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M25 Widening Project, UK

Case Study 99

Aspects of Sustainability

This project highlights the following:

Green Aspects

Energy

Carbon

Materials

Water

Local Impacts

Social Aspects

Human Resources

Corporate Community Involvement

Business Ethics

Health and Safety

The M25 widening set new standards for highway projects in terms of resource efficiency, embodied carbon, public relations, biodiversity and sustainable drainage solutions. The project has been recognized by a number of industry awards and realized significant efficiency-related financial savings.

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Energy

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Materials

Water

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Project Introduction

The M25 widening project involved the widening of 60 km of the highway that encircles Greater London over a 3-year period. The project was carried out by a Skanska Balfour Beatty Joint Venture valued at US$ 1.6 billion and was completed in June 2012. The widening project is part of a US$ 9.7 billion Design, Build, Finance and Operate (DBFO) highways project to maintain and operate 400 km of the M25 over a 30-year period. The DBFO is being delivered by Connect Plus, which is a consortium that is 40 percent owned by Skanska. The widening project and the DBFO is been conducted for the Highways Agency, which works with Connect Plus as part of a public-private partnership. The M25 is one of Britain's busiest and most congested highways with approximately 200,000 vehicles using the route each day. The project's completion was deliberately timed to improve highway infrastructure ahead of the London Olympics in July 2012.

The project involved widening from 3 to 4 lanes with a hard shoulder in both directions of the M25 between junctions 16-23 and 27-30, and the widening and refurbishment of the 1.1 km long Hatfield Tunnel. The project also included the replacement or upgrade of footbridges and viaducts, removal of 13 gantries, construction of 125 signage gantries and the construction or replacement of noise barriers adjacent to housing. Sheet pile retaining walls were used to enable widening within the existing highway boundary, thereby allowing the project to be carried out under the Highways Act as permitted development. The widening project spent around US$ 1.6 million per day 7 days/week over a 3-year period, and involved the widening of around 1 km/month of highway, which is around three times faster than typical UK highway widening projects.

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The consortium promoted a high degree of innovation and efficiency to realize significant environmental and financial savings throughout the project, and the DBFO's long-term nature ensures that decisions are made from a lifecycle performance perspective. The project conducted seven CEEQUAL (Civil Engineering Environmental Quality Assessment and Award Scheme) assessments and was awarded scores of Excellent, which is highest rating possible. CEEQUAL is the Assessment and Awards Scheme for improving sustainability in civil engineering and infrastructure projects. The section of works between Junction 16 and 18 achieved a Whole Project CEEQUAL score of 87 percent, which was the highest ever score for a highway project under the scheme at the time. The project team then used CEEQUAL to drive continual improvement on subsequent sections to achieve scores of up to 92.5 percent. The project has also been recognized by a number of industry awards, including the Green Apple Award Winner 2011, Brownfield Briefing Awards 2011 "Best Reuse of Material" Winner, National Recycling Stars "Gold Award", Construction News Awards 2011 "Environmental Project of the Year" Finalist and National Recycling Awards 2011 "Waste Minimization Award" Finalist.

Contributing Toward Sustainable Development

The M25 widening project has helped to promote journey time reliability, reduce congestion and improve safety. The project realized significant environmental and financial savings by treating waste as a resource, being a net importer of waste and incorporating existing infrastructure where possible. A carbon footprint was conducted for the project and embodied carbon was reduced by between 20 and 35 percent, primarily through efficient resource management. Water use during the project was reduced by harvesting rainwater and recycling gray water. Biodiversity adjacent to the site was preserved and enhanced, and several archeological studies were conducted in areas disturbed by the project. The team worked with local stakeholders to minimize disruption and the project benefitted the wider community through the employment and procurement of regional workers and materials, and high standards of safety.

Green Aspects

Energy

Operational energy efficiency

The DBFO team plans to implement various energy saving measures throughout the concession period in order to realize total operational energy savings of over 10 percent. During the widening project, the team minimized energy use on site by draft proofing and adding insulation to temporary site offices, using energy efficient site lighting and continuously monitoring energy use. Reverberi power controller units are being trialed on the project, which can optimize lighting voltage, and dim or switch off sections of lighting during the night based on the number of vehicles using the highway, particularly between midnight and 5:00. It is estimated that the units could reduce lighting energy use on the M25 by 27 percent, which annually equates to over 1,500 MWh, 1,000 tCO_2e and US$ 8,500 with the original investment of the units repaid within 4 years. In addition, the team is trailing SunMasts, which are solar-powered photovoltaic lighting columns that are designed to provide net-zero energy street lighting by feeding electricity into the grid during the day and utilizing grid electricity at night.

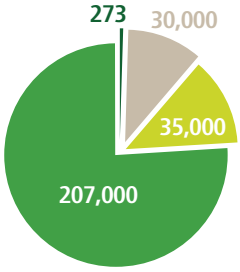
Carbon

Carbon footprinting

The team used the Highways Agency Carbon Calculation tool, which calculated the project's total carbon footprint to be 272,800 tCO_2e. The carbon footprint calculated that 207,000 tCO_2e or 76 percent would result from the embodied carbon and transportation of construction materials. The project has focused on managing and reducing its embodied carbon, and the tool has played a vital role in indentifying potential carbon savings throughout the project.

Reducing embodied carbon

Carbon reduction measures focused on three main areas: low-carbon sheet piles, the use of recycled aggregates and the reuse of the existing pavement, to reduce carbon emissions by around 103,000 tCO_2e or 27 percent in total compared with the original carbon estimate for the project of approximately 380,000 tCO_2e. The project's sheet piles were made



Carbon Footprint (following savings)" (tCO_2)

Embodied carbon of construction materials – 207,000
Staff commuting and business travel – 35,000
Site electricity, gas and diesel usage – 30,000
Waste management – 273

entirely from recycled steel and, in conjunction with a king sheet pile system (long pile with short intermediate piles), reduced the steel required by 25 percent, which is equivalent to savings of 44,000 tCO_2e. 2.4 million tons of recycled aggregate and processed demolition waste from excavation and other construction sites, saved approximately 35,000 tCO_2e and cost around 60 percent less than virgin materials. A 35 mm wearing course was overlaid where possible rather than the originally proposed crack and seat with a 180 mm overlay, which saved 360,000 tons of asphalt, 24,000 tCO_2e in carbon emissions (based on 0.066 tCO_2e/t asphalt).

Materials

Environmentally responsible materials

Sustainably sourced timber was used on the project and sheet piles were manufactured from 100 percent scrap steel using a highly efficient electric arc furnace. A king-pile system was used and the steel was imported from Luxembourg, which was effectively a 'local' supplier as alternative suppliers are located in the Far East. Existing highway structures were refurbished and reused where possible, for example, existing sign gantries were refurbished to prevent over 1,300 tons of waste, 6 km of existing vertical concrete barriers were incorporated into the new central reservation and 2 km of existing noise barriers were refurbished rather than replaced as originally planned. The project also incorporated excavation materials from the site and demolition materials from other construction sites as detailed in the waste management section below.

Waste management during construction

The M25 widening project sent less than 3 percent of construction waste to landfill, although the project was actually a net importer of waste by incorporating 2.4 million tons of construction and demolition waste from other local projects, in comparison with only 14,000 tons of the project's waste being treated off site.

The team designed out waste and used lean construction processes to minimize the amount of waste generated during construction, including an earthworks strategy that was developed to retain all inert excavation and demolition material on site. Material recycling facilities were established on site to process 2 million tons of inert construction and demolition waste in accordance with the WRAP (Waste & Resources Action Programme) Quality Protocol for aggregates. The project created 1.36 tons of waste per US$ 160,000 (£100,000) turnover, compared with the UK Contractors Group (UKCG) target of 8.11 tons. The incorporation of waste as a resource on the project saved US$ 23 million compared to conventional waste management.

The materials strategy involved depositing 1.8 million tons of excavated material at eight sites to create environmental bunds adjacent to the highway to provide noise and visual screening. A simple color-coded classification system in combination with a bar code ticketing system was used to ensure that materials were moved to the right place and that movements could be audited. Through careful mapping and monitoring, the strategy also minimized impacts on 119 adjacent contaminated sites, including 10 historic landfills.

Imported waste materials included 250,000 tons of Pulverized Fuel Ash (PFA) that was used as lightweight fill. Manufactured aggregates, such as over 60,000 tons of glass sand, required a slight deviation from the standards to allow their use, in close consultation with the Highways Agency and Environment Agency. Glass sand is a difficult to reuse by-product of the glass recycling process that was used as backfill. Vegetation clearance represented one of the project's main waste streams, which was chipped and used as biomass fuel at a nearby combined heat and power plant. 240,000 dowel bars were used to join the new concrete pavement to the existing highway surface, which avoided the need for a gun-applied chemical anchoring system and the disposal of 60,000 contaminated cartridges.

Water

Water efficiency

The project implemented various measures to reduce potable water consumption by around 10 percent during construction. Rainwater was collected in permanent and temporary attenuation ponds for dust suppression and damping. For example, around 79 percent or approximately 2,000 m^3 of the water used for dust suppression and road cleaning at the South Mimms Bund Site came from harvested rainwater between April 2011 and April 2012. Both compound sites used a package sewage treatment plant to enable waste effluent to be fully treated on site and either reused or discharged directly into the environment. Compound and office water use was monitored with water meters on a monthly basis.

Stormwater management

Extensive consultation with the Environment Agency led to the use of a combination of pollution control devices, including silt traps, oil interceptors, hydrodynamic separators, bypass separators and automatic penstock valves. Such solutions improve the quality of highway runoff, facilitate maintenance and enhance biodiversity adjacent to the highway. Highway drainage was also made more low maintenance by incorporating self-regulating offline balancing ponds or attenuation tanks, which require less intervention than inline attenuation. The solutions also reduced the risk of contaminating sensitive ponds and wetland habitats that were adjacent to historically contaminated sites.

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Other Green Aspects

Minimizing environmental impacts

Dust on site was minimized by enforced speed limits and surface dampening in dry weather. Wheel washing facilities, including rumble strips and wheel spinners, were used to ensure that debris and dust was not transferred by site vehicles onto the highway and local roads. The wheel washing facilities were self-cleaning and recycled the water. Road sweepers continually patrolled the highway and local roads to keep them free of debris. The team created Environmental Incident Action Sheets, which advised on what to do in the event of specific potentially damaging incidents. However, there were no serious environmental incidents during the widening project.

Enhancing biodiversity

A biodiversity assessment was made prior to the project to identify important habitats for animals, such as reptiles, Great Crested Newts and bats.

Biodiversity mitigation efforts included:

- 3,000 newts and reptiles relocated
- 47 km of newt/reptile fencing constructed
- 41 water voles captured for a re-colonization program
- 60 bat boxes installed
- 400 bird boxes installed
- mitigation works to 20 badger setts, and badger tunnel
- 2 artificial otter holts created

Tree and shrub clearance was minimized, and around 130,000 new trees and shrubs were planted to more than compensate for the cleared vegetation. Biodiversity enhancement efforts also involved the creation of grassland, scrub and woodland to encourage wildlife back onto highway verges following the widening project. The bird and bat boxes were sourced from a company that makes them from wood off-cuts.

Social Aspects

Stakeholder communication and involvement

The project team sought to involve and communicate with local communities throughout the planning and construction phases via dedicated public relations teams and in cooperation with the Highways Agency. A public awareness campaign informed local residents of how the various stages of the project might affect them, through public meetings, leaflets, project newsletters, online information and a free phone helpline. Local charity events, educational engagement with local schools and the training of local people aimed to leave a beneficial legacy in the community. Over US$ 14,000 had been raised for local charities by the project team as of the summer 2011. The project also won two Considerate Constructors Scheme Silver Awards and one Bronze Award.

Raising sustainability knowledge and awareness

The team made suggestions to the UK Environmental Department on how carbon-related knowledge from the project could be shared through activity sheets, the establishment of a carbon working group, business improvement fora and lunch & learns. Presentations and site visits were also made, including numerous educational safety engagement activities across the project.

Avoiding public disruption during construction

Potentially disruptive activities were scheduled so as to minimize public disturbance. For example, three lanes in each direction were kept open at all peak times and activities that involved significant lane closure, such as the installation of sign gantries, were conducted during the night. Several stretches of the affected highway were reopened to normal traffic speed well ahead of schedule, for example the entire project was completed over 3 months early.

Reducing highway noise disturbance

8.7 km of environmental barriers, bunds or embankments were constructed to reduce traffic noise disturbance for properties adjacent to the scheme. These barriers reduced traffic noise by up to 5 dB for nearby residents and the visual impacts of the highway compared with prior to the project.

Occupational health and safety

The M25 widening project had a high safety risk profile due to its combination of high traffic volumes, heavy equipment and large workforce.

16 Lost Time Incidents occurred between 2009 and May 2012 during 11,866,789 hours, and the project's All Accident Frequency Rate was 1.33 as of May 2012. The project won a RoSPA (Royal Society for the Prevention of Accidents) Gold award. Local children were also actively discouraged from entering the site by publishing information material about the associated dangers, and through participation in the national Crucial Crew Scheme, which involved over 900 school children from 20 different schools in the Thurrock area.

Improving highway safety

The project is intended to reduce congestion, which is expected to improve highway safety by increasing the distance between vehicles. Improved signage, including electronic messaging, will better inform drivers of potential dangers and risks. The project has also improved highway surveillance, including the installation of new monitoring equipment that is linked to the new control systems in the Highways Agency's Regional Control Centre.

Archeology studies

Several archeological surveys were conducted during the widening project. One site of particular importance was a 4-hectare site at Bricket Wood, where the remains of two rare mid 1st century pottery kilns were discovered, documented and relocated, with some to be displayed at a local museum.

Green travel plans during construction

Travel plans were implemented to encourage the project workforce to use more sustainable modes of transport. The plans involved posting public transport information on notice boards and the project website, and offering site minibuses to collect staff from local train stations. All sites had teleconferencing facilities to help avoid the need to travel off-site for meetings. Car sharing was promoted and a cycle rack was constructed to provide secure bicycle storage.

Economic Aspects

Regional construction workforce and materials

Between 600 and 1,350 people were involved in the project depending on the construction phase. The majority of which were from the London area. The M25 project sourced construction materials from the closest suppliers where possible, which made transport-related carbon emission savings, and benefited the regional economy. 56 percent of the supply chain spend was sourced from within 50 km of the site.

Efficiency financial savings

The widening project made significant financial savings. Key financial savings were made by reusing 2.4 million tons of recycled aggregate and saving 360,000 tons of asphalt, which saved approximately US$ 23 million and US$ 38 million respectively (based on US$ 108 /t laid), whilst reducing the project's environmental impacts, including carbon emissions and pressure on landfill space.

Learning From Good Practice

The M25 project made significant environmental and financial savings by designing out waste, identifying opportunities to recycle aggregate and engaging with the supply chain early on in the planning phase.