

## Stainless Steel Rebar Supplied to the A82 Allt Chonoglais Bridge, Scotland

The existing A82 Allt Chonoglais Bridge was identified as being understrength to carry future traffic loads. Its repair and strengthening was deemed uneconomic and so in August 2012 work started to demolish and replace the existing bridge with a new stronger reinforced concrete structure, incorporating both carbon steel and stainless steel rebar.

### The Problem

Concrete reinforcement corrosion is the major cause of premature deterioration of reinforced concrete structures not only in the UK but worldwide. The corrosion of carbon steel reinforcement is usually due to the presence of chlorides which can penetrate the concrete. The two main sources of chlorides are sea water and de-icing salts applied to roads and highway structures. The level of chlorides in concrete can build up with time and when a certain level is reached, the so called critical chloride threshold level (CCTL), corrosion of the reinforcement is initiated. This leads to a deterioration of the surrounding concrete, loss of reinforcement cross section and a reduction in structural strength as a consequence.



Original Allt Chonoglais Bridge prior to demolition and showing signs of rebar corrosion

## The Solution

In order to create a durable and economic bridge over the full design life period, and in line with the recommendations of both the Highways Agency Interim Advice Note IAN 124/11 and Transport Scotland, TS Interim Amendment No.39, it was decided by the consultant engineers that stainless steel rebar should be used in the areas which are at greater risk from chloride induced reinforcement corrosion due to the application of de-icing salts during the winter months. This included the bridge deck, abutments, wing walls and bearing plinths.

## Implementation

The original specification called for 1.4301 (304) stainless steel rebar, but after several weeks of discussions and correspondence with Outokumpu, steel designation 1.4362 (2304) was accepted as an alternative.

The BS 6744 duplex steels 1.4162 (LDX2101) and 1.4362 (2304) are now widely used both in the UK and worldwide and are replacing the more traditional 1.4301 (304) and 1.4436 (316) steel designations, due to their competitive and cost stable price and their high resistance to chloride induced corrosion in concrete. Tests show that both steels have a CCTL over 4% per mass of cement at room temperature, which is over ten times the figure usually associated with carbon steel rebar and beyond the levels normally expected at typical rebar depths of cover, concrete quality, and for a 120 year design life, even in the most severe of chloride environments.

An order for 67 tonnes of cut and bent to shape, 1.4362 stainless steel rebar, in diameters 10, 16 and 25mm was placed with Outokumpu in November 2012. In order to avoid contamination with carbon steel, all of the stainless steel rebar was fully cut and bent to shape on machinery designed and used solely for stainless steel rebar, as recommended by guides and advice notes published by The Concrete Society, fib and various other bodies.



Stainless steel reinforcement having been fully cut and bent at Outokumpu's Sheffield Stainless Bar facility

The first stainless steel rebar deliveries to the construction site took place during December 2012, with subsequent deliveries taking place in January and February 2013. In total, over 7000 individual pieces of stainless steel rebar were supplied.



New Bridge under construction

**Outokumpu Stainless Ltd**  
Long Products  
PO Box 161, Europa Link, Sheffield, S9 1TZ, United Kingdom  
Tel: +44(0)114 261 6000, Fax: +44(0)114 6006, [www.outokumpu.com](http://www.outokumpu.com)

Registered Office: PO Box 161, Europa Link, Sheffield, S9 1TZ, United Kingdom, Registered in England Number 2794127



Wing walls and bridge deck under construction using stainless steel rebar

Stainless steel rebar is being increasingly used in high chloride environments to produce durable concrete structures with medium to long design lives. In fact, cost studies in Concrete Society and fib technical reports show that in high chloride environments and over the full design life period, it is cheaper to initially use stainless steel rebar than conventional carbon steel, because of the costs of remedial work and concrete repair due to the effects of corroding carbon steel rebar within the design life.

Outokumpu are the only manufacturer to provide critical chloride threshold level data on their stainless steel rebar and the level of technical assistance often required by consultant engineers. All of which makes Outokumpu the supplier of choice for stainless steel rebar.

The new Allt Chonoglais Bridge joins a growing number of road bridges and coastal structures both in the UK and worldwide to use Outokumpu's stainless steel rebar.

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**Project Details:**

Client: Transport Scotland

Consultant Engineers: Scotland Transerv

Contractor: Morrison Construction Ltd

Stainless Steel Rebar: 1.4362 (2304) in diameters 10mm, 16mm and 25mm. Manufactured and supplied by Outokumpu. Total quantity 67 tonnes

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