Schöck ComBAR®

Schöck ComBAR®
The alternative solution in reinforced concrete structures

The new generation glass fibre reinforced polymer (GFRP) rebar Schöck ComBAR® is a viable alternative to the various methods attempted to date to alleviate corrosion problems due to its extremely high tensile strength (more than twice that of steel rebar). It is corrosion resistant, extremely durable, non-magnetic, easily machined, is much lighter than steel and has equivalent bond properties.

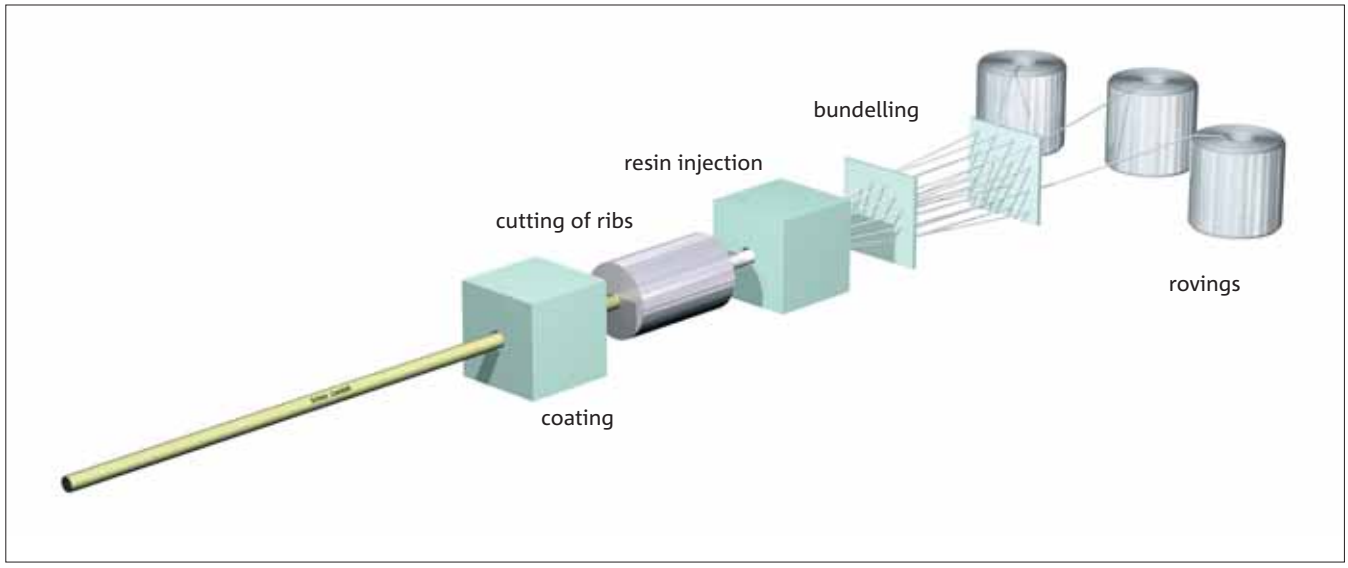
Unsurpassed properties

High tensile strength & extremely durable
Extremely high tensile strength allows for large factors of safety in the structural design of concrete members and structures, such as bridges.

Chemical resistance
Schöck ComBAR® is permanently resistant to acids and bases. Corrosion protection is not required. Thus, Schöck ComBAR® is ideally suited for any type of construction in highly corrosive environments.

Non-conducting & non-magnetic
As it is electromagnetically non-conducting, ComBAR® is ideally suited for applications in electrical and research facilities.

Easily machined
Schöck ComBAR® can be cut by tunnel boring machines. Therefore it is the ideal temporary reinforcement in tunneling projects resulting in substantial time and cost savings.



GFRP Specialty: Double Headed Bars

A significant characteristic of pultrusion is the fact that it is a linear process. A large number of glass fibre strands is pulled through the pultrusion machine. The resin is injected onto the closely grouped and linearly oriented fibres at high pressure. As high-strength and chemically durable resins harden virtually immediately, it is not possible to pull the bars around corners or to bend them into stirrups.

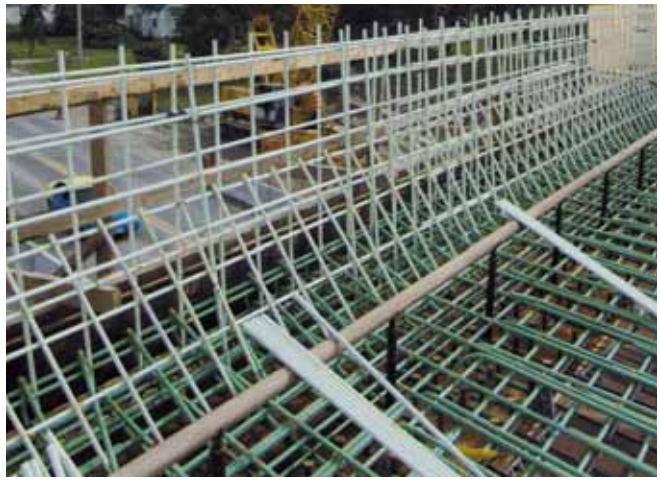
In conventional reinforced concrete members, shear forces are usually transferred via stirrups. Research and development at several producers of GFRP rebar focus on the production of stirrups and bent bars strong enough to transfer sufficient loads for the installation as shear reinforcement. An alternative GFRP reinforcement element to stirrups is the ComBAR double headed bolt. The headed ends of these bolts are form-sprayed onto the bar ends at high pressure. The head is composed of a resin which is chemically very similar to the resin matrix used in the pultruded bar. As a result, it has similar durability properties as the straight bar.

Certification tests in Canada and Europe
At this point only a small number of codes exist for the testing of GFRP rebars and for the design of concrete sections using GFRP rebar. In the United States guidelines and recommendations have been developed by the American Concrete Institute (ACI). In Canada the Canadian Standards Association (CSA) and the ISIS are the two bodies which have developed guidelines on the design and testing of GFRP rebar. All these guidelines require tests of the tensile strength, the modulus of elasticity, the bond properties, the creep and fatigue behaviour as well as the durability of the bars.

Tests according to ACI 440.R3 have shown that ComBAR bars exceed all requirements for long-term installation. In Canada the extremely high tensile strength of the bar was confirmed. In addition, the material was certified to clearly exceed the requirements for a Grade I GFRP reinforcement as specified by the ISIS Research Network Canada. The main criterion for this classification is the modulus of elasticity. Grade I bars must have a modulus of at least 50 GPa. ComBAR's Young's modulus is higher than 60GPa for all diameters.

Temperatures in Canada can be very low and deicing salts are often required to keep traffic flowing in the winter months. This combination represents one of the harshest exposure environments for reinforced concrete structures. To insure that ComBAR bars retain their load bearing capacity in concrete at extremely low temperatures the tensile properties were tested at sub-zero temperatures. Tests at temperatures as low as -40 °C showed no significant effects on the mechanical properties of ComBAR bars.

In most of Europe, GFRP bars are certified by the existing materials certification authorities. General construction permits have been issued in Germany (ø 16 mm) and in The Netherlands (ø 8, 12, 16 mm).



Schöck ComBAR® **in barrier walls**

A significant issue in both European certification processes was the durability testing of the GFRP bars. An entirely new durability concept was developed for this purpose which is experiencing growing international acceptance.

References in Canada

The first installation of ComBAR material in highest load level PL-3 type barrier walls on a bridge (classification according to CSA) occurred at the Irvine Creek Bridge, a tributary to the Grand River, near Fergus, Ontario in the summer of 2007.

In the process of a general bridge rehabilitation, commissioned by the Ministry of Transportation Ontario, the existing barrier walls and the top slab of the bridge were removed. Originally the structural design called for epoxy coated steel rebar to be installed in the new bridge deck and for stainless steel rebar in the barriers. After finding out about (ø 16 mm) and its greatly improved material properties, the contractor on the project decided to install this rebar in the barrier walls.

Irvine Creek Bridge near Fergus, Ontario, Canada

Irvine Creek Bridge near Fergus, Ontario, Canada

Meanwhile the first approach slabs have been reinforced with ComBAR in Ontario.

MTO approved the contractor's Change Proposal to replace the 20 mm diameter stainless steel bars with 16 mm diameter ComBAR bars. All MTO requirements were met.

Quantum-Nano Centre in Waterloo, Ontario, Canada

These were: equivalent flexural capacity at ULS, compliance with SLS stress limit for GFRP of 0.25 x fu and limitation of crack width < 0.50mm under load. In addition, ComBAR's unique anchorage system was able to replace the bent bar connectors between the slabs and the wingwalls.

Several further bridge rehabilitation and new bridge projects in Canada using ComBAR as reinforcement in the barrier walls and parapets as well as the approach slabs will commence soon or are in the planning phase. Also in planning are projects where not only the barrier walls but the entire bridge deck and the bridge curbs are to be reinforced with ComBAR.

In the winter of 2008/2009 ComBAR has also been installed in the approx. 600 m^2 raft foundation on the ground floor of the new Quantum-Nano Centre in Waterloo. The new centre will be the first nano technology research facility of its kind in the world. The fact that ComBAR is non-magnetic was the deciding property in addition to its superior bond properties (crack width limitation requirements) as well as its durability characteristics.

Summary

A new generation GFRP rebar has been developed over the past couple of years. Schöck ComBAR® has substantially improved material properties compared to first generation GFRP rebars available on the world markets. The high strength and extreme durability of these bars make them suitable for long-term installation. As the bond, creep and fatigue properties of the new bars are equivalent to those of conventional steel rebar the bars meet all the requirements for installation in high-rise and bridge structures.

An extensive testing program in Europe and in Canada as well as first bridge projects in Ontario have proven that ComBAR can be a technically and economically feasible alternative to other corrosion protections measures.

About Schöck

As an international supplier to the building industry, Schöck develops, produces and markets innovative components for structural applications with additional thermal and acoustic benefits. Schöck focuses on innovative solutions for the prevention of thermal bridges and impact noise in buildings.

Schöck Isokorb®

The core product is the Schöck Isokorb® - the load-bearing thermal insulation element for preventing thermal bridges in cantilever components such as balconies or canopies. Schöck is the leading specialist in this field with over 10 million installations in Europe over more than 25 years. 12,000 standard types and solutions for applications in concrete, steel and wood are produced. With many decades of experience in balcony connections, Schöck was the first to produce product and system solutions for balcony renovations and refurbishments using the Isokorb® Type KST and Purismo® balcony system.

Besides the other thermal and acoustic products such as Schöck Novomur® and Schöck Tronsole® for housing construction, the company has also developed high-performance elements for industrial and commercial construction with Schöck Bole® and the Schöck dowel system.

Schöck achieved the breakthrough in specialized reinforcement with the development of the Schöck ComBAR® GRP reinforcement. This material is non-corroding, resistant to chemical attack, not magnetisable, electrically insulating and has high thermal insulation properties.

All Schöck products are subject to strict quality control. Evidence for the safety of the components is provided by numerous certifications and awards. Besides product innovation, Schöck particular importance on service features placedssuch as application technology, seminars, design programs, the websites, technical documentation and an enthusiastic site support team offering technical advice. The international Schöck AG Group with its headquarters in Baden-Baden employs a total of 450 staff. In addition, Schöck is represented in Essen, Halle/Saale, Austria, Hungary and Poland through its production and logistics facilities. Foreign subsidiaries are located in Austria, Switzerland, the Netherlands, France, Great Britain, Canada, Poland and Hungary. Schöck's international business activities extend beyond these countries through agencies or business partners throughout Europe, in the Middle East and in Japan. The Schöck Group is ISO 9001 certified.

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