The Contribution of Latin America to the Development of Long Span Bridges

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Summary
The size of the South American rivers – like Paraná / Argentina and Orinoco / Venezuela –, the ocean going ships sailing on them and the often extremely bad subsoils required advanced designs and construction techniques for the bridges across them. Innovative technologies applied for the first time for Latin American bridges are e. g.

- deep water foundations with big diameter piles
  Whilst in most countries still driven steel or concrete piles with rather low capacity were used, the bridge across the Maracaibo Lake / Venezuela, built from 1959 to 1962, is founded on prefabricated prestressed concrete piles with a diameter of 1.35 m and lengths up to 50 m.

- prestressed concrete bridges built by launching
  The first bridge from prestressed concrete built by launching was a 480 m long road bridge across the Caroni River in Ciudad Guayana, Venezuela, opened to traffic in 1961. The bridge was built completely behind the abutment and later launched, Fig. 1. The logical further development has been to build the bridge in segments and then launch it incrementally. This procedure has been applied to hundreds of bridges worldwide.

- bridges with double steel composite section
  The Angosturita bridge across the Caroni River / Venezuela, built from 1986 to 1992 and designed for combined road and railway traffic, was the first bridge of this type with a mainspan of 214 m, a world record for steel composite bridges, Fig. 2. Further innovations incorporated to this bridge were e. g.
  - the use of Perfobond instead of stud shear connectors
  - construction of the haunched bridge deck by launching

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- cable-stayed bridges for full railways

The two Zárate-Brazo Largo Bridges across the Paraná in Argentina, built from 1971 to 1978, were the first cable-stayed bridges with highway and – eccentrically placed – full railway in the world, Fig. 3. The design and construction of this bridge comprise a number of first applications like

- shop fabricated parallel wire cables
- use of hydraulic cylinders in order to transmit the big railway braking forces to both towers
- railway expansion joints with uncommon dilatation and rotation
- concrete – instead of asphalt – roadway layer
- free cantilevering erection from the towers

- protection of piers against ship impact

The protections vary between anchored pontoons in 1979 for the Zárate-Brazo Largo Bridges and concrete platforms for the Rosario-Victoria Bridges in 2002 supported by Ø 2 m high strength steel composite piles from StE 690 and C45, Fig. 4. The piles are designed for absorbing the ship energy by plastic deformation and for a probability of collapse of 10^{-2} in 100 years.