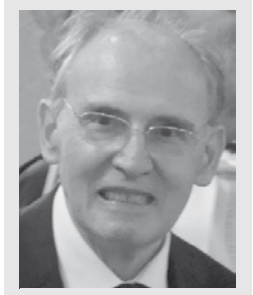
AIG

Gustave Magnel Gold Medal
27 November 2009

The Third Millennium Bridge over River Ebro in Zaragoza



Professor Juan José Arenas de Pablo

Professor Juan José Arenas de Pablo, born in Spain in 1940, graduated as a Civil Engineer in 1963 and obtained his Doctorate in 1970 at the Polytechnic University of Madrid (UPM).

He began his academic career as Assistant Professor of Prestressed Concrete at UPM in 1970. In 1976, he became Professor of Bridge Design at Cantabria University. He is the founder and President of the engineering company, Arenas & Asociados, Ingenieria de Diseño, Santander, Spain.

The Third Millennium Bridge is a white bowstring arch bridge. The concrete bridge has a deck width of 43 m and a main span of 216 m, making it the biggest span of this type built to date.
The design of the central arch with open "A" frames at each end, where the main arch divides itself into two leaning legs linked by a crossbeam, was inspired by the Barqueta Bridge (a steel bridge with a span of 168 m and a width of 30 m) which was also designed by Dr. J. J. Arenas for the Universal Exposition of Seville (Expo 1992). The Barqueta Bridge may be considered as a test model for the design and construction of the much wider and longer Third Millennium Bridge made of post-tensioned high-strength concrete.

This new challenging bridge has several remarkable aspects:

1. Urban function and location
The bridge is situated in the city of Zaragoza (Spain) and traverses the River Ebro (the highest water flow rate of all Spanish rivers). It completes the third ring road of the city, giving the people on the left bank of the river fast access to the recently built high speed train and bus station. The main road to the International Exposition of 2008, organised in Zaragoza from June to September 2008, runs over this bridge.

2. Dimensions
With a length of 270 m, main span of 216 m, height of the arch above the deck of 36 m and a deck width of 43 m, it is the largest concrete bowstring arch bridge built to date.

3. Aesthetics
The quality of its aesthetical design is high, making the bridge an icon of the city and the Expo 2008 event.

4. New materials
High strength self-compacting white concrete is used for almost the entire bridge. Theoretically, a compressive strength of 75 N/mm^2 for the arch and 60 N/mm^2 for the deck was required. The applied concrete, however, had a compressive strength exceeding 85 N/mm^2, due to early prestressing construction requirements.

5. Slenderness
The thickness of the elements was kept to a minimum by the quality of the structural design. A large number of external and internal post-tensioning tendons, positioned in a highly complex way, helped to achieve the remarkable slenderness of the concrete arch.

6. Construction procedure
A complex construction procedure was necessary. The bridge deck, 43 m wide and with a total weight of 200.000 kN, was launched from one bank of the river. The deck has a longitudinal curvature and a curved bottom cross section.

The concept, detailed design and site construction management of the bridge were all provided by the Arenas & Asociados team, led by Dr. J. J. Arenas.
Dr. J. J. Arenas has designed a large number of arch bridges during his career, becoming a reference architect for this type of bridge. The Third Millennium Bridge, a work of structural art, is the greatest and most ambitious of the arch bridges designed by Arenas & Associates, and the culmination of all previous work.

Professor Engineer Gustave MAGNEL

The late professor Gustave Magnel was born in Essen (Belgium) on 15th of September 1889, he graduated as a civil engineer from Ghent University in 1912. From 1914 to 1919, he worked with the London contractor D.G. Somerville & Co. In 1919, he was appointed chief assistant in the Laboratory for Strength of Materials at Ghent University and in 1937, he became a full professor. He taught courses on the design of concrete structures and structural analysis. He passed away unexpectedly on July 5th 1955.

G. Magnel was first involved in the elaboration of design methods for reinforced concrete structures. During the Second World War he developed his own prestressing system, which was characterised by the fact that the wires were arranged in the cable in a predetermined pattern. Additionally, the wires were anchored by means of "sandwich" plates and only two wires were tensioned at a time. As a professor and a lecturer, Magnel had a unique talent for explaining fairly complicated theories in a clear and concise way. He was the author of more than 200 publications among which several textbooks for the practitioner.
It is undoubtedly due to the persuasiveness of his publications and numerous lectures worldwide that prestressed concrete developed rapidly and was soon used widely in Belgium, France and other countries. His manual on prestressed concrete was translated into English and Spanish. The English version was the first systematic handbook on the subject in that language. Magnel was instrumental in the construction of the first prestressed concrete bridge in the United States of America.

Professor Magnel was an active member of numerous scientific committees and was awarded several Belgian and international distinctions. The laboratory he founded in 1926 has been named after him after his death.
The Association of Engineers of Ghent University (AIG) bestows the "Golden Medal Gustave Magnel" every fifth year on the designer of a structure, which is deemed to be an important and remarkable application of reinforced or prestressed concrete. The previous ten recipients were:

1959 Engineer N. ESQUILLAN (France)
"Voute-coque sur plan triangulaire du palais des Expositions de Paris"

1963 Engineer P. BLOKLAND (The Netherlands)
"De Nablaliggers van de Spuisluis in het Haringvliet"

1968 Prof. Dr.-Ing. F. LEONHARDT (Bundesrepublik Deutschland)
"Die Brücke über den Rio Caroni, Venezuela"

1973 Dr.-Ing. U. FINSTERWALDER (Bundesrepublik Deutschland)
"Die Wartungshalle V des Rhein-Main Flughafens Frankfurt"

1979 Engineer R. De KEYSER (Belgium)
"Le Viaduc d'Houffalize"

1984 Dr.-Ing. E.h. H. WITTFOHT (Bundesrepublik Deutschland)
"Die Autobahnbrücke über das Siegtal in Siegen-Eiserfeld"

1988 Engineer René GREISCH (A.I.Lg) (Belgium)
"Le Pont de Wandre sur la Meuse et le Canal Albert"

1994 Dr. Techn. Olav OLSEN (Norway)
"The Draugen Platform"

1999 Prof. Dr. Engineer Michel VIRLOGEUX (France)
"Le Pont de Normandie"

2004 Prof. Dr.-Ing. Drs h.c. Jörg SCHLAICH (Germany)
"The bridge of the Auerbachstraße in Stuttgart"

Gustave Magnel Gold Medal

Laureate 2004-2008
Professor Doctor Engineer Juan José Arenas de Pablo

Construction:
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Willy Naessens Industriebouw
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