

## Improvement of Serviceability by Strengthening with Prestressed NSM

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## Summary

Carbon fibre reinforced polymers (CFRP) are often used for strengthening. In most applications the CFRP-reinforcements are externally bonded (EBR) to the structure. An improvement can be achieved by near surface mounted CFRP (NSM), due to the better bond behaviour. Further improvements can be obtained by prestressing, for example: utilization of the high strength, activation of dead loads and much lower deflections, without losing ductility by approaching the ultimate load (if appropriately designed). The advantage of a delayed cracking of concrete and yielding of the steel reinforcement leads to lower crack widths, higher durability and an increase in the serviceability load. Durability is further enhanced by the “bond anchorage”, where no corrosive materials are applied to the structure.

**Keywords:** Repair and strengthening, maintenance and repair work, fibre reinforced plastics, post-tensioning, reinforcement, repair, rehabilitation, serviceability.

## 1. Introduction

Carbon fibre reinforced polymers (CFRP) are rarely prestressed for repairing structures, thus the advantages of prestressing and the full utilization of the CFRP material have not become fully evident yet. The main reasons are the high costs of the anchorages and the labour intensive anchoring process of existing CFRP anchorages.

Utilization of CFRP- strips can be improved by applying prestressing force to the strips. Prestressing enables an increase of the serviceability and load-bearing capacity. Due to the high tensile strength and the lateral pressure sensitivity of the CFRP, anchoring up to ultimate load is a difficult task. Many CFRP prestressing systems require big anchorages, which must be attached to the structure. These anchorages require corrosion protection and are very expensive.

The wedge anchorage system presented here is a major step forward and is designed for near surface mounted (NSM) strips. The complexity and also the labour input for anchoring are reduced dramatically by means of friction interfaces, because the load can be applied at once, and no curing time is required. To present the state of the art assignment of CFRP strengthening, NSM and EBR application are illustrated in *Fig. 1*.

For prestressed near surface mounted usages the CFRP strip is also positioned in the silt. Prestressing force is applied and the strip is adhered to the structure. The application of this method is presented for prestressing plates with 5 m span. In order to provide a simple and durable anchorage a bond anchorage was developed at university of technology Vienna [1], [2]. After prestressing the strip and bonding it to the structure, the anchorage system is removed. The ends are