



The benefits of **REINFORCED PREFABRICATION**

BAR
BRITISH
ASSOCIATION OF
REINFORCEMENT
www.uk-bar.org

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The British Association of Reinforcement [BAR] is the trade association of UK manufacturers and fabricators of steel reinforcement products including cut and bent bar and mesh as well as suppliers of associated reinforcement products. BAR aims to add value to the UK reinforcement sector through the promotion of good industry and health and safety practices, product and market development, and by forwarding the benefits of reinforced concrete construction solutions.

Disclaimer

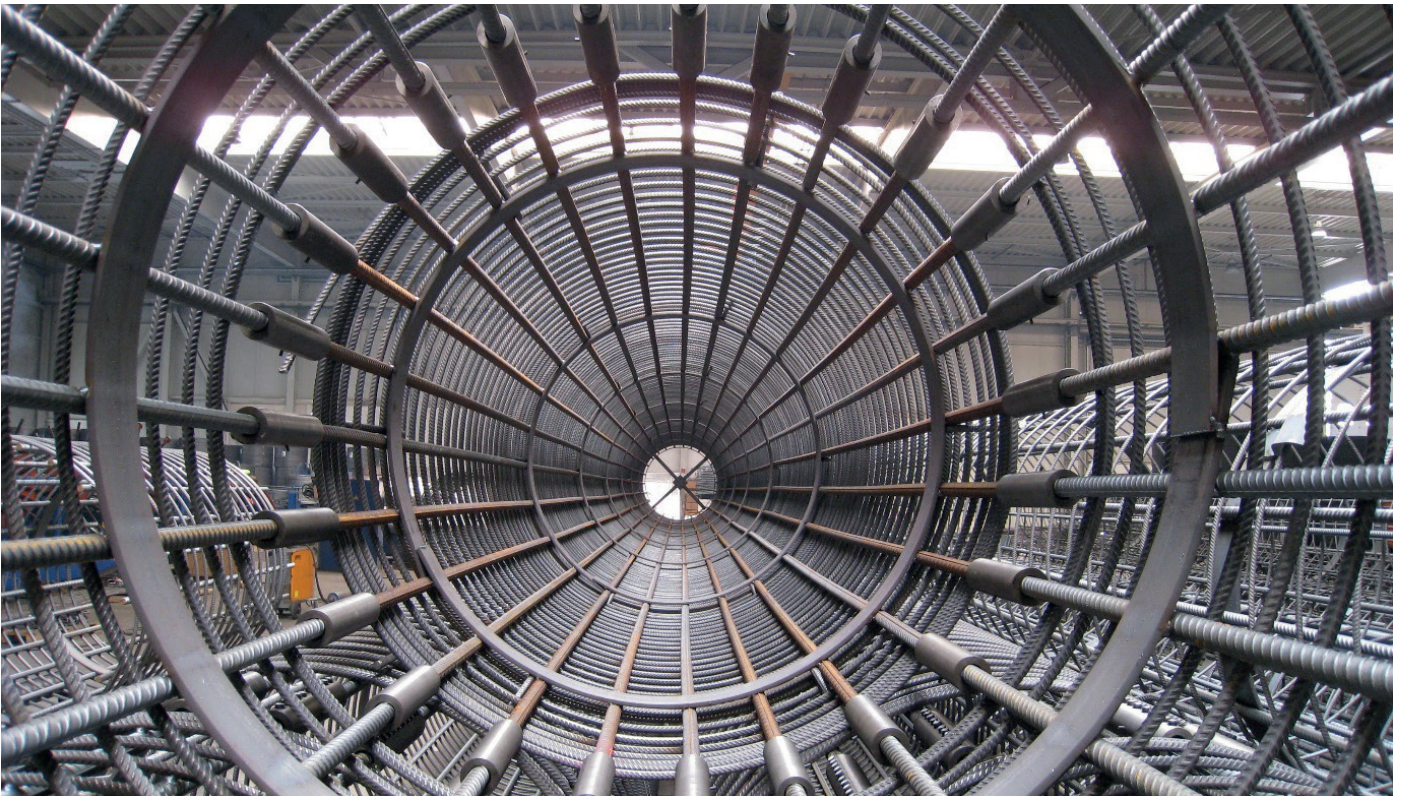
This document has been prepared by the British Association of Reinforcement [BAR] to provide information on the benefits of prefabricated reinforcement. All advice and information herein is intended for those who will evaluate the significance and limitations of its contents and take responsibility for their use and application. No liability (including that for negligence) nor any loss resulting from such advice and information is accepted by BAR. Readers should note that this publication is subject to revision from time-to-time and they should, therefore, ensure that they are in possession of the latest version.

INTRODUCTION

The construction industry is being driven by the need for greater cost efficiencies and increased sustainability. The use of reinforcement prefabrication can deliver both of these. Reinforcement prefabrication incorporates all of the benefits of Modern Methods of Construction by providing a quality controlled, factory manufactured product that benefits from simplified detailing, is delivered to site on a just-in-time basis where it can be fixed simply and quickly. The result is reduced construction time, reduced on-site labour requirements and increased buildability with improved site planning and organisation.

There is also the sustainability benefit of reducing waste that comes from the full involvement of the reinforcement fabricator at the design stage. The fabricator, armed with in-depth experience and expertise, can provide prefabricated solutions that fully embrace reinforcement repetition for increased cost savings and reduced material waste whilst still allowing the freedom to determine the specific bar size and space to suit particular design requirements.

PREFABRICATED REINFORCEMENT: A MODERN METHOD OF CONSTRUCTION



The traditional method of placing reinforcement involves using cranes to move bundles of bars close to the fixing location and then tying individual bars into position using falsework and formwork for support. This can pose safety concerns when steel fixers are working on elevated platforms. It also leads to longer construction time as workers are required to offload bundles of cut & bent reinforcement from a trailer into a storage area. The relevant bundles then need to

be identified prior to being moved to the location as and when they are required.

This inefficient use of man-hours dedicated to reading drawings, schedules, identifying bundles of bars and fixing requires more highly skilled workers at a higher cost.

As a recognised Modern Method of Construction [MMC], prefabricated reinforcement offers a cost efficient and sustainable alternative.



MMC is focused on offsite factory construction techniques that enable fast onsite installation. It is a construction approach that has many significant benefits over more traditional building techniques. For prefabricated reinforcement, these include:

■ Assured quality

MMC prefabricated units produced in a factory-controlled environment have consistent quality and precision and allow for greater accuracy of reinforcement placement and installation,

■ Increased site productivity

The use of prefabrication increases onsite productivity and efficiency with units being delivered just-in-time for installation and allows for streamlined processes that can reduce construction costs, for example, reduced onsite handling and crane operation time. Given the difficulties of many sites with greatly reduced space and vehicle access, prefabrication allows reinforcement items to be taken direct from the delivery vehicle straight to installation, therefore reducing site congestion. The use of MMC prefabrication means that site programmes are not affected by poor weather that can delay traditional construction,

■ Improved site health and safety

Prefabricated reinforcement offers improvements in onsite management and health and safety resulting from the removal of reinforcement tie bars, stray bars and surplus tying wire provides a tidier, and therefore safer, site. Plus, it reduces the time that operatives work at height or in enclosed spaces,

■ Rationalised solutions

Smart prefabricated solutions provide simplified and rationalised detailing that reduces congestion, improves buildability and reduces materials waste thanks to the realisation of repetition and standardisation,

■ Reduced onsite labour requirements

With the construction industry facing a skills shortage this is increasingly important.



REINFORCEMENT PREFABRICATION APPLICATIONS

In addition to the traditional and accepted forms of prefabricated reinforcement such as pile cages and diaphragm wall panels, reinforcement prefabrication can also be used for a wide range of structural and civil elements. This includes rafts, pile-caps, bases, slabs, columns, beams and walls that accordingly come in a multitude of shapes and sizes.

Mesh fabric is the most common form of prefabricated reinforcement as specified in BS 8666:2020 Table 6. Other mesh fabric can be machine

manufactured using bar diameters up to 20mm and offering flexibility of bar size and spacing. Refer to supplier for availability.

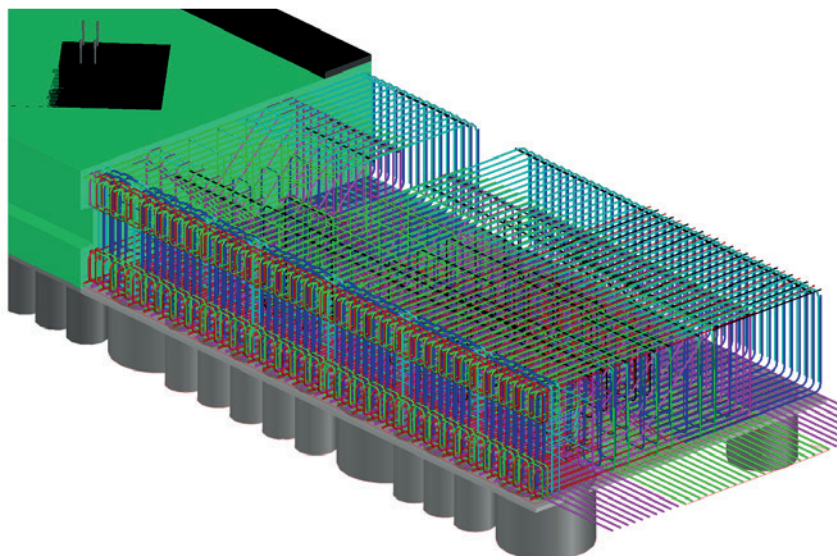
In addition, welded mats which are manually welded can be manufactured up to 2.9m wide and 14m in length using bars diameters of 12 to 50mm. A variety of bar spacings and staggered laps can be incorporated as well as the use of bent bars. Transportation must be considered when designing bespoke mats.



PREFABRICATED REINFORCEMENT CASE STUDIES

BAR member fabricators have a wide range of experience and expertise in delivering MMC prefabricated reinforcement, as the case studies below demonstrate:

EXPRESS REINFORCEMENTS: LEADENHALL BUILDING



The project involved constructing a Level 3 basement with a donut-shaped raft foundation measuring 2.7 meters in thickness. Incorporated into this design was a shear key to facilitate the future addition of a downstand beam for the Level 4 basement slab.

During construction, access to the shear key face was limited, requiring reinforcement to be installed from behind. The design required the shear key face to function as a waling beam, necessitating the placement of 28 B40 rebars arranged in seven layers. Additionally, the piles adjacent to the retaining wall were equipped with protruding reinforcement bars.

To meet this challenge, Express Reinforcements engineered an innovative cage system positioned perpendicular to the retaining wall, encompassing the majority of the shear key reinforcement and incorporating integrated chair bars and supports for the waling beam bars. A strategic “trombone” U-bar design was implemented at the rear, serving dual purposes: it allowed for efficient transportation of the cage in a compact form, and upon deployment, the U-bars could be released and pulled through the pile reinforcement toward the retaining wall, ensuring adequate lap length. By integrating steel supports for the waling bars within the cage, these bars could be fed through seamlessly from the end of the pour once all cages were positioned, significantly reducing laps in the pour process. Importantly, the need for working at height was virtually eliminated through this process.



Two cages positioned end-to-end on a trailer. The top bars are spaced 50mm apart at 235mm centres, and the largest cage weighed 5.1 tonnes.

EXPRESS REINFORCEMENTS: THAMES TIDEWAY

The project involved constructing the base slab for the Thames Tideway's Kirtling Street shaft, a 60-meter deep shaft with a diameter of 32 meters, which required nearly 600 tons of steel reinforcement. The construction of the shaft was a critical path on a challenging schedule and posed significant health and safety risks.

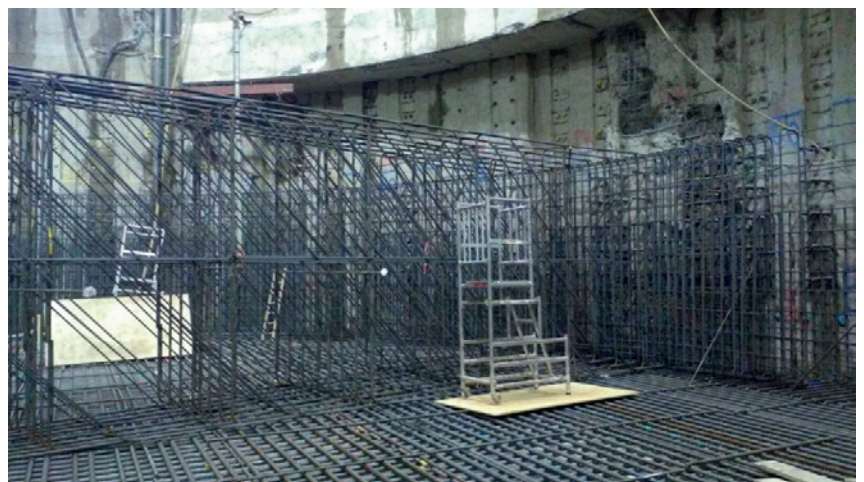
The site team, in collaboration with Express Reinforcements, sought approval to modify the slab design from a domed excavated profile to a flat base slab. This change aimed to enhance installation efficiency and support the project's schedule, as identified during detailed planning. The revised design facilitated over 90% of steel reinforcement to be prefabricated off-site, thus hastening on-site work and addressing key residual risks highlighted by the design. This aligns with the principles of CDM regulations for safety and efficiency.

Steel reinforcement was pre-fabricated into two primary components:

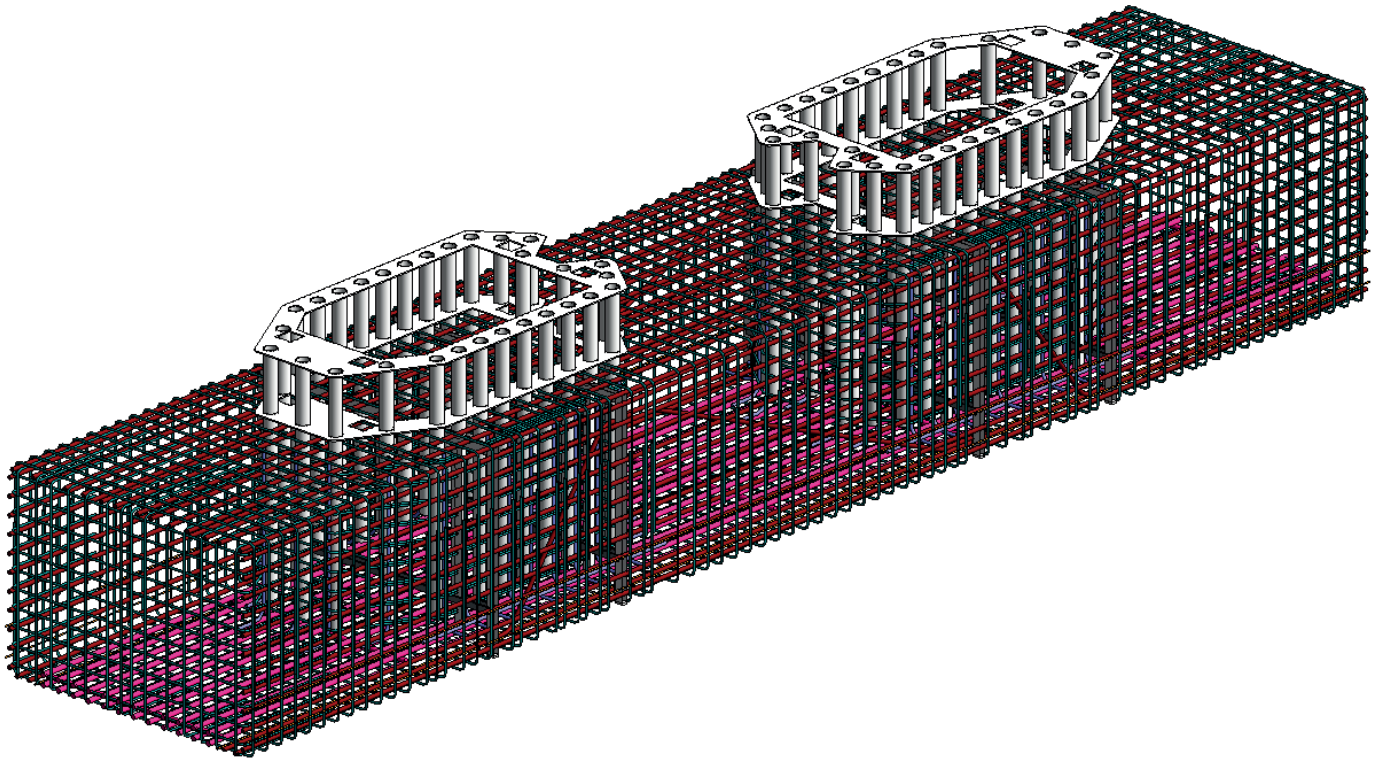
1. Welded mats for the two lower and six upper steel layers.
2. Pre-fabricated radial beams incorporating shear reinforcement, temporary steel chairs, spacers, and support steel for nearly 300 tonnes of top mats, alongside concrete placement systems. Fifty radial beams were required, each weighing 2.33 tonnes.

The prefabrication strategy ensured that major components were lifted and positioned using on-site gantry cranes, eliminating manual handling risks. The use of prefabricated radial beams allowed for the secure installation of upper steel mats from a stable platform, effectively mitigating the risk of falls while working at height - a critical concern identified if fixing the steel in-situ at nearly 4 meters above blinding. The installation of prefabricated steel for the base slab was completed safely within three weeks, achieving peak installation rates of up to 70 tons per day.

Subsequently, the shaft upstand walls were also pre-fabricated, and this successful approach was extended to the remaining central shafts.



ARCELORMITTAL CONSTRUCTION SERVICES: THAMES VALLEY VIADUCT



This project involved a complex pile cap design that required millimetre precision and was initially requested to be delivered loose as cut and bent. Due to the precision required, AMCS proposed these cages be designed through 3D modelling and delivered as prefabricated elements. 3D modelling detected potential clashes and allowed the prefabricated elements to be produced to the specified tolerances.

For fabrication, the elements jigs were taken directly from the models which allowed for accurate and efficient placement of all links

and main bars in their final locations. This improved site safety by mitigating the need for manual handling and using cranes to hoist bars into position for welding and by eliminating working at height hazards.

By prefabricating these elements material steel reinforcement was optimised and waste minimised thanks to precise cutting and assembly rather than on-site fabrication. Another benefit from this, and all, off-site prefabrication was reduced requirements for on-site labour and reduced carbon footprint.



ARCELORMITTAL CONSTRUCTION SERVICES: THAMES TIDEWAY PORTALS AND LINING WALLS

The Thames Tideway project involved construction of a variety of different prefabricated elements including lining walls and portals. The project took place across five different sites- Chambers Wharf, Deptford, Greenwich, King Edward Memorial Park, and Earl Pumping Station.- that required a combined 2000 tonnes of prefabricated portals, lining walls, and the lapping steel to accompany them. In addition to these, the diaphragm walls and base slabs for these sites were also prefabricated and delivered in the earlier stages of the project.

The portals comprised of four sections, with the heaviest exceeding 30 tonnes. Due to the large quantities of steel used within the fabrication of these elements, it was important to ensure that pitches of main steel were as per the design in order to join all four sections together without issue, and to ensure that the portal eye was the correct diameter. To ensure the accuracy of the portals, and lining walls, the elements were prefabricated using jig plates with bar positions cut out/etched into them for precision placement.

Prefabricating these elements offsite provided a range of benefits including a quick and safe fabrication style, with manual handling risks eliminated, through crane usage and cut outs in the steel frames to support the bars as they are being welded. Additionally, there was reduced labour requirement and the sites were not overly congested, with fabrication being conducted inside sheltered factories which prevent additional delays from weather. Due to the elements' sizes and quantities it was important to ensure that installation was fast and efficient. The use of 3D modelling ensure this by checking and removing potential reinforcement clashes whilst prefabricated elements all had pre-delivery inspections and just-in-time programming.



REALISING THE POTENTIAL OF PREFABRICATION

Early involvement and meaningful engagement with the reinforcement fabricator means that the full benefits of repetitive prefabrication with all the advantages of rationalisation and economies of scale are realised. It means that the most efficient prefabricated unit is designed, manufactured and delivered to site ready for fast installation. All BAR member prefabricated assemblies are subject to the requirements of the most up to date standards for reinforcement, their fabrication and welding.

BAR members are committed to realising the potential of reinforcement by aiming to deliver the following:

■ Delivering a quality product

All BAR fabricators and the reinforcement that they offer meet and conform to all relevant UK and international standards. In addition, BAR members sit on industry committees to provide expertise for standards review and development.

Furthermore, all BAR members are fully signed-up to recognised industry certification schemes. Their accreditation provides external recognition of consistent product quality and adherence to standards that is underlined by regular, independent auditing.

■ Delivering a sustainable product

All BAR members are committed to reducing their environmental impact and increasing their sustainability credentials.

Reinforcing steel is produced using recycled material via the Electric Arc Furnace (EAF) method, giving a 97% recycled content to the finished product. Producing steel by the EAF method currently reduces the carbon footprint by nine times when compared to the Basic Oxygen Furnace (BOF) method. The reinforcing steel produced by BAR members is 100% recyclable.

All members are actively addressing key issues such as waste management, recycling, reduction of water and energy usage and reduction of transport emissions.

The commitment of BAR members to ongoing environmental improvement is underlined by their accreditation to recognised sustainable certification schemes such as EcoReinforcement, the CARES Sustainable Construction Steels scheme and standards such as BES6001 and ISO14001.

■ Delivering a responsibly sourced product

Responsible sourcing is an important consideration for BAR members who have all adopted this approach to their sourcing and supply chains. Each of them actively and consciously source materials and products in an ethical, sustainable and socially conscious way.

In addition, BAR members are fully signed-up to comprehensive health and safety programmes, anti-human slavery and equality policies, and the implementation of robust supply chain traceability and corporate accountability.

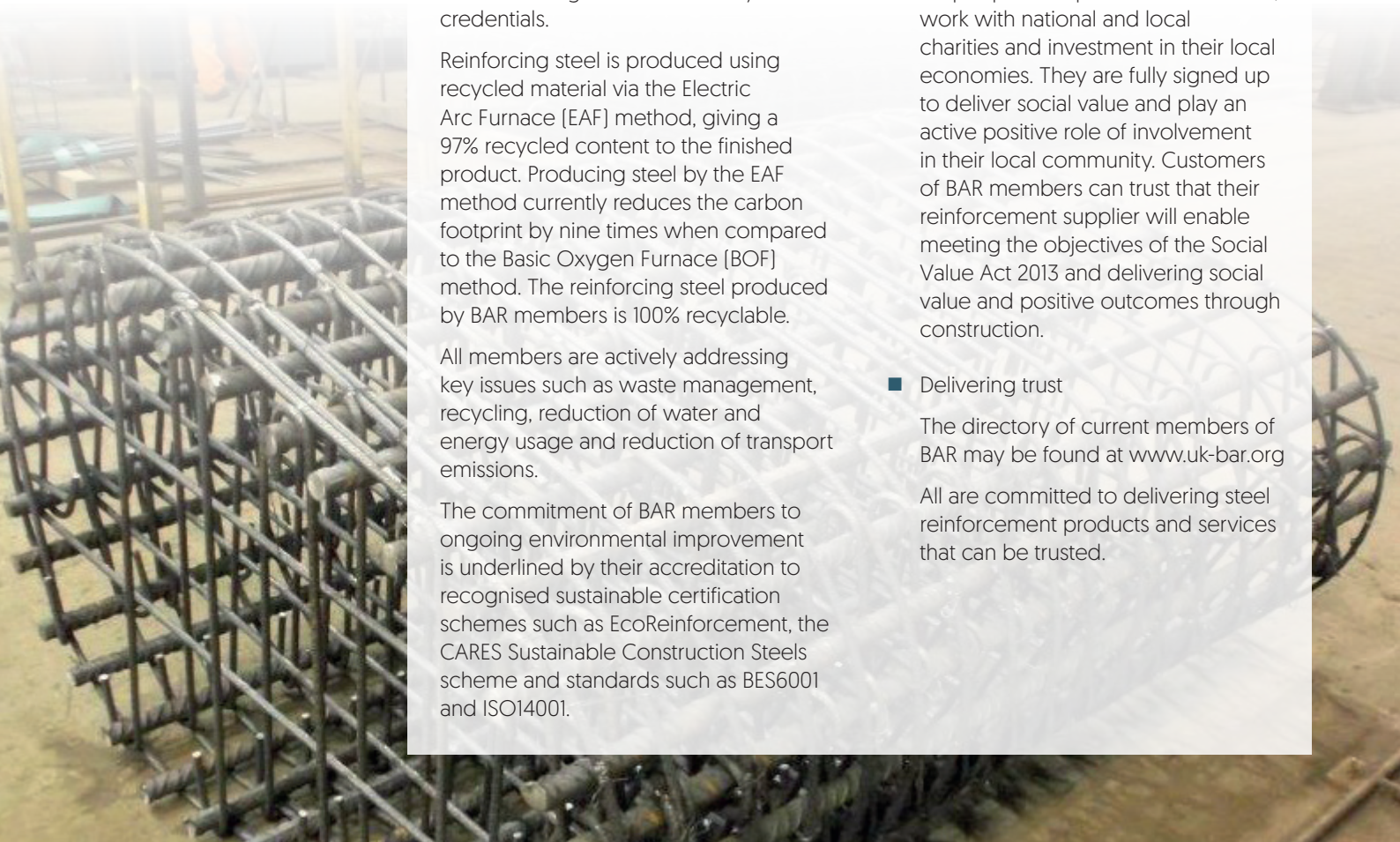
■ Delivering social value

BAR members have active programmes of community and schools engagement, employment for people with previous convictions, work with national and local charities and investment in their local economies. They are fully signed up to deliver social value and play an active positive role of involvement in their local community. Customers of BAR members can trust that their reinforcement supplier will enable meeting the objectives of the Social Value Act 2013 and delivering social value and positive outcomes through construction.

■ Delivering trust

The directory of current members of BAR may be found at www.uk-bar.org

All are committed to delivering steel reinforcement products and services that can be trusted.



RAISE THE BAR

A man in a dark blue t-shirt and light grey shorts is performing a squat in a gym. He is holding a barbell with yellow weights above his head. The background is a blurred gym environment with other people and equipment.

FOR REINFORCED SUCCESS CHOOSE A MEMBER OF
THE BRITISH ASSOCIATION OF REINFORCEMENT

- DELIVERING QUALITY AND ADDED VALUE
- FULL ADHERENCE TO REQUIRED TECHNICAL AND INDUSTRY STANDARDS
- COMPLIANCE WITH RELEVANT CERTIFICATION SCHEMES
- COMMITMENT TO HEALTH & SAFETY, SUSTAINABILITY AND SOCIAL VALUE
- ONGOING PRODUCT INNOVATION AND PROCESS DEVELOPMENT



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