CASE STUDY: Highways Agency - M25 DBFO Widening

SECTOR TYPE: Infrastructure - roads
LOCATION: M25
CLIENT: Highways Agency
PRINCIPAL DESIGNER: Connect Plus Consortium
CONTRACTORS ENVIRONMENTAL CONSULTANT: Connect Plus Consortium
PRINCIPAL CONTRACTOR: Connect Plus Consortium
CONTRACT VALUE: c.£1 billion
CONTRACT DURATION: 30 years

The Project

The M25 DBFO (Design, Build, Finance and Operate) project involved both widening of the M25 and its operation and maintenance. It includes the M25 orbital and a series of major feeder roads onto the M25, making up half of the 400km length of the total project road.

The widening works spanned 63km of motorway between Junctions 16-23 and 27-30 to provide four lanes with hard shoulder, as well as refurbishment of the Hatfield Tunnel on the A1(M). The Connect Plus, a consortium of Skanska, Balfour Beatty, Atkins and Egis Projects, was formed to deliver these services on behalf of the Highways Agency. The works were completed in May 2012, three months ahead of schedule.

The widening had to be carried out while maintaining three lanes of traffic in both directions for the 150,000 daily user vehicles. Keeping the widening within the existing highway boundary allowed it to be carried out under the Highways Agency’s ‘permitted development’ classification, but this required a significant length of retaining wall to be constructed to provide the additional 3m of space to widen into. Value engineering reduced the number of retaining wall options to two basic designs, keeping things simple to maintain the accelerated programme.

The innovative design and procurement approach taken by Connect Plus Consortium resulting in various environmental, social and economic benefits, including reduced carbon footprint and cost, increased programme security and workforce and public safety.
The Benefits

- **Reduced carbon** – the use of 100% recycled sheet piles from Europe, coupled with the reduced quantity required, reduced embodied carbon by 44,000 tonnes or 75%, whilst also lowering transport emissions.
  - 92% of aggregate used was either recycled or from a secondary source, which reduced embodied energy and transport emissions by 35,000 tonnes compared with primary aggregate. Where primary aggregate was used, it was responsibly sourced to BES6001.
  - Reduced pavement thickness was achieved by matching existing construction rather than creating a fully flexible pavement by ‘crack and seat’. This saved around 400,000 tonnes of asphalt and reduced embodied carbon by 25,000 tonnes.
  - Areas of land were purchased by agreement with adjacent landowners for the construction of drainage and attenuation ponds. This meant that much of the planned inline attenuation using oversized drainage pipes could be replaced by pond capacity. Reduced pipe size not only reduced the quantity of pipe, but also the associated earthworks were reduced by around 90%, significantly reducing plant emissions.

- **Materials** – Balfour Beatty’s King Sheet Pile™ (KSP) system achieved double the output of conventional sheet piling methods, providing programme security and taking retaining wall construction off the critical path. It also reduced the steel required by 30%, in addition to reduced installation time which saved over £10 million. The piles used can remain uncoated, meaning virtually zero maintenance.
  - Control of aggregate production on site meant that quantity and quality could be managed. This provided certainty of supply and flexibility in how material was used, rather than being reliant on an external supply chain. It provided flexibility to create the most efficient outcome for the project.
  - There was also increased flexibility of control due to the installation of motorway lighting with separate controls for junctions and the main carriageway.
  - A system is being trialled to provide dimming or completely switch off lighting depending on the volume of traffic using the motorway. This reduces electricity consumption by 25%.
  - Innovative pollution controls (including penstocks that automatically shut off the drainage network if oil is detected, and hydrodynamic separators to remove silt laden with heavy metals) also contributed to an efficient design, replacing bulky equipment.

- **Safety** – quicker installation meant less time working alongside the busy motorway with 150,000 vehicles passing by each day, which resulted in increased safety for both the workforce and travelling public.

- **Public** – existing sections of pavement could be retained without work, reducing the requirement for working across the full carriageway. This reduced the project programme and was less disruptive for the travelling public.

- **Cost** – the use of recycled and secondary aggregates was cheaper, saving the project around £18 million. The reduced material use for the pavements also resulted in a saving of £25 million.

The Process

The key processes underpinning the project:

- The team achieved a more sustainable solution by using Balfour Beatty’s KSP™ retaining wall system. This revolutionises 120 years of an innovative approach to sheet piling practice by taking advantage of spare structural capacity and eliminating the structural excess by replacing alternative pairs of full length Z piles with lighter, thinner and shorter piling sections spanning horizontally between the remaining full length sheet piles.

- This, in combination with the sheet pile profile, reduced the quantity of steel required by 30%, directly reducing embodied carbon in steel use, transportation and installation energy.

- A major benefit of the short intermediates was the virtual elimination of clutch friction, which contributes substantially to the energy required to drive sheet piles. This can be the case particularly in ground, where large flints can cause piles to deviate slightly during installation. As a result, the installation rate on some sections was routinely four times that planned and the overall installation rate was at least doubled. An important advantage was that the majority of the piles could be driven using a vibrator without recourse to the percussive impact driving often required for a conventional sheet pile wall. In the limited cases where impact driving was still required, the noise and energy consumption was more than halved, benefitting residents and the environment.

- The team developed a materials strategy to maximise the use of recycled, secondary and manufactured aggregates in preference to primary aggregates. This required specifications to be adapted and agreed with the Highways Agency.

- Inert construction and demolition waste such as concrete and brick were sourced from other construction and demolition projects in the south-east and processed at two recycling hubs. Other sources of material were also identified, such as glass sand, a by-product of processing co-mingled domestic waste collections. This innovative approach gave the consortium more direct control over the quality of material available, rather than being reliant on an external supply chain. It provided flexibility to create the most efficient outcome for the project.

Key Learning Points

Innovation in design and procurement of the major materials for the project has led to a reduced carbon footprint and cost, increased programme security and benefits to safety.
End User Feedback

“The Highways Agency was pleased to see the JV recognising innovation as a contributor to more sustainable development. The JV have approached the construction challenges intelligently and conscious of numerous sustainability aspects. Together these have delivered efficient and effective solutions to the motorway widening without compromising the essential operational requirements. The keen awareness of costs, resource consumption, efficient production and transportation led to solutions which the Agency should seek to transfer to comparable locations were prudent and practical.”

Dean Kerwick-Chrisp, Sustainability, Equality and Diversity, Highways Agency

Learn more


www.connectplusm25.co.uk/aboutus.html

For more information on The Green Construction Board visit www.greenconstructionboard.org or email green.board@bis.gsi.gov.uk