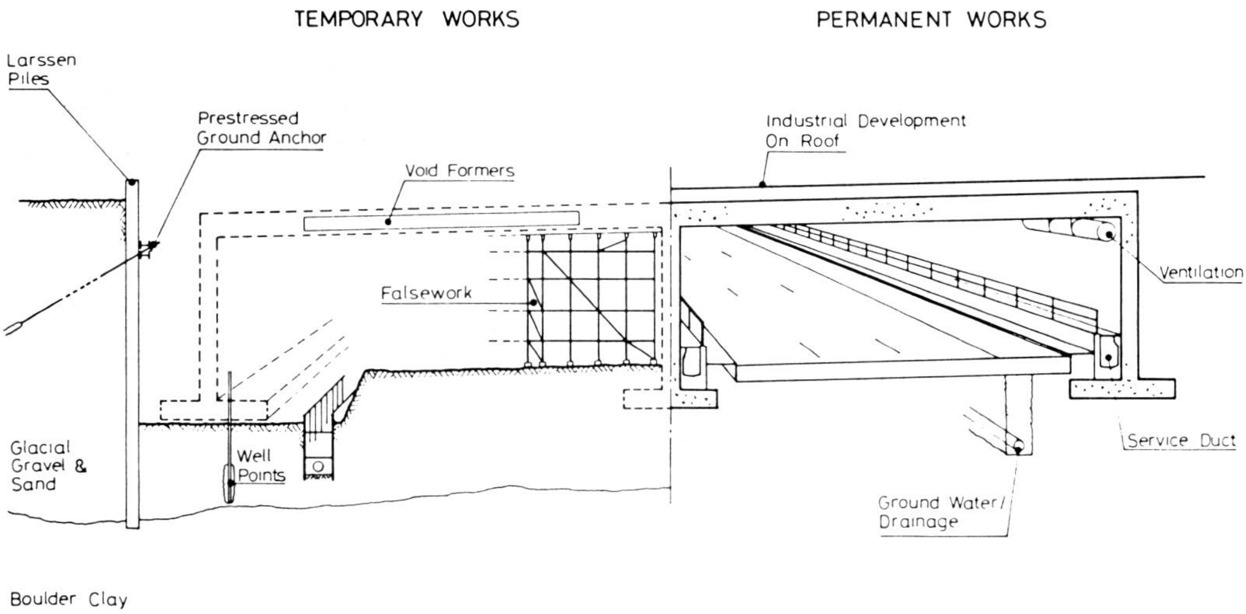

Fig. 2 Tunnel Cross Section

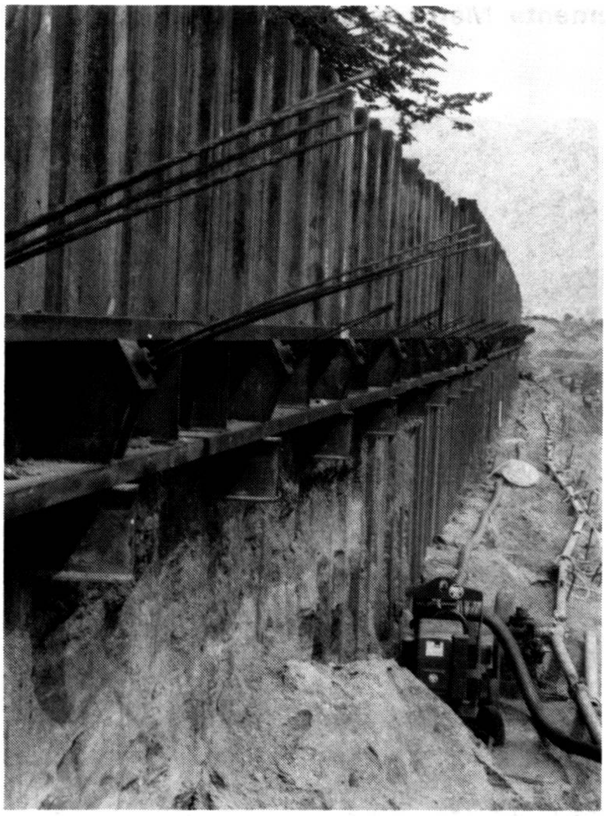

Fig. 3 Anchored Sheet Pile Wall

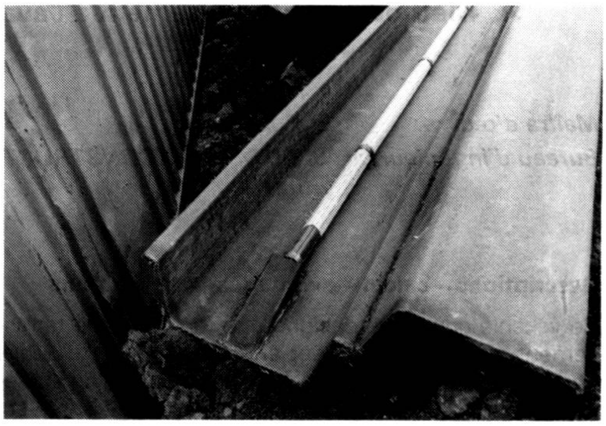

Fig. 4 Pile Inclinometer System and Driving Shoe (C) Crown Copyright

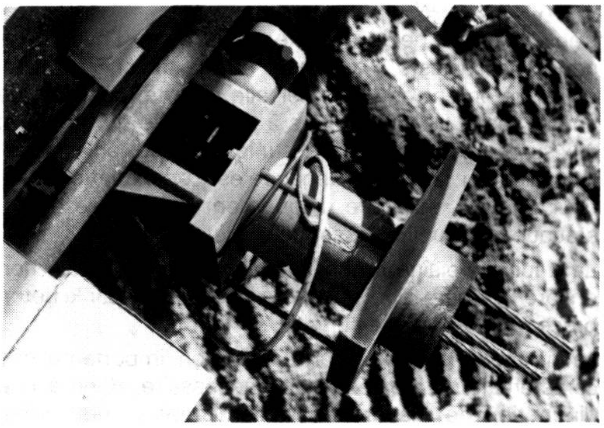

Fig. 5 Anchorage Load Cell and Single Point Extensometer (C) Crown Copyright

Following the driving of Larssen sheet piles up to 14 metres long, excavation was carried out to 3 metres depth to allow installation of 16 metre long ground anchors by the Vibrodrive technique. Bulk excavation continued to a depth of over 9 metres with the water table controlled by wellpoints (Fig. 3). After construction of the reinforced concrete walls and roof of the tunnel, the working space between the permanent and temporary walls was backfilled, the prestressed anchors detensioned and the sheet piles extracted.

Ground movements of about 50 mm were measured close to the piles during driving and the pattern of subsurface movements indicated that densification of the granular soils was caused by vibration and downdrag. Additional smaller movements of the retained ground were measured during the subsequent stages of construction, so that by completion the total settlements lay within the zone suggested by Peck from previous field observations.

The wall deflected as a free cantilever prior to installation of the ground anchors. A reversal of these movements occurred during tensioning of the anchors which limited movements at and above waling level. A maximum lateral movement of about 15 mm took place below waling level in the period up to completion of the permanent wall. No damage was observed to the adjacent services and property as a result of these ground movements.

The bending moments calculated from the measurements of pile strain generally reflected the pattern of wall deformation (Fig. 4). A maximum moment of 75 kN m/m was obtained on completion of excavation which increased to 110 kN m/m prior to backfilling. These values compare with an orginal design value of 422 kN m/m which had been calculated from the net total earth pressure distribution using both free and fixed earth support conditions, with a factor of safety greater than 2 against rotation of the wall about the prop position Rowe's method of design, which takes into account the stiffness of the wall and propping system, gave a moment closer to the values obtained from the strain measurements.

The measurements of anchor behaviour indicated that they supported the wall satisfacorily with no evidence of distress, the loads remaining close to the initial prestress value throughout (Fig. 5). The behaviour of the anchorage system was largely governed by extension of the fixed anchor length through relaxation of the strans. The measured strain distribution over the fixed length showed the expected progressive decrease towards the end of the anchors.

The research described is fully reported in TRRL Research Report 99, published in early 1987.

(E. C. Chaplin)