

Dados sobre projecto exploratório reVer

Referência do projeto:

EXPL/ECM-COM/1801/2013

Título / Title:

reVer - Modelação do desempenho de ciclo de vida de edifícios vernáculos portugueses – contributos para a sustentabilidade do edificado

reVer - Modeling the life-cycle performance of Portuguese vernacular buildings – contributes to the sustainability of buildings

Summary:

The research project aims to contribute for reducing the gap of technical information on the performance of Portuguese vernacular architecture and of its construction techniques. The aim is to support building professionals with more detailed information about this type of constructions to be used both in the refurbishment or regeneration of vernacular buildings as in the design of new buildings that use vernacular building strategies. The study will focus on a set of three types of vernacular buildings whose strategies, which were identified in a preliminary research work (Fernandes 2012), have potential to contribute to sustainable construction. The case studies are located in three zones of the country, distinct at the level of several factors. To understand the performance of buildings in their specific context, this research will use three methods of analysis: characterization of material properties and Life-cycle inventory (LCI); monitorization of indoor and outdoor environmental parameters (temperature, relative humidity and air velocity), and parametric simulation under dynamic situation using software tools. The research team has members from the fields of Architecture and Civil Engineering, with specialization and work developed in the areas of sustainable construction, life cycle assessment and sustainability of buildings, building physics, energy efficiency and dynamic building simulation. This project aims to be the first part of a broader project that will create a knowledge database about Portuguese vernacular building technologies and design strategies. This will include information about the contribution of this type of construction to the improvement of the life-cycle performance of buildings at the level of the three dimensions of sustainability: environment; society; and economy.

Aim:

Portuguese vernacular architecture has been investigated mainly from an interpretative perspective and with qualitative analyses. At the level of sustainability issues analysis the context is the same, and the research is at the moment in an early stage and with great development potential. Fernandes (2012) has addressed comprehensively and with qualitative analysis the sustainability principles present in Portuguese vernacular architecture. In his work, a set of strategies adopted in these constructions with potential to be transposed

to contemporary building are presented. This study also indicates the need for further studies in this area, particularly quantitative, in order to create databases and tools useful for architects, engineers and other stakeholders in the construction sector.

In this sense, giving continuity to the mentioned work, this research project will focus on: analyzing the comfort conditions in vernacular buildings throughout the different weather seasons and if they are consistent with the current comfort requirements; realizing what is the contribution and effectiveness of the several adopted passive strategies to ensure indoor comfort conditions; and analysing the embodied life-cycle impacts in common vernacular building materials. Briefly, the research questions that will guide the study try to answer to: How effective are vernacular solar passive strategies ensuring comfort conditions? What is the potential of vernacular strategies and construction systems in current building context to improve its sustainability? Based in the literature review, studies on vernacular strategies should be further developed because this type of construction have the potential to holistically contribute to the sustainability of the built environment, both at environmental and socio-economic levels.

This research project aims to contribute to the development of knowledge through a systematic and quantitative study about the life-cycle performance of Portuguese vernacular buildings. In this direction, the R&D objectives of this project are: i) To characterize the materials and construction technologies used in vernacular architecture; ii) To assess the environmental performance of materials/construction systems commonly used in these constructions;

iii) To assess the passive climate responsiveness of three case studies (locate in different Portuguese zones) through in-situ monitoring of the indoor and outdoor hydrothermal environments; iv) To develop a calibrated hygrothermal model (and hygrothermal datasets and libraries related with the analysed building elements) to be used by the design teams in the design of refurbishing operations in vernacular buildings of the analysed zones. v) To develop and disseminate knowledge about vernacular architecture and construction technologies in order to encourage its preservation and the use of its principles in the design of new constructions.

These objectives aimed to overcome the following problems found in the state of the art: i) lack of technical information about vernacular building systems, that can enable architects and engineers to prepare more assertively their interventions on these specific buildings; ii) absence of data about the environmental performance of Portuguese vernacular materials for assessing the sustainability of buildings that use these types of techniques — in the near future only industrially-produced materials will have this type of data, which would generate again a gap of information on vernacular materials; iii) lack of information about the indoor environmental performance of these buildings, throughout the various weather seasons of the year, leading to the need to carry out in situ hydrothermal monitoring and to create simulation tools that; iv) based on all the mentioned data can predict the life-cycle performance of other buildings of same type. In an increasingly demanding and complex disciplinary area, the

incorporation of the aforementioned data in dynamic simulation and BIM (Building Integrated Model) tools is very useful. This can afterwards be used to support design teams both in the rehabilitation projects of vernacular buildings as in the design of new buildings that use vernacular strategies and building systems. □ The plurality of the Portuguese territory resulted in a profuse expression of different types of vernacular buildings, which represents a vast research field. Nevertheless, at this stage, the project will focus only on three areas of the country, different from one another in several local factors (climate, lithology, tree crops, etc.) which consequently led to distinct architectural manifestations. The selected areas - central coast, northern interior and southern interior - represent in general the major contrasts of the Portuguese territory. The selection of the case-studies followed criteria like the contrast between areas at the level of local factors, the differences in vernacular architecture of each of these and their potential to contribute for a more sustainable built environment, according to the previous work carried out in the C-TAC research centre (Fernandes 2012). Based on this work, the vernacular buildings to be considered in the project are: the wooden buildings of the coast, referred as "palheiros"; the buildings of Beira Alta with glazed balconies; and the Alentejo's earthen buildings. It is also intended to draw comparisons between the buildings and used strategies, based in the specific conditions of the territory. □ The first stage of the research will consist in gathering information on primary and secondary sources and in visiting the selected areas, which allows selecting the most relevant case studies. After defining the case studies, new qualitative data will be gathered to understand both the context and characteristics of each building (orientation, internal arrangement of spaces, natural ventilation, solar passive strategies, materials, building elements and thermal inertia). □ The next step will consist in quantitative data collection and development. The amount of data required for the study will be defined depending on the conclusions of the qualitative analyzes. Briefly, quantitative data corresponds to: □ - Characterization of the thermal-physical properties of the vernacular materials and construction elements (mass; thermal conductivity; thermal diffusivity; volumetric thermal capacity; and mean temperature); □ - Development of a Life-cycle Impact Assessment (LCIA) database for vernacular construction materials (based in up-to-date standards and specific life-cycle inventory that will cover the cradle to gate stage plus the end of life) □ - Thermal environmental performance of vernacular buildings (in situ measurement of hygrothermal parameters that characterize the indoor environment and local weather). □ Based on the quantitative data collected in previous tasks, in the next phase a parametric analysis under dynamic conditions using DesignBuilder/EnergyPlus or/and Ecotect software is performed. To validate the software, measured and simulated data will be compared. After calibrating the model, the data from the study can be extrapolated to a computational tool to assess the thermal performance of similar buildings.