Electric Arc Furnace 'Green' Steel Reinforcement

A47 Tuddenham & Blofield

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Date: 26/07/2024

Case Study No: CS2454

Knowledge/Case Study Type:

Quality, Efficiency & Improvement

Environment, Sustainability & Carbon

Engineering & Design

Key Points:

Reduction in carbon emissions when using steel for reinforced concrete by switching from conventional Basic Oxygen Furnace (BOF) steel to Electric Arc Furnace (EAF) steel, utilising a higher recycled content with lower associated emissions. This resulted in a product (A1-A3) carbon saving of **2703 tCO2e** (78% reduction) against the baseline for steel reinforcement.

Description

In 2021 National Highways set out their plan for Net Zero Highways which includes a commitment to net zero emissions from construction and maintenance activity by 2040. Galliford Try is committed to achieving this goal and is actively targeting the reduction of Carbon on all projects. Achieving this target will require significant reductions in emissions relating to the materials we use including steel reinforcement which is one of the principal materials for both construction and for carbon emissions.

This case study focuses on the use of Electric Arc Furnace (EAF) steel for use in reinforced concrete in the A47 Tuddenham and Blofield projects, a key initiative to procure and specify lower carbon steel.

Action

Taking inspiration from the National Highways Carbon Opportunities Register, Galliford Try implemented the carbon reduction opportunity with reference STR-045 to procure low carbon steel.

Selecting the right contractors:
We selected steelwork contractors based on their ability to measure and report carbon emissions and their commitment to carbon reduction targets.

Celsa Steel UK: Demonstrates high qualifications and expertise through compliance with British and European standards, CARES approval, and production of high ductility steel. They are committed to sustainable practices and have transparent carbon emission reporting.

Express Reinforcements Ltd.: Holds BES 6001 and Eco-Reinforcement certifications, showing their commitment to responsible sourcing and environmental sustainability.

Low Embodied Carbon Steel:
Emphasis was placed on procuring steel with defined specific emissions intensity, accounting for the proportion of end-of-life scrap.

Specifying Low Carbon Steel Products:
We specified steel products with product-specific or company-specific Environmental Product Declarations (EPDs) to provide transparency about the environmental impact of the steel used.

Comparison of EAF and BOF Steelmaking:

EAF Process: Capable of processing up to 100% scrap content. Scrap used ranges from scrapped cars to turnings from machining factories. A specific blend is used to achieve each product grade. EAF process results in lower emissions compared to the BOF process, which is limited to a technical maximum of 30% scrap content. Additionally, the EAF process can be further decarbonised using renewable or zero-carbon electricity sources.

BOF Process: While necessary for some steel products, the BOF process has higher associated emissions due to its reliance on iron ore and limited scrap content and use of fossil fuels.

Supplier Selection: For this project, we selected Celsa Steel UK, a leading producer of reinforcement steel using the EAF process. Celsa's high ductility hot rolled ribbed steel reinforcement bars met the project's specifications and sustainability goals. Their Environmental Product Declaration (EPD) confirms compliance with ISO 14025 and EN 15804 standards, detailing the environmental impacts from cradle to gate.

Figure 1: Extract from Celsa EPD with registration no: S-P-07496

09 Environmental Product Declaration / **Celsa** Steel UK

3 Environmental Information

Average steel product from the Rod & Bar Mill

Basic environmental impacts	Units	A1-3	C1	C2	C3	C4	D
GWP-GHG	kg CO_2 eq	4.29E+02	5.67E+01	1.94E+01	1.36E+00	5.17E-01	-7.56E+01
GWP-total	kg CO_2 eq	4.37E+02	5.73E+01	1.96E+01	1.38E+00	5.28E-01	-7.95E+01
GWP-fossil	kg CO_2 eq	4.33E+02	5.73E+01	1.96E+01	1.37E+00	5.27E-01	-7.97E+01
GWP-biogenic	kg CO_2 eq	3.53E+00	1.59E-02	1.05E-02	9.55E-04	1.04E-03	2.73E-01
GWP-luluc	kg CO_2 eq	4.36E-01	4.52E-03	6.98E-03	1.69E-03	1.47E-04	-1.28E-02

Notes:

- The baseline carbon intensity in accordance with the latest revision of the National Highways carbon tool (v2.6) is 1.99 tCO2e/t for steel bar and rod.
- From figure 1, a carbon intensity of 0.437 tCO2e/t for reinforcement produced by Celsa was used to quantify the carbon reductions associated with procuring the lower carbon EAF reinforcement.

Result

The A47 schemes selected 1740.54 tonnes of High Yield B500 Ribbed Cut and Bent Reinforcement produced using 100% Single Source UK Supply Chain Reinforcing Bar. This switch from conventional BOF steel resulted in a product (A1-A3) carbon saving of **2703 tCO2e** (78% reduction) against the baseline for steel reinforcement. To put this saving into perspective, a return flight from London to New York producing around 1tCO2e.

Transfer

The methodology and findings of this case study can be applied to other projects where lower carbon steel alternatives are feasible. Galliford Try central resource is available to help achieve our business goals. For more details please contact:

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