ROMA TRE
UNIVERSITÀ DEGLI STUDI

ROMA TRE UNIVERSITY
DEPARTMENT OF CIVIL, COMPUTER AND AERONAUTICAL ENGINEERING
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MSc Course in Civil Engineering for natural risk protection
Laurea Magistrale in ingegneria Civile per la protezione dai rischi naturali

MSc Degree Thesis
Tesi di Laurea Magistrale

Candidate: **FEDERICA DE MEO**
Supervisor: PROF. ING. STEFANO DE SANTIS
Co-supervisor: ING. VALERIO VEZZARI, ING. MAURIZIO RICCI, ING. GIOVANNI MORETTI
Stage: INTERNAL

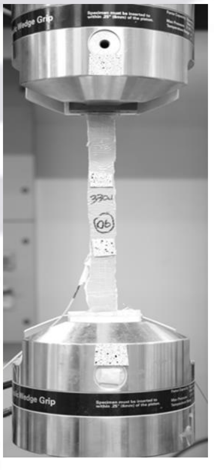
October 2025

Prototype development of integrated systems for structural reinforcement and monitoring using steel reinforced polymer composites and FBG sensors

Motivations and aims

SRP systems are an innovative solution for the external strengthening of structures, consisting of unidirectional high-strength steel fabrics bonded with polymeric resin. Their use in civil engineering has been investigated since 2004, showing mechanical and structural performance comparable or even superior to FRP systems. Their durability still represent open issues, which are further complicated by the sensitivity of the polymeric matrix to temperature and moisture, and long-term monitoring could help detect the deterioration of the materials and the safety of the retrofitted structure.

Methods and results



This thesis focuses on the development of an integrated SRP-FBG system for structural strengthening and health monitoring, aimed at defining effective bonding and protection materials (TEFLON and PEEK were consdered) for optical fibers on steel micro-cords to ensure accurate strain transfer and long-term sensor durability. Tensile tests were performed with a load protocol consisting of 5 cycles between 0 and 1‰ strain, 5 cycles between 0 and 2‰, 5 cycles between 0 and 5‰, and a final loading ramp up to failure. The experimental results enabled the comparison of FBG sensor data with independent measurements obtained through DIC (digital image correlation) and LVDT displacement transducers. All tests were carried out at the Laboratory of Structures of Roma Tre University.

Conclusions and future developments

Strain data recorded by the FBG sensors were consistent with those measured by DIC and LVDTs. The RMSD error values were generally on the order of less than 1‰, confirming the overall effectiveness of the integrated SRP-FBG system. The results also showed that the Teflon capillary introduced a signal damping effect, whereas the PEEK coating ensured a more stable and consistent response, without significant attenuation. The research will continue with the application of SRP-FBG self-sensing strengthening systems in more realistic conditions to further validate their performance. This work is the result of a collaboration between Roma Tre University, Kerakoll S.p.A., and Global Sensing S.r.l.