

# **"Half a century of lifetime of Large Adriatic Arch Bridges"**

## **- experience and guidelines for future –**

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Six large reinforced concrete arch bridges were constructed over the past four decades with spans ranging from 200 m to almost 400 m: Sibenik, Pag, Krk (two arches), Maslenica and Skradin Bridges. The most famous among them is Krk Bridge, completed 27 years ago but still the largest spanning conventional reinforced concrete arch in the world.

Adriatic Arch Bridges are world-renowned not only because of their large spans, but also due to introduction and subsequent improvements introduced in construction of reinforced concrete arches using the suspended cantilever technique. In fact, the Sibenik Bridge is the first concrete arch in the world which was erected entirely by cantilever method. The culmination of the development of cantilever erection procedure for reinforced concrete arches was the construction of Krk Bridges from 1976 to 1980. Temporary steel ties were used for an innovative cantilever erection scheme in which concrete spandrel columns, temporary steel tension tie top chords and diagonals were combined to form a truss.

The bridges are set in very harsh environment in terms of frequent strong winds (Bora) that carry sea-salt and spray exposed structural elements. Additionally, high average annual temperature, high moisture content and occasional winter temperatures below 0°C accelerate chloride penetration and reinforcement corrosion.

Unfortunately, older Adriatic Arch Bridges, particularly Pag and Krk Bridges, suffered greatly over decades of service, due to combination of aggressive exposure conditions and inadequate attention to durability issues which was to the best knowledge at the time. Serious deterioration of structural members with reinforcement corrosion being the major issue, led to many complex and expensive repairs.

The experience of performance in service of previously described large reinforced concrete arch bridges and severity of the aggressive maritime environment was carefully considered while designing much more recent Maslenica and Skradin Bridges. Significant improvements with respect to considering long-term performance of the structure already at planning stage were introduced in the design.

Outstanding management efforts are essential to ensure preservation of such large and significant bridges and their environment. Croatia is currently placing large efforts to develop a reliable and efficient motorway asset management system, an important part of which is bridge management system. In the course of this work it was established that major structures should be hand-picked from the entire bridge stock and treated separately because these are very complex structural systems that have huge environmental, social and cultural impact. The intention is to develop bridge-specific maintenance and management strategy and programme, as well as employ dedicated bridge engineers for each of the bridges. The programme would be tailored to individual structural aspects and present structural condition. Additionally, effective management of bridges for sustainability should be adaptive and learn from success or failures of past actions.