



Recent failures of external prestressing grouted tendons: the paramount role of the HDPE duct

Bruno Godart, Laurent Gaillet, Laetitia Van Schoors

Université Gustave Eiffel, IFSTTAR, Champs sur Marne & Nantes, France

Laurent Labourie, Didier Germain, Bastien Vaurigaud

Cerema, Lille & Bron & Bordeaux, France

Contact: bruno.godart@univ-eiffel.fr

Abstract

The article describes recent cases of tendon ruptures by corrosion and investigations carried out on some bridges. Several causes related to HDPE ducts have been identified as damages during handling, degradation during threading and tensioning of strands, defective connection of the duct to the anchor body, damage during construction or operation, low quality of HDPE material, etc.

A warning note on existing structures with external prestressing has been updated by Cerema in November 2018. It describes the diagnosis methodology based on detailed inspection, destructive and non-destructive techniques. New non-destructive investigation techniques such as guided-wave ultrasonic technique and magnetic leakage field test using permanent magnets and induction coils are presented. Innovative methods of local repair of the ducts are presented. Different protective devices are analyzed with regards of safety of workers in the case of a sudden failure of tendon.

Keywords: external prestressing, HDPE, rupture, corrosion, diagnosis, investigations, grout, testing, repair, safety.

1 Introduction

Since the end of the 1970s, external prestress has experienced remarkable growth in France and in the world, and it is now systematically used for prestressed concrete structures with large spans. Moreover, this technique has been successfully used for the repair of existing prestressed concrete bridges of the first generation (beam and slab bridges) or of the second one (box girder bridges).

In the 1990s, failures of external prestressing tendons occurred in France due to corrosion of tendons because of an instability of the grout

during its setting, possibly coupled with an unsuitable injection procedure. In general, these injection defects result from filling defects (partial or total voids, especially near the high points possibly filled with water) and / or by the presence, in the upper part of the duct, of a non-crystallized and whitish paste located below a layer of water and an air pocket. This water comes from the bleeding of the grout and remains trapped within the HDPE duct. This phenomenon led to the publication by Setra of the technical note n° 29 [1] and mainly concerns grouts having a high quantity of admixtures (super-plasticizer with high water reduction effect) used in the years 1980-2000. A