



## Wedge Anchor For Fiber Reinforced Plastics (FRP)

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### Summary

Anchoring of fiber reinforced plastics (FRP) is a difficult task, because of the high axial and low lateral strength. Most anchorages found in literature use epoxy resin to establish the interface between the FRP-tendon and the anchorage itself. The anchoring process is time consuming and often multiple steps are necessary. Wedge anchorages were used with great success for anchorages for steel strands. To achieve an efficient, economic and easily applicable anchoring system special wedges were developed for FRP. The special design of the wedges provides an evenly distributed lateral pressure and shear stress along the wedge FRP – interface. Therefore high anchoring loads are possible. Experiments were performed on strips and rods made of CFRP and GFRP using epoxy bonded and friction only interfaces. The tests showed a high efficiency in terms of ultimate load and that the economic friction only interface transfers higher loads than the epoxy bonded one.

**Keywords:** post-tensioning; anchors; wedge; FRP; strip; rod.

### 1. Introduction

In recent years strengthening of concrete structures has become a large application field for carbon fiber reinforced plastics (CFRP). The structures are strengthened by bonding or prestressing the strips on the tensile surface. Bonded strips increase the load bearing capacity of the structure. Prestressed strips or rods allow a better exploitation of the excellent tensile strength and additionally a reduction of the structural deflection. In some cases it is also possible to increase the durability of the structure. For this purpose anchorages that are able to anchor high post tensioning forces are necessary. In the passed decades investigations on cast anchors with resin or grout, anchors with expansive material, spike anchors, wedge anchors, other clamping mechanisms and various combinations are described in literature, see e.g. [2]. High anchoring loads were found for cast anchorages and other systems, where the CFRP tendons are fixed by bonding using resin.

Anchoring of a fiber reinforced plastic (FRP) strip or rod is a difficult task because the strength and the modulus are high in fiber direction, but low in lateral (normal to fiber) direction. The surface of the FRP is very smooth, which makes the transfer of shear forces difficult. The efficient anchorages developed in the past decades use epoxy resin to establish good shear transfer. The drawbacks are that several hours are necessary for curing and the applicability is dependent on environmental conditions. For cast anchorages this curing process has to be done off-site, while for other anchor types a curing process usually has to be done on-site. A major disadvantage of cast anchorages is the need for the tendon and the anchorage system to be preassembled entirely off-site. In addition, the assembly of the anchorages and the tendons is time consuming and a high accuracy during off-site assembly and on-site installation is required. Other anchorage types that use epoxy have to be bonded at the construction site. Due to the necessary on-site curing, the anchoring process becomes again time consuming and multiple steps for installation and bonding are necessary. To reduce the effort and the critical curing actions on-site, a different type of anchorage has to be developed.

For many years high strength steel strands have been anchored with wedge anchorages. This system is well accepted by the market and has been in service with great success for many years. The