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Experimental and numerical study on the re-anchoring of wire in grouted prestressed tendons

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ABSTRACT

Some recent researches have focused on strand wire damage in external prestressing tendon. When some strand wires of a grouted prestressing cable are damaged, the tension in the cable can be preserved due to the re-anchoring phenomenon. For safety issues, it is important to study the damage limit that a tendon can suffer before the rupture. While the re-anchoring of a strand is well studied, there is less literature on wire re-anchoring. In this study, we tested grouted seven-wire strands which are put under tension and then cut out wire by wire to simulate the wire damages. The re-anchoring is observed by strain gauges installed in the strands and on the sheath. In addition, a numerical model has been developed with the help of FEM to analyse the mechanical phenomenon during and after the wire cuts. The results show that the tendon is bent and twisted because of the loss of tension and moment when one or several wires are cut off. Moreover, the strand strain is various following the gauge position in each wire and its distance to the cut section. This result contributes to the comprehension of the wire damages in grouted tendons, and could be extended to grouted multiple-strand tendons.

Keywords: external prestressing, prestressed tendon, strand wire damage, wire re-anchoring

1 INTRODUCTION

The re-anchoring of tendons with a whole broken strand was reviewed by Abdelatif, Owen and Hussein (2017). The re-anchoring occurs due to friction. The mechanical characteristics of steel and concrete turn out to be the main parameters influencing the re-anchoring length. This result was confirmed by experimental studies of Watanabe et al. (2011). The re-anchoring is similar to a pretensioned strand bond, studied in some articles such as Oh, Kim, and Choi (2006) or Ramirez-Garcia et al. (2016), which take into account loss of grout strength due to cracking. It suggests that the stress of the strand changes exponentially from 0, at the cutting position, to the final stress value, at a distance called transfer length from the cut strand. The Poisson's effect causes the cut end to adopt a wedge-like form that leads to friction with the other wires and the grout. Furthermore, the loss of tension in the wire unfolds the wire and thus increases the contact with the concrete; this is called the Hoyer effect, Briere et al. (2013). The re-anchoring of a whole strand is presented in several

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