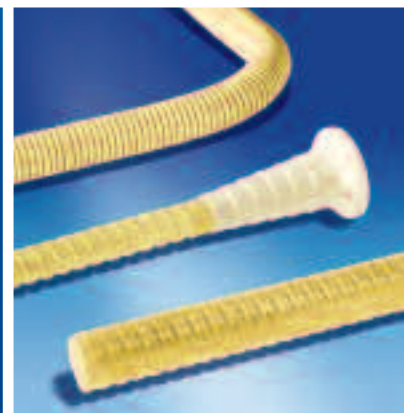


# WHERE STEEL REACHES ITS LIMITS

## SCHÖCK COMBAR®: GFRP REBAR



**Schöck**  
build simply better

# SCHÖCK COMBAR®: AT THE CORE OF EXTRAORDINARY STRUCTU



►► For decades steel has played an important role as reinforcement in concrete. There are, however, applications which cry out for an alternative. This is where Schöck ComBAR® comes in. Its unique material properties are similar to those of steel, but Schöck ComBAR® is resistant to chemicals and magnetically as well as electrically non-conductive. In addition, it is easily machined. As a result, Schöck ComBAR® is not only well suited for long-term application, but also for temporary installation. It is a building material with entirely new capabilities: a new world for engineers and planners. ◀◀

## GFRP-REBAR: UNIQUE ADVANTAGES COMPARED TO STEEL.



### HIGH TENSILE STRENGTH

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.

## SCHÖCK COMBAR® - STEEL: THE COMPARISON

material properties of straight bars (acc. DIN 1045-1)	reinforcing steel DIN EN ISO 15630 DIN 488	stainless steel EN 10088	Schöck ComBAR®
tensile strength $f_{tk}$ (N/mm <sup>2</sup> )	550	550	1000 char.
characteristic yield strength $f_{yk}$ (N/mm <sup>2</sup> )	500	500	1000
design value of yield strength $f_{yd}$ (N/mm <sup>2</sup> )	435	435	435
strain at service load	2.18 ‰	2.72 ‰	7.25 ‰
tension modulus of elasticity (N/mm <sup>2</sup> )	200,000	160,000	60,000
design value of bond stress $f_{bd}$ C20/25 (N/mm <sup>2</sup> )	2.3	2.3	2.3
design value of bond stress $f_{bd}$ C30/37 (N/mm <sup>2</sup> )	3.0	3.0	3.0
design value of bond stress $f_{bd}$ C40/50 (N/mm <sup>2</sup> )	3.7	3.7	3.7
concrete cover	acc. to DIN 1045-1	$d_s^* + 10$ mm	$d_s^* + 10$ mm
density (g/cm <sup>3</sup> )	7.85	7.85	2.2
thermal conductivity (W/mK)	60	15	< 0,5
coefficient of thermal expansion $\alpha \cdot 10^{-6}/K^{-1}$	$0.8 - 1.2 \times 10^5$	$1.2 - 1.6 \times 10^5$	$0.6 \times 10^5$ (axial) / $2.2 \times 10^5$ (radial)
magnetism	yes	very low	no

\* $d_s$  = bar diameter

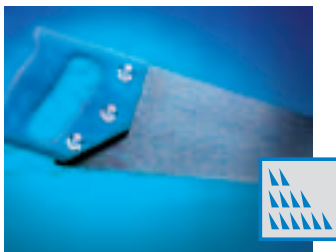


**CONTINUOUSLY  
IMPROVED, TESTED  
IN THE FIELD**



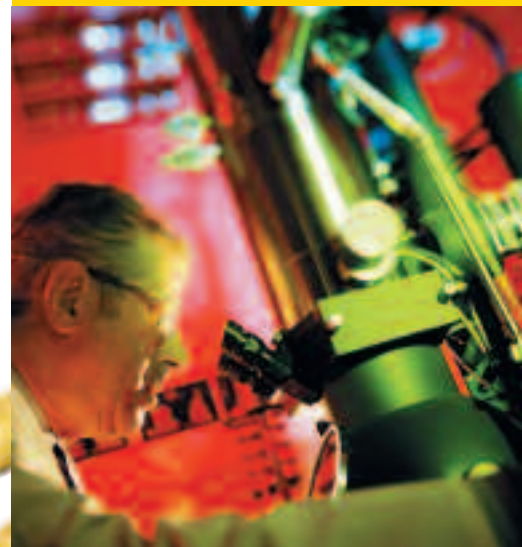
### NON-CONDUCTING

As it is electro-magnetically 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 tunnelling projects. The installation of ComBAR® results in substantial time and cost savings.



## THE RESULT OF RESEARCH AND TECHNOLOGY

Schöck has invested in the development of ComBAR® since 1995. In close cooperation with leading research organisations, the product was successfully introduced to the market. We would like to thank the following personalities and institutions:



Prof. Schießl, Institut für Baukonstruktionen  
(Institute for Building Structures), TU München



Prof. Wörner, Institut für Statik  
(Institute for Structural Engineering), TU Darmstadt



Prof. Ehrenstein, Institut für Kunststofftechnik  
(Institute for Polymer Technology), Erlangen



Deutsche Bundesstiftung Umwelt  
(German Federal Environmental Foundation)

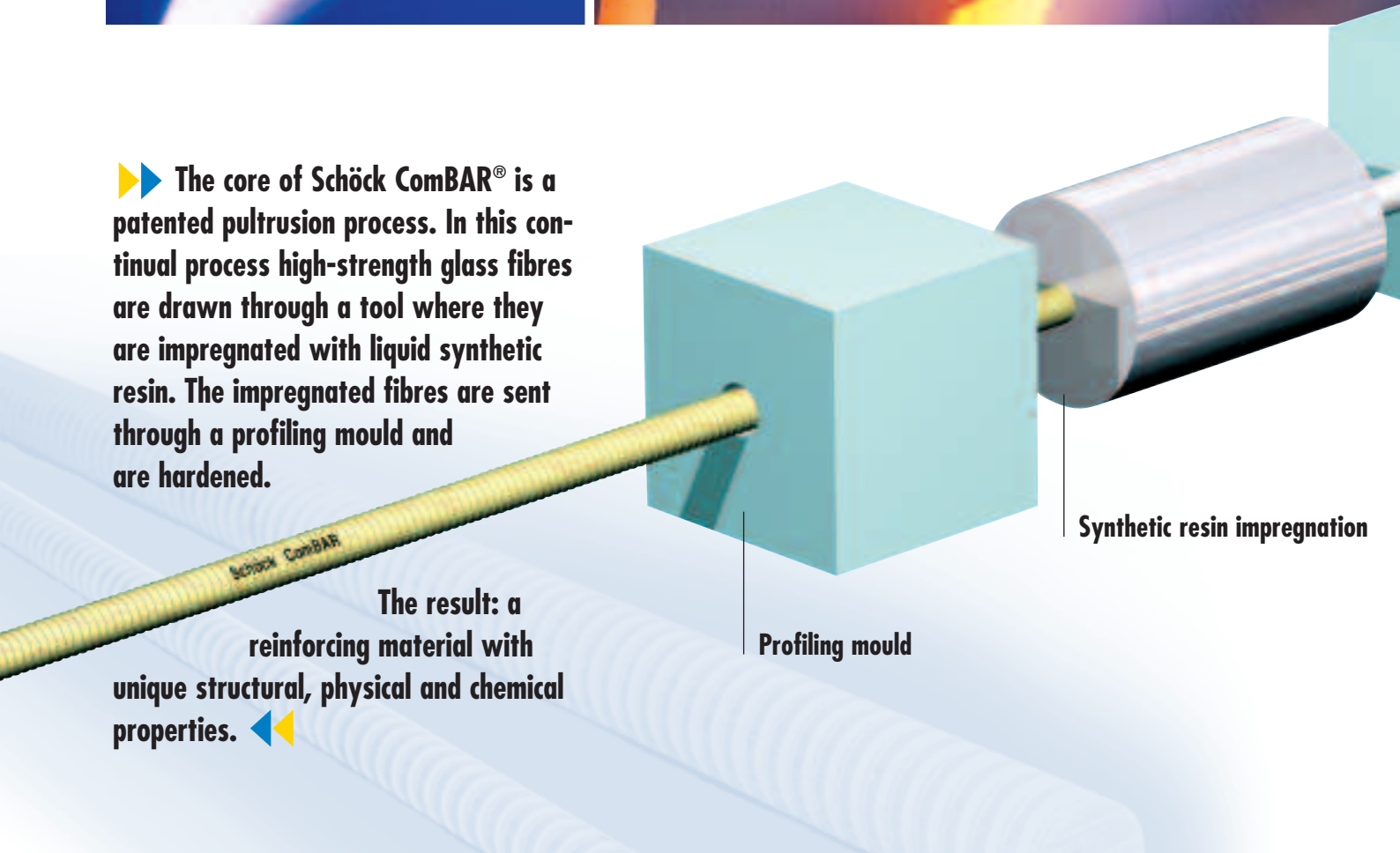


Prof. Walraven, The Technical University Delft

# A MILESTONE IN INNOVATIVE MATERIAL TECHNOLOGY



▶▶ The core of Schöck ComBAR® is a patented pultrusion process. In this continual process high-strength glass fibres are drawn through a tool where they are impregnated with liquid synthetic resin. The impregnated fibres are sent through a profiling mould and are hardened.



The result: a reinforcing material with unique structural, physical and chemical properties. ◀◀

## PRODUCT RANGE



The classical straight Schöck ComBAR® reinforcing bar, equivalent to conventional steel rebar.



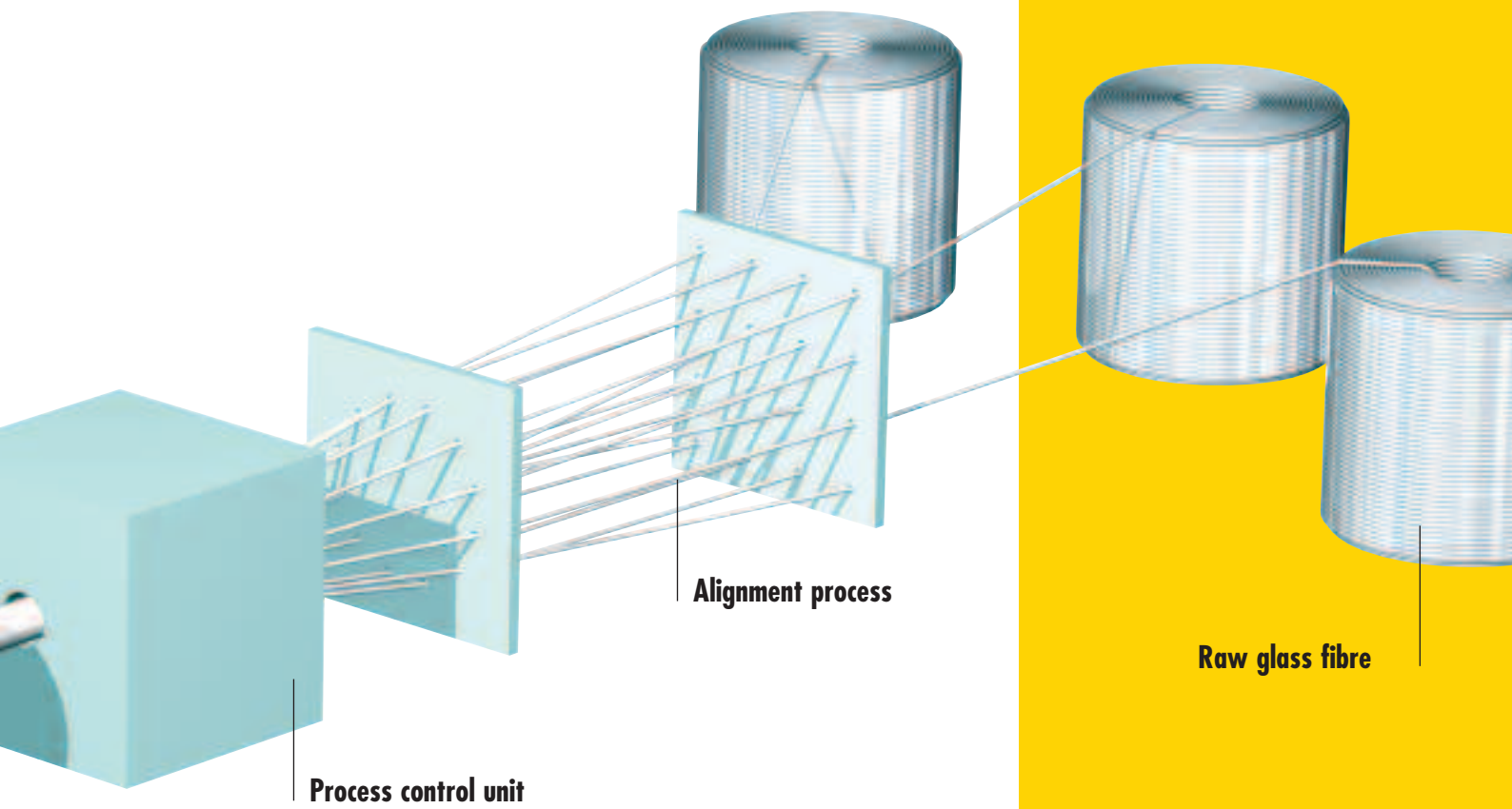
Bent bars are custom made in the factory and delivered to the site.



The straight reinforcing bar – here as end-anchor with a headed end.

type	diameter	standard-length
straight bar	8 mm	5 m, 10 m
	12 mm	5 m, 10 m
	16 mm	6 m, 12 m
	32 mm	6 m, 12 m
double headed bolts	16 mm	< 2 m
	32 mm	< 2 m
bent bars	12 mm	–
	20 mm	–

Further lengths are available upon request.



## CONVINCING BOND

The bond behaviour of Schöck ComBAR® is characterised by high bond stress, little slip, ductile behaviour after failure and by low tensile splitting forces. (Up to concrete of grade C50/60 failure of the concrete corbels limits the bond strength). The design can be based on the same values of bond stress as those of reinforcing steel.



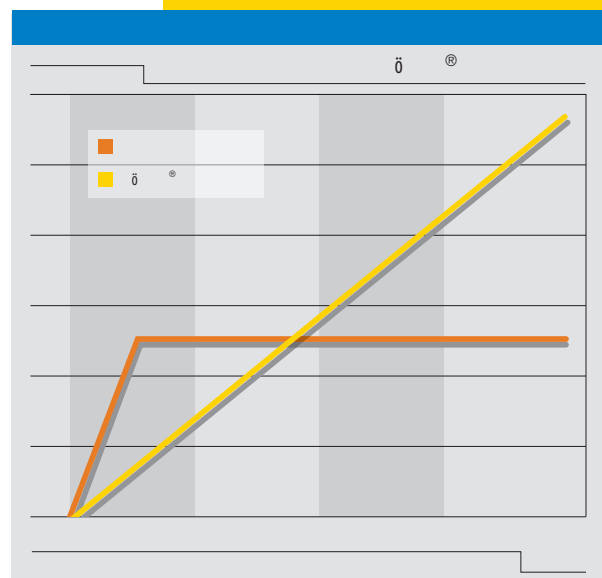
The surface profile of Schöck ComBAR® guarantees an excellent bond between the reinforcement and the concrete.

## PHYSICAL BACKGROUND

Strength and stiffness of a composite material are defined by the type, amount and orientation of the strengthening fibres. The fibres of Schöck ComBAR® are oriented linearly. The result: highest possible strength. Even under maximum loads Schöck ComBAR® remains linearly elastic (see diagram).

Nevertheless, a structural element reinforced with Schöck ComBAR® behaves in a ductile fashion. Deformation and cracks provide early warning of the impending failure of the element.

Through the special geometry and its unique material properties, the ribbing is designed to display bond behaviour like that of steel rebar, not only at service but also at ultimate loads.



High strength, low modulus of elasticity, linearly elastic (no yielding)

# SCHÖCK COMBAR® – OFTEN THE RIGHT SOLUTION



▶▶ Schöck ComBAR® opens up new horizons, due to its special material properties. Particularly in cases where steel is not advantageous due to its physical properties, Schöck ComBAR® is the appropriate alternative. First reference projects show that Schöck ComBAR® is a material with a bright future. ◀◀

## OUR SERVICES FOR YOUR PROJECT

- ▶ structural design
- ▶ preparation of reinforcement drawings
- ▶ site support
- ▶ on-site installation support
- ▶ consulting services on building physics
- ▶ consulting services on application technology
- ▶ special solutions and further development
- ▶ support with permit applications, expert opinions

## APPLICATIONS

- Its high tensile strength makes the installation of Schöck ComBAR® advantageous in architecturally demanding bridges and structures.
- Due to its non-magnetic properties it is well suited for the installation in research and medical facilities, such as magnetic resonance imaging departments.
- As it is corrosion resistant, application in aggressive environments, in tunnels and in dams is possible.
- Thermally non-conductive – therefore ideal for mounting brickwork, cladding and curtain walls.
- Because it does not conduct electric currents it can be used to reinforce walls in the vicinity of high-voltage machinery and equipment.
- The high resistance to chemicals makes Schöck ComBAR® an ideal reinforcement in sewer treatment plants, salt mines, and ocean harbours.
- Because it is easily machined, it can be installed in structural elements which are to be cut or drilled through.
- Application in cases where low weight is an important issue.
- Easy removal of temporary structural elements which are intended to be built back.
- Because of its corrosion resistance the required concrete cover is less than that of steel rebar. As a result, Schöck ComBAR® is well suited for reinforcing slim building components, such as cladding.



## A PROJECT OF GREAT DEPTH



Civil and tunnel engineering: one of the special areas of application, where Schöck ComBAR® leads to decisive advantages in construction methodology.



The shield of a Tunnel Boring Machine for the construction of a subway tunnel.



Schöck ComBAR® is being successfully used in the construction of new tunnels. The latest - and quite a spectacular - example, of its use is the new North-South Line of the Amsterdam subway. The tunnels between the stations are bored by Tunnel Boring Machines. The fact that Schöck ComBAR® is easily cut led to its application on this project. The Tunnel Boring Machines have to cut the reinforced concrete walls upon entering and exiting the station structures. Had conventional steel reinforcement been installed in these walls, this would not have been possible.

This project is just one example of the multiple possibilities which the usage of Schöck ComBAR® opens up to the designing engineer. Many more applications are found in the construction industry, where the unique material properties of Schöck ComBAR® lead to breakthroughs in construction methodology.

◀ The course of the new North-South-Line in Amsterdam.

# North-South-Line

# SCHÖCK COMBAR® – COMPLEMENTARY SERVICE FOR YOU

I am interested in this innovative reinforcement for special building structures.

Please send me  material samples.

Please provide the following:

Technical information

Product catalogue

**PLEASE FAX TO +49 7223 967-454**

company

name

title

street

zip code

city

country

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e-mail

Calculation and design program Schöck ComBAR®  
[www.schoeck.com](http://www.schoeck.com)



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