# The Val-Benoit cable-stayed bridge

# The Val-Benoit Cable-Stayed Bridge

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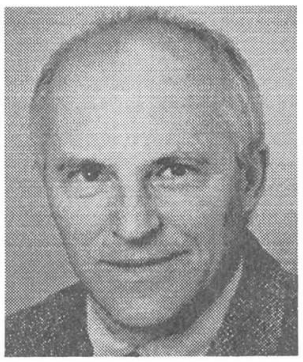


Jean-Marie Cremer, born 1945, received his Civil Engineer's diploma at the University of Liège, 1968. He presently carries on the function of managing director at the ENGINEERING OFFICE GREISCH. He performs the direction of the bridges department. Professor at the bridges chair of the University of Liège.

## 1. Choice of the type of bridge

Squeezed between two tunnels, the bridge crosses the Meuse river and roads on both banks at Liège in Belgium

The grade profile on the bridge does not allow slopes over 6,5 % to enter or exit the tunnels.

In addition to the sharp curvature of the river, the site is characterised by a sharp housing dissimetry. On the right bank, the outer side of the curve, the quite flat ground is mainly occupied by industrial constructions, dominated by the important railway junction. On the left bank, the inner side of the curve, the urbanistic texture is mainly made of habitations, squeezed between the river and the hill.

The numerous technical requirements and the site constraints have led to the choice of a cable-stayed bridge with a single pylon on the right bank.

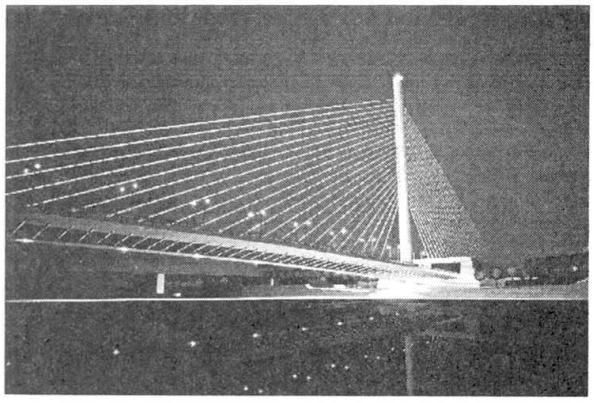
Its particularity of highway bridge in urban site has also led to the need to combine simplicity and impeccable appearance, with the following particularities :

- The necessary readability of the structure has led us to choose a single cable plane, located on the axis of the bridge.

- The search for thin structural elements bordered by more monumental abutments is satisfied by the stays and the very thin circular pylon, which slenderness is accentuated by the truncated cone shape.

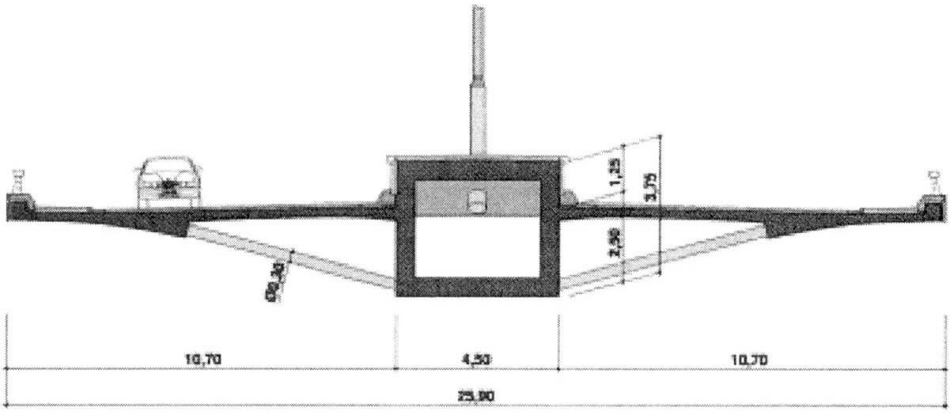
  On the contrary, the choice of a single cable plane thwarts this search for slenderness for the deck. Indeed, the height of the deck box-girder, required by the torsional stiffness, does not match this objective.

  However, the design of the cross-section allows to limit its visual impact. The deck slab is located around mid-height of the box-girder and is supported by very sloping lower steel tubes which improve the lower part and accentuate the impression of slenderness, as the upper part is hidden by the lateral security barriers.



- The balancing span replaced by a balancing abutment which, on the one hand, points out the entrance portal of the tunnel and, on the other hand, acts as an acoustical protection for the near by habitations.
- The visible concrete facings are concreted on site in plank-structured formworks; the lower face of the deck is particularly being taken care of as it is very closely perceived by the walkers.
- The faces of the abutments are realised with country natural stone as the roof of the balancing abutment is entirely covered with vegetation.
- The pylon, shaped as a slightly truncated cone, is covered with glazed glass, fixed with bolts.
- The sheathes of the stays as well as the external sleeve of the steel tubes supporting the deck slab are made of stainless steel.
- A specific lightning device points out the bridge and respects the habitation neighbourhood.

- Absorbent coverings are widely used to limit at best the acoustical nuisances.
- Landscaped arrangements such as pedestrian and cycle tracks, rest zones, street furniture and vegetation complete the urbanisation of the site, strongly perturbed by the monumental bridge.
- An esplanade, widely open on the river, clears the base of the pylon.




## 2.Technical description

The main span of the bridge over the river is 162 m long, in continuity with a short 31 m long span above the left embankment and a very short 12 m long span between the pylon and the balancing abutment. This abutment is 122 m long and is the first part of a tunnel that goes on under the railway junction.

The prestressed concrete deck, 25,90 m wide, has a rather uncommon cross-section, with a small central box-girder, 3,75 m high and 4,50 m wide, and two cantilever slabs, located 1,25 m beneath the upper level of the box-girder.

The prolongation of the box-girder above the cantilever slabs is necessary to obtain a torsion rigidity sufficient to resist to the transversal loads of balances. The cantiliver slabs are supported every 3 m by steel tubes with stainless steel sleeve, they are also transversally prestressed by 4T15 cables every 50 cm.

The pylon, located on the axis of the bridge, has a total height of 82 m. It is rigidly restrained to the deck. It is covered with granite. Its dubble foundation sole allows a slight translation due to the effects of shrinkage, creep and temperature variation in the part of bridge that separates the pylon from the fix point in the middle of the balancing abutment.

The deck is supported, above the river, by 22 stays, balanced on the pylon by 22 other stays which are anchored in the balancing abutment. The 44 stays are made of sheathed greased galvanized strands in an external 2 mm thick stainless steel sleeve.

At the lower part of the stays, a 5 m long dubble sheath, filled with wax, insures an excellent dumping towards parasital vibrations.

## 3.Execution

The deck is positionned by incremental launching. He is made of 18 pieces, out of which 16 ones are 12 m long, and is built on a fix site located on the right bank and positionned by incremental lauching 12 m at a time.

The pylon, cuminating 70 m above the deck, He has a circular cross-section, slightly in the shape of a cone frustum. The granite facing is planned for the end of the works.