CASE STUDY: Carillion - Heads of the Valleys, A465 Dualling

SECTOR TYPE: Infrastructure
LOCATION: A465 Dualling, Brynmawr to Tredegar South Wales
CLIENT: Welsh Government
PRINCIPAL DESIGNER: Arup
CONTRACTORS ENVIRONMENTAL CONSULTANT: TACP
PRINCIPAL CONTRACTOR: Carillion
CONTRACT VALUE: Key Stage 3 (Development) £4m
Key Stage 4 (Statutory Process) £2m
Key Stage 6 (Construction) £87m
KS 4 Sept 2011 – Oct 2012
KS 6 Oct 2012 – March 2015

The Project
The Heads of the Valleys, A465 Dualling, Brynmawr to Tredegar, is an Early Contractor Involvement (ECI) road improvement scheme for the Welsh Government.

The existing substandard three-lane carriageway will be replaced by 7.8km of new dual carriageway, approx. 5km of which will be offline reconstruction and the remainder online. The project consists of eight bridges, three underpasses, six major retaining walls and a number of smaller drainage underpass structures. Over 900,000m$^3$ of earthworks are required, of which 300,000m$^3$ is in rock.

The site presents many challenges as it passes over the highest point of the Heads of the Valleys road adjacent to the Brecon Beacons National Park with a rich industrial heritage of coal and ironstone mining.

Carillion was awarded the contract in March 2010 to develop the design and publish orders. A Public Local Inquiry was held to examine the orders in March 2012. Extensive local consultation resulted in just 14 objections, only three of which remained once the Inquiry opened, and eight letters of support. Having received approval to proceed from the Minister in August 2012, Carillion will design and build the project for completion in 2015, with ongoing environmental management until 2020.

The use of a carbon assessment and detailed consideration of various alternatives have resulted in significant predicted carbon and cost savings. Taking account of both short-term and long-term carbon emissions has also impacted on the team's decision making process.
The Benefits

- **Reduced construction carbon** – a whole life carbon assessment was completed to inform design development. It identified carbon expenditure during construction and in operation for the first 60 years. Construction carbon emissions were estimated at 57,059 tonnes, 54,000 tonnes of which were contained in the road pavement, steel and concrete structures. A viaduct structure crossing the Carno Valley contained 9,761 tonnes, whilst an alternative reinforced earth embankment option required only 4,358 tonnes. The latter option was adopted, resulting in a saving of 5,403 tonnes or 10% of the total construction carbon.

- **Reduced operational carbon** – The existing section of highway has three ‘at grade’ junctions, which requires vehicles to stop and start, increasing emissions. Detailed traffic modelling using VISSIM software enabled consideration of these effects on individual vehicles. This showed that in the opening year, as a result of grade separating the junctions, carbon emissions decrease by 10%, saving 2,541 tonnes of carbon. Over the first 15 years of service, 18,304 tonnes will be saved as a result of this improved efficiency. This carbon reduction offsets approx. 35% of the carbon produced during construction.

- **Materials** – construction earthworks accounts for only 4% of total construction carbon. As demonstrated by the viaduct alternative above, earthworks solutions are far more carbon efficient compared to structures when the material is already available onsite.

- **Cost** – the Welsh Government’s outline scheme required disposal of 750,000m³ of surplus earthworks materials. Detailed consideration of vertical alignment, junction provision and requirements for noise and visual mitigation have reduced this to under 75,000m³. This resulted in a client budget saving of £9 million against off-site disposal.

The Process

The key processes underpinning the project:

- The Carillion team invested in the initial carbon assessment to support design development and gather evidence for public consultation. It was also a valuable learning opportunity for the team, supporting decision making and options appraisal.

- The change to the Carno crossing, earthworks profile improvements and grade separation at junctions have all been taken forward into the final design.

- Measurement of actual carbon expenditure during construction will be benchmarked against that predicted in the assessment.

Key Learning Points

- Considering carbon early in the design development process enables its use as a key indicator in the optioneering process.

- **Highway construction carbon** – steelwork, concrete and bituminous surfacing accounted for 80% of construction carbon.

To make meaningful savings, these areas need to be targeted in design - efficient construction will not recoup inefficient design.

- **Highway in-service carbon** – when considering the whole life carbon cost of this project over 60 years, 78% comes from road users. To make carbon savings, highway design needs to make the road as carbon efficient as possible for users. 'In use' efficiency should be considered when appraising short-term construction carbon gains from, for example, adjusting the vertical alignment to balance the earthworks. Considering carbon in both the long-term and short-term is important to ensure that short-term gains are not produced at the greater cost of long-term inefficiencies.

End User Feedback

The Inspector at the Public Local Inquiry, in his opening remarks, said that:

"the evidence is clear and of excellent quality… the Environmental Statement quality is immaculate… it is all most commendable."

Additional Information

**Options Benefits table**

A full breakdown of costs for the entire alternative scheme compared to the final chosen sustainable solution is not available. However, the tables below provide more detailed information regarding cost benefits and carbon analysis.

Three scenarios are detailed below:

1) **Construction Carbon (Replacing Viaduct with Embankment)**

| CAPEX Embodied Carbon | £94m | 57,059 TCO₂e
| Traditional Solution | Sustainable Solution | £88m (-6%) | 51,653 TCO₂e (-10%) |

2) **In Operation Junction Efficiency (Grade separating junctions)**

Operational Carbon (first 15 years)

| Operational Carbon (first 15 years) | £448,407 TCO₂e |
| Traditional Solution | Sustainable Solution | £430,104 TCO₂e (-4% which offsets approximately 35% of construction carbon) |

3) **Total carbon saving in context of first 60 years of service**

| Operational Carbon (first 15 years) | £1,107,000 TCO₂e (-2%) |
| Traditional Solution | Sustainable Solution | £1,107,000 TCO₂e (-2%) |

Learn more

www.a465brynmawr2tredegar.co.uk

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