



## Flexural Behavior of RC Beams Strengthened with Near Surface Mounted Prestressed FRP

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### Summary

Strengthening concrete structures with FRP (fiber reinforced polymer) have grown to be a widely used method over most parts of the world today, which FRP was developed in 1960's. A method to apply prestressing force to FRP is developed newly in these days, which can use the maximum performance of FRP materials. This study investigated the flexural behavior of simply supported Reinforced Concrete (R/C) beams strengthened with Prestressed Near Surface Mounted (NSM) CFRP (carbon fiber reinforced polymer). CFRP plate and rod were used for flexural strengthening. Prestressing level changed from 0 % of CFRP tensile strength to 50 %. Any mechanical device has not been used to maintain the prestress during testing. Static four point loading tests are conducted for eleven R/C beams strengthened with Prestressed Near Surface Mounted (NSM) CFRP and Non-prestressed Near Surface Mounted (NSM) CFRP. The test shows that the beams with prestressed NSM CFRP exhibited a higher yielding load and a higher ultimate load, compared to the beams with non-prestressed NSM CFRP and the control beams. Beams strengthened by CFRP rod failed due to fiber rupture of the FRP in the groove, but beams strengthened by CFRP plate failed due to concrete cover separation.

**Keywords:** CFRP; prestressed; Near Surface Mounted (NSM); beam; flexural capacity

### 1. Introduction

Near Surface Mounted (NSM) is a strengthening method for the concrete member to enable the interfacial bond force in between the concrete member and the epoxy to operate as stress transmission implement between the member and the FRP [1]. This is required by mounting the epoxy by creating a fixed width depth groove on the concrete member, and using the FRP. This method has been used since the 1940's, and at its early stages, grout had been processed by mounting steel bars into the groove or additional concrete covers had been manufactured for use [2]. However, it was difficult to attach the steel bars into the groove and corrosion was a major problem. Hence, this method did not really come into the spotlight. Nevertheless, the corrosion problem was solved by replacing steel bars with anti-corrosive FRP since the 1960's.

Very limited literature is available to date on the use of Prestressed Near Surface Mounted (NSM) CFRP for structural strengthening. Research on Near Surface Mounted (NSM) using FRP has begun since the late 1990's and bond behavior of materials [3,4,5,6], along with flexural and shear strengthening effectiveness are among its main researches. Regarding bond behavior, research is being made on viewing the interface failure difference between the epoxy – FRP interface and the concrete - epoxy in relation to the form of the FRP and the capacity of the epoxy primarily used in failure mode [7,8]. Regarding to flexural and shear strengthening effectiveness, research on the load-carrying capacity efficiency when comparing externally sheet and plate bonding method and when using Near Surface Mounted (NSM) method is in progress [9,10,11].