Educational research in architecture: ICT tool for historical buildings evaluation

Ana L. Virtudes, and Filipa Almeida

***Abstract*—**Historical buildings have been threatened by the vulnerability to degradation. This problem is not an exception in Portugal, where the few remaining examples of vernacular architectural wooden stilt-houses of river banks, have been neglected, with the disappearance or abandonment of almost all buildings.

This research presents the results of an educational research in architecture, creating a software for evaluation of status of historical buildings conservation. It will present as a case study, the portuguese wooden stilt-house village of Lezirão, where this ICT (information and communication technology) platform was tested. This is one of the remaining five vernacular architectural villages of river banks that still exist in the country, nearby Tagus river. This research was developed in a PhD thesis in Architecture at the University of Beira Interior in Covilhã.

This ICT platform is a pioneer approach in educational research in architecture, related on wooden stilt-houses evaluation in Portugal and it can be used in other similar buildings all over the world.

***Keywords*—**Architecture; Educational research; ICT tool; Status of historical buildings conservation.

I. Introduction

VERNACULAR architecture typologies, such as wooden stilt-houses, have been threatened by the vulnerability to degradation. In Portugal, this problem reports to the wooden stilt-house villages of the Tagus river. This legacy has its roots in a migratory movement of a fishing community coming from the Atlantic central west coast to this river banks (Fig. 1). They settled their urban settlements at least since the 1860s. Lezirão is one of the five remaining settlements, from the 80 identified in the 1950s, that have been neglected, with the disappearance or abandonment of almost all historical buildings, damaging its architectural and urban spatial features.

In this sense, this research presents the analyses of the results from the application of a method using an ICT (information and communication technology) platform, designed for the evaluation of wooden stilt-houses, considering their status of conservation. The study, developed in a PhD thesis in Architecture, at the University of Beira Interior in Covilhã, includes about 90 buildings, considering all villages as a whole.

This paper presents the results obtained to the village of Lezirão, which total 6 historical buildings. In this village, the waterfront remains as the centre of the urban space, concentrating the social spaces of the community life.

It concludes that the use of ICT platforms in educational research, focused on the evaluation of status of historical buildings conservation, in the domain of vernacular architectural features is at the cutting edge of the scientific knowledge.

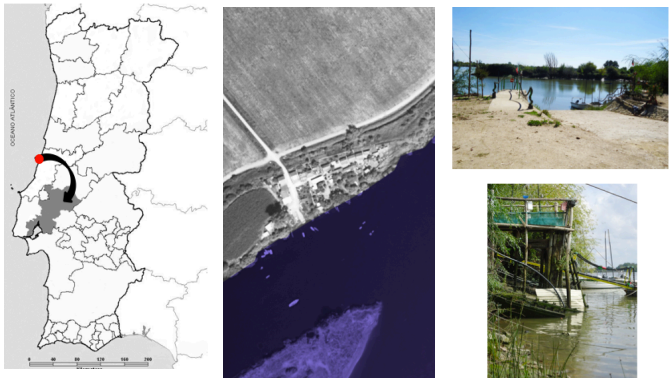

Fig. 1 – Migratory movement from central west coast to Tagus river banks and pictures of Lezirão.

II. The Use of ICT in Educational Research

The information technology revolution requiring the need for specific hardware, software and expertise is producing multiple impacts on society in general. At the European scale, including in Portugal, it is clear that the evolution of countries is closely linked to the collection and analysis of data.

Has a decision-making tool in educational research in particularly, in domains such as spatial planning, civil engineering or architecture, it has enhanced methods of analysis and communication with maps and other types of spatial data. Thus, the importance of computer technologies for both quantitative and qualitative analysis has been recognised by the educational actors and scholars. However, this issue is novel in historical buildings analysis and there is still a lack of research projects working about the availability and role of information, for the well being of society, the economy and the environment, using new technologies.

New technologies have thus the potential to introduce more transparency and participation, improving the 'good' governance principles in architectural rehabilitation and urban regeneration actions. New urban lifestyles and locational issues for hi-tech production activities have thus emerged.

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III. The Software Design

A. Existing evaluation methods of status of buildings conservation

As review of current literature has revealed that the existing evaluation methods of status of buildings conservation, are focused on conventional buildings, mainly residential houses. Therefore, they were not designed for the features of vernacular architecture, such as wooden stilt-houses.

Nowadays in Europe, the methods for status of buildings conservation assessment, used in countries such as the Home Condition Report (HCR) from 2004 used in the United Kingdom, the Inspección Técnica de Edifícios (ITE) used in Spain, the Grille d'Évaluation de la Dégradation de l'Habitat from 2011 used in France or the NEN 2767 Dutch standard for condition assessment of buildings from 2006 used in the Netherlands, don't fit in vernacular architecture features. In this sense, the presented method, designed as a software suitable for vernacular architectural buildings is a pioneer approach.

B. Initial page data of ICT platform

The computing programme software, created as an ICT platform was developed in order to allow the compilation and processing of the data related on the historical buildings, collected in the visual inspection of wooden stilt-houses. This method has the advantages of allowing a comparative analysis of the results, not only between all buildings under analysis but also in between different villages.

The developed computing programme is a database, which makes all the calculations, regarding the evaluation of the status of historical buildings conservation, automatically.

The initial page of the software allows to open or to create the following data: the diagnosis projects giving them a name (each project corresponds to a different village); localization coordinates of each village with an interactive Google map visualization; characterisation plan of the village; list of buildings of each project, giving them the Diagnosis Record and an Identification Photograph.

C. Diagnosis Record

The Diagnosis Record of each building, based in the visual inspection record, allows the introduction of the following data: Identification (address, building owner and building number); Photographs, until four units (maximum of 60 Kb per photo); Localization map, in JPEG format (100 Kb maximum); General characterisation of the building (use, number of floors, type of occupation, volumes, orientation of the front façade related to the river, existence of outbuildings, and number of attached historical houses); Constructive characterisation (structure, roof, exterior walls, existence of stairs/ramp, gallery, terrace, spans such as windows or doors, chimney and gutters); Status of Building Conservation, with the record of the anomalies levels given to each constructive element of the building and with the automatic calculation of the Anomaly Index of each group of constructive elements.

Then, the data processing of the software begins. It is automatically generated an Individual Record for each building which gives two types of information, considering the points and the weights given to each constructive element and group of constructive elements: analysis 1 - needs for immediate intervention, with the alert indicators activated (in red) and the corrective actions to make; analysis 2 - status of historical building conservation, with data graphs about the level of the structural (ECe), non-structural (ECne) and global (EC) qualities, considering the Anomalies Index of the groups of constructive elements.

The partial and global results of all buildings are put into the Global Record of the village, which allows the Statistics Analysis, comprising the following data: sorted table of the buildings, from the highest to the lowest number of active warning indicators (which means the needs for immediate intervention), and from the best status of building conservation to the worst status of building conservation; synthesis table and circle graph, which comprise the buildings ratings in intervals by the number of active warning indicators (from 1 to 5); Level of Global Quality (EC) of the status of building conservation (very bad, bad, average, good or very good);

This diagnosis record, which has a table configuration, is useful for each village for the comparative analysis in between buildings, allowing the definition of strategies and intervention priorities locally, at the urban settlement scale.

Finally, in the Global Analysis the results from both previous analyses in the several villages are synthesised in a table and graphs, allowing the comparative analysis in between them.

IV. The Fishing Community of Lezirão Village

In the relationship established with other wooden stilt-house villages existent in Portugal, Lezirão is the smallest and the newest, having its roots in the decade of 1950. Is located in the Municipality of Azambuja, situated about 50 Kms upstreams of Lisbon, in the right side of Tagus river.

In the front of this village there is the White House *Mouchão*, which is an islet integrated in river tourist circuits, where is possible to watch the Lusitano horse in the wild environment.

Currently, this urban settlement corresponds entirely to the historical buildings nucleus and includes stilt-houses (the dominant architectural typology, usually used for housing) and single-story houses (the non-dominant architectural typology mainly used for kitchen). It is organized (Fig. 2) in two alignments of houses, parallel to the river, concealed between the dike and the waterline edge. Due to its location, the dike represents the separation between the fertile agricultural fields nearby, which are protected from the floods by the dike, and the fishermen community exposed to them.

The urban morphology has a parallel orientation to the river, being the defining element of the urban shape. Thus, this aspect reinforces the linearity of the buildings alignments.

Fig. 2 - Urban morphology of village of Lezirão.

The riverfront is the central part of the village, concentring the social spaces of the community, still dedicated to the fishing, such as the café with a terrace facing the Tagus, the repair atelier for boats or the public public dock.

V. Application of the ICT Tool in Lezirão

In the wooden stilt-house village of Lezirão, the most downstream, the six historical buildings, total 7% of all wooden stilt-houses of Tagus river banks, remaining in the five villages as a whole.

Five of these buildings are in the typology of stilt-houses and one of them is in the typology of single-story house, which represents 8% e 3% of each one of these typologies of vernacular architecture, considering all villages.

Regarding the status of historical buildings conservation (Fig. 3 and Fig. 5), the results show that two thirds of the buildings (66,7%), including three in the typology of stilt-houses and one in the typology of single-story house, are in the 'average condition' level. The others (33%) are in the 'good condition' level, which comprise two buildings belonging to the typology of stilt-houses.

From the ICT platform application to the wooden stilt-houses of Lezirão is possible to conclude that none of these buildings need immediate intervention (Fig. 4), since they have no warning indicators activated. On the other hand, none of this village buildings is neither in 'very bad condition' level nor in 'bad condition' level.

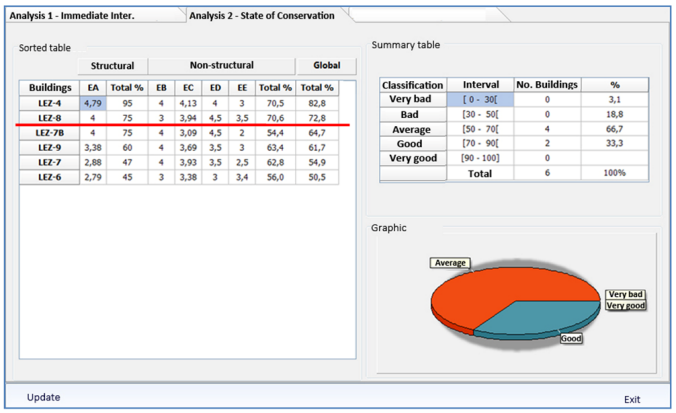

Fig. 3 - ICT platform for evaluation of the status of historical buildings conservation: Lezirão.

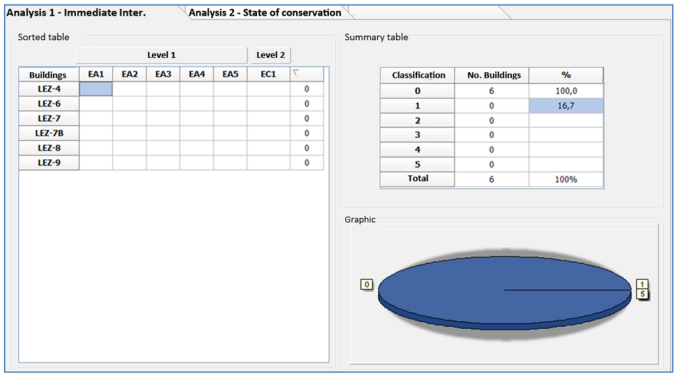

Fig. 4 - ICT platform for evaluation of the historical buildings conservation: Lezirão, needs for immediate intervention.

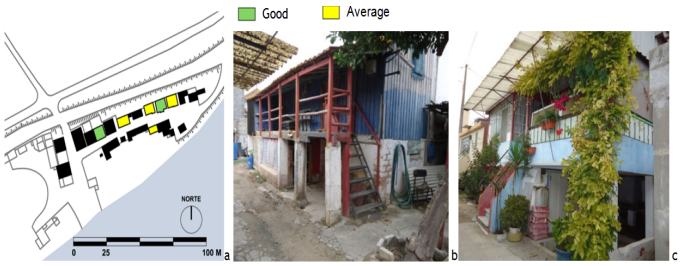

Fig. 5 - ICT platform for evaluation of the status of historical buildings conservation: a. Lezirão; b. house in the worst status of conservation; c. house in the best status of conservation.

VI. Conclusions

The development of this ICT platform started with a simple set of software requirements achieved subsequent developments of versions until the system being implemented as a whole, with specifications, design and development of prototypes. It included the study of programming language, databases, software components and an integrated development environment. Thus, the research plan and methods for doing this included the project organization, requirements analysis, structuring of tasks, schedule, and software development process (a web development).

The result of this research was the functionality of the software, due to its proper functioning, working as it was originally established for, according to the expectations of previous working step. The research main goal was achieved by the development of an evaluation method regarding its application to the wooden stilt-houses of Tagus river banks.

Further research includes the improvement of the method as an intuitive, friendly and mobile ICT platform, able to insert the data in situ easily, concerning the goals of the user, including getting more detailed or more general output for one single building or for a set of buildings, belonging to one single village or to several villages.

Finally, this knowledge is ready to be transferred from the educational domains, given that it was developed in a PhD thesis in architecture, to the business environment. In this sense, is crucial to engage software companies in order to improve this tool, regarding the input from the enterprise environment, and its experience in terms of commercial applications and distribution channels, promoting the development of its expertise, and reinforcing the knowledge exchange in between research entities, scholars, economic and enterprise entities.

Therefore the transferring and dissemination of this knowledge and know-how to the enterprise market will be the next step, in order to make it available for users keen on this type of analysis tool.

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