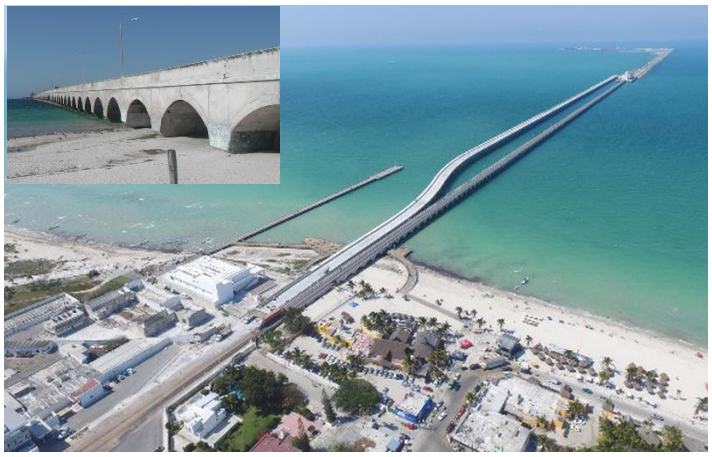
NDTitans in action

Case 6.2 BOND-TEST used for measuring adhesion strength of CFRP Strips on the Old Viaduct of Progreso, Mexico



The port city of Progreso, in the Mexican state of Yucatán, boasts one of the longest piers in the world. The long length is necessary to allow large ships to dock because the Yucatán coast is shallow.

The Danish company Christiani & Nielsen build the pier at Port Progreso in 1941. The old Progreso pier consisted of a 1.7 km long viaduct and a 205 × 50 m dock platform. The viaduct comprises 145 concrete arches supported by 145 girders, which in turn, are supported by two massive circular concrete piles.

It is one of the first high-durability-performance structures in the world because the project design considered not only the environmental loads but also the characteristics of the local construction materials (porous limestone aggregate) and the environmental exposure to corrosive chlorides (e.g., stainless steel reinforcing bars were used).

During the 80s, the Mexican government initiated the construction of a Remote Terminal, to which the old Progreso pier was joined by a 4-lane, 4.5 km long viaduct. This addition transformed the Progreso port into a deep port, which resulted in heavy traffic on the old, 2-lane viaduct, subjecting it to loads several times greater than the design service loads according to the Mexican Institute of Transportation.

Inspections carried out in 2001 found no important effects of chloride-induced corrosion over the stainless steel reinforcing bars, however, they identified cracking in several arches, parallel to the direction of the viaduct, due to tensile stresses produced by settlements induced by the heavy loads.

In 2003, 54 arches were externally reinforced with Carbon Fiber-Reinforced Polymer (CFRP) composites, but because of budget restrictions, the cracks were only “stitched” locally. In 2008, inspectors found that the cracks had “moved” to non-reinforced areas within the same arches and other arches also began to exhibit cracking. In 2009, the authorities managed to secure the needed resources and CFRP strengthening of all the arches was carried out. Since then, the viaduct has performed well but, due to the increased traffic volume, in 2019, a modern high-performance prestressed concrete viaduct was built parallel to the 80-year old structure and today, both structures give access to the port simultaneously.

The **Germann Instruments’ Bond-Test** was used by the manufacturer of the CFRP strips to perform **pull-off tests** and verify that the required adhesion to the concrete surface was achieved (tensile bond strength > 1.5 MPa).

Testing and reporting by **NDTitan Hugo Orozco**