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NEW BRIDGE OVER THE RIVER ANOIA BETWEEN IGUALADA AND SANTA MARGARIDA DE MOTBUI

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Abstract: *The initiative of building a bridge over the River Anoia between the towns of Santa Margarida de Montbui (10000 inhabitants) and Igualada (30000 inhabitants) comes from a proposal by both City Councils when they become aware of their lack of communication ways. With the city centres separated by the river Anoia it was connected only at two points: the bridge of the road B-213 (the Valls road) and a single-line small bridge with precarious situation before avenues. The article, apart from presenting the bridge from its technical side, contains reflections on its genesis that constitute the main body of the paper. Finally, a new bridge to be constructed in 2005 makes its debut, placed upstream and part of a group together with the bridge described in the present article.*

1 BACKGROUND AND MOTIVATION

When the gestation process of a bridge starts many questions such as “Why, to whom, why here, why there, why like this” are resolved.

Although the two first questions are trivial (particularly to anybody who has dared to face any obstacle without the inestimable help of a good bridge), we will not take time to answer them. Let us focus on the two final questions, which have substance and which are the crux of the matter.

Why placing the bridge here?

In order to answer this question we should make another one: what territorial arterial roads do we find around here?

On the side of Igualada, we can see the road of Ódena and Prats de Rei, arterial road crossing the industrial state and the Nacional II road –more precisely the consecutive Nacional II roads or royal roads- and continuing along the Avenues Jaume Balmes and Antoni Gaudí, the Rec Street and the future continuation towards the tanneries, forming the internal road of Igualada, also the road of Sta. Coloma de Queralt and Espelt Street (arterial road of Fátima’s district).

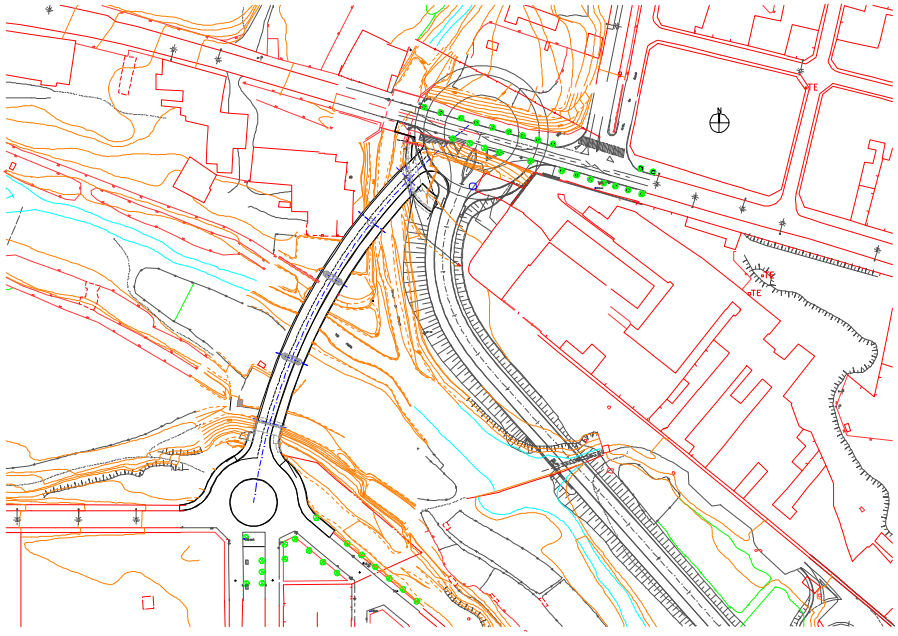

Figure 1: Ground Plan of the Bridge. Bottom: Roundabout at the Montbui side. Above: Future Roundabout at the side of Igualada and Rec Street.

At Montbui the situation is tougher. La Mercé Street (finished recently) is the western arterial road of Sant Maure and in the future the southern internal road of Igualada that the Catalan Government (Generalitat) will have to deal with and, obviously, the road of Valls (main arterial road of Santa Margarida), the communication towards the south and Tarragona.

The main junction of this road network is the roundabout to the north of the bridge. Considering it this way, the bridge is the continuation of La Mercé Street towards the roundabout. The Southern roundabout will have, momentarily, a local service for distribution at Montbuí.

With this configuration La Merçé Street will be an alternative for the traffic with origin and/or destination in the sectors to the west of the city centre. The rest of the population, until the south end of the street gets better, will keep using the current bridge at the road of Valls (excellent piece of engineering that will take on value and will go up in value as soon as it is possible to look at it from the bridge in a daily basis). The remaining waypoint, the "palanca", will still be used.

The rest of arterial ways, the natural ones, are the hydraulic network, the River Anoia and the Torrent de l'Espelt. They are the obstacle to overcome and their rise in level requires the bridge to have generous eyes. We know well how rivers can be in this country.

1.1 Maillartian. Why is the bridge the way it is? Part 1

An element that always plays a part in a bridge construction is tradition: the tradition of the built pieces that have influenced us and that are understood and assimilated in the work that is about to being built. It is the personal and collective referent.

When tackling a bridge with certain singularity, we tend to say that a record is being broken. We will be more modest about this bridge (not that we want to, to be honest, but because we find the unhealthy lack of imagination of the record without reason something out of place). We have no aspirations whatsoever –and we will not have them in the future (at least at the moment), to break any record.

Well then, where is such singularity? To answer this question we will look back in time to the 30s and to a group of pioneers that brought to the prime the technique and expressiveness of the reinforced concrete constructions. We can nowadays consider this period as a classic period. We will mention Carlos Fernández Casado and Eduardo Torroja in Spain; Eugene Freyssinet (founder, by the way, of the Construction Company of the bridge) in France; and, a bit later, Pier Luigi Nervi and Ricardo Morandi in Italy. The experts on the subject will miss a name. We have left it to the end due to his particular influence on the formal composition of the Bridge of Montbuí. We are talking about the Swiss Robert Maillart who, without forcing technical solutions, has managed to touch everyone who has had the pleasure of contemplating his works.

Here, the singularity over the Anoia centres on the formal aspects of the bridge. We relieve we have found a shape that, without trying to give it a gratuitous spectacular nature nor forcing the gesture, explains and applies well "to the place". Following Maillart, shape and technique are inserted in the art of constructing, job as old as the oldest. Be that proof of our debt. This bridge is a small tribute to the virtuous interpreter and composer of the structural shape. Without him it would have been much more complicated to reach a solution to resolve the bridge.

You are warned now: if you ever (on the way to or on the way back) go to your favourite bank in Central Europe (with the object of giving the slip to the monetary authorities of the

euro) and, making a detour, you find a bridge with a “family” resemblance to the Montbui Bridge, it is almost sure that you are before one of the little treasures of the Swiss master. Curiously, Maillart did not build big bridges (in size): the Salgina-Tobel Bridge, from 1930 and probable his key work, has only (a piece of information for record seekers) 90 m of span, in a moment in which more than one kilometre had been jumped. You will then learn, while delighting in the view of the bridge, why although different techniques and materials have been used (70 years do not go in vain) the conception of the Montbui Bridge is Maillartian.

Picture 2: Salgina-Tobel Bridge. 90 m span. Robert Maillart (1930).

1.2 Two for the price of one. Why is the bridge the way it is? Part 2.

Lastly, we will talk about the taken solution. But allow us first to state a theorem:

Theorem:
The new Montbui Bridge has a distinguishable characteristic: there are two bridges in one (the 2x1 of a department store).

As a mathematic would go on, let us prove the statement.

The new branch must cross the River Anoia and the Torrent de l’Espelt, just at the confluence of both streams. The place, the jump point, is strongly asymmetric: the two watercourses differ significantly; solutions that are accepted for one do not square with the other one (and vice versa).

What we have presented as Maillartian, close exercise to our friend Robert’s aesthetics, is the solution provided by us to overcome the River Anoia: false arches. In essence, it is a slow, symmetric form, with inclined struts cutting the beam spans.

[A short aside and marginal note about costs: the configuration of a continuous portico

beam is structurally effective. This fact causes that part of what we could call “aesthetic economic increase” vanishes in favour of the efficiency of the shape.]

In the Torrent de l’Espelt we have a different situation. The deck is bent, contrasting with the Anoia, which is not. Here river and bridge are not perpendicular; each one goes its own way. A typical solution for this type of bridges is to use a single central pier at the intermediate supports, so that the water runs without obstacles and the structure is simpler. The problem lies in avoiding the bridge to swing from side to side and to overturn. Because of this, it is necessary to collect the torsion at the ends.

This solution, valid for the Espelt, is the solution used as a harmonic continuation of the false arches’ caissons, valid for the Anoia. Eureka! We have two bridges in one, just what we wanted to prove.

From this fact arises the strength of the bridge: the single pier and the junction between both bridges give tension to the group, which, up to this point, was calm and quiet. The tension instils into it its uniqueness, its singularity.

Picture 3: View of the new bridge

The project’s key is to reflect on the bridge the determining factors of the place, known sometimes as “the magic of the place”, key concept in the beauty of constructions. Note that it was never required during the exhibition the theory of making an emblematic object as a necessity (so widespread nowadays and which provides justification for any entelechy). It has never been necessary to establish a secret code, a work language based on concepts from the place itself or from the constructive techniques. The dimensions, materials and shapes with which civil engineering works, well articulated, take us directly to the emblem, the symbol; at least that is what the authors of the present article believe. We would even dare giving recommendation or handing out a guide against swindlers, scoundrels and tricksters: distrust those who conceptualise excessively their constructions or realizations: there are enormous possibilities that our leg is being pulled. The answer to the question “why is the bridge so?” must be as a will: short and clear.

2 TECHNICAL FEATURES

The ground plan determining factors at the ends gave the advice to define the bridge axis as a circle that were simultaneously more or less the extension of La Merçé Street in Santa Margarida de Montbui and had a bearing on the Igualada side, according to the bisector of the angles formed by Rec Street and the Road C-241. The compromised solution is a 250 m-radius circle, which is orthogonal to the course of the River Anoia, unlike the Torrent de l'Espelt (with which it has skew). The following are the bridge basic features:

Total length: 125 m between the outer support axes (30 + 40 + 30 + 25 m). 11.50 m wide, 4.00 m of pavement (3.50 free) + 7 m of road + 0.50 m of barrier

Bridge with double portico typology (false arches) at the three first spans and continuous beam typology at the last one, with various sections: mixed at the deck and from steel at the false arches (inclined piers).

At all deck spans the section has min. 1.30 m deep, formed by two unicellular steel caissons 0.75 m wide separated 5.00 m. and a 30-cm concrete slab on the central part (between caissons) that develops up to 20 cm deep on the cantilevers' ends. The deck slab was concreted by means of collaborating pre-slabs of reinforced concrete. Pre-slabs were prefabricated at the building site.

False-arches section, inclined piers, in double steel caissons, separated also 5.00 m. with variable depth and constant width of 0.75 m. Steel crossbeams are placed between the caissons on the outer supports and at the single support of pier 3.

Picture 4: Bridge steel assembly.

Piers 1 and 2 are massive “in situ” concrete, with rectangular section and circular buttress, taking in the false arches and founded directly on the marls of Igualada. Pier 3, at the area of the Torrent de l’Espelt, is a single circular shaft of 1.00 m of diameter founded by means of a square footing on the marls. The abutments are also “in situ” concrete, with direct foundation.

The bridge finishings are:

Surfacings: 8 cm hot bituminous mix S-12 in wearing course on the road and concrete prefabricated slabs of 60x40x7 cm on the pavement.

Lighting: 6 lights type INDALUX 150-IHV/1u, located 7.5 m high and with a 20-metre separation between them on the pavement.

Impost, rail, handrail and barrier: the imposts are concrete prefabricated. A pedestrian rail is placed on the pavement on a cantilever end and between the pavement and the road, a handrail “safety barrier”. At the other end of the bridge a shock-resistant barrier is placed. The uprights from all elements, as well as the imposts, are modulated according to the pre-slabs width.

Picture 5: Bottom view of the new bridge

3 CONSTRUCTION BUDGET

The construction budget (VAT incl.) was 1.323.455,49 €. (220.204.465, -PTA). For a bridge area of approximately 1437.5 m2, it turns out 920.66 €/m2 (153.185,-PTA/m2).

4 WORK CREDITS

Promoters:	City Council of Santa Maria de Montbui and Igualada
	Diputació de Barcelona
	GISA
	FEDER
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Work Direction:	Manuel Reventós Rovira
	Albert Mas Soler
Construction Company:	Freyssinet S.L.
	Christian Pottiez Puyané
	Benoit Alleaume
Machinery Workshop:	Ascamon

5 FUTURE NOTE

Upstream from the bridge over the River Anoia (but over the Torrent de l'Espelt) the bridge over the Torrent de l'Espelt will be found shortly (construction planned for 2005).

The bridge has a total length of 100 metres and it is 15 metres wide. It crosses the Torrent's ravine, of approximately 70 metres at this point, by means of two parallel mixed arches of 67 metres span.

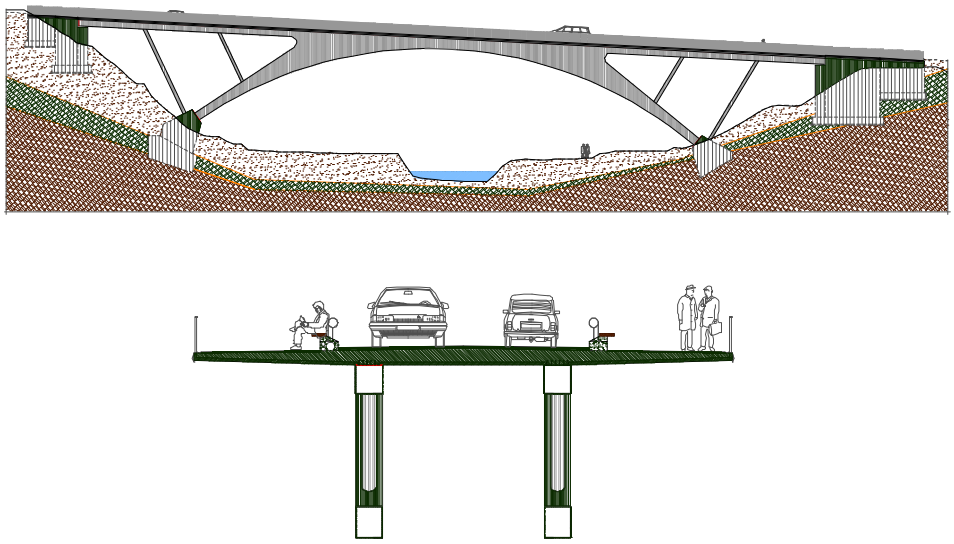

Figure 6: Bridge over the Torrent de l'Espelt (Igualada).

The 15 metres are divided (from a road point of view) into 7 m of road (2 x 3.5 m) and 8 m of pavement (4 m on each side). The surface of the bridge (pavement included) is at the same level, being the road separated from the pavement by means of a concrete dwarf wall and a tubular steel handrail.

The bridge rails are from steel and they consist of an 80x20 mm solid handrail and vertical uprights of 60x5 mm and 1000 mm high with a 12 cm separation between them. The impost is a folded steel plate 3 mm thick anchored to the bridge slab.

The bridge bearing structure consists of two parallel steel arches separated 5.26 m, which, together with the superior concrete slab, make a mixed structural section. Each of the arches is made by a variable-depth caisson. The bridge is completed by two access way sections made of steel caissons 82 cm deep supported on the abutments, on the arch and on two inclined tubular uprights (ϕ400x12 mm). The arch and the access way sections are fused, so that they form a single structural element at the span centre. The tubular upright that is closer to the abutment is supported by the arch abutment, while the distant one is supported by the arch itself. The caissons' width and the arch's width are of 75 cm. The arches are recessed into the abutments.

Crosswise, the structure consists of two cantilevers of 4.50 metres, two caissons of 0.75 metres and a central section between caissons of 4.50 metres. The deck's surface is a HA-35 concrete slab of variable thickness between 20 cm on the cantilever's end and 44.5 cm at the deck's centre. The slab, between porticos and on the cantilevers, is formworked with 40 self-bearing nervated pre-slabs of reinforced HA-45 concrete.

The arch foundation has been solved by means of HA-35 concrete dead-abutments 8 metre wide and trapezoidal section with a 5 metre-base supported by the grey marls resistant stratum.

The planned execution budget by contract (VAT incl.) amounts to 1.634.728,80 €. For a bridge surface of approximately 1500 m2 it turns out 1.089,82 €/m2 (181.331,-PTA/m2).

As the plans attached prove, the future bridge over the Torrent de l'Espelt dialogs well with the bridge over the Anoia.

The authors of the article would be pleased if the great master Maillart came around (or if he saw us from wherever he may be –as believers would say) and if not staring dumbfounded, at least could give an accomplice smile.