

# THE ARCHIVE OF HISTORICAL MATERIALS IN DIGITAL ERA AS CULTURAL VALUE

**António Santos Silva<sup>1</sup>, Marluci Menezes<sup>2</sup>, Maria João Correia<sup>3</sup>**

<sup>1</sup> Laboratório Nacional de Engenharia Civil (LNEC), Av do Brasil 101, 1700-066 Lisboa, Portugal, e-mail: [ssilva@lnec.pt](mailto:ssilva@lnec.pt)

<sup>2</sup> Laboratório Nacional de Engenharia Civil (LNEC), Av do Brasil 101, 1700-066 Lisboa, Portugal, e-mail: [marluci@lnec.pt](mailto:marluci@lnec.pt)

<sup>3</sup> Laboratório Nacional de Engenharia Civil (LNEC), Av do Brasil 101, 1700-066 Lisboa, Portugal, e-mail: [mjmcorreia@lnec.pt](mailto:mjmcorreia@lnec.pt)

## ABSTRACT

Documenting and preserving materials data is important both to fulfill researcher's needs and to obtain social benefits concerning the related educational and historical value. The samples repository is also demanded as a basis for further understanding, innovation and development, besides the preservation of the materials historical value and information. The dissemination of those materials importance to non-specialized interested publics may also be enhanced by a database. DB-HERITAGE project (Database of building materials with historical and heritage interest) discusses in this paper the meaning of the archive as a cultural value that is established from the relationship between tangible (physical archive) and intangible (digital archive). Reflecting on the archive of historical materials as a heritage value, it is pointed out its significance for the valorization of the architectural heritage.

Keywords: Construction materials / Traditional techniques / Architectural heritage / Free ICT tools / Web-based free database

## 1 INTRODUCTION

Interventions on cultural property, particularly in the context of historical and architectural heritage, implies a knowledge of the constituent materials (e.g. stone, mortars, concretes, paints, ceramics, metals, wood) and of their conservation state, in order to provide recommendations on the conservation plan and on the materials and the techniques to be used.

However, information on a particular historic material, when available, is normally difficult to obtain, since it is disseminated through several institutions. For example, the Laboratório Nacional de Engenharia Civil (LNEC), and the Aveiro, Évora and Nova Universities have been coordinating a considerable number of projects not only related with the historical and technical survey of construction and on their long-term performance, but also on the techniques and interventions. Therefore, all these institutions have an unparalleled collection of information on physical, chemical and mechanical characterization of materials and on their forms of decay and conservation needs. Besides these institutions, other public institutions and universities, as well as construction and restoration companies, have a wealth of information that deserves to be collected and disseminated.

This is the context of DB-HERITAGE project (Database of building materials with historical and heritage interest), intended to build a reference sample collection or a

repository for historical materials. Besides it proposes to create an IT-tool to collect the related data on construction materials history, properties, and performance, assuming an intangibility representation, of such information.

This article presents an overview of the objectives of the DB-HERITAGE project, and introduces the different means that will be used to accomplish them. A reflection is made on the significance of the developed hybrid tools for the valorization of the Portuguese architectural heritage.

## **2 MAIN OBJECTIVES OF DB-HERITAGE PROJECT**

DB-HERITAGE Project is developing four areas of research, namely:

- General information on Portuguese building construction materials history, properties and performance
- Collection and characterization of historic building material samples;
- Collection of physical samples of historic building materials;
- Database tool on Portuguese historic building materials.

### **2.1 GENERAL INFORMATION ON PORTUGUESE BUILDING CONSTRUCTION MATERIALS HISTORY, PROPERTIES AND PERFORMANCE**

In the last decades there has been increasing global information on building materials composition and characteristics, as well on their deterioration and ageing mechanisms. The compilation of such information is of utmost importance due to researcher's needs, historic value and the legacy for future generations. Social and economic aspects will also be favored, namely by the improved awareness of the populations for their built heritage, enhancing attraction by the so-called cultural heritage tourism. This favors also the local employment, particularly in areas related to the use of traditional arts and materials, and contributing to the fixing of populations in more inland parts of the country.

The main objective is collecting information on building construction materials in Portugal, namely related with the constituents, production technologies and main raw materials sources. For the accomplishment of this objective, the compilation of data already available on partner's institutions, accompanied by the research published on papers, thesis, books and site references in all the country will be carried out. The results of this research should be uploaded on the upgraded database, in order to be shared and made entirely available. This work should also allow to obtain information on the performance of building materials in different contexts, namely in terms of their exposition, and whenever possible on conservation materials and practices.

### **2.2 COLLECTION AND CHARACTERIZATION OF HISTORIC BUILDING MATERIAL SAMPLES**

The collection of samples already available in the different partners (e.g. xylarium existing at LNEC, historic paintings sample collection at HERCULES Lab), including scattered material which should now be all reassembled, is being systematized and complemented with samples collected but not characterized from selected new case studies. These data should be gathered in order to give information on material and constituents type, function, localization, exposition to particular environment, historic period, type of building, composition, physical and mechanical characteristics, etc. The predictable results should allow educational and scientific improvements on different

disciplines related with cultural and architectural heritage preservation.

### **2.3 SAMPLES REPOSITORY OF HISTORIC BUILDING MATERIALS**

Besides the members of the project, other institutions and companies are expected to supply samples of historic building materials for the creation of a physical archive. These samples are being properly accommodated and classified, with a short synthesis of the information obtained during the sampling and on its main characteristics, and can be supplied for external institutions for further studies and comparisons. A substantial enlargement of the number of samples with different specimens from public and private entities is expected, including samples extracted from new case studies during the project duration. A built facility is being created on LNEC to collect these samples, which includes a storage area, a work area for organizing and processing, and a public area for unrestricted access.

### **2.4 DIGITAL ARCHIVE ON PORTUGUESE HISTORIC BUILDING MATERIALS-DB-HERITAGE DATABASE**

The results obtained are being archived on a free access web-based application, making use of the potential of information and communication technologies. This tool is being upgraded by the already available information obtained in precedent projects, namely FCT IMPROVE and the Atlantic Area DURATINET project, both related to the characterization and performance of building materials.

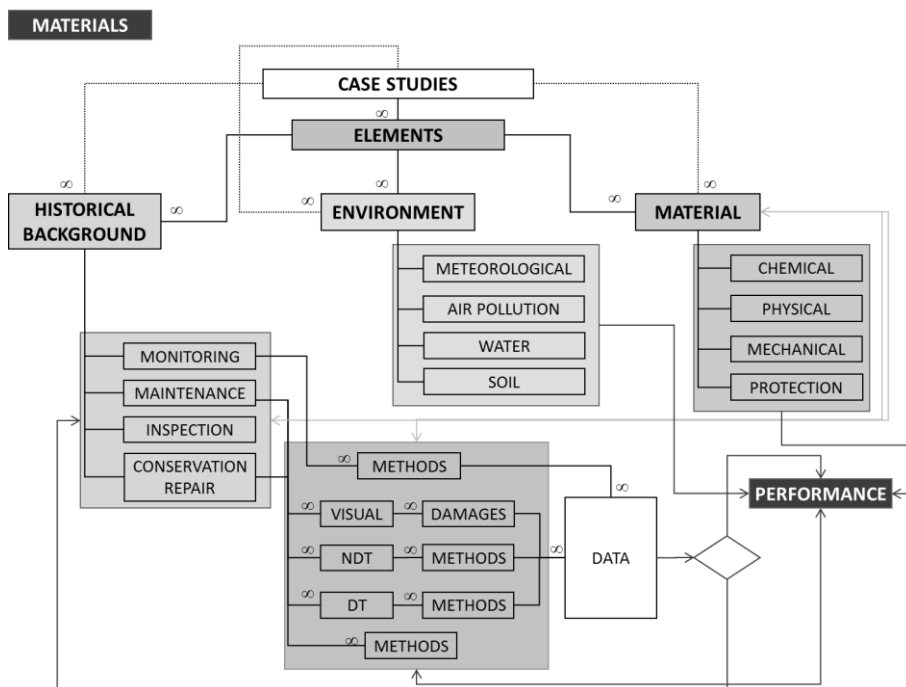
DB-HERITAGE project is using the previously developed web-based free tool by DURATINET project, DURATI database, which was designed for performance assessment and deterioration modelling of construction materials used on the built environment. The further development of this application is intended for DB-HERITAGE project effectively managing the repository of samples and related materials data providing for its systematization. In particular, DB-HERITAGE database should both provide for a customized interface with the end user and classify construction materials by type and function, addressing the historical background related data. Some of the database main fields comprise origin, use, chronology of interventions, properties, environmental exposure conditions, result of observations, and archive management details.

Efficiently and systematically organized materials and related information, properly collected and preserved, are valuable information for supporting research to prolong historic building materials life both by delaying deterioration and efficiently supporting their selection and use.

DB-HERITAGE database uses the web Django platform, being scalable, secure and expansible. This web-based tool only requires a browser to provide for all its functionalities, thus being accessible from any part with access to the network. It allows simultaneous multiple users as well as the easy migration of data. The associated users management system allows the definition of different access levels, from restrict to full access, for different user groups assuring the data confidentiality whenever necessary. This tool is expected to provide for a greater and more comprehensive access to historical materials data, which is usually inaccessible for the interested public, facilitating the dissemination of information.

For storing and displaying reliable data on materials performance the database was designed according to the major influencing factors on materials performance, which are

environment characteristics, material properties, historical data related with actions taken during service life (Fig. 1). This information is accessed according to the user defined structuring of a work of art.



**Figure 1: DB-HERITAGE database detailed scheme.**

The database has been created to simplify data analysis, reducing the time involved in this type of activities. Its main advantages include also indexation and data integration. The database comprises some simplified tools, such as graphics and filters, being possible to export data in different formats (Fig. 2). It is also possible to filter the hierarchic description of the case study for obtaining the elements which fulfil criteria selected by the user.

The interaction of the DB-HERITAGE database with different tools should also be provided for facilitating the share and replication of information on heritage architectural works of art and historical construction materials. Different initiatives, like the Collaborative Map for the registration of brick industrial masonry chimneys, have been predicted to motivate the interest of the scientific community and the general public in DB-HERITAGE project.

DB-HERITAGE is open and welcomes external collaborations and anyone wishing to actively participate with the project may send an application request through the contacts given in the project website (<http://db-heritage.lnec.pt/>).

The screenshot displays the DB-HERITAGE database interface. At the top, there are several filter boxes: 'Bridge X', 'Filter by Element Type', 'Filter by Component Type', 'Portugal X', 'Filter by Environment Type', 'Filter by corrosivity', 'Filter by exposure type', 'Wrought iron X', 'Steel X', 'Chemical analysis X', 'Metallography X', and 'Microstructural analysis X'. A 'Submit Query' button is located below the filters. A central logo for 'structures Bridge Eiffel Bridge' is also visible.

The main content area is titled 'Eiffel Bridge special inspection' and features a table with columns for elements (C1, C2, C3, D1, D2, D3, D4, D5, D6, D7, D8, D9, SouthV) and rows for different test types: 'Axial force controlled method (fatigue)', 'Bend test', 'Chemical analysis', 'Microstructural analysis', 'Tensile testing', and 'Visual examination'. The table contains green checkmarks and red boxes with numbers (1, 2, 3) indicating specific test results.

Below the table, there are three detailed views:

- Tensile testing 1:** Shows a table of test results with columns for '2.7% proof strength (Rp0.2)', 'Modulus of elasticity (E)', 'Percentage of elongation after fracture (A)', 'Percentage of elongation at fracture, 90° (A90)', 'Tensile strength (Rm)', and 'Metal percentage elongation at maximum force (Ap1.2)'. It includes a photograph of tensile test specimens and a 'Chemical analysis 2' section.
- Chemical analysis 2:** Shows a table of chemical composition with columns for 'Carbon, C (%)', 'Oxygen, O (%)', 'Sulfur, S (%)', 'Manganese, Mn (%)', 'Nickel, Ni (%)', 'Phosphorus, P (%)', 'Silicon, Si (%)', and 'Sulphur, S (%)'. It includes a photograph of a material sample.
- Microstructural analysis 3:** Shows a table of observations and microstructure data. The 'Observations' column contains text like 'Microstructure composed of perlite and ferritic matrix' and 'Inclusions with inferior size to 2µm and/or in inferior quantity to class 1'. The 'Microstructure' column contains 'Grain size' and 'Inclusions classification'. It includes a photograph of a material microstructure.

Figure 2: Different filters and ways of accessing data currently available in DB-HERITAGE database. Examples of test results in the case study complying with the selected criteria.

### 3 CONCLUSIONS

DB-HERITAGE project is intended to function as a hybrid repository, since it integrates the two facets of heritage: first in a material perspective accomplishing the objective of a collection of physical samples of historic building materials; second as an immaterial (digital) facet, creating and sharing a database tool on Portuguese historic building materials characteristics and performance.

Both physical and digital repositories are intended to archive, organize, preserve and disseminate the architectural heritage, although in different complementing ways, thus

contributing to the preservation, dissemination of knowledge and facilitating the decision making process of interventions in architectural heritage.

The free and easily accessible data on historical materials is essential for the conservation and enhancement of heritage. This contribution is especially important when integrating the tangible and intangible aspects of heritage. In particular, the Portuguese built heritage case studies addressing both aspects give certain specificity to the data, increasing the cultural value of the DB-HERITAGE database.

## 4 REFERENCES

DURATINET Project - **“Durable Transport Infrastructures in Atlantic Area - Network”** - 049/2009, approved in the Atlantic Area Transnational Programme, co-financed by ERDF.

IMPROVE Project – **“Improvement of performance of aggregates in the inhibition of alkali-aggregate reactions in concrete”**, ref. PTDC/ECM/115486/2009, <http://bit.ly/M13NF7>.

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