The challenge

Wuhan City, with an area of more than 8,400 km², is situated at the crossroads of central China: Wuhan is a transportation hub for air, railway as well as ferry traffic. The distance from Beijing, Shanghai and Guangzhou is more or less equal; moreover, the giant Yangtze River (Chang Jiang) the world’s third longest river, and the Han River pass through the city.

Wuhan, capital of the Hubei province, is an energetic city with a population of about 9.7 million, a commercial center of finance, industry trade and science with many international companies. With scientific, technological and educational institutions such as Laser City and the Wuhan University, Wuhan is also an intellectual centre.

Tianxingzhou cable stay bridge

In 1957, when the first bridge was opened, for the first time, cars and trains were able to cross the Yangtze River.

In 1995, the second Wuhan Chang Jiang River bridge is opened (Cable Stayed Bridge). The double-decked bridge of Tianxingzhou, completed by beginning of 2009, is the second local bridge for trains. The first one, built 40 years ago, can no longer handle the fast increasing rail transport demand across the river.

The bridge is located over the fork of Tianxingzhou, 9.5 km north of the second Yangtze River bridge of Wuhan. The bridge starts at DK 7 + 449.400 (Pier #070) and ends at DK 12 + 106.500 (Pier #20). The span distribution is as follows (direction of increasing chainage):
- 4 x 40.7 m prestressed concrete single span box girders,
- 54.2 + 2 x 80 + 54.2 m prestressed concrete continuous box girders,
- 62 x 40.7 m prestressed concrete single span box girders,
- 98 + 196 + 504 + 196 + 98 m cable stayed bridge with 5 spans and a combined steel truss,
- 15 x 40.7 prestressed concrete single span box girders.

The total length of the bridge is 4,657.1 m, of which 2,638.6 m is constructed in combination for roadway and railway (28 spans of 40.7 m at the north end + the cable stayed bridge + 10 spans of 40.7 m at the south end). The remaining 2,018.5 m (1,815 at north end + 203.5 at south end) is separated for construction of roadway and railway. In the roadway-railway combination section, the roadway is on the upper level and the railway on the under-level. In the road/railway separating section, the roadway and railway are gradually changed to the same level with a distance of 40 m between them.

At the location of the new bridge, Tianxingzhou Island splits the river into two branches. Consequently, the bridge project consisted of two crossings connected by a viaduct.

The main section of the 1,815 m long northern crossing is a prestressed-concrete box girder with two navigation spans of 80 m each, which is erected using a cast-in-place balanced cantilever method.

The main section of the 2,842.1 m long southern crossing consists of a 1,092 m long cable stayed bridge, which includes a 504 m center span, and side spans of 196 m and 98 m spans (span distribution: 98 + 196 + 504 + 196 + 98 m). The vertical navigational clearance is 24 m above the high water level, and the minimum navigation channel width is 455 m.

The stay cables consist of parallel galvanized steel wires, with double PE cold-cast anchors. They are distributed into 3 planes, corresponding to the 3 steel trusses. The stay cables are anchored at the top of the steel trusses, every 14 m longitudinally.

The bridge deck is 16.97 m high and 31.30 m wide and carries six lanes of highway traffic at the upper level and four railway tracks at the lower level. The deck structure consists of 3 steel trusses with N-shape arrangement, distant of 15 m transversely. The steel trusses are stiffened transversely by steel structure or composite structure systems.

The pylons are 188.5 m tall “inverted-Y shape” concrete towers, each supporting 16 pairs of stay cables in a fan-shaped array.
pylon cross section is a hollow rectangle with variable sizes along the height. Each pylon rests on 6 m thick pile caps supported by 32 and 40 drilled concrete piles in 3.40 m diameter for respectively the North and South pylons. The bridge has a total of 90 spans and 91 piers. It is supported by 1,535 bored piles of 1.50 m, 2 m, 2.50 m and 3.40 m diameter. The pile depth varies from 37 m to 94 m.

**SYSTRA’s role**
On November 2004, a contract was awarded to SYSTRA for providing services for the construction of the cable stay Tianxingzhou bridge project in partnership with the China Academy of Railway Sciences (CARS).
SYSTRA is responsible especially for:
- review of detailed Design Drawings:
  - permanent Works,
- construction Methods and Temporary Works,
  - programme of Works.
- scheduling and co-ordination of the Civil Works studies,
- work supervision:
  - review of Contractor’ Documents,
  - review of Material,
  - site Inspection,
- construction Supervision Management.
- assistance on acceptance of the completed works.

**FACTS AND FIGURES**
- Total bridge length: 4,657 m
- Main centre span: 504 m
- Passenger train speed: > 250 km/h
- Designed load capacity: 20,000 tons (Cable Stay Bridge)
- Four rail tracks on lower level
- Six lanes motorway on upper level

**ORGANISATIONS INVOLVED**
- Client: Ministry of Railways (MOR)
- Construction Supervision: China Academy of Railway Science and SYSTRA
- Lot 1 Contractor: Zhongtie Major Bridge Engineering Group Co, Ltd (MBEC)
- Lot 2 Contractor: China Railway 12th Bureau Group Co, Ltd (CRCC)
- Designer: Major Bridge Reconnaissance & Design Institute Co, Ltd (MBRDI)

**COST**
- Total: 2.7 billion Yuan (£ 270 million)

**FINANCING**
- Ministry of Railways: 80%
- Wuhan City Government: 20%

**KEY DATES**
- September 2004: commencement of the works
- February 2008: completion of steel segments
- June 2008: track laying
- March 2009: completion of the works
- December 26th, 2009: inauguration of the bridge