

Carbon Fiber Stone CFS – Application as reinforcement bars (rebar) for concrete

Reinforcement bars or rebars are often used to enhance the performance of concrete subjected to **tensile loads**. Traditional steel rebars are in use for many years and have some clear benefits, such as the similar thermal expansion coefficient to concrete. However, steel rebars are heavy and often prone to corrosion. Many alternative materials are available, such as glass fibers, basalt fibers, carbon fibers and CFS.



Commercial CFRP rebars

Carbon fiber reinforced plastics (CFRP) can be used to manufacture rebars and achieve advantages in **corrosion resistance and reduced structural weight**. However, there is a mismatch between the thermal expansion coefficient of concrete and CFRP.

Comparison between thermal expansion of different materials

Thermal Expansion Coefficient ($10^{-6}/K$)	
Steel	12
Concrete	10-12
CFRP	0
Granite	5-6

CFS can be used for reinforcement grids as well and the stone's thermal expansion coefficient lies right **between concrete and carbon fibers**. The stone interface has the elasticity to match the remaining difference of thermal expansion coefficient if well dimensioned according to the expected temperature range. Simulations and tests indicate that 5 mm stone thickness could cover a range of 50°C without fractures within the stone layer or delamination between the three materials.

Using **ratios between 4:1 and 2:1 of stone to carbon fiber thickness**, it is possible to use the stone as interface between concrete and carbon fibers. In addition, the flat CFS ribs can reinforce thickness-constrained structures.



CFS rebar grid (5x10mm ribs, 60x60mm spacing)

The depicted CFS grid consists of ribs with 60x60 mm spacing. These values can be adjusted to fit the desired application. The flat structure of CFS-ribs can **reduce the amount of carbon fiber utilized and reduce costs by half**, while tackling the issue of different thermal material expansion.