XII MEZINÁRODNÍ VĚDECKÁ KONFERENCE
INTERNATIONAL SCIENTIFIC CONFERENCE

20—22 / 04 / 2009

Materiálové inženýrství
Building Materials Engineering

1899—2009

VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ

FAST

110 LET UNIVERZITNÍHO VZDĚLÁVÁNÍ STAVEBNÍCH ODBORNÍKŮ

FAKULTA STAVEBNÍ

BVV Veletrhy Brno

5

sekce / section

u příležitosti 110. výročí založení FAST VUT v Brně
a XIV. výročí Stavebních veletrhů Brno

on the occasion of the 110th anniversary of the founding
of the Faculty of Civil Engineering of Brno University of Technology
and the XIVth anniversary of Building Fairs Brno

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BUILDING MATERIALS ENGINEERING

SBORNÍK PŘÍSPĚVKŮ
PROCEEDINGS

20. – 22. duben 2009
April 20 - 22, 2009

Brno, Czech Republic

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Edited by Klára Křížová and Luboš Pazdera

Date: April 20 - 22, 2009

Location: Brno, Czech Republic

ISBN 978-80-7204-629-4

List of Invited Articles

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INVITED ARTICLES
VYZVANÉ PŘÍSPĚVKY

CIVIL ENGINEERING EXPERIENCES IN PORTUGAL

José Aguiar*

The good cooperation established between Universities, Laboratory National of Civil Engineering and private companies made possible the execution of a considerable number of civil engineering works by Portugueses, inside and outside the country. Some good examples are presented in this paper.

Introduction

In order to talk about civil engineering in Portugal, it is important to present the fields: teaching, research and construction works. These fields are connected and to have success in the last one is important a good support from the others. Portugal has a good tradition in activities related with civil engineering. This is a result of good conditions of the search and of the innovation related with the construction techniques [1]. It is possible the consideration of four phases in civil engineering teaching and research during the twenty century. There was a good articulation between the phases and during each one the basis for the next were developed.

The civil engineering works in Portugal were possible with the contribution of good construction companies and good civil engineers. Firstly, there was the construction of a considerable number of dams along all the country and some important bridges. After, with the adhesion of Portugal to European Union in 1986, there was a big increase in the construction or the modernization of highways, railways and airports, between others.

Teaching and research

In 1911, the 2 first civil engineering superior teaching courses were created, in Universities of Lisboa and Porto. Presently, there are more than 25 along the country, in several Universities and Polytechnics. In 1946, the Laboratory National of Civil Engineering (LNEC) was created. This Laboratory was very important for the development of the civil engineering research. LNEC developed the technique of reduced models firstly applied to the study of dams and dam-foundations. After, this technique was also applied to reinforced concrete structures.

Connected with this development of research, it started the activity of consulting and design. One important name of that time is Edgar Cardoso. He was professor at University of Lisboa and also a notable designer because he had good imagination and he completed the calculations with studies with reduced models. The Arrabida bridge in Porto is one of the notables designed by Edgar Cardoso (Fig. 1). This is a bridge in reinforced concrete built in 1963. This is an arch bridge consider as a leading one (Tab. 1) [2].

From the cooperation between teaching, research and design resulted also the construction of important dams, like Cabril dam (Fig. 2). This is a concrete dam built in 1954. Great university professors put their advanced scientific knowledge to the service of the big civil engineering works [1]. The success of these works was possible also with the contribution of the civil engineers graduated by the several universities and the solid companies developed in the country.

In the last 30 years, there was a considerable development in civil engineering research at universities. There was more and more a need to support the technology in fundamental research and to use a number considerably higher of qualified scientists.

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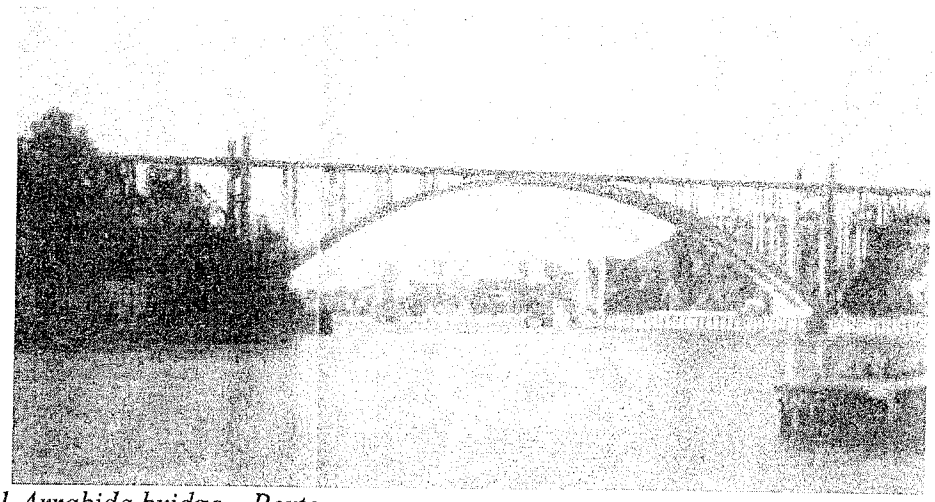

Fig. 1 Arrabida bridge – Porto.

Tab. 1 The leading concrete arch bridges [2]

Bridge	**Main Span (meters)**	**Completion Date**	**Location**
New River	510	1981	Virginia, U.S.A.
Krk	390	1980	Adriatic Coast, Yugoslavia
Gladesville	305	1964	Sydney, Australia
Foz do Iguassu	290	1964	Parana River, Brazil-Paraguai
Arrabida	270	1963	Porto, Portugal
Sando	264	1943	Angerman River, Sweden
Shibenik	246	1967	Krk River, Yugoslavia
Fiumerella	231	1961	Catanzaro, Italy
Novi Sad	211	1967	Bregenz, Austria
Von Stadens Gorge	198	1970	Port Elizabeth, S. Africa
Matrin Gil	192	1942	Andavias, Spain

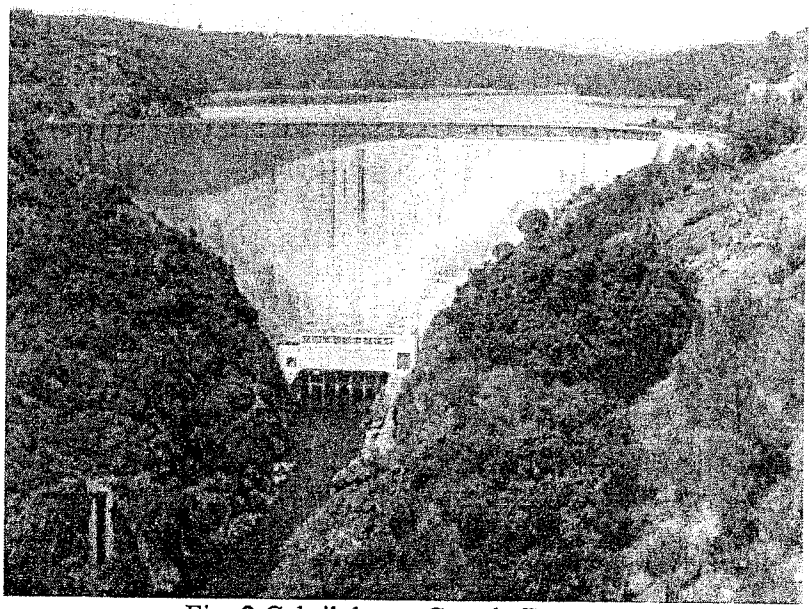

Fig. 2 Cabril dam – Castelo Branco.

Civil engineering works

The development of the sector of civil engineering during the twenty century was notable. The domains involved were the design, the construction management and the execution. In the first half of the twenty century the majority of the studies and designs were developed by the public sector. After the fifty years, there were a development of consulting companies capable of study and design all the civil engineering works built by Portuguese, inside and outside the country [1].

The evolution of the construction companies were based essentially in the increase of their levels of quality. Lot of these companies obtained the quality certification, also important for their internationalization. Good examples of civil engineering works in Portugal are the Madeira airport (Fig. 3) and the Oriente station (Fig. 4). The Madeira airport was built in 1963. The big civil engineering work was its extension till 2 781 m. This extension was built in reinforced concrete with columns founded in submersed soil. In foreign countries good examples are the Amizade bridge in China (Fig. 5) and the Cahora Bassa dam in Mozambique (Fig. 6) [3]. The Amizade bridge was built between 1990 and 1994. It is a reinforced concrete bridge that makes the connection between Macau and Taipa Island in China. The Cahora Bassa dam was built between 1970 and 1975. It has the possibility of energy production of 18 000 x 10^6 kWh. The lagoon has an area of 2 666 km^2.

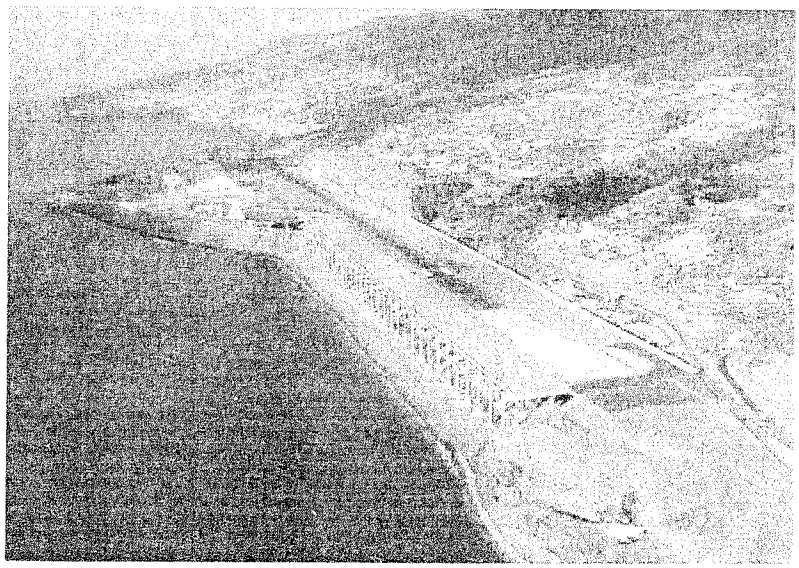

Fig. 3 Madeira airport – Funchal, Madeira Islands.

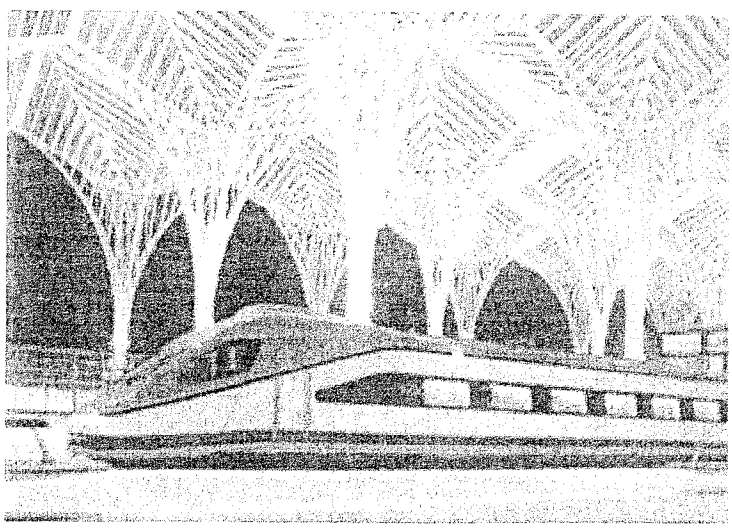

Fig. 4 Oriente station – Lisboa.

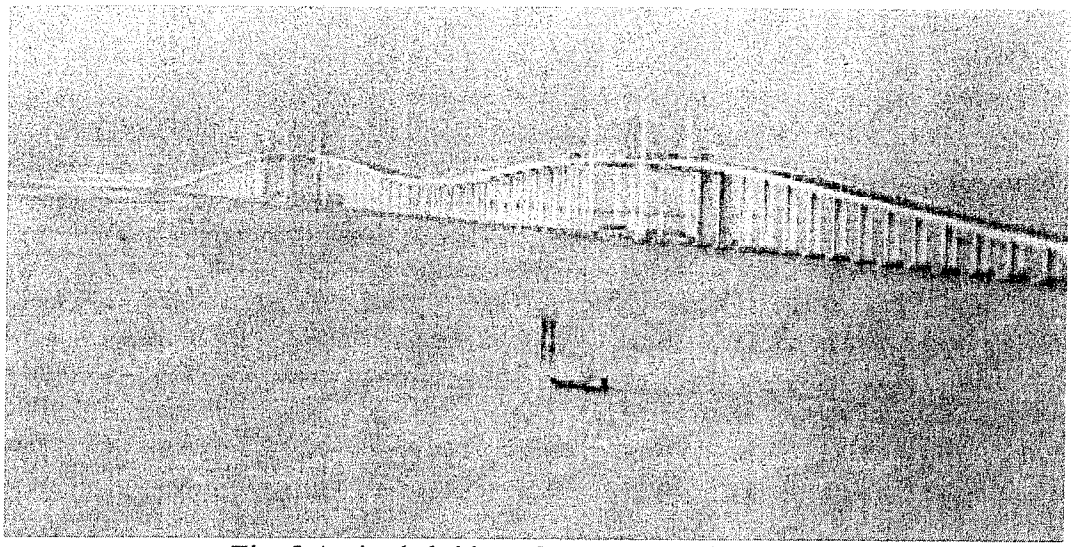

Fig. 5 Amizade bridge – Macau and Taipa, China.

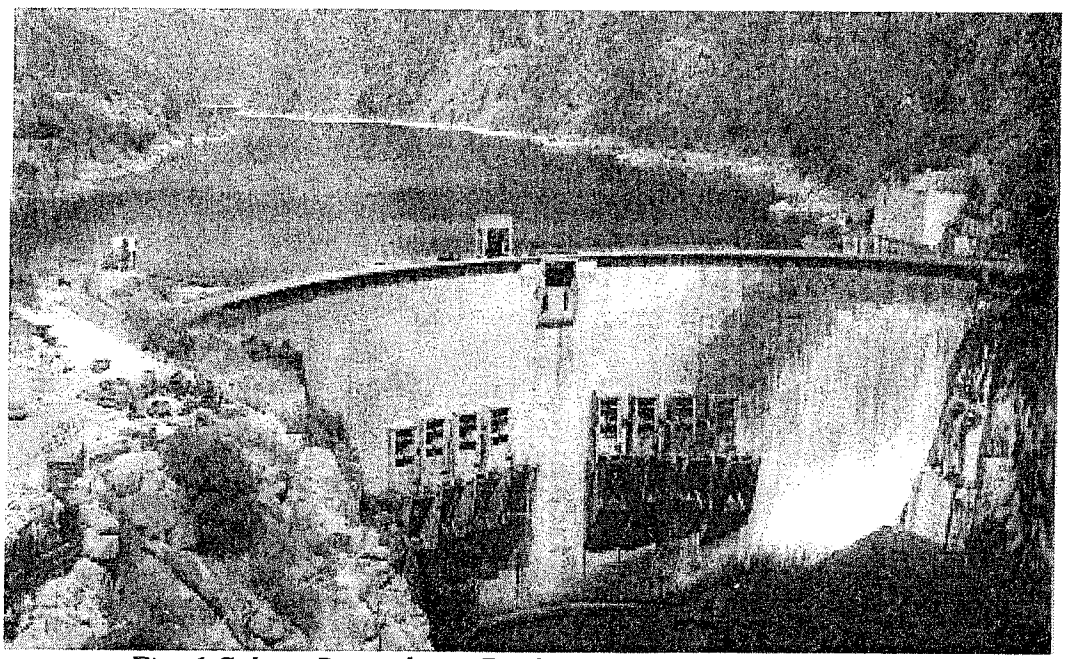

Fig. 6 Cahora Bassa dam – Zambeze River, Tete, Mozambique.

References

[1] INSTITUTION OF ENGINEERS, *100 obras de engenharia civil no século XX: Portugal,* Lisboa, Portugal, 2000, ISBN 972-97231-7-6 (in portuguese).

[2] GARRISON, E. G., A history of engineering and technology: artful methods, CRC Press, Boca Raton, U. S. A., 1999, ISBN 0-8493-9810-X.

[3] INSTITUTION OF ENGINEERS, *100 obras de engenharia portuguesa no mundo no século XX,* Lisboa, Portugal, 2003, ISBN 972-98843-2-3 (in portuguese).