

MOST RELEVANT CHARACTERISTICS TO IMPROVE RESIDENTIAL ENERGY EFFICIENCY

¹Raúl-Tomás Mora-García; ²María-Francisca Céspedes-López; ³Raúl Pérez-Sánchez; ⁴Juan-Carlos Pérez-Sánchez

¹ Universidad de Alicante, rtmg@ua.es

² Universidad de Alicante, paqui.cespedes@ua.es

³ Universidad de Alicante, raul.perez@ua.es

⁴ Universidad de Alicante, jc.perez@ua.es

Keywords: *Energy efficiency, Energy performance certification, Retrofitting, Linear regression, Barcelona.*

Abstract

Urban areas play a crucial role in global energy demand and in policies to mitigate climate change. Energy use in residential buildings is one of the main sources of greenhouse gas emissions in cities. Spain has more than 25.8 million dwellings, of which around 9.3 million are more than 50 years old. Of these, 16.4% are in a poor or deficient state of conservation (INE, Population and Housing Census 2011). This situation of obsolescence and poor conservation of the building stock requires a major structural, functional and energy refurbishment. As a research hypothesis, it is proposed that the current Spanish building stock has a great potential for energy savings and CO₂ reduction and that with an appropriate selection of interventions aimed at refurbishment it is possible to increase the energy efficiency of buildings and make them more sustainable. The main objective proposed is to identify the architectural, design and building system or installation factors that are most relevant for improving the energy efficiency of existing residential buildings in Spain. A large database with geo-referenced observations of housing energy certificates is used for this purpose. The certificates correspond to individual dwellings located in blocks of buildings in the city of Barcelona (C2 climate zone according to the CTE). From these certificates, information on energy consumption and CO₂ emissions, as well as the technical characteristics of the envelope and heating/cooling systems, can be obtained for each dwelling. The dataset contains information on energy consumption and CO₂ emissions with their rating (energy letter); in addition to the characteristics of the buildings such as the surfaces and transmittances of the envelope (opaque and glazed enclosures), the climate zone, type of dwelling, year and building code, heating and air-conditioning installations, percentage of windows according to orientation, etc. Using a linear regression model, the influence of each housing characteristic on energy consumption and CO₂ emissions can be estimated. The interpretation of the regression coefficients allows determining to what extent energy consumption can be reduced, for example by improving the envelope (opaque or glazed), systems/installations, thermal bridges, among other aspects. The linear regression analysis has shown promising results due to its reasonable

accuracy for model estimation, and the relative simplicity of its application and interpretation compared to other methods (Fumo et al., 2015).

References

- [1] Brounen, D.; Kok, N. y Quigley, J.M. (2012). Residential energy use and conservation: Economics and demographics. *European Economic Review*, 56(5), 931-945. doi: <http://dx.doi.org/10.1016/j.euroecorev.2012.02.007>
- [2] Catalina, T.; Virgone, J. y Blanco, E. (2008). Development and validation of regression models to predict monthly heating demand for residential buildings. *Energy and Buildings*, 40(10), 1825-1832. doi: <https://doi.org/10.1016/j.enbuild.2008.04.001>
- [3] Elawaf, N.; Abdel-Salam, T. y Pagliari, L. (2012). Evaluation of heat pumps usage and energy savings in residential buildings. *Int J Energy Environ*, 3(3), 399-408. http://www.ieefoundation.org/ijee/vol3/issue3/IJEE_06_v3n3.pdf
- [4] Fumo, N. y Rafe Biswas, M.A. (2015). Regression analysis for prediction of residential energy consumption. *Renewable and Sustainable Energy Reviews*, 47, 332-343. doi: <http://dx.doi.org/10.1016/j.rser.2015.03.035>
- [5] INE, Instituto Nacional de Estadística. (2013). Censo de población y vivienda 2011. Obtenido de http://www.ine.es/censos2011_datos/cen11_datos_resultados.htm
- [6] Mastrucci, A.; Baume, O.; Stazi, F. y Leopold, U. (2014). Estimating energy savings for the residential building stock of an entire city: A GIS-based statistical downscaling approach applied to Rotterdam. *Energy and Buildings*, 75, 358-367. doi: <http://dx.doi.org/10.1016/j.enbuild.2014.02.032>

CITE 2022

23th, 24th and 25th of March 2022

ESCUELA TÉCNICA SUPERIOR DE EDIFICACIÓN
UNIVERSIDAD POLITÉCNICA DE MADRID
Avda. Juan de Herrera, 6-28040-MADRID

DEPARTAMENTO DE TECNOLOGÍA DE LA EDIFICACIÓN



© jcomp - freepik.es

ABSTRACTS BOOK

LIBRO DE ACTAS

**VII International
conference on
Technological
Innovation in
Building**

**VII Congreso
Internacional de
Innovación
tecnológica en
edificación**





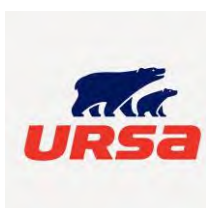
VII CONGRESO INTERNACIONAL DE INNOVACIÓN TECNOLÓGICA EN EDIFICACIÓN CITE 2022



POLITÉCNICA



ESCUELA TÉCNICA SUPERIOR
EDIFICACIÓN
UNIVERSIDAD POLITÉCNICA DE MADRID



CONSEJO GENERAL
DE LA ARQUITECTURA TÉCNICA
DE ESPAÑA



ESCUELA TÉCNICA SUPERIOR DE EDIFICACIÓN

Avenida Juan de Herrera, 6. 28040 – Madrid

Tel. 91 336 75 95 Fax: 91 336 76 44

Organizador: Departamento de Tecnología de la Edificación de la ETSEM.

Universidad Politécnica de Madrid

Patrocinadores:

CGATE

MDPI

Cátedra Empresa PROIESCON

URSA Insulation



9 788418 255410

Depósito Legal : **M-5181-2022**

A REVIEW OF VERTICAL GREENERY SYSTEMS (VGS) CLASSIFICATIONS AND THEIR FUNCTION 62

Mitra Manouchehri, Mercedes Valiente López, Joaquín Santiago López

DEVELOPMENT OF A RECYCLED GYPSUM PLASTER WITH PLASTIC AGGREGATE 63

Manuel Alejandro Pedreño-Rojas, María Jesús Morales-Conde, María Isabel Romero-Gómez

MOST RELEVANT CHARACTERISTICS TO IMPROVE RESIDENTIAL ENERGY EFFICIENCY 64

Raúl-Tomás Mora-García, María-Francisca Céspedes-López, Raúl Pérez-Sánchez, Juan-Carlos Pérez-Sánchez

AQUACULTURE FOR GREEN BUILDING ENVELOPES AND ENERGY EFFICIENT FACADES 66

Somayeh Ebrahimi, María del Mar Barbero Barrera

IMPACT OF THE NEW TECHNOLOGIES OF MAPPING AND PROJECTIONS IN THE URBAN NIGHTSCAPE 67

Nubi León Martínez, Mercedes Valiente López, Ma. Carmen Sanz Contreras

Building Technology 69

STATISTICAL STUDY OF MECHANICAL PROPERTIES OF PLASTER EMPLOYING NEW WASTE MATERIALS FROM DISCARDED TENNIS & PADEL TENNIS BALLS 70

Marta Rodríguez Aybar, Álvaro Pérez Raposo, Cesar Porras Amores, M^a Esther Moreno Fernandez

APPLICATION OF ADVANCED DATA ANALYSIS TOOL IN BUILDING ENVIRONMENT 73

Arrate Hernández-Arizaga, Ana Picallo-Pérez, José María Sala-Lizarraga

AQUA LOW-TECH. ASSEMBLIES FOR DEVELOPMENT 75

Alba Ojero Revenga

CONNECTIONS IN COMPOSITE WOOD-COLD FORMED STEEL FLOORS 77

Sergio Santana-Almeida, Borja Cruz, Joaquín Antuña

LOW COST SUSTAINABLE ALTERNATIVE BUILDING THROUGH CONTAINER HOUSES 79

José Antonio Hernández Torres, Alberto Jesús Flores Lora, José Miguel Dávila Martín, Ángel Mariano Rodríguez Pérez, Julio José Caparrós Mancera

ADHERENCE AS SHEAR TRANSFER MECHANISM IN COMPOSITE SECTIONS OF CONCRETE AND COLD-FORMED STEEL 82

Sergio Santana-Almeida, Borja Cruz, Joaquín Antuña