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ON TECHNOLOGIAL INNOVATION
IN BUILDING

9° CONGRESO INTERNACIONAL INNOVACION TECNOLOGICA EDIFICACION

DEPARTAMENTO DE TECNOLOGÍA DE LA EDIFICACIÓN
Escuela Técnica Superior de Edificación de Madrid
Avda. Juan de Herrera Nº 6 28040 Madrid

LIBRO DE ACTAS
ABSTRACTS BOOK

CITE 2024

13, 14 & 15 MARZO

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GREETINGS

IX INTERNATIONAL CONGRESS ON TECHNOLOGICAL INNOVATION IN BUILDING CONSTRUCTION (CITE 2024)

13th to 15th March 2024

CITE was born in 2016 with the aim of promoting the transfer of knowledge on learning, innovation and competitiveness between productive and training areas, as well as to disseminate best practices on innovation in training and learning in the building sector. Likewise, the congress has acted as a meeting point between different social agents related to training, in order to promote cooperation between its participants and extend it to other areas related to learning, innovation and competitiveness in this sector.

We hope that this new version of the International Congress on Technological Innovation in Building, CITE24, will be a success in terms of communications and that we will be able to obtain enriching results in the field of technological innovations, which will help us to improve future editions.

The organisation of the CITE 2024 programme once again this year contains all its activities (oral communications and posters) in virtual format and available through the website. The different thematic areas are building environment, building technology, domotic and smart cities, innovation in building and civil works, materials and construction systems, rehabilitation pathology and building maintenance, installations, general issues and gender perspective in construction.

In this ninth edition, it is worth highlighting the quality and involvement of all the participants, which has led to the presentation of a large number of papers, more than ninety, bringing together more than 221 national and international attendees.

We would also like to thank the invaluable collaboration of the companies SIGNUS Ecovalor, Trimble and Saint-Gobain for sponsoring this congress.

The Organizing Committee

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STUDY OF THE IMPACT ON EMBODIED AND OPERATIONAL CARBON IN RESIDENTIAL BUILDING OF PARTITIONING AND GLASS SYSTEMS WITH HIGH RECYCLED CONTENT AND LOW CARBON FOOTPRINT

[1,2]Enrique Gómez de la Peña; [2]Mariluz Jimeno Romero

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Keywords: *Carbon, Embedded, Operational, Glass & PYL*

The current building stock is responsible for 35% of the planet's global energy use and 38% of CO2 emissions [1]. The actual climate emergency has led the architecture and construction community to set ambitious targets for reducing emissions from buildings, which will have to be CO2 neutral by 2050 in Europe [2]. In this context, the reduction of the global emissions of the building process is essential to achieve these targets, with the drastic reduction of CO2 emissions in the operational phase through passive energy efficiency strategies and the major challenge of reducing the embodied carbon in buildings. The present study analyzes the impact of the inclusion of new partitioning and glazing systems with a high content of recycled material in the manufacture of raw materials [3][4] and the consequent reduction of their carbon footprint. The composition of which can be seen in table [1].

Table 1*. Global Warming Potencial (GWP) (A1-C4) and amount of secondary material (post-consumer recycled) of the solutions used in the study*

Partición	GWP (kg CO2 equiv/m2 sistem)	Secondary material by partitioning (Kg/m2)	Recycled content in the composition of Plasterboard and Glass Substrate.
Original partitioning	19.53	3.37	5%
Partitioning with low CO2	15.63	19.07	28%
Original glass system	11.45	1.09	19%
Glass system with low CO2	6.64	6.41	64%

For this purpose, an analysis is made of the impact that these materials used in a residential building would have by replacing them with their counterpart materials, based on the data provided by the study on embedded carbon in buildings carried out by AFELMA [5] on a building with ventilated façade and the same building replacing the ventilated façade with ETICS. The results obtained can be seen in Table 2 and Table 3.

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Table 2. *Results on the embodied carbon of the building for a useful life of 50 years calculated from phases A1-C4 of the EPD of the materials studied.*

Partición	% kgCO2eq totals in element analyzed	kgCO2eq equiv. totals in element analyzed	kgCO2eq totals Full building with Ventilated façade	%kgCO2eq Embodied total in Ventilated façade option	kgCO2eq Full building with ETICS	%kgCO2eq Embodied total in ETICS option
Original partitioning	0.00%	803325.60	4122678.51	0	3946118.59	0
Partitioning with low CO2	-19.04%	643142.48	3962495.39	-3.89%	3785935.47	-4,06%
Original glass system	0.00%	51481.36	4122678.51	0	3946118.59	0
Glass system with low CO2	-42.00%	29859.1888	4101056.34	-0.52%	3924496.42	-0,55%
TOTAL		-181805.30	3984117.56	-4.41%	3807557.64	-4,61%

Table 3. *Results on the embedded and operational carbon of the building for a useful life of 50 years calculated from LCA phases A1-C4 of the materials studied, including phase B6.*

Partición	kgCO2/m² Embodied in Ventilated façade option	kgCO2/m² 50 years in Ventilated façade option (Total)	%kgCO2/m² 50 years in Ventilated façade option (Total)	kgCO2/m² Embodied in ETICS option	kg CO2/m2 50 years in ETICS option (Total)	%kgCO2/m² 50 years in ETICS option (Total)
Original partitioning and glass system	530.13	892.63	0.00%	510.07	873.07	0.00%
Partitioning with low CO2	509.51	872.01	-2.31%	489.36	852.36	-2.37%
Glass system with low CO2	527.37	889.87	-0.31%	507.26	870.26	-0.32%
TOTAL	506.75	869.25	-2.62%	486.56	849.56	-2.69%

The results show that the use of such solutions can reduce the embodied carbon of the building compared to a comparable example by up to 4.61% and 2.69% of the total carbon of the building (embodied + operational), increasing the use of recycled material by up to 5 times compared to comparable solutions and thus reducing the use of natural resources.

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Achievements in Building Environment

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PARADIGM SHIFT IN THE CONSTRUCTION SECTOR: EVOLUTION OF THE SECTOR TOWARDS INDUSTRIALIZATION AND CIRCULAR ECONOMY.

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Keywords: *Industrialization, circular economy, carbon footprint.*

Abstract

The purpose of this publication is to reflect on how industrialization or the modification of processes has to be adapted to the new paradigm. Taking into account that an urban settlement has gone from being a strategic place that, due to its location, environment and its own resources, made life possible. It has become an area in permanent change and continuous growth, motivated by the evolution and needs of the generation that inhabits it, where the existence of resources has been substituted by belonging to commercial routes.

An initial trend towards globalization as the basis for development has led to new proposals, towards a model where the reduction of the carbon footprint, use of waste and available technology, in a local framework, circular economy, is the one that is postulated as the new basis for development in the construction of this 21st century. Therefore, a substitution of the traditional model where the importation of materials or manufactured products from any part of the world are replaced by prefabricated elements of local production with a rational consumption of natural resources in addition to the use of waste as raw materials.

Technological resources and their accessibility to all industrial sectors have generated great changes, substantially modifying work procedures and the processes into which they can be broken down. Artificial intelligence, telecommunications, 3D printing, robotics, open up a wide field of possibilities where the technology necessary to cover our needs is not a limitation. They allow us to mass-produce efficient, sustainable, reliable, precise and profitable products or construction components, as well as providing us with a solvent methodology for production quality control and with global significance. However, the impact on the construction sector has not been the same as in other sectors. An example is the automotive sector, which, in addition to modifying the manufacturing process of its products, has also modified the final result, where there

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is a notable difference between vehicles manufactured within a few decades of each other and which are aimed at the same end user as our constructions.

Nowadays, efficient production methods and available technology offer us a wide variety of prefabricated construction solutions that are applied in all parts of the world and in different productive sectors. Human capital is an essential part of this change and must also evolve towards the specialization and specificity of its work in all categories. A new way of working, where, in order to execute a project, their main working day takes place in a factory and minimize their presence at the point of destination is undoubtedly one of the most significant changes. On the other hand, this specialization must be sufficiently flexible to coexist in a sector where the level of implementation of these new models is slow and where innovation in transversal solutions to the same need, in different geographical areas and traditional construction methods, must be constant.

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EFFECT OF CELLULOSE FIBER AMOUNT ON THE PHYSICAL PROPERTIES OF HARDENED CEMENT PASTE

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Keywords: *cellulose, hardened cement paste density, ultrasonic pulse velocity*

Abstract

This research performed an analysis of the physical properties of cement stone using various amounts of cellulose fiber in the mixture. During tests, samples with appropriate amounts of cellulose fiber were used, all samples had different amounts of cellulose fiber. A total of 8 different batch samples were formed with proportions: 0 % - control sample, 0.25%, 0.5%, 0.75%, 1.0%, 1.25 %, 1.5%, 1.75% and 2.0%. There was performed density, ultrasound, water absorption, and porosity tests on all the samples. The results showed that by increasing the amount of cellulose fiber to 2.0 % the density of cement stone decreased by 3.6 % the open porosity decreased by 17.6%, and the closed and total porosity increased and 7.8%, respectively. Based on the research results, the recommended amount of cellulose fiber is 1.0% in cement stone.

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PERCEPTION OF YOUNG PEOPLE ON THE ENVIRONMENT BUILT WITH CLIMATE HOSTILE ARCHITECTURE: A PHOTOVOICE STUDY

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Keywords: *Built Environment, Climate Change, Qualitative Research, Hostile Architecture, Photovoice*

Abstract

In 2018, IPCC highlighted the unprecedented scale of the challenge to limit warming to 1.5 °C. So far, both the pace and magnitude of action taken and current plans are insufficient to effectively address climate change (IPCC, 2023). At the regional level, climate change manifests itself as urban overheating and represents a significant challenge for most major cities globally (Santamouris, 2021). This makes urban climate research increasingly crucial due to climate change and the current urbanisation trend (Ward et al., 2016).

Climate change is causing existing buildings and their occupants to face situations for which they were not originally conceived (Barbosa et al., 2016). At the built environment level, several factors are involved in the overheating of spaces, such as morphological and urban planning aspects, such as the structure of buildings, the presence of vegetation, the projection of shadows, the proportion of impervious surfaces and the presence of surface water, are considered key elements to understand the accumulation of heat in an urban area (Ahmed et al., 2023).

Over the years, certain urban designs have been intended to marginalise undesirable groups from specific locations. This type of urban planning is known as "hostile architecture", and includes features such as benches designed to prevent resting, structures that prevent standing, and obstacles that complicate various recreational activities (De & Licht, 2020). In a context of climate variability, existing buildings are likely to be compromised by conditions for which they were not initially conceived, putting their functionality at risk (Barbosa et al., 2016). The built environment, with resilience to climate change, includes buildings, open spaces, and infrastructure, exhibiting an inability to cope with climate change's negative impacts due to design, construction, or lack of adaptation.

Photovoice is a Participatory Action Research technique, which emphasises the participation and empowerment of marginalised individuals. The implementation of this approach involves members of a community capturing images related to problems or

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issues that concern them, and then discussing them in order to seek social change. Through critical dialogue about identified shortcomings or problems, they are even given the opportunity to advocate for changes within their communities (Cuerdo- Vilches,2017).

A qualitative study was carried out with first year students of a double degree in Law and Political Science at the Universidad Carlos III. A total of 21 young people participated in the research, distributed in 4 working groups, composed of 13 women and 8 men. They were asked to take two images for each participant, accompanied by a narrative that answered four questions that would allow them to better contextualise the intentionality of the images taken. In addition, they were given the task of categorising all the images, which had previously been coded through the working groups. As a final result, 11 images were selected and classified into 4 categories: squares and recreational areas, building, street and esplanade. Finally, the students themselves identified the problems associated with the built environment and the limitation of architectural solutions in the face of climate change, proposing several ideas to improve the situation.

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SIMULATION-BASED MULTI-OBJECTIVE OPTIMIZATION TO REDUCE TOTAL BUILDING ENERGY CONSUMPTION, CO2 EMISSIONS, THERMAL DISCOMFORT HOURS, VISUAL DISCOMFORT HOURS, AND IMPROVE INDOOR AIR QUALITY: CASE STUDY IN IRAN

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Keywords: *Building energy simulation, Multi-objective optimization, CO_2 emissions, Indoor air quality, Thermal comfort, Visual comfort.*

Abstract

The paper describes a simulation-based multi-objective optimization approach for architectural design and control parameters to achieve energy-efficient, environmentally friendly, and occupant-centric building designs. Simulations are carried out using EnergyPlus and the OpenStudio SketchUp plug-in. JEPlus identifies objective functions and decision-making parameters, and jEPlus + EA does multi-objective optimization through NSGA-II. Also, in this software, Morris sensitivity analysis was used to determine how input variables affect objective functions. The study 24 design variables are considered the most important of them are orientation, heating and cooling setpoint, infiltration rate, activity level, materials U-value, and shading control type. The annual total site energy consumption, CO_2 emissions, zone air CO_2 concentration, thermal discomfort hours, and visual discomfort hours are considered five objective functions simultaneously minimized. The weighted sum method selects the final answer from Pareto solutions. Based on the findings, considering the design variables, the suggested optimization approach results in a substantial reduction in the annual total site energy consumption compared to the initial design. It also decreases CO_2 emissions, zone air CO_2 concentration, and thermal and visual discomfort hours. The results demonstrate that careful selection of design variable specifications can have a significant impact, not only by reducing energy losses and CO_2 emissions but also by improving indoor air quality and enhancing thermal and visual comfort for building occupants. According to the optimization's findings 3.18-42.21% decrease in the annual total site energy consumption compared to the initial design with 0.46–18.41%, 4.52– 43.57%, 1.08-28.33%, 2.57-87.69% reduction in CO_2 emissions, zone air CO_2 concentration, and thermal and visual discomfort hours, respectively. Also, the Amounts of additional pollutants (CH_4, NOx, N_2O, SO_2, and water environmental factors) were examined before and after optimization.

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REVITALIZING VULNERABLE URBAN SPACES IN MADRID: EVALUATION OF STREET VEGETATION FOR EFFECTIVE URBAN HEAT ISLAND MITIGATION VIA ENVIMET SIMULATION

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Keywords: *ENVImet, Building heating, Mitigation scenarios, Urban Heat Island (UHI)*

Abstract

The Urban Heat Island (UHI) effect, driven by the substitution of natural materials with artificial ones in urbanization processes [1], is a pressing concern for medium- and large- sized cities [2], often leading to higher temperatures than their rural surroundings. Recognized as a significant threat to urban inhabitants warming [3], the UHI effect is known to double the impact of global warming, resulting in increased death rates among urban residents and heightened energy demand for cooling buildings [4, 5].

Within the context of the Csa climate zone, according to Köppen-Geiger classification [6], characterized by hot and dry summers and concentrated rain events in fall and spring, the UHI poses particular challenges [7]. In this region, summer UHI intensities can reach as high as 8 °C, necessitating urgent mitigation efforts, especially in densely urbanized Mediterranean cities where the urban structure may limit the installation of mitigation measures [8].

As global awareness of UHI as a threat grows, urban expansion plans and mitigation strategies need to incorporate scientific knowledge to develop areas with minimal or no UHI. For already highly urbanized areas affected by UHI, the assessment of potential mitigation strategies before implementation is crucial. Microclimate modeling software has become essential for this purpose, with ENVI-met [4, 9] emerging as one of the most widely used tools for numeric simulation studies.

This study focuses on investigating the impact, at the pedestrian level, of UHI mitigation scenarios in a densely urbanized city like Madrid. Specifically, the research aims to determine the optimal vegetation ratio to mitigate UHI in a vulnerable urban area. Mitigation scenarios are based on varying the coverage percentage of urban vegetation in a plaza within a residential neighborhood as part of the URBAN therCOM research project [10]. Utilizing ENVI-met V4.3.2, the study simulates the plaza under both the reference case (without vegetation) and an increased vegetation scenario, considering both reference and RCP 8.5 2050 weather files (Figure 1). The analysis of meteorological outputs aims to identify the most effective vegetation scenario, offering guidance for the application of UHI-mitigation measures. The results highlight that increasing

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vegetation coverage linearly enhances UHI mitigation potential, providing valuable insights for sustainable urban planning and climate resilience.

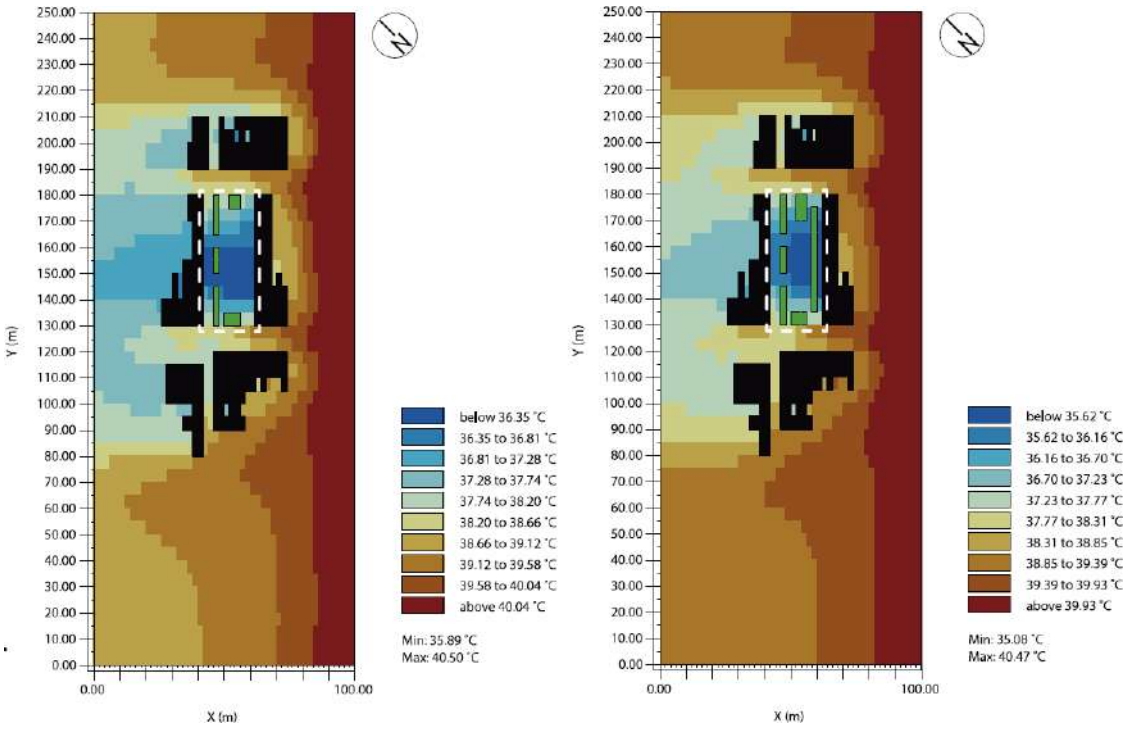

Figure 1: *ENVImet case study, Temperature: RCP 8.5 (left) and RCP 8.5 and mitigation strategies (right). (Source: own images)*

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ASSESSING ENERGY DEMAND IN VULNERABLE URBAN BLOCKS OF MADRID: IMPACTS OF CLIMATE CHANGE AND URBAN HEAT ISLAND

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Keywords: *Urban Weather Generator (UWG), Building heating load, Mitigation scenarios, Urban Heat Island (UHI)*

Abstract

Buildings in the EU account for 40% of energy consumption and 36% of greenhouse gas emissions [1]. Meeting the climate neutrality goals of the European Green Deal necessitates significant contributions from the building sector. However, the built environment confronts obstacles hindering progress that include building energy consumption, energy poverty and local climate change [2]. In Southern European countries, cooling represents 10% of the total energy consumption per dwelling. However, this is likely to be much higher under climate change [3] as the residential sector will rely more on the use of air conditioning systems to adapt to higher temperatures [2]. Along with climate change, the Urban heat island (UHI) phenomenon has a major impact on low income and vulnerable populations of the cities [4]. UHI effect influences energy consumption, outdoor and indoor thermal discomfort, health-related issues, and a strong association with the climate change impacts [5]. Efficiently utilizing urban materials and assessing their impact on solutions can contribute to the transition toward climate-neutral cities [6]. Furthermore, there is a pressing need for specialized tools and workflows capable of comprehensively evaluating the interaction of buildings with urban environment [7,8]. This paper delves into the impact of UHI on the energy demand of buildings, specifically focusing on a comprehensive research effort to optimize the urban microclimate in a vulnerable neighborhood of Madrid within the URBAN therCOM research project [9]. The study utilizes the Urban Weather Generator (UWG) [10] to assess the energy performance of the urban block under UHI. Energy performance comparisons are drawn between non-retrofitted and retrofitted buildings under reference and extreme climate conditions. The maximum UHI intensity is simulated as +12.9 °C in summer and -3.2 °C in winter. UHI implications include a -3.4% reduction in heating demand under reference weather conditions and -19.5% for the RCP 8.5 2050 scenario, indicating a heightened UHI impact concerning climate change. The Typical Meteorological Year TMY file for Madrid reveals a -3.4% decrease in heating demand due to UHI but a +162% increase in cooling energy demand. The RCP 8.5 2050 weather file indicates a -19.5% drop in heating demand and a +27% rise in cooling energy demand due to UHI. This research suggests that in the future, cooling demand is

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expected to surpass heating demand in all scenarios, regardless of UHI presence. These findings underscore the negative impact of UHI on buildings, with annual cooling demand exceeding reduced heating demand. It also emphasizes the importance of computational investigations in exploring and evaluating various mitigation scenarios to address the Urban Heat Island effect in residential buildings. Subsequently, the research will progress to assess urban microclimate improvements, optimize heat sinks, and address potential adverse impacts on indoor and outdoor thermal comfort. The research findings provide valuable insights for urban planners and designers, aiding them in making informed decisions to create sustainable and thermally livable residential communities. The applicability of this research extends beyond the specific context of Madrid and can be adapted to other scenarios, contributing to broader initiatives for climate-resilient urban development.

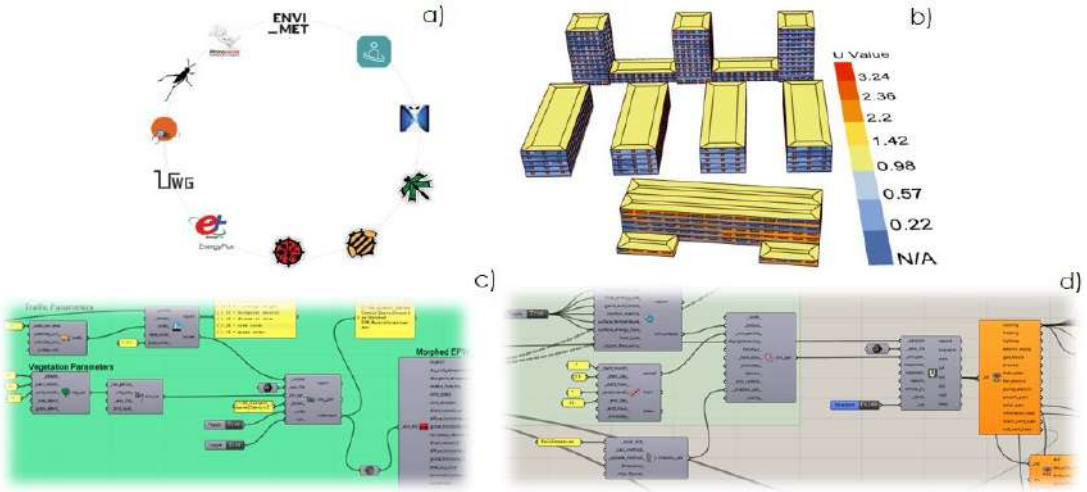

Figure 1: *Simulation strategy. a) Computational Tools; b) U values as per Spanish Technical Code; c) EPW morphing to include UHI Impact; d) Energy simulation URBANopt Api. (Source: own images)*

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EVALUATE THE ENTIRE CITY'S ENVIRONMENTAL SUSTAINABILITY, WITH A FOCUS ON SUSTAINABLE DEVELOPMENT TOWN

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Keywords: *Environment, Sustainable Urban Development, Sustainability, Climate Change.*

Abstract

There is an emphasis on environmental sustainability assessment since it is regarded as one of the most crucial tools in the planning process for sustainable development. Planning and politics are unavoidable. It is considering the swift alterations that have transpired in numerous Iranian cities. The assessment of cities' ecological sustainability concerning appropriate urban planning has been ongoing for the past ten years. Additionally, given the fluctuations in the natural environment, it appears necessary. Appropriate study methodology and research design. The work approach is analytical and descriptive, using the same methodology to evaluate the environmental sustainability of the entire city with a focus on It's a facet of environmentally friendly growth. The study's findings demonstrated that the city is subject to the rule of law. There are signs of unsustainability that suggest this tendency will continue in the upcoming years due to the province's climate and the ongoing process. It will enlarge the city and create as much instability as possible throughout. The issue is durability; sustainable development will have no value regardless of cities and villages. The world is becoming more unstable, and urban and global sustainability are intellectual constructs. A city inhabited by people. Its primary sources of pollution include manual labor and overuse of contaminated areas, including noise pollution from irrigation systems, surface water and drinking water contamination, and more. The entrances now. Cities and households, pollutants and chemicals, surplus solid waste, and chemical and microbiological leaks into water sources. One of the most significant environmental risks to the city is garbage disposal, recycling, and health concerns. They show up. No all- encompassing program was in place to safeguard water resources, particularly regarding aquaculture and harvesting techniques. One of the most significant environmental hazards in cities is urban catastrophes.

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AUTOMATIC VENTILATION AND COOLING OF THE BUILDING USING THE COMBINATION OF WIND DEFLECTOR AND SOLAR CHIMNEY (STATE 3D WITH DIFFERENTIAL PERSPECTIVE)

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Keywords: *natural ventilation, radiative cooling, windcatcher, solar chimney*

Abstract

Using new sources of energy and inventing new methods for energy consumption has always been the focus of researchers. The building sector is known to contribute largely in total energy consumption and CO2 [1]. Expanding the availability of energy storage technology and materials is considered as crucial as discovering new energy sources [2]. The International Energy Outlook by the EIA examines and predicts future trends in building energy usage. It anticipates a 34% growth in energy consumption within the built environment over the next two decades, with an average annual increase of 1.5%. By 2030, it is projected that approximately 67% of this consumption will be attributed to dwellings, while the non-domestic sectors will account for about 33% [3]. This study endeavors to combine one of these ventilation techniques from ancient Persian architecture, known as the windcatcher in the form of an innovative roof radiative cooling (Windcatcher) with a solar chimney [4]. In order to save energy consumption and reduce environmental problems by presenting the idea of using solar energy to exhaust the air inside the building through the chimney and using the latent heat of water evaporation to create cooling that is carried out in the direction of the wind by the windcatcher [5]. Hence, fuel consumption can be created in hot and dry areas, in a comfortable environment with suitable humidity conditions. The purpose of this research is to introduce computational areas (3D) and determine the governing values and methods calculated by Ansys Fluent software, which has enabled the use of suction and the creation of moisture balance and heat reduction without fuel consumption, which plays an important role in It implements energy efficiency in the building. This system is also able to save 60% cooling energy and 80% of the ventilation energy during peak hours in a warm and arid climate. Furthermore, the effects of a wall opening on ventilation and thermal efficiency were examined.

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FALSE CEILING TILE MANUFACTURING PROCESS REDESIGN: BUSINESS IMPLICATIONS, SUPPLY CHAIN STUDY AND ENVIRONMENTAL IMPACTS

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Keywords: *circular economy, supply chain, prefabrication, sustainability.*

Abstract

Today, the construction sector faces a twofold challenge: to mitigate the environmental impact caused by its industrial activity and to offer new sustainable products that meet the needs of increasingly environmentally conscious customers. From a business perspective, sustainability in construction has not only implied the redesign of traditional construction systems, but has also been understood by construction companies as a potential source of competitive advantage to differentiate themselves from their competitors in the medium and long term [1]. The excessive consumption of natural resources, the large volumes of waste generated, and the harmful greenhouse gas emissions emitted daily into the atmosphere have challenged conventional construction practices and the performance of firms with a low capacity for innovation and adaptation [2].

This study covers the development of a novel prefabricated panel made under circular economy criteria, studying its possible commercial exploitation and supply chain management. To this end, the technical and environmental feasibility of recovering end- of-life tyres (ELTs) for their reincorporation into the manufacturing process of a new sustainable construction material based on gypsum has been analyzed. This offers an environmentally friendly product that can be used as an appropriate substitute for traditional prefabricated false ceilings, reducing the consumption of the original raw material by replacing it with recycled shredded rubber. This application contributes not only to lowering the final cost of the prefabricated part but also to reducing the environmental impact generated as a result of the progressive accumulation of NFU in cities, which is estimated to reach annual figures close to 1.2 billion pieces by 2030 [3].

The research was conducted at the E.T.S. de Edificación de Madrid in two distinct stages. In the first phase, prefabricated slabs were produced on a laboratory scale to determine their most relevant physical and

mechanical properties, with the aim of having a starting point for comparing these new products with those already on the market. Subsequently, once the compliance of these new composite materials with the regulations had been checked, their business viability was explored by analyzing unit production costs, improvements in the supply chain and mitigation of the resulting environmental impact.

Thus, encouraging results have been obtained that contribute to further progress towards greater circularity of construction products and efficient use of natural resources in the sector. It has been possible to verify how the progressive incorporation of recycled material in partial substitution of the original composite material makes it possible to reduce consumption in liters/kilometer derived from the distribution of these prefabricated products, offering an innovative product in line with the current needs of the market. The implications for the redesign of the manufacturing process incorporating the addition of these rubber aggregates would not imply a modification of the current distribution in the plant, although it is true that the balance point could be progressively reduced, being lower in the plates with greater NFU content. In this regard, the expectations of obtaining benefits from the use of secondary raw materials in the production of new construction materials are reinforced, and differentiated and attractive products can be obtained for current technicians, designers, and customers.

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TOWARDS THE ECO-UNIVERSITY OF THE FUTURE: LEED AND BREEAM ANALYSIS OF THE ETSEM BUILDING

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Keywords: *Sustainability, Certifications, Educational Buildings*

Abstract

The aim of this paper is to analyze the possibilities and needs to improve the real estate of the Universidad Politécnica de Madrid (UPM) in order to achieve an eco-university of the future based on LEED and BREAM sustainability criteria.

Educational buildings play a key role in the development of society and its culture, however, with some exceptions, the buildings that make up university campuses are built in the last century. This does not suggest or mean that they have no place in today's world, but they must be evaluated under logical criteria, but in line with the objectives of sustainability to be achieved by humanity.

For this purpose, the study of the headquarters building of the Escuela Técnica Superior de Edificación was chosen, whose history goes back to the evolution of university studies in the country and to the project drawn up by the architects Pascual Bravo Sanfeliú and Carlos López Romero, the works were awarded in the last month of 1960 and completed in 1962 [1], This university complex was evaluated under the criteria of the LEED [2] and BREEAM [3] certifications in its existing buildings modality, with this we can know the performance of the building and its capacity to achieve an environmental certification that will contribute to the achievement of environmental goals with the minimum of necessary intervention.

We considered the energy consumption of its current state [4] and its potential for the implementation of energy efficiency strategies, waste management, water use efficiency, renewable energy generation and its corresponding analysis through the specialized software Design Builder.

Design Builder is based on a 3D model that functions as the core of the simulation, from this core are integrated modules of 9 analysis modules, which grant a specific type of analysis in the areas of: visualization, energy and comfort simulation, HVAC, daylighting, costs, design optimization, CFD, BREEAM / LEED credits and reports that comply with various national building regulations and certification standards [5].

The results obtained are very revealing since although the building under study was built in the decade of the 60's it shows positive savings values with respect to a similar building with the minimum standards of a 2016 regulation, that is, almost 50 years after its construction the

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building is able to demonstrate savings with respect to a new project and very close to the certification target, as shown in Figure 1.

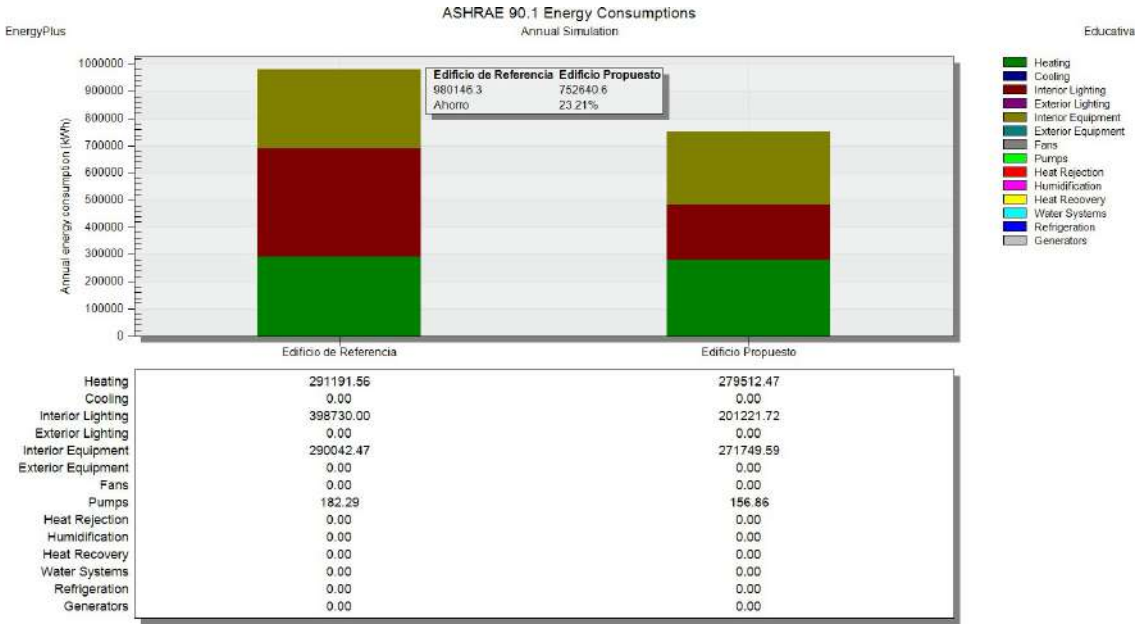

***Figure 1**: Comparison of consumption of reference building and studied according to ASHRAE in DB*

In addition, when evaluated with the energy consumption reported by the institution to which it belongs through the specialized USGBC - LEED platform, it indicates that the building is a candidate to obtain a gold level certification, as shown in Figure 2.

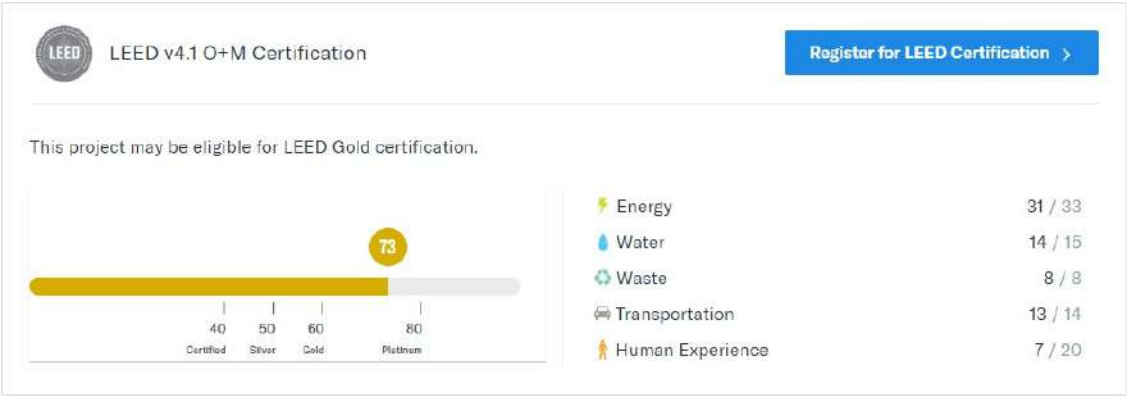

***Figure 2:** Score estimation result for LEED v4.1 BO+M.*

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ENERGY EFFICIENCY IMPROVEMENT STUDY FOR A SEMI-DETACHED SINGLE-FAMILY HOUSE BY SEFAIRA.

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Keywords: *Sketup; Sefaira; energy efficiency*

Abstract

The Sefaira plugin for SketchUp is a powerful tool that allows architects and engineers to perform energy performance and sustainability analysis within the familiar SketchUp environment. Energy effiency is aligned with several Sustainable Development Goals (SDGs) set out in the United Nations 2030 Agenda for Sustainable Development. [1]

Figure 3. ODS 09. Source: Guidelines for using the SDG logo.

Figure 2. ODS 11. Source: Guidelines for using the SDG logo.

Figure 1. ODS 13. Source: Guidelines for using the SDG logo.

In particular, it contributes to the achievement of key goals, such as SDG 11 as shown in Figure 2 , (Sustainable Cities and Communities), SDG 9 as it appears in **¡Error! No se encuentra el origen de la referencia.** (Industry, innovation and infrastructure) and SDG 13 (Climate action) icon that appears in Figure 1, while indirectly supporting other goals related to health, environment and social equity.

This research for CITE 2024, focuses on the analysis of a design to perform real-time assessments of how design decisions affect a building's environmental performance. This includes the ability to analyze energy efficiency, indoor air quality, lighting and other aspects crucial to the comfort and sustainability of building occupants. [2-4] Taking into account the characteristics of the original building, it is modeled in the SketchUP program so that the SEFAIRA plugin can be used. Once the house is modeled, as it is shown in Figure 4 the surfaces are classified as shown in the image: roof, floor, wall, window, shadow elements and ignored elements. The building is a single-family house located in Bilbao, its main façade has a south-east direction, and the rear façade has a north-west direction. The analysis is done in

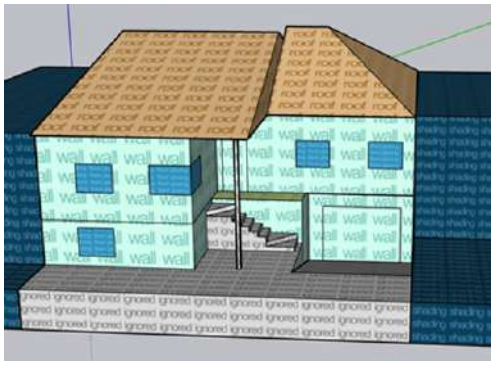

Figure 4. Housing design with the Sefaira plugi.

Source: In-class elaboration of my work in joint elaboration.

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the plugin, configuring the location of the building in Bilbao. And seeing each of the variables that the plugin offers us.

*Figure 5. Energy consumed in the dwelling with the **original proposal by Sefaira.***

Source: In-class elaboration of my work in joint elaboration

The analysis was performed with a first phase specifying the type of housing properties. The general thermal transmittances of the original building were entered by hand in the relevant option, observing an annual energy expenditure, which in this case is 126 kWh/m^2 per year, as it can be seen in figure 6. With a predominant expenditure of equipment in the current state.

Then the transmittance of the improved option, which had been analyzed with the econdensa program, was also entered manually in the corresponding option. The result was obtained in a very visual way, in the proposal that there was still an energy cost of 44 kW/m^2 per year as shown in Figure 6 and a predominant electricity cost of the building in the proposed solution.

It continues with setting the occupancy of the residence, setting the temperatures for the home heating and cooling systems to operate, occupational density, and HVAC operating hours. Following with air exchange section, water temperature in the house, specifying the type of heater, natural ventilation or not, the Sefaira simulation obtained: in the original building an energy cost of 32 151 kWh per year and in the envelope proposal an energy cost of 19 425 kWh per year. This translates to an optimization of 40%.

*Figure 6. Energy consumed in the dwelling with the **final proposal by Sefaira.***

Source: In-class elaboration of my work in joint elaboration

In conclusion, the results obtained from Sefaira show an improvement in the energy cost of the building, with an optimization of 40%, and it can be seen that the greatest cost is for lighting, accounting for nearly 50% of the energy cost.

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THE FIGHT AGAINST CORROSION: A NEW PORTABLE AND REAL-TIME DEVICE

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Keywords: *Device; Corrosion; Degradation; Cloud; Design 3D.*

Abstract

In the world of industrial production, corrosion is a relentless enemy, silently eroding the integrity of materials and jeopardising the safety and efficiency of operations. This insidious phenomenon, which manifests itself in a variety of ways, wreaks havoc in industries ranging from power generation to automotive to precision medical [1], [2].

The scope of corrosion goes far beyond surface damage, as its damaging effects penetrate the very foundations of technological advances. It can lead to catastrophic failures, equipment breakdowns, costly repairs and even environmental disasters [3].

To combat this phenomenon, industry has employed many expensive testing methods, from scanning electron microscopy (SEM), which reveals minute morphological changes, to X-ray diffractometry (XRD), which reveals elemental composition [4]However, these techniques often require significant investments in equipment and expertise, making them prohibitively expensive for many organisations.

In this search for a cost-effective and accessible solution, we present a novel portable device. This ingenious device, depicted in figure 1, embarks on a mission to measure corrosion progression in real time, providing information on the current state of the material and its susceptibility to future degradation.

The transformative potential of the device lies in its ability to perform a series of tests, as outlined in Table 1, and then seamlessly transmit this data via Wi-Fi to the cloud for comprehensive analysis. This real-time monitoring capability allows users to proactively address corrosion issues before they become serious problems.

In addition, the device's portability eliminates the need for bulky and expensive equipment, making it an ideal tool for on-site inspections and continuous monitoring. Its independence from the power grid further extends its versatility, allowing it to operate in remote or inaccessible locations.

By adopting this innovative device, industries can unlock a host of benefits:

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- Reduced costs: Eliminates the need for expensive, specialised equipment, reducing testing costs.

- Comprehensive analysis: Provides a holistic understanding of the material's condition.

- Real-time monitoring: The device's Wi-Fi connectivity enables continuous monitoring and proactive corrosion mitigation.

- Portability and autonomy: The device's compact size and wireless capabilities facilitate on-site inspections and remote monitoring.

In conclusion, this innovative device represents a transformative breakthrough in the fight against corrosion, offering a cost-effective, comprehensive and real-time solution to a pervasive industry challenge.

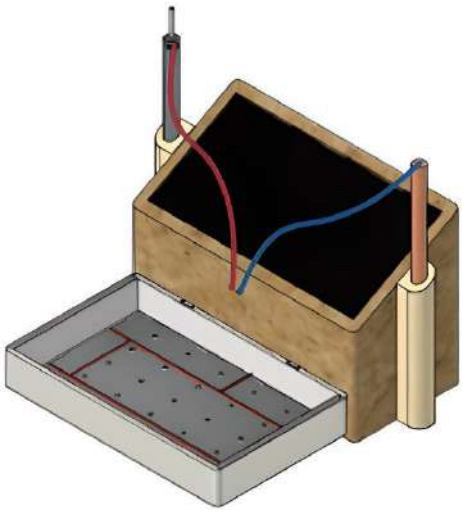

Figure 1: *Novel portable device (Source: Preparated by the authors)*

Table 1: Measuring variables of the apparatus and degree of accuracy.

Variable	Measuring range
Weight	Grams
Thickness	0,01 [mm]
Electrical Resistance	0,01 [Ω]

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LONG-TERM EXPERIMENTAL CLIMATE DATA FOR THE ENERGY AND THERMAL COMFORT EVALUATION IN BUILT ENVIRONMENT

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Keywords: *Experimental monitoring climate, climate change tendencies, building energy demand, outdoor comfort, urban resilience*

Abstract

As climate change impacts intensify, especially with the rising frequency of extreme weather events such as heatwaves, understanding their effects on the built environment becomes paramount. These impacts extend far beyond mere consideration of building energy demands; they encompass broader aspects related to mental and physical health [1], [2].

The urgency of addressing this situation is underscored by projections from the Intergovernmental Panel on Climate Change (IPCC). However. The current state of urban building energy models lags behind in incorporating this evolving climate reality [3]. Widely-used tools such as EnergyPlus (IWEC, SWEC) and normative data files, including those utilized for the Spanish Technical Building Code (MET), still rely on outdated climate data [4], [5]. These data sources, often derived from rural environments, neglect the crucial influence of urban environments on the built environment's energy dynamics.

This study provides a comprehensive solution by introducing updated climate data spanning over a decade (2008-2021) from an experimental campaign carried out at Moncloa´s CIEMAT headquarters (Madrid) [6]. These data (EXP), recorded with a frequency of less than an hour, have undergone thorough processing to generate an accurate and reliable Madrid´s multi-year climate database considering key weather variables such as air temperature (Ta), Relative humidity (HR), Global radiation (Gr) or wind velocity (Wv). Subsequently, meteorological variables were sampled to create an annual hourly database, analogous to commercial climate files (i.e. epw files), representing the most representative meteorological year. By providing a detailed and up-to-date climate database specifically tailored to Madrid, this study contributes significantly to addressing the limitations associated with outdated climate data in urban building energy models.

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Building on this experimental data, the study conducts a comprehensive analysis that aligns climate conditions with future scenarios, including projections such as those from IPCC [2]. The analysis involves a comparative assessment among widely-used climate data files (e.g., SWEC and MET), current climate experimental data (EXP) and potential future climate tendencies based on experimental data (EXPt). The examination spans three critical level to detail understand the climate impacts on the built environment (Fig.1):

- Climate level: Utilizing climate indices from the European Climate Assessment & Dataset (ECA&D), the study unveils nuanced climate tendencies. This provides insights from both historical and potential future scenarios [7].
- Urban level: Calculation of key outdoor thermal comfort indices sheds light on the potential impact of climate change on the well-being of individuals [8].
- Building level: Estimating the energy demand of buildings through the calculation of degree-hours accumulation offers insights into the modification of cooling and heating necessities' periods.

This comprehensive analysis enables a robust estimation of both thermal comfort and building energy demand conditions in the near future. The findings derived from this research serve as a foundation for tailored climate change mitigation plans. By fostering urban resilience and sustainable development, the study contributes to the proactive adaptation of the built environment to the challenges posed by evolving climatic conditions. The insights gained are valuable for policymakers, urban planners, and
stakeholders involved in climate-responsive design and sustainable urban.

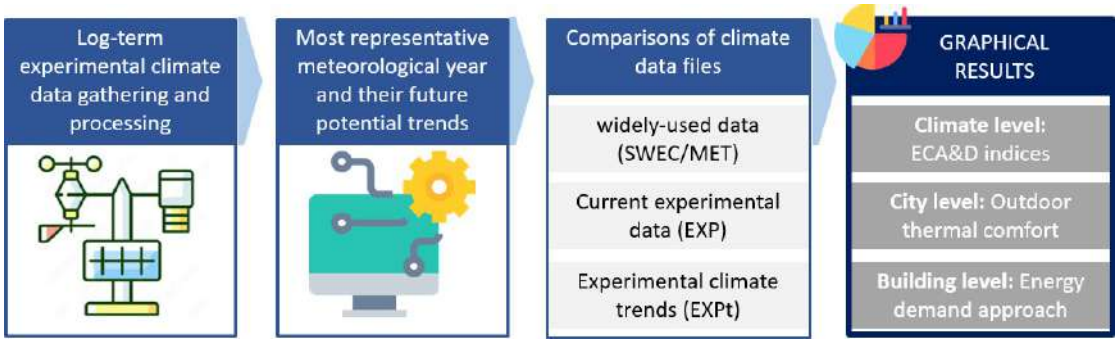

Figure 1. *Graphical abstract of the proposed methodology*

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THE BARRACK: PARADIGM OF A MINIMAL HOUSE, SELF-BUILT INTEGRATED INTO THE ORCHARD OF MURCIA

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Keywords: *Minimal house, murcian barrack, self-construction, orchard of Murcia.*

Abstract

From the fourteenth century to the end of the nineteenth century, the murcian barrack was the traditional construction of the farmers who lived and worked in the orchard of Murcia, a simple and small house, self-built by its future inhabitants with natural materials, collected in the immediate environment in which it was implanted, and can be considered as a paradigm of a minimal house, self-built, and integrated into what was its natural environment: the orchard of Murcia. [1]

Figure 1: *Views of murcian barrack integrated into the orchard of Murcia. (Source: Postcards published during the 19th and 20th centuries)*

The traditional barrack of the orchard of Murcia, according to the sample that exists in the Ethnographic Museum of Alcantarilla, was a small construction with a rectangular floor plan and a gabled roof, with dimensions of 6.60 meters long and 4.60 meters wide, that is, a built area on the ground floor of 30.36 m2c and 15.18 m2c on the mezzanine/andana floor. Its total constructed area is therefore 45.54 m2c.

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The construction system of the murcian barrack was self-built by its future inhabitants, it was executed with the help of a family member or friend who was an expert barraquista, and with materials extracted from the immediate environment, which represents an antecedent of the contemporary concept of construction "kilometer zero".

There were three types of construction in the murcian barrack: atobas, headers and mixed. [2]

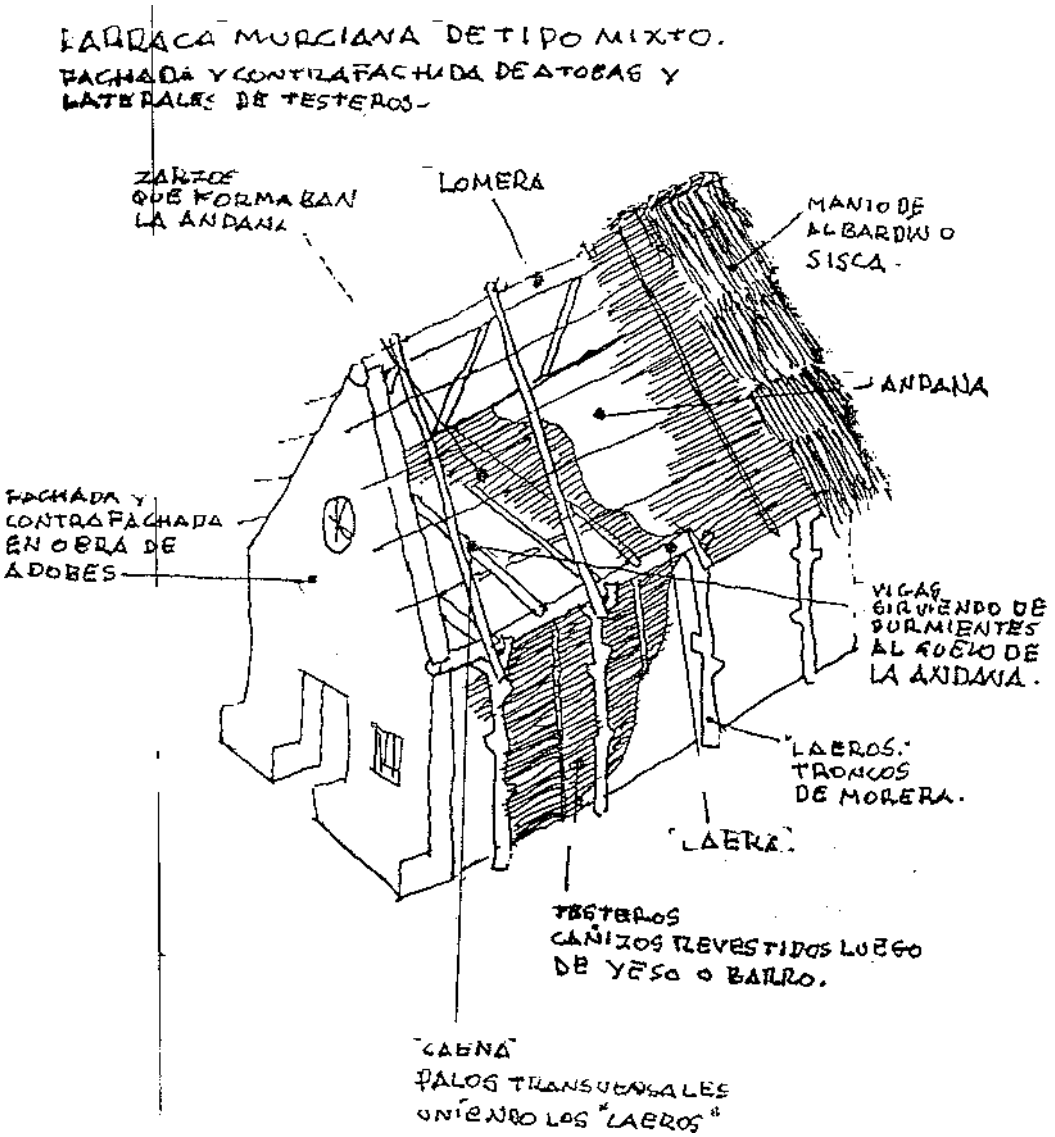

Figure 2: *Axonometric drawing of the mixed type murcian barrack. (Source: Ethnographic Museum of Alcantarilla.1970).*

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The environmental and urban integration of the hut in the orchard of Murcia is the result of the symbiosis of the spirit of the place, or "genius loci", and the implicit quality of the murcian barrack as a natural refuge, as a result of the need for shelter and protection of its inhabitants.

The image of a house with a "gabled" roof, cubic volumetric, natural textures and earthy colours, compose and define the perception of its close image and its distant perspective, which results in the natural integration of the hut into the territory where it is located.

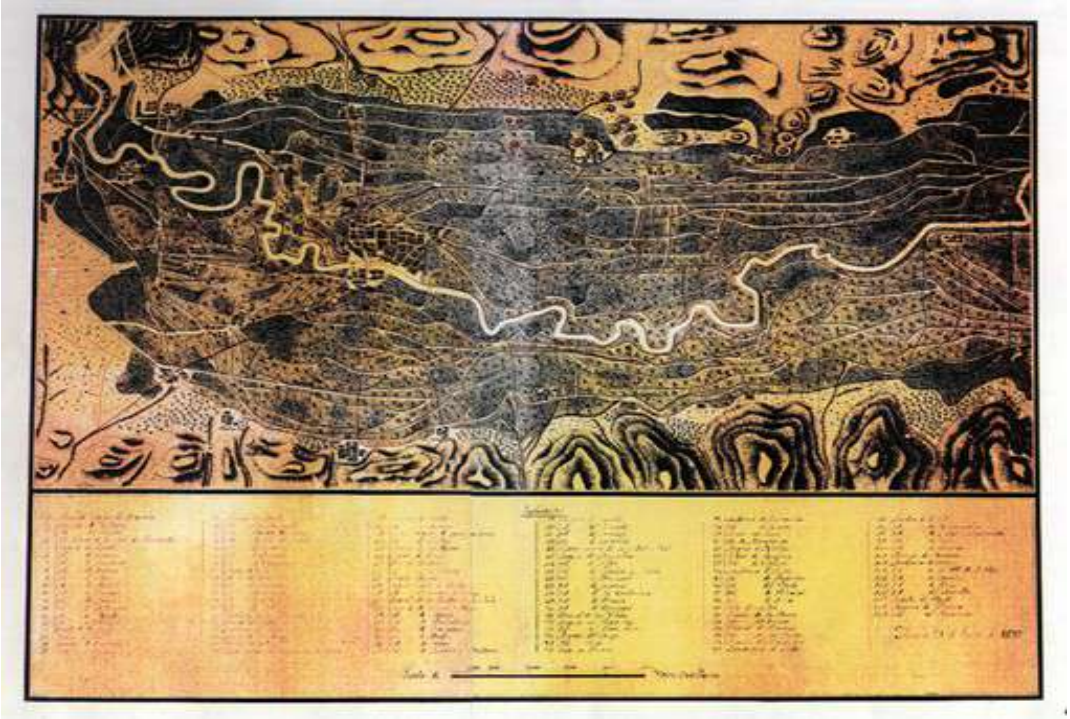

Figure 3: *Traditional irrigation system of the orchard of Murcia. (Source: D. Juan Ibáñez-Fonds of the Museum of Murcia. 1839)*

The great ethnographic interest of the orchard of Murcia [3] is based on its grateful fertility, sustainability demonstrated throughout its long history, and as a non- renewable natural resource, which is "capable of irrigating three times with the same water", therefore, it is intended that the orchard is not lost as a sign of identity, and also, its enhancement as ethnographic and cultural heritage.

The urban planning regulations of the current General Plan are currently obsolete since they foresee a build ability of the order of 50% lower than the existing "de facto", as analytically justified in the monographic work: "The orchard of Murcia: analysis and diagnosis from 1960 to 2030 (Evaluation and contrast between horticultural morphology and urban building ordinances"), in view of which, a modification of the current urban planning regulations will be proposed to enable the construction of minimum self-sufficient houses of the size of the murcian barracks, and this, to promote the population, cultivation and inhabitation of the orchard in a sustainable way.

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ASSESSMENT OF THE SUSTAINABILITY OF URBAN ENVIRONMENTS WITH A FOCUS ON SUSTAINABLE URBAN GROWTH

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Keywords: *Sustainability, Urban planning,* Green *city, Environment.*

Abstract

Environmental sustainability assessment has been considered as one of the most important tools in the sustainable development planning process, and therefore a focus on it, make Policies and planning are inevitable. Furthermore, assessing the ecological sustainability of cities to suitable urban planning has begun the past decade and is underway. Also, Evaluate the environmental sustainability of cities to a suitable urban planning seems necessary with natural environmental variations. This research study is an applicable study and due to the nature of the work, its methodology is descriptive - analytical and the main objective is assessing urban sustainability while considering and focusing on the urban environmental developments. The results of the study showed the entire condition of city shows lack of sustainability and Indicators shows with considering the given the climate conditions in the province of case of study and the continuation of this process, in the coming years, this unsustainability trend will continue. Therefore, this condition will increase the size of the city and make the whole city as unstable as possible. The link between urban development and urban sustainability is a difficult balance. While development promotes economic growth and job creation, it frequently extends cities in ways that conflict with sustainability objectives. Sprawl depletes ecosystems, transportation emits pollutants, and resource consumption skyrockets. Sustainable urban development aims to balance the two by maximizing resource utilization, using clean technology, and designing compact, accessible, and green cities. This includes prioritizing pedestrians and bicycles, incorporating sustainable energy, and safeguarding disadvantaged groups. In essence, it is about creating thriving communities that suit the demands of current generations while preserving the future. It's a difficult undertaking, but it holds the key to producing healthy, resilient, and livable urban settings for everybody.

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PHYSICO-MECHANICAL BEHAVIOUR OF RECICLED MORTARS WHIT POST- CONSUMER POLYETHYLENE TEREPHTHALATE (PET)

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Keywords: *pet, vibration, fibers, plastic, Charpy test*

Abstract

The use of PET (polyethylene terephthalate) fibers in cement mortars is a practice that seeks to give a new use to plastic waste while improving the mechanical properties and durability of the mortar. PET is a type of plastic commonly used in beverage and food packaging, and its recycling can contribute to the reduction of plastic waste. In this research, the fibers were obtained by simple mechanical cutting of post-consumer water bottles, analysing the behavior of five different typologies in shapes and dimensions. Fibres were added in different volumes of 1% and 5% in three types of mortars made with natural sand, recycled sand from the crushing of concrete structural elements and ceramic bricks. The Portland cement used was CEM II/BL 32.5 R, with a variable cement/water ratio to obtain a plastic consistency and a shaking table run-off value between 175 ± 10 mm. The addition of PET fibers to the different mortars tested has a significant influence on their mechanical properties, especially their toughness, since the fibers act as reinforcement, distributing stresses throughout the matrix of the material, preventing the propagation of cracks and avoiding their sudden fracture, which contributes to a greater energy absorption capacity and provides the material with a certain ductility. To quantify their value, the area under the curve of the applied load and deflection graph was calculated for the flexural rupture test and the load/deformation area for the compression rupture test. Likewise, the toughness of the different mortars was analysed and the energy absorbed during impact fracture by means of the Charpy test. For the calculation of the static elastic moduli, a universal testing machine was used with the aid of extensometers and compared with the dynamic elastic moduli obtained by means of ultrasonic testing equipment and by calculating the fundamental resonance frequency using the impact resonance method. Other physical properties analyzed were the calculation of air entrapment, where the incorporation of PET fibers helps to reduce the amount of air entrapment by acting as surfactants, facilitating air dispersion during the mixing process, and improving compaction; the capillarity coefficient by filling the pore spaces, limiting its capacity to absorb water, which favours its impermeability, which is beneficial in applications where water penetration is to be avoided. It decreases its open porosity and bulk density. The influence of the incorporation of PET fibers in a real fire test at high temperatures was analysed, quantifying the reduction in both flexural and compressive strength due to the decomposition of the fibers when they melt or burn. An estimate was made of the pollutant gases released

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during combustion. In summary, the reuse of PET as an additive in cement mortars reduces the amount of plastic material entering landfills, makes use of existing resources, and gives the material a second life. This promotes the circular economy and reduces dependence on virgin raw materials.

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THE THERMAL BEHAVIOUR OF GREEN ROOFS INCORPORATED IN THE REHABILITATED BUILDINGS OF THE LIFE-myBUILDINGisGREEN PROJECT

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Keywords: *Green roofs, Heat waves, Thermal monitoring, Nature-based Solutions, Energy rehabilitation of buildings*

Abstract

Climate change is generating an increase in heat waves in the Iberian Peninsula [1]. High temperatures especially affect the most vulnerable population, including children [2]. Many educational buildings in the country are not prepared to address the thermal problem due to their architectural and construction characteristics. When cooling systems are used to generate a comfortable or at least a tolerable thermal environment, the energy consumption of the building increases. Otherwise, users of buildings that do not have these systems have to carry out their activities in thermally uncomfortable conditions, which can lead to problems related to health or work or academic performance. In this context, the LIFE-myBUILDINGisGREEN project has tried to respond to this problem by incorporating Nature-Based Solutions (NBS) [3], these techniques take advantage of the complex mechanisms of natural elements to address climate change [4]. Within the project, three educational buildings have been selected to be rehabilitated through NBS, among which is the Escola Basica do 1º CEB/Ji do Falcao located in the city of Oporto, Portugal, and the Gabriela Mistral School in Solana de los Barros, Badajoz, Spain. Several NBS have been incorporated into both buildings, including vegetal coverings.

With the aim of having a first approach to the thermal impact that green roofs represent, academic and administrative spaces of the educational buildings have been thermally monitored. In the Badajoz building, the thermal behaviour of three types of green roofs with different plant characteristics has been established. In the Oporto building, the thermal behaviour of spaces and floors with vegetal and non-vegetable roofs has been compared. In both buildings, the results show notable differences in the temperature traces that allow establishing initial findings for future studies. In Badajoz, differences have been found in the records of green roofs that may be linked to the different density and height of the integrated plants. In Portugal, the differences between the types of vegetal and non-vegetable covers may be related to the climatic conditions that occurred during the monitoring. Finally, the results allow us to infer the thermal impact derived from the characteristics and natural mechanisms of substrates and vegetation.

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ANALYSIS OF THE THERMAL ENVELOPE IN INDUSTRIAL WAREHOUSE USING MEP TECHNOLOGY.

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Keywords: *Energy Consumption, Thermal Demand, Industrial Warehouse, MEP, Energy Modelling*

Abstract

Nowadays, cities need to continue to expand their urban nuclei dedicated to buildings for industrial warehouses, factories, etc. Sustainability is a broad concept that needs to be conceived from the very beginning of a building's design. Knowing the energy demand of the building prior to its construction is an advantage to be able to use better materials that help to reduce the energy consumed in the operation of the building. Nowadays it is necessary that there is a minimum energy saving according to the current regulations. This work uses the CYPECAD MEP tool to carry out the analysis of the thermal envelope of industrial warehouses, surprisingly, the negative effects of glazed walls or skylights on roofs in this type of building.

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WEB SURVEY ON THE USAGE OF CIRCULAR ECONOMY TOOLS

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Keywords: *circular economy; construction sector; web survey, CE tools, climate mitigation*

Abstract

The construction sector stands as a significant contributor to global environmental impact, characterized by extensive natural resource extraction and solid waste generation. This is primarily attributable to the prevailing adoption of a linear economic approach. The current absence of the Circular Economy (CE) perspective within widely utilized climate mitigation models, such as the JRC-EU-TIMES [1], poses a substantial hindrance to the European Union's journey toward carbon-neutral economies. Given the pivotal role of these models in shaping EU energy and climate policies, particularly in critical sectors like construction, the integration of CE principles is crucial for advancing sustainability goals [2]. Its focus goes beyond simply reducing the negative environmental impact linked to the linear economy; it actively advocates for a shift in the production system toward restorative and regenerative practices [3], aiming to maximize the value of building materials and minimize resource extraction and waste generation [4].

In this context, the primary objective of the European project CO2NSTRUCT [5] is precisely to integrate circularity into the TIMES energy and climate mitigation model. Recognizing existing gaps in evaluating the present state and impediments to the Circular Economy (CE) within the building sector of European countries, the project adopts a multifaceted approach. The project will identify specific CE measures geared towards valorizing the primary carbon-intensive building materials and seeks to pinpoint which aspects of CE analytical tools, including Life Cycle Analysis (LCA) and Material Flow Analysis (MFAs), can be integrated into the TIMES model.

To enhance the knowledge base on essential concepts in CE analytical tools and their potential for integration into climate mitigation models, a web survey has been developed, targeting experts in the construction field. It can be accessed through the link https://constructsurvey.ciemat.es/ [6]. This survey builds upon a prior literature review that provides comprehensive insights from the research community but may lack perspectives from other critical stakeholders, such as industry or government.

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The web survey is structured into three sections. The first section is dedicated to identifying stakeholders who are actively applying CE principles. This involves understanding the sectors and regions in which CE is being employed and delving into the specific strategies and system boundaries that are involved (Figure 1). The second section identifies the methods employed by stakeholders, including stand-alone indicators and circularity indices. In the last section, a detailed analysis is conducted on how stakeholders apply CE assessment frameworks, either in isolation or in combination with other frameworks.

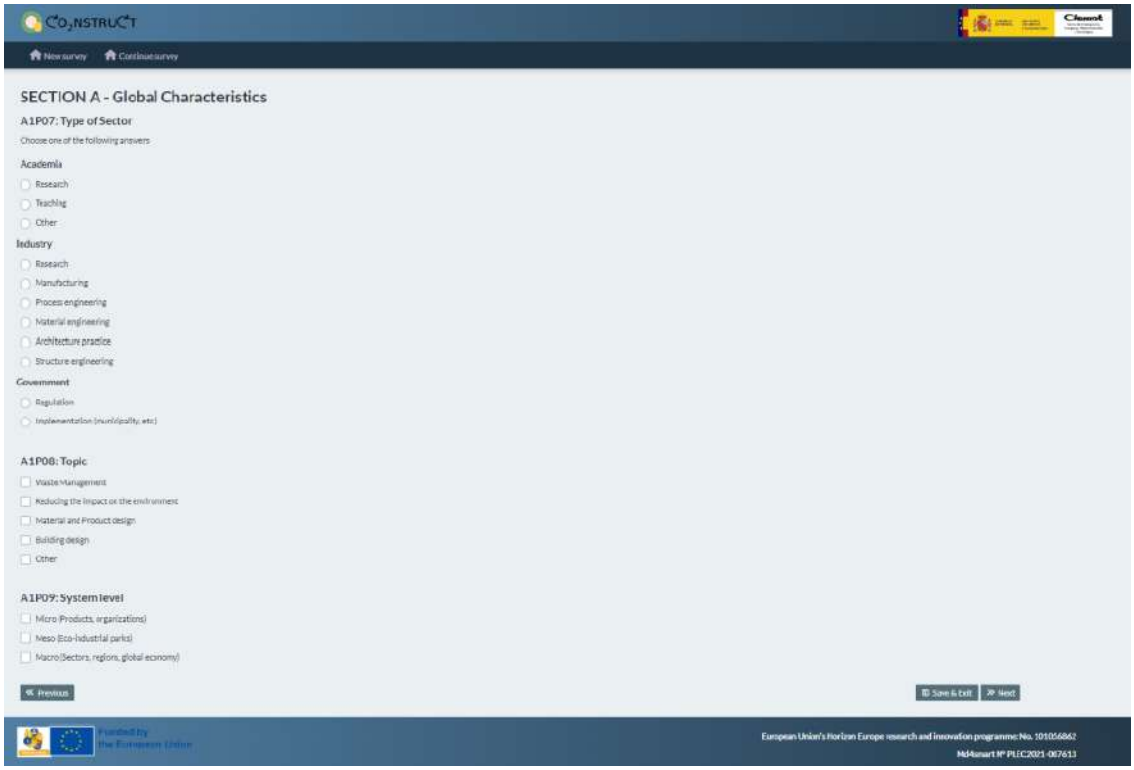

Figure 1: *CO_2NSTRUCT web-survey [6]*

The collected information allows for the identification of current practices within industrial sectors, with a special emphasis on the building sector. The aim is to establish relevant terms for the concept of 'circular climate mitigation,' facilitating the identification of diverse frameworks for utilizing CE tools. This comprehensive analysis, considering objectives, scope, phases, dimensions and impacts, contributes to identifying strengths or constraints. Ultimately, it leads to a deeper understanding of how these tools consider circularity options and opportunities to integrate these CE methods with climate mitigation models.

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HYDROGEN-POWERED HYBRID SYSTEMS: A SOLUTION TO EXPLOIT ENERGY EXCESS IN BUILDINGS

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Keywords: *hybrid systems, renewable energies, green hydrogen, energy storage, sustainable buildings.*

Abstract

The transition towards a sustainable energy future necessitates the development of innovative strategies to address the intermittency of renewable energy sources. Green hydrogen production through water electrolysis is recognized as a pillar for the energy transition toward a complete decarbonized economy [1]. Hydrogen, an energy vector with dual application as a storage medium and a Power-to-Power (P2P) carrier, emerges as a promising solution to bridge the gap between energy production and demand. In this study, we explore the potential of utilizing excess renewable energy to generate hydrogen for sustainable energy solutions in urban and industrial construction [2].

Hydrogen production via electrolysis, powered by excess renewable energy, offers a viable means of storing surplus electricity. This stored hydrogen can then be utilized to meet energy demands during periods of low renewable energy production. Additionally, hydrogen's P2P capability enables its conversion back into electricity via fuel cells or combustion engines, providing flexibility and resilience to energy grids.

The integration of hydrogen into micro- and Mini grids, particularly in urban and industrial settings, holds immense promise for sustainable energy solutions [3]. Microgrids, self-contained power systems, can leverage hydrogen storage to optimize energy utilization and enhance grid stability. Additionally, hydrogen-powered fuel cells can provide reliable electricity backup and emergency power, enhancing the resilience of critical infrastructure. Considering the integration of hydrogen-based energy technologies since the construction process is crucial for realizing the full potential of sustainable energy solutions. By incorporating hydrogen storage systems and fuel cell applications into new buildings and infrastructures, as shown in Figure 1, it is possible to pave the way for zero-net-carbon emission facilities.

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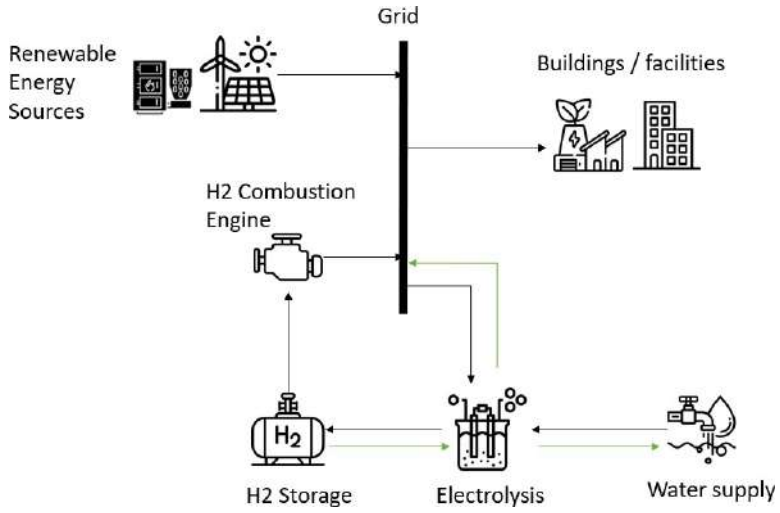

Figure 1: *Proposed H2 cycle for sustainable building. (Source: Own elaboration)*

Previous studies conclude that green hydrogen will most probably play a role in buildings where heat pumps are not a technically feasible solution, or in dedicated regions with a high hydrogen demand density [4].

To fully realize the potential of hydrogen as a sustainable energy vector, several challenges must be addressed. These include optimizing hydrogen production efficiency, reducing production costs, and developing safe and reliable hydrogen storage technologies [5]. Additionally, establishing comprehensive hydrogen infrastructure, including production facilities, storage tanks, and distribution networks, is essential for widespread adoption.

In conclusion, utilizing excess renewable energy to produce hydrogen offers a promising pathway towards sustainable energy solutions in urban and industrial construction. The dual application of hydrogen as a storage medium and a P2P carrier provides flexibility and resilience to energy grids, while its integration into micro- and Mini grids enhances energy efficiency and reliability. By incorporating hydrogen technologies into the construction process, we can achieve zero-net-carbon emission facilities and contribute significantly to the transition towards a sustainable energy future.

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ENERGY EFFICIENCY IMPROVEMENT STUDY FOR A SEMI-DETACHED SINGLE-FAMILY HOUSE BY DESIGN BUILDING.

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Keywords: *Energy efficiency ; Design Building*

Abstract

Design Building is a comprehensive program that focuses on innovative architectural and structural design concepts. It integrates cutting-edge technologies and sustainable practices to create efficient and aesthetically pleasing buildings. Through a combination of theoretical knowledge and practical application, Design Building aims to cultivate skilled professionals capable of shaping the future of architecture and construction. Energy effiency is aligned with several Sustainable Development Goals (SDGs) set out in the United Nations 2030 Agenda for Sustainable Development. [1]

Figure 1. ODS 9, 11 and 13.

Source: Guidelines for using the SDG logo.

In particular, it contributes to the achievement of key goals, such as SDG 11, (Sustainable Cities and Communities), SDG 9 (Industry, innovation and infrastructure) and SDG 13 (Climate action) icons that appear in figure 1, while indirectly supporting other goals related to health, environment and social equity.

This research for CITE 2024, focuses on the analysis of a design to perform real-time assessments of how design decisions affect a building's environmental performance. This includes the ability to analyze energy efficiency, indoor air quality, lighting and other aspects crucial to the comfort and sustainability of building occupants. [2-4]

The building must be drawn in 3D, it can be drawn with REVIT or directly from Design Bulidin Design. In particular, this is a single-family dwelling with a semi-basement and first floor, with direct access for people and vehicles on the main façade, a three-slope roof, with vents and chimneys grouped on the ridge.. In figure 2 it is shown the path of the sun in the different months of the year, both on the main façade and on the back.

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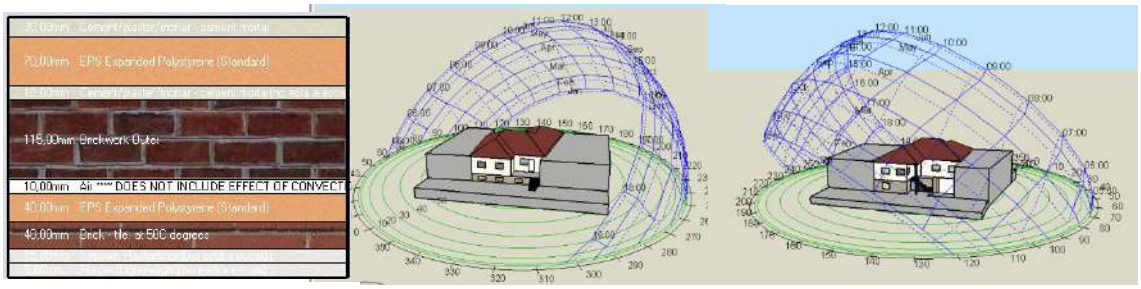

Figure 3. Sheets of the fachadee wall. Source:Own elaboration.

2 Sun path in differnts moths of the year by Design Building. e:own elaboration.

Design Building provides a more comprehensive and holistic integration of architectural design, than others programs such as the plugin of Sefaira, it gives a structural engineering, energy efficiency. The program gives aN implementing sustainable design practices and technologies to optimize energy usage and reduce environmental impact, because everything is very visual and the program lets you choose from a wide range of models, giving also their energetic characteristics, as in figure 3 where it was changed the composition of the fachade wall

The program allows to incorporate smart technologies for enhanced convenience, security, and energy management within the home.

The proposal shows an improvement in the heating design, where from an initial ventilation cost of 8.65 KW it is reduced to 8.37 KW in the proposal, as it is shown in figure 4, with an improvement of 4 %. Similarly, in simple heating, the cost is reduced from 12.26 KW to 10.28 KW, with an improvement of 17%. While the loss through walls changed from

Figure 4 Temperature gains and heat loss.

Source: Own elaboration.

1.74 KW initially to 1 KW, with an improvement of 43%, and the loss through the roof went from 1.52 KW to 0.56 KW**, with an improvement of 74%.** Thus, the optimization of the envelope is evident. The temperature fluctuation is very similar to the graph of the original building, but with better stability when using the air conditioning.

In summary, although ventilation energy losses persist and energy consumption during the use of air conditioning is maintained, the proposal has achieved a significant improvement in the building envelope. A notable decrease in energy losses is evident, indicating a considerable optimization in this aspect.

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EVALUATING THE IMPACT OF INPUT VARIABLES ON THE ESTIMATION OF THERMAL LOADS IN OFFICE SPACES USING VALIDATED MODELS

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Keywords: *validated models, performance-gap, influential variables, uncertainties, sensitivity analysis*

Abstract

The optimization of energy-efficient passive strategies in the building design often relies on simulation tools [1]. To bridge the gap between simulated and real data obtained through monitoring campaigns, experimentally validated models are employed. These accurate models help to quantify deviations arising from uncertainties in the input information, allowing to identify the influence of each variable on the building thermal loads [2]. The calculation of these uncertainties adjust the estimation of the real building consumption, generating a more reliable model that allows optimizing the most energy efficient strategies [3]. Under this umbrella, an experimentally validated theoretical model for an office located in Almeria has been developed, within the In-Situ-BEPAMAS project [4].

This article focuses on quantifying the impact that different input variables have on the heating and cooling loads of an office model. This office is located in the southwest corner of a building at the Plataforma Solar de Almeria, in southeast of Spain. The methodology applied involves developing a dynamic simulation model for the office, generating reliable data produced by monitoring campaigns, validating the model against experimental data and quantifying the uncertainties in thermal loads due to the variability of the input variables (Figure 1).

The simulation model is developed in a transient regime by coupling conventional types of TRNSYS until the model convergence is reached. Input variables defined for the base case are: actual office volume, characteristics of construction materials, real climate file, ground temperature recorded at 50 m depth, air infiltration ratio based on measured data and occupation estimation within the office. After modelling the base case by adjusting input values to nominal values, an hourly simulation over one year is conducted under free-floating evolution conditions. Model validation is performed by comparing the air temperature generated with TRNSYS against experimental data measured inside the office.

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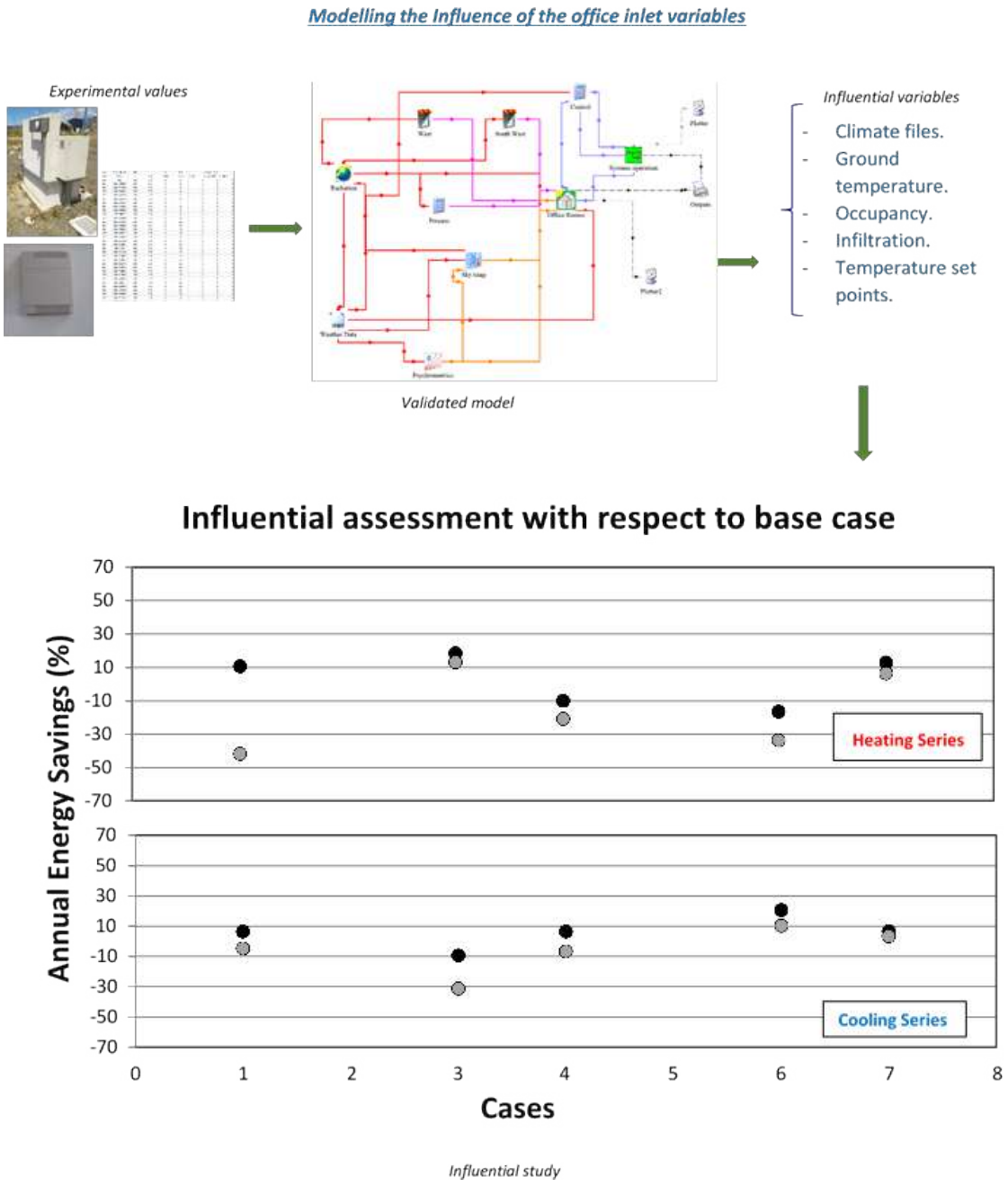

Figure 1: *Analysis methodology for quantifying the influence of the input variable on office thermal loads. (Source: CIEMAT)*

Finally, the quantification of the energy deviations produced by variations of the input variables is conducted through a sensitivity analysis. Climate files, ground temperature, occupancy, infiltration and set-point temperatures are evaluated. Heating and cooling loads are set as outputs by defining seasonal set-point temperatures. This analysis runs a series of parametric simulations modifying the model's input values, obtaining the annual thermal loads. The assessment of these loads provides the energy response of the office to the input variables, identifying those values that need to be adjusted more accurately to obtain a more reliable model.

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RETHINKING THE ENERGY FOOTPRINT OF MADRID'S MUNICIPAL FOOD MARKETS: A SUSTAINABLE APPROACH

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Keywords: *Sustainability, food markets, thermal envelope, energy consumption, European directives.*

Abstract

Municipal food markets, cornerstones of urban life, have traditionally played a multifaceted role, from nourishing communities to fostering social interaction. However, as sustainability and circularity gain prominence, these markets face the added challenge of adapting to evolving regulations and promoting energy-efficient practices [1]. This study delves into the energy landscape of Madrid's municipal food markets analyzing their building envelopes. Our findings reveal that while some markets have made significant strides in sustainability, substantial room for improvement exists [2]. Only a small fraction of markets currently implements renewable energy systems [3]. To meet the demands of the future and align with EU directives [4], a concerted effort is required to enhance the energy efficiency of Madrid's municipal food markets serve as vital spaces in cities, providing fresh and healthy food to their inhabitants. Additionally, they play a crucial role in the local economy [5], supporting local producers and merchants. In recent years, sustainability has become an increasingly important priority for food markets. This is driven by a range of factors, including growing awareness of climate change [6], the need to reduce reliance on fossil fuels, and the increasing demand for sustainably [7] produced food.

This study examines the energy landscape [8] of Madrid's municipal food markets. Data was collected through interviews and questionnaires conducted with market managers. The data was analysed to identify the strengths and weaknesses of the markets in terms of sustainability.

The study's results reveal a wide range of energy efficiency among Madrid's municipal food markets. Some markets have made significant investments in energy-efficiency measures, while others have significant room for improvement.

By embracing sustainability as a guiding principle, we can transform these cherished hubs into beacons of environmental responsibility, contributing to a healthier planet

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and a more sustainable future for all. To meet the demands of the future and align with EU directives, investments in energy-efficiency measures are required.

Some measures that could be implemented to improve the energy efficiency of Madrid's food markets include: [9] Enhancing the building envelope to reduce heat and cold loss, develop an energy-efficiency plan for each market, prioritize investments in energy- efficiency measures with a high return on investment [10].

By implementing these measures [11], Madrid's municipal food markets can become models of sustainability for other cities around the world.

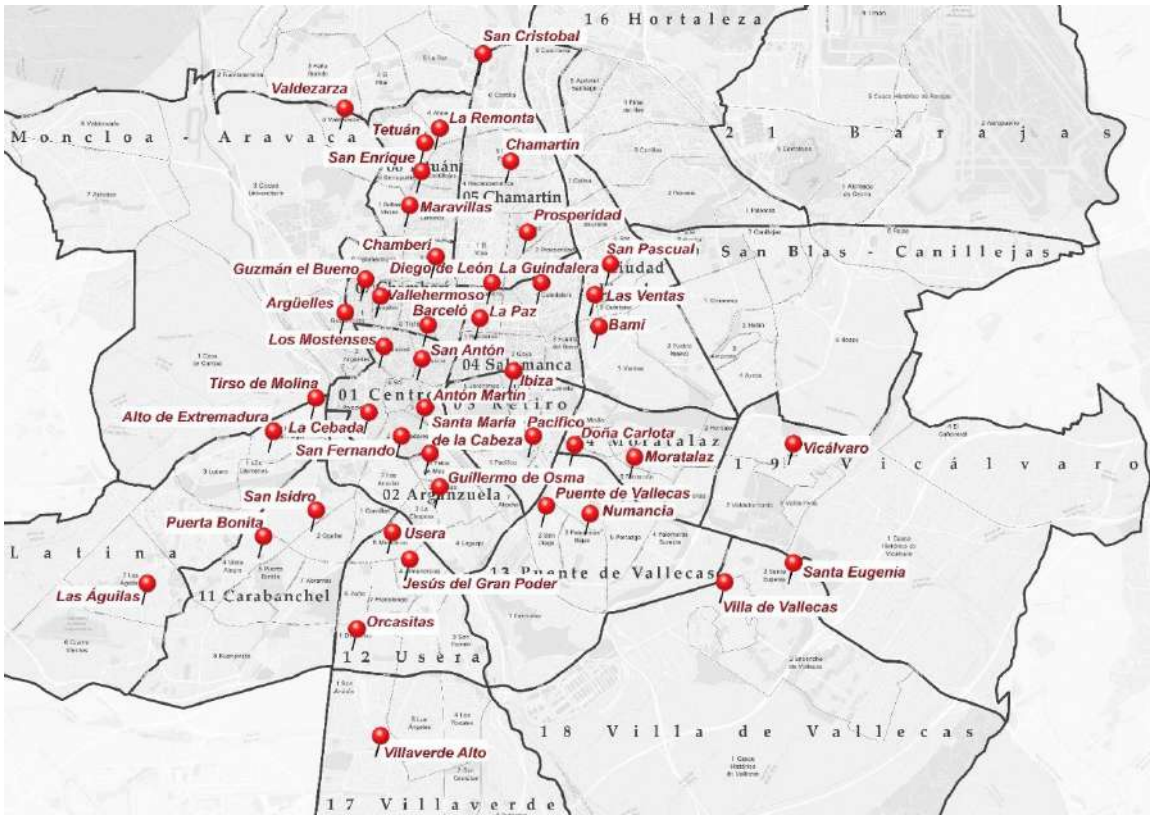

Figure 1: *Network of municipal markets. (Source: Distritos, barrios y viales: Instituto de Estadística de la Comunidad de Madrid.)*

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OPTIMIZING URBAN OUTDOOR COMFORT FOR URBAN HEAT ISLAND MITIGATION: A COMPUTATIONAL EXPLORATION IN A VULNERABLE AREA OF MADRID

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Keywords: *ENVImet, Building heating load, Mitigation scenarios, Urban Heat Island (UHI)*

Abstract

In the current context of the climate crisis, the discernible global temperature rise is becoming increasingly pronounced in urban settings [1]. The Urban Heat Island (UHI) phenomenon represents a critical challenge, particularly in densely populated areas where the clustering of buildings, roads, and human activities contributes to elevated local temperatures [2]. Projections from the Intergovernmental Panel on Climate Change (IPCC) underscore an anticipated substantial temperature increase by 2050 [3]. Two primary factors drive this temperature surge: the impermeability of most urban construction materials, inhibiting moisture dispersion and impeding heat dissipation, and the prevalence of dark-colored materials and urban layouts creating canyon effects, which escalate the absorption and retention of solar energy [4]. Cities such as Athens, Rome, Madrid, and Paris have grappled with challenges related to the urban heat island phenomenon, contributing to an expanded global ecological footprint across diverse urban landscapes. A study conducted by Yang, Javanroodi, and Nik [5] specifically highlights Madrid as one of the cities poised to experience a substantial temperature increase in the future.

This paper introduces an innovative approach to generate modified weather files that incorporate the UHI effect for various mitigation scenarios within a residential neighborhood within the URBAN therCOM research project [6]. The study focuses on a vulnerable area in Madrid, distinguished by its expansive dimensions and Mediterranean climate, rendering it ideal for scrutinizing the UHI issue. The research employs an advanced integrated procedure, coupling ENVImet and Ladybug Tools [7, 8], to evaluate individual and combined scenarios. These scenarios assess the impact of mitigation strategies on outdoor thermal comfort, emphasizing the efficacy of techniques such as utilizing different envelope and pavement materials and integrating green elements to significantly enhance outdoor thermal comfort [9]. The study uses reference and RCP 8.5 2050 weather files (Figure1). This approach aims to offer practical solutions for ameliorating the adverse effects of UHI in urban residential areas,

contributing valuable insights to the broader discourse on sustainable urban development and climate resilience.

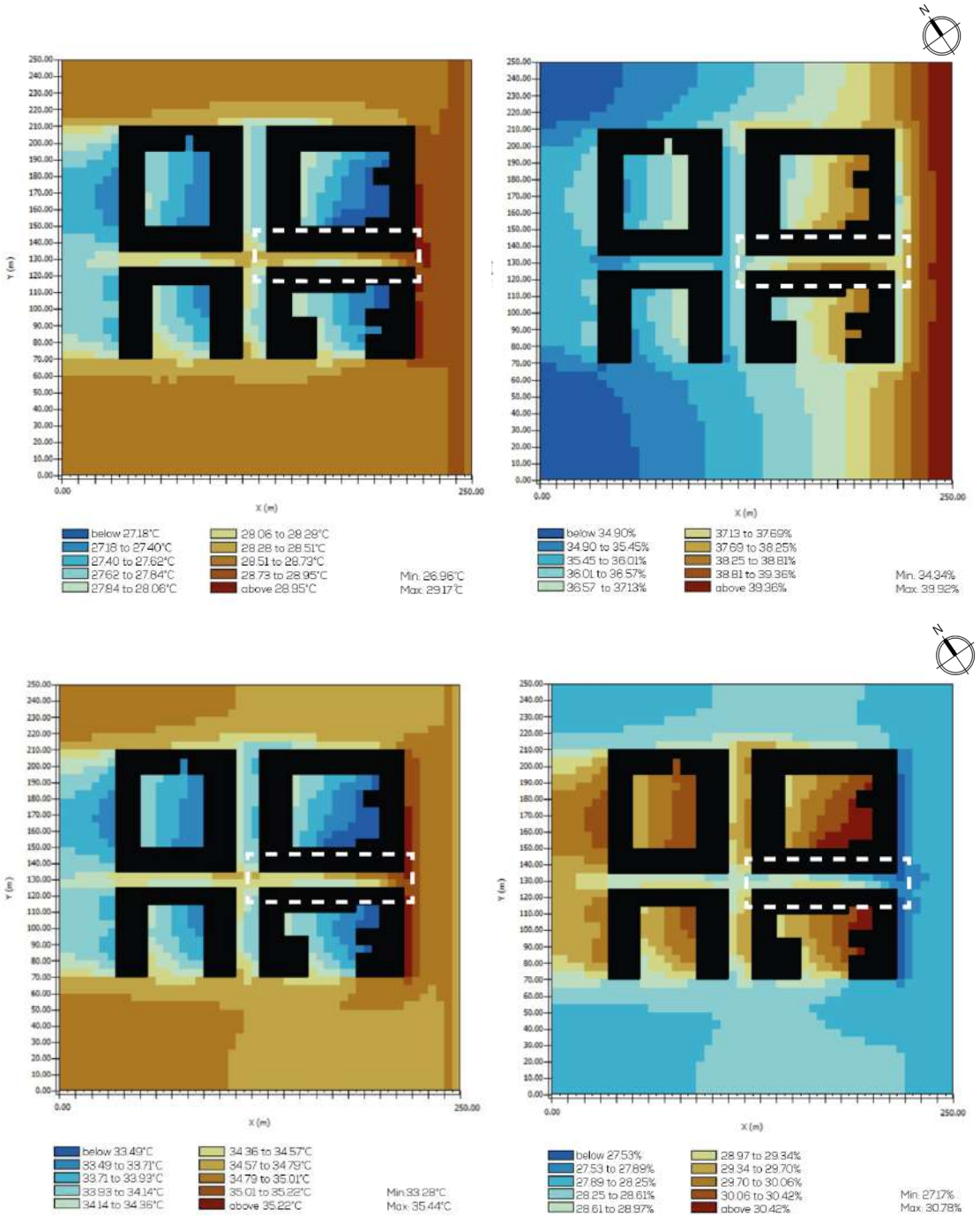

Figure 1: *ENVImet case study, Actual (above) and RCP 8.5 (below). (Source: own images)*

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Domotic and Smart Cities

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Enhancing Electrical Demand Prediction: A Multifaceted Modeling Approach

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Keywords: *prediction, multifaceted modeling, AI, statistical models*

Abstract

This proposal addresses critical challenges in the energy sector through the development of a predictive model for electrical demand, recognizing the pivotal role of accurate demand forecasting in planning, decision-making, and resource optimization within the electrical supply chain. Employing a multifaceted approach, the study integrates statistical models, machine learning techniques, and high-frequency data analysis to enhance the precision of electrical demand predictions [1]. A key contribution is the introduction of the Model of Multivariate Adaptive Regression Splines (MARS), expanding the modeling repertoire to offer a comprehensive solution for the complex task of modeling electrical demand [2].

The proposal commences with statistical models, including ARIMA (Autoregressive Integrated Moving Average) and its seasonal extension, SARIMA. These models prove crucial for capturing temporal patterns, seasonality, and trends in electrical demand. To further refine predictions, regression models are introduced, incorporating exogenous variables such as temperature and holidays. The addition of the Multivariate Adaptive Regression Splines (MARS) model introduces adaptability, allowing accommodation of intricate demand patterns.

Emphasizing high-frequency data analysis, the proposal considers hourly or more frequent data to capture daily effects, seasonality, and atypical events in electrical demand. Artificial Intelligence techniques are incorporated, leveraging algorithms to predict electrical demand with precision.

In conclusion, this proposal aspires to make a significant contribution to the advancement of demand forecasting methodologies in the energy sector. The multifaceted modeling framework, incorporating various statistical and machine learning techniques alongside the MARS model, provides a comprehensive and adaptable solution. By addressing the complexities inherent in electrical demand patterns, this proposal aims to enhance resource optimization, network management, and long-term planning within the electrical supply chain.

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Design and Development of an Smart Control System for Lighting and Thermal Comfort

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Keywords: *sensors, climate conditions, control systems*

Abstract

This study focuses on developing an innovative control system to address the prevalent energy wastage in educational and public spaces. The current inefficiencies stem from the lack of effective control over lighting and thermal variables, resulting in unnecessary energy consumption and increased electricity costs [1].

The proposed system integrates advanced technologies such as proximity and light sensors, along with temperature and humidity sensors [2]. Automation plays a pivotal role in minimizing human intervention, ensuring optimal energy utilization even during scheduled hours when devices like lights, fans, and air conditioners are not in use [3].

The key advantage lies in the system's ability to adapt to real-time needs, adjusting lighting and temperature automatically. By doing so, the system not only enhances energy efficiency but also significantly contributes to user comfort and well-being. This is achieved by creating a more pleasant and productive environment, as excessive lighting and uncomfortable temperatures are mitigated [1].

Moreover, the system actively addresses environmental concerns by reducing the carbon footprint [4]. Automatic adjustments based on real-time requirements minimize the emission of greenhouse gases, aligning with sustainability goals and environmental regulations. Compliance with energy efficiency norms is a crucial aspect, making the proposed control system not just a convenience but a necessity for educational institutions, government facilities, and other public spaces.

The flexibility and adaptability of the control system extend beyond energy savings. It allows easy customization for different schedules, diverse activities, or varied climatic conditions, contributing to overall space management. The research also underscores the advantages of remote monitoring and maintenance, offering a proactive approach to issue detection and ensuring the system's sustained efficiency over time.

In conclusion, this research aims to provide an effective solution to energy wastage in educational and public spaces. The proposed Intelligent Control System addresses the root causes of inefficiencies, promoting energy savings, user comfort, and environmental sustainability. The study emphasizes the system's compliance with energy regulations, making it a comprehensive and essential tool for modern spaces striving for efficiency and sustainability.

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Low-Cost Real-Time Monitoring System for Household Low Voltage Distribution Transformers using Arduino

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Keywords: *monitoring, low voltage, sensors, Arduino, energy efficiency*

Abstract

This proposal introduces a comprehensive system designed to revolutionize the monitoring of low-voltage distribution transformers, catering specifically to domestic consumption. Leveraging cutting-edge Arduino technology, the primary focus lies in providing tangible benefits to electricity distributors [1]. The core problem addressed is the imperative need to elevate energy efficiency and streamline network management in the household electricity consumption field [2].

One of the principal advantages offered by this system is the integration of Internet of Things (IoT) capabilities and General Packet Radio Service (GPRS) for data transmission. By incorporating IoT, the system facilitates seamless connectivity and communication between the various components involved in real-time monitoring [3]. Sensors capturing voltage, current, and power parameters can transmit data efficiently, enabling continuous tracking and analysis. This connectivity enhances the system's ability to detect anomalies, ensuring a proactive approach to rectifying issues such as power losses, overloads, or faults.

Other significant benefits provided by this system include the ability to enhance energy efficiency through real-time remote monitoring. By enabling the continuous tracking of voltage, current, and power parameters, the system provides utilities with unprecedented insights into consumption patterns. This facilitates the identification and rectification of anomalies such as power losses, overloads, or faults, ensuring the seamless operation of the electrical grid and contributing to the reduction of energy waste [4].

Moreover, the proposal seeks to significantly reduce operational costs for electricity distributors. Traditional methods of sending personnel for on-site measurements are not only time-consuming but also resource-intensive. The implementation of remote measurement capabilities eliminates the need for physical presence at transformer sites, resulting in substantial time and monetary savings. This operational efficiency is crucial for utilities aiming to optimize their resource allocation and enhance overall network management.

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General Issues

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IMPLEMENTATION OF THE ISO 9001 STANDARD IN THE INTERNAL STRUCTURE OF A CONSTRUCTION COMPANY

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Keywords: *ISO 9001 Standard, Implementation, company, construction*

Abstract

The implementation of the ISO 9001:2015 standard in construction companies leads to the adoption of standardized processes and procedures for essential control to ensure the necessary requirements that guarantee the maximum quality of products and services. This involves conducting a thorough diagnosis of the company, assessing its current structure, goals, personnel, and clients. This analysis will contribute to identifying potential issues in control management within the company, thus allowing the establishment of high-quality guidelines and directives for effective.

The construction sector is one of the most important in the world, representing 12.2% of world GDP in 2012 and it can reach 13.5% of GDP in 2025, which would mean a turnover of 15 trillion dollars.1 Similarly, in Spain, this sector is one of the most important in the national economy, which plays a fundamental role in the country's economic growth, contributing significantly to the Gross Domestic Product (GDP) in 2019, with 5.9%. Thus, the importance and relevance to make improvements in this sector has an impact in the other sectors. Spain remains the fifth country globally and the third in Europe with 3.926 of 60,617 certified workplaces according to ISO 9001 registered at the end of 2022. The most relevant construction companies with the ISO 9001 in Spain are Alsina Group, APS Group, DB Construction and Shades of Confort, among others.

ISO 9001 certification is crucial for companies in the construction sector, where collaboration with subcontractors is common. It not only helps manage subcontractors effectively but also enhances contract opportunities by demonstrating a commitment to quality standards, aiding in competitive bidding. The ISO standard mandates

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compliance with industry-specific legal requirements. In a sector prone to budget overruns and delays, the ISO standard's process-focused approach isolates key project areas, resulting in time and cost savings.

INTERNAL ASPECTS: Enhancements in organizational processes, operations, and human resources management aim to improve coordination, efficiency, and employee satisfaction. This includes optimizing production management, reducing costs, and implementing better controls.

EXTERNAL ASPECTS: The focus is on commercial competitiveness, financial growth, and effective customer management. This involves entering new markets, increasing turnover, and improving customer relations for overall market image enhancement. Certification according to the ISO9001 standard enhances the processes necessary for a global improvement in the quality of construction processes. However, its implementation does not always guarantee benefits for companies, when the standard has not been adopted in all processes or the participation of the teams has been poor, so there is a long curve of learning that demotivate the company. The implementation in a company of a correct application of the ISO9001 standard depends on training the resources of each construction company, aligning the management of procedures to the standard as much as possible, exploiting the benefits in the medium and long term.

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SAFETY IN THE USE OF CHEMICALS FOR THE CURING OF CONCRETE AND MORTAR

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Keywords: *acrylic lacquer, solvent, maximum surface area, minimum drying time, maximum application rate.*

Abstract

When carrying out construction work in hot weather, it is common to apply acrylic coatings to pavements to improve the curing of concrete and mortar, prevent rapid water evaporation, and ensure optimum hydration. In this way, resistance, durability, and mechanical properties are improved, as is the use of paints for priming and consolidation.

The application of these products results in a continuous film of flammable liquid, which can become a hazard during the drying process and has associated legal obligations for both the workers involved and the equipment and tools used [1, 2, 3].

The calculation consists of estimating the ventilation and flow rate of flammable vapors generated during the drying process to determine the operating conditions that will define a theoretically negligible area so that a potentially hazardous atmosphere is not created [1, 2].

Two lines of work have been followed, using the standards UNE EN 60079-10-1:22 and UNE 202007:2006IN, in addition to considerations of the regulation on thermal installations in buildings [1, 2, 4].

It is concluded that in outdoor environments, the latest published version of the standards for the calculation of explosive atmospheres, UNE EN 60079-10-1:22, should be used, while in poorly ventilated indoor spaces, the UNE 202007:2006IN standard is more appropriate.

In addition, the difference in the behavior of the application parameters and their deviation as a function of the air speed and the ambient temperature at which the drying process is carried out is analyzed. The results obtained in a poorly ventilated indoor environment are shown for a commonly used solvent, such as toluene, in acrylic paint applications (Figures 1 and 2).

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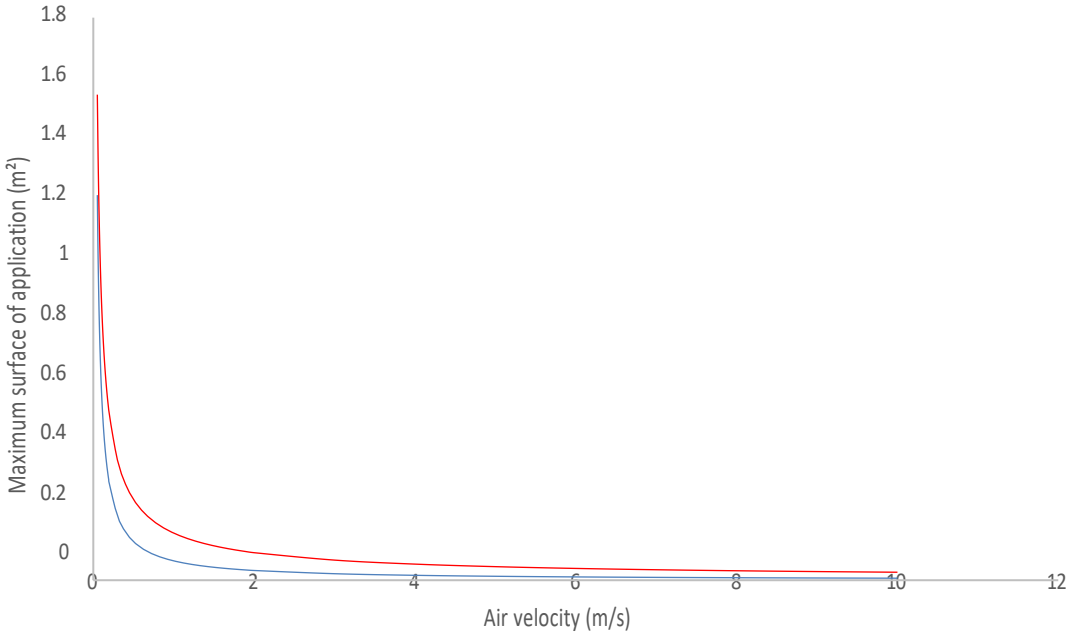

***Figure 1**: Maximum indoor application range of toluene as a function of air velocity. Where: the red line refers to "Risk Management Model Behaviour" and the blue line refers to "Model Performance Standard UNE EN 202007IN". (Source: Own work)*

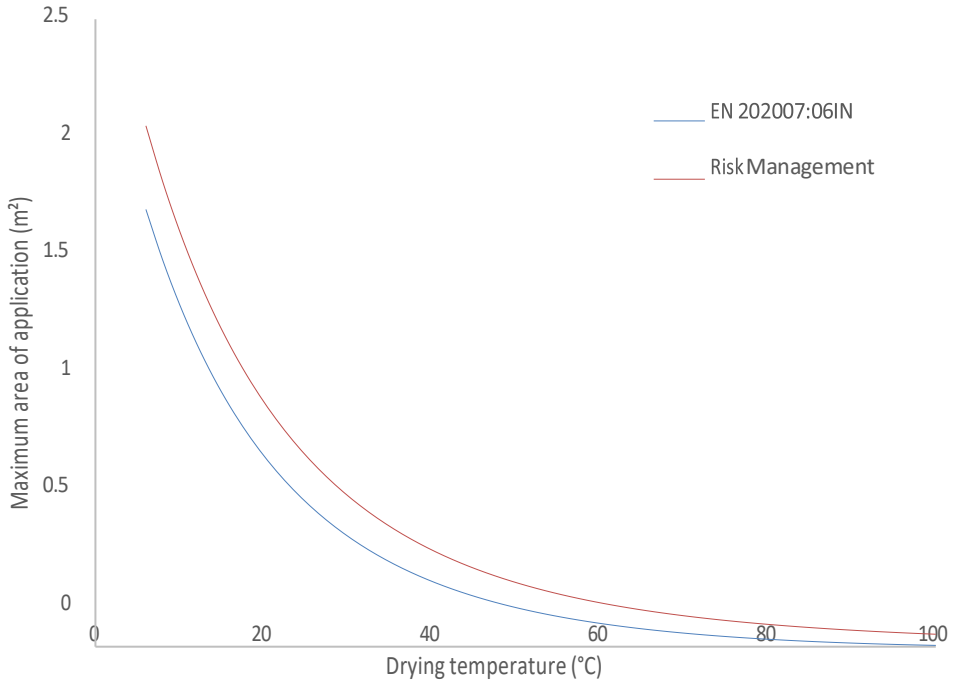

***Figure** 2: Maximum area of the application range of toluene in poorly ventilated interiors as a function of drying temperature. (Source: Own work)*

The increase in surface air velocity allows greater dilution of the vapors generated during the drying process, thus increasing the waiting time between applications, but also

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increasing the vapor flow rate generated. This has the effect of reducing the maximum application areas so that yields remain constant.

As the ambient temperature rises, the application speed must be reduced, and at around 40°C it is not possible in practice to apply the coatings without creating a flammable atmosphere.

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EVOLUTION OF THE SPANISH ELECTRICITY PRODUCTION STRUCTURE: 2009 - 2024

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Keywords: *electricity production, evolution, non-renewable energy, renewable energy*

Abstract

New climate objectives in the Europe Union makes the electricity production structure change into a more renewable one investing in new infrastructure to substitute non-renewable generators and be prepared for further challenges such as the net zero emission by 2050.

All countries in EU were doing efforts and investments in this area which become more intense after the beginning of the Ukraine – Russia and Israel – Palestine conflicts. The dependence on these countries makes EU weak, energetically, increasing prices per MWh and severely impacting on the economics of industries, families and, even, governments.

In 2009, when one of the first Directives about renewable energy was published [1], there were a lot of further regulations which established new objectives both in general and specifically in certain strategy areas such as buildings or transport. This drive countries to develop new regulations to adapt their energy structure to each objective. Nowadays the net zero emissions by 2050 is a long-time objective which shows the way the EU must follow in the next almost three decades.

Although there were some barriers to this deep change, energy production structures have been changing from the late 2000s until now, and renewable energy acquire more and more importance. Even more in Spain which is one with most sunny days in the world and photovoltaic infrastructure has multiplied in the recent years.

In this work, some data about the evolution of the electricity production structure from January 2009 to January 2024 has been analysed. It was demonstrated that renewable energy is the predominant in our country (more than 60% weight on average in 2022) and it is still increasing.

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RMCC RESILIENCE IN COOPERATION CONTEXTS FROM A MULTIDISCIPLINARY PERSPECTIVE

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Keywords: *International Cooperation; Climate Change; Teaching for the society;*

Abstract

Succession of extreme natural events (including extreme temperatures, heavy rainfall and flooding, as well as droughts, storms, and combined actions) had been intensified in the last years owing to the climate change. The main problem is that the evidence has shown that, even small temperature increases on 0.5ºC cause substantial shifts, at both regional and global levels, as reflected in the document issued by the IPCC in its sixth report [1].

According to the Internal Displacement Monitoring Centre (IDMC), at the end of 2022, 71.1 million people having to be internally displaced globally, of which 32.6 million people did so as a result of extreme natural events. Moreover, the number of affected population increased by 45% in the year 2022 due to the acceleration of climate change-related phenomena, particularly focused in Asia and Sub-Saharan Africa [2].

One of the main challenges is that most of slums and precarious regions are placed in areas vulnerable to those extreme events. In them, devasting effects coupled with limited adaptative capacity jeopardize the future of inhabitants. Repercussions are not only economic, potentially leading to a reduction in the GDP of regions or countries by more than 6% [3], but also social, in terms of food security and fundamental principles of basic living conditions [4]. Those consequences are intensified in areas prone to earthquakes, where precariousness of constructions and the lack of technical guidance pose a risk to the safety of the people inhabiting them.

The importance of addressing the needs of over 1.1 billion people living in slums or precarious conditions [5] requires that Universities raise awareness about the prevailing reality in the world. From Architectural point of view, there is a need to find solutions to the uncontrolled

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growth of cities [6] where precariousness is glorified, and where the demands for housing are not met [7-8].

ICHaB-ETSAM cooperation group has been providing post-graduate training for more than twenty-five years. The expert course addresses the issues of precarious human settlements and offering tools to improve the lives of the population inhabiting them, while helping meet their basic housing needs. However, the urgency of providing an effective and appropriate response to each context demands that, at the very least, introductory training in cooperation be provided to undergraduate students, with a holistic and integrative perspective.

In this communication, we present the recently awarded Service-Learning project on climate resilience for cooperation contexts. In collaboration with three NGOs operating in different contexts, our goal is to reach the largest number of undergraduate students and engage them to work alongside postgraduate students, in addressing the identified needs in each of the regions where we are operating. This involves working with real-life cases and study scenarios to effectively respond to the challenges posed by climate change. In this way, the article outlines both the objectives and the working methodology that will be followed throughout this year to achieve the proposed goals.

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USER-FRIENDLY SOFTWARE FOR ELECTRICAL CONDUCTOR CALCULATIONS AND SELECTION IN COMPLIANCE WITH REBT REGULATIONS FOR BUILDING INSTALLATIONS

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Keywords: *Electrical installation designing tool, User-friendly application, Low Voltage Electrotechnical Regulations (REBT)*

Abstract

The generation of electricity is followed by its transmission through high-voltage power lines, reaching designated receiving facilities and building for consumption. As specified in the Low Voltage Electrotechnical Regulations (REBT)[1], low-voltage electrical installations (<1000V AC) must adhere to strict design criteria, encompassing conductor installation methods, spacing, type, and so forth. The developed program that is disclosed in this paper, simplifies the calculation of phase and, if applicable, neutral conductor cross-sectional areas, ensuring compliance with REBT guidelines. The application delivers results within seconds, liberating users from manual calculations and regulatory searches. The main methods in low-voltage installations for cross- sectional area is applied: thermal heating criterion-based calculations and voltage drop assessments. The app is divided into three stages:

1. Basics and general installation characteristics such rated power, power factor, conductor distance and so on. It is indicated in figure 1.
2. Specific regulatory characteristics for the installation employed: aerial, underground, or interior shown in Figure 2 a) b) c), respectively. Figure 2 show each pop-up window for the installation selected.
3. Results marked as 3 in Figure 1. This tab is divided in turn into three parts, the first two correspond to the section applying the different criteria and the last part shows the final cross-sectional area.

Existing commercial applications are limited to providing commercial sections. The proposed application here provides the exact technical sections, informs the commercial one and indicates the criteria that prevails for the selection. It computes isolated lines within electrical installations, distinct from the integrated diagram, while allowing users to specify the starting point within the diagram as part of the input data. Furthermore, the program provides the following features: a user manual,

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complementary technical instructions (ITCs) for different installations, and the option to export results in different formats.

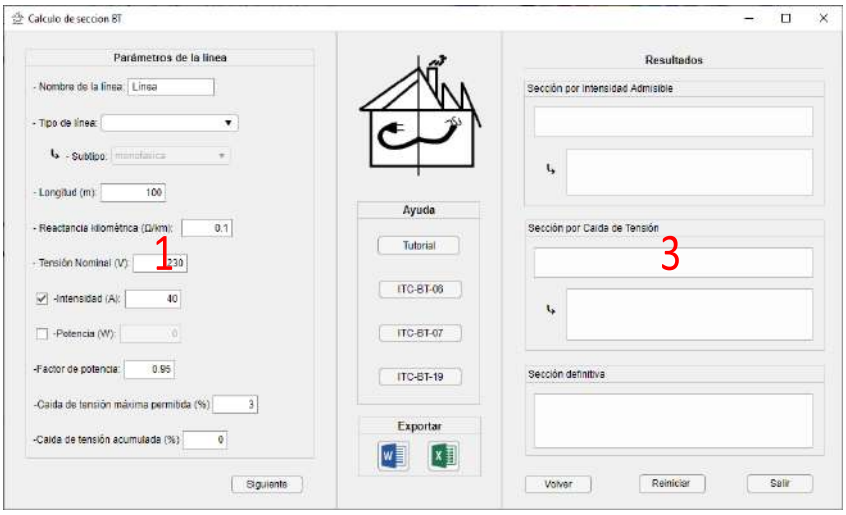
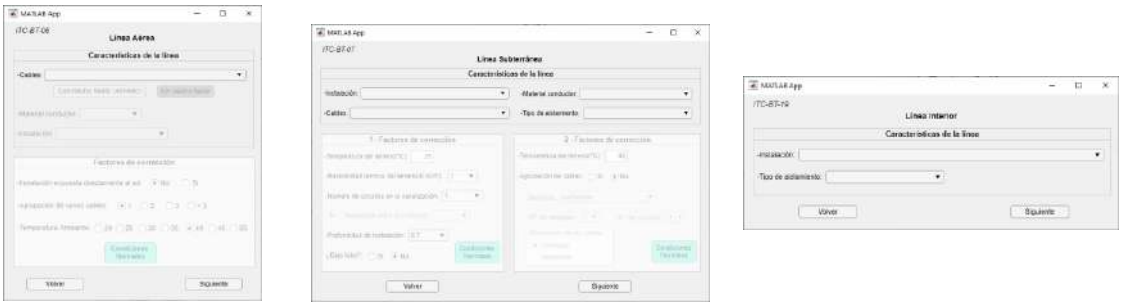


Figure 1: *Application appearance: Stage 1 and 3.*



a) b) C)

Figure 2: *Application appearance: Stage 2. a) aerial b) underground c) interior*

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POPULAR CONSTRUCTION: LÓPEZ MEZQUITA AND HIS FIRST WORKS

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Keywords: *López-Mezquita, Granada, pintura, construcción popular, casa de pueblo. López-Mezquita, Granada, painting, vernacular architecture, country-house.*

Abstract

José María López Mezquita is one of the most renowned painters from the 20th Century with great recognition during his life, but he has become a forgotten author for most of the society. The greatest part of his work was done in the United States of America, although he was well-known and famous in Spain, and due to his artpieces, one of the best examples of the Spanish Realism School [1].

However, it is less known that he was a precocious painter, who did a vast catalogue of paintings, specially from Granada, where he painted mostly his city, daily life scenes and the environment from his child point of view. Some of them are examples of vernacular architecture and a way of living of a time long ago finished that help us to rebuild and understand places of previous years.

He portrayed popular buildings as cottages, mills and houses that had a great documentary value, showing images of an essential city at the last years of the 19th Century, which are also reference documents to understand and analyse some of his later -and more mature- works painted by this author, where he portrayed the cities of Madrid or New York [2].

In these paintings from this first years are shown some of the essential characteristics of the vernacular architecture are reveal [3][4][5][6]; the entrapment on the land, the belonging to the environment; the utilitarian sense, subordinating composition to needs; adjusted to tradition, technique, aesthetics and framing; sobriety endowed with elegance; independent of fashion.

This paper reviews the works done in the early stages of this great Spanish artist from the 20th Century and the relation he had with the popular works, as the starting point of a honesty in his style, hardly achievable by others. These painting are an amazing ensemble of the vernacular architecture developed in the immediate surroundings of his city, where he was developing as person and as an artist.

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At the same time, this ensemble of paintings provides an inestimable information as a source of information. This is due to the fact that in most of the cases, the portrayed examples are no longer standing. [7]. There is not even a single example of some of the typologies represented.

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STUDY OF OPERATING CASES WITH NATURAL VENTILATION TO ENSURE INDOOR AIR QUALITY NATURAL VENTILATION TO ENSURE INDOOR AIR QUALITY IN WORKPLACES IN WORKPLACES ALLOWING A HEALTHY ENVIRONMENT HEALTHY

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Keywords: *Air quality; Natural ven0la0on; Hygrothermal condi0ons; CO_2 level.*

Abstract

The pandemic originated in 2019 by the famous SAR-Cov-2 virus has triggered numerous inves?ga?ons, one of the main ones being its route of transmission
and contagion among humans. It is now confirmed by scien?sts with years of experi ence that the dominant route of transmission is the inhala?on of aerosols, thus re-em erging the need and the importance of ven?la?on of spaces(1).

As a consequence, a series of preven?ve measures are reconsidered(2), such as, for example, total ven?la?on in shared spaces in order to guarantee a healthy indoor air quality for the user, thus altering the development of the work ac?vity
considered normal un?l then, since the thermal comfort that the occupant may feel is somehow forgoKen.

The main objec?ve of this study is to analyze the indoor air quality together with the hygrothermal condi?ons in a specific work center, classrooms belonging to the School of Building Engineering of Seville (ETSIE), verifying its suitability for the development of its ac?vity, in this case teaching, in the healthy condi?ons established by the R egula?on of Thermal Installa?ons in Buildings (RITE) (3) and the RD 486/1997(4). It is important to point out that a good air quality provides benefits such as an improvem ent of the working environment or improvement in the quality of the maintenance of t he facili?es, reducing the risk of contagion of common diseases such as flu or a simple cold, even reducing some kind of discomfort that the student may feel as headaches or nasal conges?on(5).

For the analysis in ques?on, a motoriza?on method will be applied in classrooms with similar construc?on characteris?cs and occupancy, but with different orienta?on. For t his purpose, a measurement schedule will be established for the extrac?on of data regarding CO2 concentra?on (ppm), temperature (ºC) and rela?ve humidity (%) in diff erent combina?ons of natural ven?la?on opening. Prior to this, TESTO 160 IAQ data loggers will be installed, taking into account the guidelines set by UNE 171330-2-2014, being these loggers capable of capturing values in five-minute periods. These data will be bounded in class schedules to subsequently develop graphs with which to visually facilitate the behavior of the parameters to be studied.

The analysis and comparison of all the data obtained between the different casuistry and classrooms, will be of great help to provide conclusions such as: the possibility of obtaining a healthy air quality inside a workspace through natural ven?la?on providing a solu?on in the design of labels to establish the appropriate opening of carpentry; or even, the exis?ng priori?za?on of such air quality before the hygrothermal comfort of the student.

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PROPOSAL FOR THE APPLICATION OF BIM USES IN THE ACTIONS OF THE TECHNICAL INTERVENTORY FOR THE EXECUTION OF PUBLIC WORKS IN COLOMBIA

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Keywords: *bim, uses, interventory.*

Abstract

The document explores the connection between the variety of uses of the BIM methodology with the functions of the technical intervention of public works, seeking to identify the BIM uses that can be of practical use in the work of the intervention, and examining the need for application of these tools, when construction projects are executed with the BIM methodology.

The analysis focuses on the development of two key components, the description of the particularities of the auditor's functions in contracting during the construction or execution phase of the asset, and the contrast between the uses and tools that the auditor would have to use to the correct performance of their role, as a party involved in the BIM information management processes.

The work strategy applied is a comparison between the main functions of the auditor and the most common BIM uses with which the audit has a direct relationship, additionally, those uses that are not so common and some of a more peculiar nature focused more on the work of the auditor. intervener, so that its implementation can improve the development of supervision and surveillance processes in the execution of public projects.

The study allowed us to determine that the success of a public works project, developed with BIM methodology, will be achieved to the extent that the project information is efficiently managed, therefore, the audit has to adapt to the information management processes. , applying the uses and tools that may be able to take advantage of the information from the existing digital model in real time, to manage, monitor, audit and monitor compliance with legal technical regulations, management processes and BIM standards established in the BEP, ensuring collaborative workflow and transparency during the construction and delivery phase of the asset.

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DIGITAL TRANSFORMATION AND ITS IMPACT ON SOCIAL NEEDS. A REFLECTION BASED ON THE HOUSING DEFICIT IN CHILE

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Keywords: *Digital Transformation, Adaptability, Housing Shortage, Social Housing, Seismic-resistant*

Abstract

Currently, the construction industry in Latin America finds itself at a crossroads, faced with the urgent need to enhance productivity to meet fundamental societal demands, such as the right to housing and to achieve adequate sustainability indices in the face of the climate crisis we are facing.

The construction industry stands the main source of carbon emissions on the planet and today is driving the insertion of new technologies worldwide, generating a total disruption that has opened new possibilities for collaborative work by implementing diverse digital tools.

These allow monitoring the different phases of the project rom conception to operation, ensuring high rates of adaptability to different circumstances to which a building is subjected through the construction of digital twins that allow testing and knowing in advance the behavior of a construction.

Digital twins are developed under the bases and criteria of standardization and industrialization in a digital environment. They can be continuously improved by adapting aspects of its configuration, according to specific climatic conditions of a place, thus allowing to adjust the type of insulation, thickness or finish of a wall that allow it to coexist properly in a defined territory.

The proactive deployment of this type of tool can have a positive impact on the way in which highly complex situations such as the housing shortage in Latin American countries are addressed.

Chile currently faces a housing deficit estimated at 650,000 homes according to data from the 2017 census. In response, the Ministry of Housing and Urbanism (MINVU) has developed a Housing Emergency Plan that seeks to overcome 40% of this figure by 2025, promoting the construction of social housing [1]. However, this projection also

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estimates that by that year the housing shortage will increase due to the consequences of the pandemic whose economic consequences have generated a significant recession in terms of real state transaction and renting, increasing the levels of overcrowding of families, with no official quantification to date.

This background supports the idea that the incorporation of new technologies and in this the digital transformation (DT) and the development of artificial intelligence (AI) can guarantee the sustainable development of the industry over time.

Emerging technologies are often inclusive, even when the industry defines a field of action, it is always possible to rethink the technique and its evolution. In this sense, the piece of baked clay, considered the first prefabricated material in the history of construction, derived from the intelligence of man who, from the efficient use of the four natural elements, creates a material capable of resisting compressive stresses comparable to stone, adapted to its physical possibilities, has evolved, and can be incorporated within the framework of standardization and industrialization [2].

This assertion is substantiated by tests conducted at the Catholic University of Peru in 2009 [3], for a spatial reinforcement system that manages to amalgamate the baked clay piece, the concrete mortar and the steel, forming a construction unit solvent to compressive and tensile stresses of high interest for countries with constant seismic activity, as is the case of Chile.

These favorable and suitable conditions from the constructive point of view, open a space for reflection to the active incorporation of this type of techniques in the processes involved in the technological development (TD) of the construction industry with a view to improving its productivity, solvency and environmental impact indexes, allowing to place the role of the industry on the current demands of Latin American society, the natural processes of familiarization of the workforce and adaptation of conditions to minimize the barriers for the implementation of such radical transformations and of the magnitude that TD poses.

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PRE AND POST COVID HOUSING PRICES IN MADRID

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Keywords: *Hedonic pricing method, Real estate market, Housing characteristics, Real estate portal, Madrid*

Abstract

The COVID-19 pandemic has had a significant impact on various aspects of society, and the housing market in Spain has been no exception. Since the onset of the health crisis in 2020, notable changes have been observed in the dynamics of the real estate sector, with direct repercussions on housing prices. One of the most evident aspects was the adaptation of the market to the restrictions and confinement measures, which led to a temporary slowdown in the number of real estate transactions. The economic uncertainty resulting from the pandemic also created a cautious environment among buyers and sellers, contributing to a slowdown in real estate market activity. However, as time progressed, there was evidence of a trend towards stabilization and, in some cases, recovery in the Spanish housing market. This research aims to quantify the effect of the pandemic on housing prices located in the city of Madrid. For this purpose, a database of georeferenced asking prices obtained from real estate portals is used, with data between 2019 and 2021. An ordinary least squares regression model with pooled cross-section data is used. The regression model includes variables related to housing (such as typology, surface area, number of bedrooms and bathrooms, and heating/cooling facilities), building characteristics (such as elevator, parking, storage room, or swimming pool), location characteristics (geographic coordinates and districts), neighborhood characteristics (proportion of elderly, foreigners, income level), time characteristics (quarters) and other market and occupancy characteristics. To model the effect of time, dummy variables have been created to identify in which quarter the properties were being marketed. In order to quantify the incidence of the pandemic on housing prices in Madrid, several estimations of the regression model are made: firstly, a global estimation where all the independent variables are included; and secondly, several estimations where the sample is segmented in each of the quarters analyzed.

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STUDY OF OPERATIONAL CASES WITH MECHANICAL VENTILATION TO ENSURE INDOOR AIR QUALITY IN WORKPLACES THAT PROVIDE A HEALTHY ENVIRONMENT

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Keywords: *Ppm, CMV, COVID-19*

Ppm: Parts per million.
CMV: Controlled Mechanical Ventilation

Abstract

During the declaration of a global pandemic as a result of the coronavirus (COVID-19) (Sars-Cov-2), many architectural buildings had their normal operations compromised due to measures taken by health authorities to reduce the spread of the virus through the air. [1]

As is well known, natural ventilation directly affects the comfort and energy efficiency of buildings. Mechanical ventilation ensures correct indoor air quality, if the air has been previously filtered and disinfected.

The study analyses the hydrothermal conditions, referring to the variables of Temperature (ºC), Relative Humidity (%) and CO2 level (ppm) in the classrooms of the School of Building Engineering (ETSIE), belonging to the University of Seville. In order to guarantee compliance with the RD 486/1997 [2] and RITE. [3]

The measurement is carried out in the winter season and for the quantitative obtaining of the variables to be studied, two data loggers of TESTO brand and model 160IAQ have been used, installed in accordance with the UNE 171330-2-2014 regulation. [4] Six different measurement scenarios are established, analyzing classrooms during the school day from 8:00 am to 21:00 pm for a total of 15 days. The analysis is carried out using graphs including each of the scenarios and variables.

The results showed that obtaining values within the OPTIMUM range for the CO2 variable does not guarantee in any of the cases that the Temperature and Relative Humidity levels are also within the OPTIMUM range. In order to guarantee that the CO2 level values are within the range classified as OPTIMAL, cross ventilation is required as a minimum.

To conclude, three options for controlled mechanical ventilation (CMV) are analyzed in order to make a real comparison of the ventilation systems available on the market and then choose the system that offers the greatest coverage, in terms of features, performance and economic cost. The analysis of the systems is carried out with the CYPE THERM tool [5], and the systems studied are: an air extractor, a heat recovery unit and an air handling unit.

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The ventilation system that offers the best performance to solve the problems described above is defined with the heat recovery unit, offering a complementary solution to the air conditioning system in the building. The economic cost of the solution is compensated by the quality of the air obtained. It is also a system that is easy to maintain, guaranteeing the necessary indoor air quality required by the standards. [5]

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ANALYSIS OF THE EXPERIMENTS CONDUCTED BY HODGKINSON IN 1840 REGARDING THE STUDY OF COLUMN INSTABILITY

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Keywords: *Buckling, columns, strength of materials, history*

Abstract

In 1840, E. Hodgkinson carried out the most significant experimental campaign on the study of cast iron pillars performed until that time. Just over 100 years earlier, in 1729, Musschenbroek conducted the first experimental campaign on the buckling of components, which were in this case made of wood, using elements of very small section and length. A few years later, in 1744, Euler analytically derived his famous expression to determine the critical load of a column subjected to vertical load. Hodgkinson's experiments can be considered, chronologically, as the third milestone in the history of the development of buckling theory.

Hodgkinson explains that the undertaken work aims to establish the laws that relate the strength of cast iron pillars to their dimensions. To achieve this, he tested pillars with lengths ranging from one inch to 5 feet and solid circular sections with diameters varying between half an inch and 2 inches. In the case of hollow circular section pillars, the tested lengths reached 7 feet 6 inches, and the diameters reached 3 inches and a half. In his publication, he asserts that the work aimed to address the deficiencies of Euler's theory regarding column buckling. The connection of the pillars to the press plates was done in two ways: by means of rounded ends and smooth ends.

For pillars with a solid section and significant slenderness, he found good agreement between the critical load and the dimensions of the pillar according to Euler's theory. He determined that the critical load (Pcr) was proportional to the fourth power of the section diameter (d) and inversely proportional to the square of the column length (L):

$$\frac{d^4}{L^2} \propto P_{cr}$$

He also found that a pillar with rounded ends had half the strength of another with flat ends and the same geometry.

However, for short pillars, deviations from Euler's theory were significant. He found the following relationship for solid circular section pillars with lengths ranging between 121 and 15 times the diameter:

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$$)\sim \square_{LL^{1.7}} \square \quad \frac{dd^{3.6}}{} \ (PP_{cccc}$$

On this point, Hodgkinson wrote the following in the memorandum presented to the Royal Society:

"In the theory of EULER, the strength is estimated by the greatest weight which a pillar would bear without flexure, whilst in the present case, the estimate is formed upon the weight which would break the pillar by flexure."

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SELF-HEALING COMPOSITES FOR AEROSPACE INDUSTRY

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Keywords: *Self-healing; composites; aerospace; industry*

Abstract

Any study on the current literature regarding materials used in the aerospace industry will bring to light that there is significant growth in the development of new materials and the improvement of existing ones. The design specifications in the aerospace industry are becoming increasingly demanding in terms of mechanical performance and also in relation to material damage tolerances and the solutions employed.

When a load is applied in the form of an impact, composite materials can undergo deterioration. Impact-induced damage begins with microscopic voids that develop into microcracks and culminate in structure delamination, causing a decrease in their load-bearing capacity and, ultimately, their failure.

The traditional solution to this problem has been the use of composite materials patches bonded with resins, resin injection, and heat-based techniques. However, these methods present limitations, such as their inefficacy for damage that is not visible from the exterior or the need for damage monitoring.

Self-healing materials do not present these limitations. The increased molecular mobility of polymers and their composites imparts a self-healing character to such materials [Bekas et al., 2016]. Currently, self-healing materials are commonly used in aeronautical structures such as fuselages, wings, engines, cascades, and other elements like barriers and protective coatings.

Recently, self-healing materials like epoxy vinyl ester, bismaleimide tetrafuran (2MEP4F), raw polymer, cyclopentadiene derivatives, cyanate ester, E-glass fiber-reinforced composites, and carbon fiber-reinforced composites have been studied.

In order to prevent delamination fracture of carbon fiber-reinforced plastic (CFRP) composites in the aerospace industry, these products were loaded with microcapsules containing sealing agents.

A dicyclopentadiene-encapsulated microcapsule served as the sealing agent and was combined with 20% by weight of epoxy resin. The interlaminar fracture resistance of the tested materials was restored to 40% and 80% of their initial values at room temperature and 80^{o}C, respectively.

Using a thermoplastic polymer matrix, thermally responsive polyurethane, and the Diels-Alder (DA) reaction, it was possible to repeatedly seal delamination in a carbon fiber composite with 85% and 75% sealing efficiency during the first and second cycles, respectively. By embedding CFRP with hollow glass fiber (HGF) into glass-fiber-reinforced plastic (GFRP) or into carbon fiber- reinforced plastic (CFRP) and then infusing it with uncured resin, the self-sealing effectiveness was transferred to the laminate. After damage occurred, some of the resin-impregnated fibers

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released the stored sealing agent and initiated the self-sealing process. The baseline laminate performance was roughly 89%, and this arrangement matched the undamaged condition by 97%.

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ENVIRONMENTAL QUALITY IN REFURBISHMENT: APPLICATION OF PARETO ANALYSIS TO CONSTRUCTION WASTE MANAGEMENT

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Keywords: *calidad medioambiental, rehabilitación, diagrama de Pareto, Residuos de Construcción y Demolición (RCD), análisis de costes.*

Abstract

The construction industry is responsible for the consumption of a large amount of natural resources and energy, making it one of the most environmentally damaging industrial activities [1]. Together with the high demand for raw materials linked to the execution of construction projects, which is close to 50% of the total consumed worldwide, around 30-40% of the world's total solid waste is produced in parallel, as a consequence of the construction and demolition waste generated in this process [2]. For this reason, it is essential that construction companies experience a change in their current production models based on linear systems, towards a new paradigm linked to the integration of circular economy criteria that include the entire life cycle of construction products [3].

In this context, the entry into force of Law 9/2022 of 14 June on the Quality of Architecture, aims to ensure that the rehabilitation of Spanish building stock is carried out incorporating criteria of quality, comprehensiveness and prior planning [4]. Thus, the incorporation of quality tools in CDW management systems that favour decision- making in the business environment has become a highly relevant asset for construction companies. For this reason, this paper analyses from an economic point of view the repercussions of implementing a plan for the recovery and revaluation of waste on site. For this purpose, data corresponding to the refurbishment works of the Malaga hospital have been used, subsequently carrying out a Pareto analysis to estimate the impact in terms of costs of the different CDW generated and to establish an order of action to mitigate this effect.

The results obtained can be seen in Figure 1, which shows the Pareto diagram drawn up for this research. This shows the goodness of this statistical analysis as a tool for quality

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management, which can be applied to the design of an efficient system for the classification and recovery of waste produced in refurbishment works.

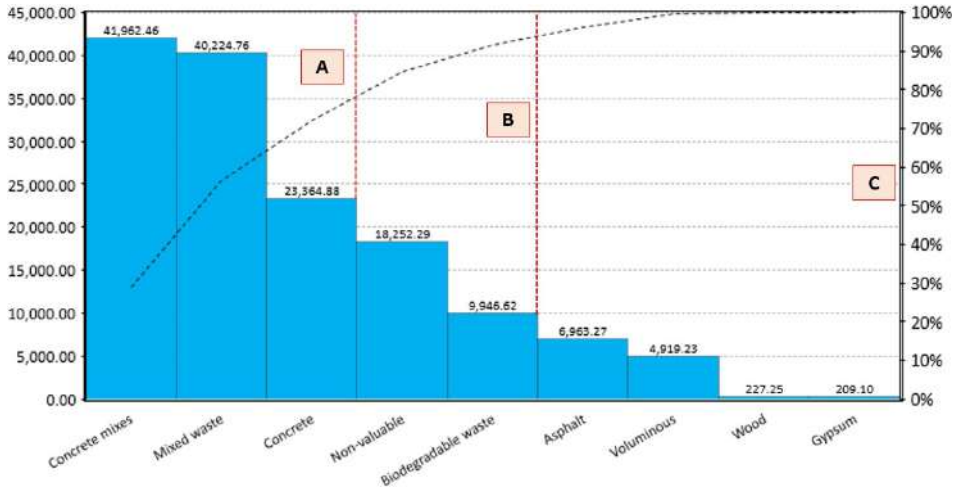

Figure 1. A Pareto analysis for waste management in terms of costs.

In conclusion, after the analysis of Figure 1, it can be seen that the waste derived from the intervention on the concrete structure is the most voluminous and that it has the greatest impact on the costs for the company (80% of the total). This highlights the importance of separating and sorting waste at source for better management of environmental quality. Also, in zone B of the graph, which corresponds to 15% of the management costs, there is non-recoverable, very bulky and inert waste, which could be reintroduced into the manufacturing process of new, more sustainable materials. Thus, it has been possible to corroborate experimentally with the research carried out, how in the case of waste, 80% of the costs come from 20% of the type of waste generated.

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COMPARISON OF THE GMPM BSSA 14 COMPLIANCE FOR THE SPANISH REGION WITH THE SEISMIC DESIGN STANDARDS

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Keywords: *GMPE, BSSA 14, GMPM, DSHA, PSHA*

Abstract

In any case, seismic activity represents a danger for society due to the different effects it may have on buildings and infrastructure and therefore on the lives of the living beings that coexist in them.

There are two modalities that are generally used to estimate or establish seismic events and affectations. Both work with a database of records with which they establish a series of statistical analyses that give an idea of the different parameters that make up an event of this random nature. The first is the DSHA, the second PSHA, being a probabilistic analysis that is estimated using all the possible locations of the hypocenter and the seismic magnitude that can generate the movement. [1]

The PSHA is mainly based on the ground motion prediction equations (GMPE), which are equations that work from different parameterized coefficients to adjust the response spectra that can be calibrated according to the site. These equations, formerly called attenuation laws, nowadays a great number of authors have generated these equations with different limitations that can be applicable to different areas or specific sites. Being able to obtain a response spectrum adjusted to the seismic data of the region allows designers of structures to generate designs that are based on the performance of the structure in the face of these actions, making it more efficient. [2]

One of the biggest problems to create or generate a GMPEs is to have enough data to have a statistical robustness in terms of calculations and the various regressions to be performed, since these equations try to predict the behavior of the soil to an event that is random in nature in every way, having as much information as possible will establish a greater range of possibilities to predict the response of a site to these events. However, there are places whose geographic locations with respect to the tectonic plates make them remote from seismic activity, making their seismic records poor and therefore presenting a great difficulty when creating a GMPEs.

With this problem, it is necessary to use alternative methodologies to obtain a response spectrum characteristic of the region. One of the methodologies that is currently being employed is the use of a reference model to analyze the behavior of the model with less robust data than that used for its creation.

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Following the residual methodology, we have been able to create a GMPEs adjusted to Spain, using the seismic data provided by the National Geographic Institute to calibrate the BSSA 14 model, which fits the characteristics of the information. Using this methodology, we obtained as a result a 5% damped response spectrum that fits the seismic parameters found in the region of Spain.

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DISTRIBUTION PROBABILITIES FUNCTIONS FOR MODELS APPLIED TO HYDRAULIC WORKS IN URBAN AREAS: LOG-GUMBEL VERSUS LOG-PEARSON III

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Keywords: *Modelling; hydrological engineering; precipitation distribution functions; drainage in urban areas.*

Abstract

Hydrometeorological calculation models are required for the design of hydraulic works, both in urban areas, e.g. for sewage works, and in civil engineering, e.g. for dams and their spillways. These models use design storms, which are based on meteorological data on extreme precipitation, and appropriate distribution probability functions. Within the distribution functions, there are different options. This paper performs a comparative analysis between the Log-Gumbel and Log-Pearson III functions. The Log-Gumbel function is a particular case of the Frèchet function (distribution of extreme values type II) with position parameter = 0. Both have been applied to rainfall data from the Almodóvar reservoir station (Cádiz). The Log-Gumbel function is a variation of the classical Gumbel function, which is itself a function of extreme values (EV type I). The Log-Pearson III function, currently widely used in many countries, has been analyzed with the formulation used in the USA, which maintains the traditional formulation and comes from a variation of the classic Pearson III formulation. For return periods T between 1 and 500 years, the functions were compared for the chosen reference station. It was found that the Log-Gumbel function, against all odds, is the one that presents results on the safety side for high T. However, it is also shown that the Log-Gumbel function is less stable than the Log-Pearson III against the data that make up the series. Thus, each year provides, at least, a new maximum annual precipitation data for the existing series. And that same data, for cases of exceptional precipitation, modifies the precipitation results obtained with the precipitation distribution functions used. The variation that occurs, for the Log-Pearson III, can be considered acceptable for high T. However, for the Log-Gumbel, given its sensitivity, it can provide results with large variations, distorting in one direction or another. Therefore, it is concluded that the Log-Pearson III function is preferable to the Log-Gumbel for data series with large variations between them, and/or for small samples receiving point data. This is the usual case for the design of hydraulic works. But, on the other hand, if the selection criterion only takes into account the largest precipitation values assigned to a T, regardless of the sensitivity of the function to variations in the sample data, then for high T the Log-Gumbel is preferable. For drainage and sewerage works in urban areas, the Log-Gumbel function is a safe alternative to other functions.

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ECONOMIC MANAGEMENT IN INTEGRATED PROJECT DELIVERY: THE PROJECT MANAGER'S PERSPECTIVE

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Keywords: *Target Value Delivery, Open Books, Risk-reward compensation, Lean Construction, Integrated Project Delivery;*

Abstract

Economic management is one of the most important activities in any construction project, and Lean Integrated Project Delivery proposes significant changes compared to the traditional system in three fundamental aspects: 1) Project cost management and its tools. 2) The way project expenses are managed. 3) How various project stakeholders are compensated. This article analyzes the differences between traditional management and that carried out in Lean Integrated Project Delivery. To do so, a comparative analysis of the scientific literature has been conducted, and 28 representatives from the main Spanish Project Management companies have been interviewed in order to identify potential barriers and levers in the dissemination of Lean Integrated Project Delivery in our country.

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PM² AS A FRAMEWORK TO IMPLEMENT NEW TECHNOLOGIES IN CONSTRUCTION SCIENCE AND PROJECTS

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Keywords: *BIM; PM²; Management; Construction*

Abstract

The PM² methodology, developed by the European Commission, is a project management framework that is characterized by its flexibility, efficiency, and ease of customization. It provides a clear structure and detailed guidelines for project management, with a strong emphasis on risk management. This methodology has become a valuable tool for project teams, enabling them to effectively manage their projects and achieve their goals [1].

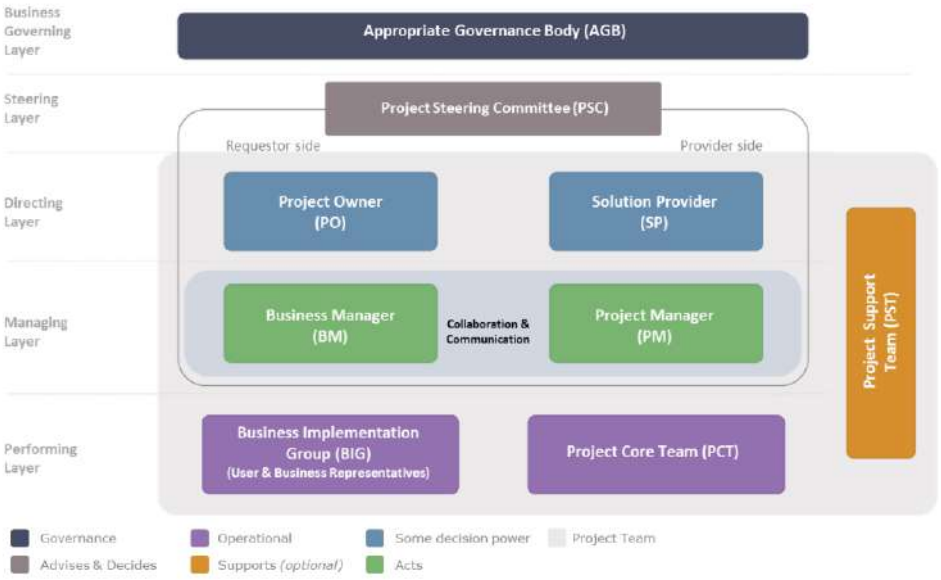

Figure 1: *Project organization according to PM² methodology. (Source:* [1]*)*

In the construction sector, the implementation of new technologies can present significant challenges. Resistance to change, lack of technical knowledge, and the risks associated with adopting new technologies are common obstacles. One example is the use of BIM (Building Information Modeling) technology.

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BIM technology, which allows for the digital representation of the physical and functional characteristics of a building, is becoming an essential tool in the construction sector. However, its implementation requires a significant change in existing processes and practices, which can be difficult to manage. Additionally, the adoption of BIM can involve significant risks, including the risk of technical failures, unforeseen costs, and project delays [2].

This is where the PM² methodology can play a crucial role. By providing a clear structure and detailed guidelines, PM² can help construction companies navigate the change process and manage the risks associated with the implementation of BIM [2]. Additionally, the PM² methodology places a strong emphasis on risk management, which can be particularly useful in the context of the implementation of new technologies [3].

To evaluate the success of the implementation of the PM² methodology in the incorporation of new technologies in construction projects, a rubric is proposed that considers the following indicators described in Table 1:

Table 1: *Indicators used for PM²efectiveness.*

Indicator	Description	Descriptor
Technology Adoption	Measure the degree to which the new technology is adopted in the project.	Number of team members using the new technology
		Frequency of use of the new technology
		Degree of integration of the new technology into existing work processes
Change Management	Evaluate how the PM² methodology has facilitated the change process necessary for the implementation of the new technology.	Number of change strategies implemented
		Effectiveness of the change strategies implemented
		Impact of change on the project
Risk Management	Evaluate how the PM² methodology has helped to identify, mitigate, and manage the risks associated with the implementation of the new technology.	Number of risks identified
		Effectiveness of the mitigation strategies implemented
		Impact of risks on the project
Team Satisfaction	Conduct surveys or interviews with team members to evaluate their satisfaction with the implementation of PM² and the new technology.	Level of satisfaction with the implementation of PM²
		Level of satisfaction with the new technology
		General perception of the impact of PM² and the new technology on the project
Tangible and Intangible Benefits	Identify and quantify the tangible and intangible benefits derived from the implementation of PM² and the new technology.	Cost reduction
		Time savings
		Improved communication and collaboration

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These indicators provide a comprehensive overview of the impact of the implementation of PM² on the incorporation of new technologies in construction projects. However, it is important to note that the choice of metrics will largely depend on the specific context of the project and the objectives of the implementation. Therefore, it may be necessary to make adjustments or adaptations to these suggestions based on the specific needs and circumstances of the project.

In summary, the PM² methodology can be a valuable tool to facilitate the implementation of new technologies in the construction sector. By providing a clear structure and detailed guidelines, PM² can help construction companies to effectively manage the change process and the risks associated with the implementation of new technologies. The proposed rubric presented in this study can be a useful starting point for evaluating the success of the implementation of PM² in the incorporation of new technologies in construction projects.

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COMPARISON OF THE EFFICIENCY OF DIFFERENT STRUCTURAL SYSTEMS FOR HIGH-RISE BUILDINGS UNDER LOAD HORIZONTAL

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Keywords: *high-rise buildings (HRB), slenderness, structural system, structural response*

Abstract

High-rise buildings (HRB) represent a challenge for both their design and in their construction. The great influence of horizontal efforts requires a different approach in its attempt to satisfy the resistance and service parameters determined by the regulations. From a structural point of view, the definition of a "high-rise building" does not depend on a height limit but on the slenderness, which is the geometric relationship between the total height of the building and its smallest dimension on the ground. In the present investigation, the efficiency of different structural systems used in high-rise buildings under the action of horizontal efforts is evaluated. The analysis was carried out comparing the structural response in parameters of lateral stiffness and resistance, in addition to non-structural parameters such as costs, architectural criteria and environmental factors. For this purpose, 3 control heights have been established, set at 25 floors, 40 floors and 60 floors, adapting the analysis to the usual typologies for each of them. The analysis is developed by comparing parameterized structural models, keeping their dimensions constant based on a slenderness between 4 and 5. The models will have to satisfy the limits of displacements, drifts, fundamental periods, maximum acceleration in stories and capacity ratio of sections. This is based on the criteria compiled from the Euro Code, Spanish Regulations, United States Regulations, investigation committees (PEER, TBI and FIB) and specialized bibliography. With the optimized structural models, construction costs, environmental factors and architectural parameters are evaluated. The results obtained are compared between the models that belong to the same group, assigning scores based on the most favorable condition. The individual results of each criterion are used together with results grouped into 7 categories that are architecture, structural response, response to wind solicitations, response to seismic solicitations, capacity ratio of sections, environmental factors, and costs; With which the advantages and disadvantages of each case are analyzed. From the results the following is achieved:

- To validate the recommended application ranges for the structural systems reflected in the bibliography and the ones applied in real life examples.
- To provide a reference of the behavior that can be expected in each structural system as a tool to intertwine the architectural design with the functionality of the building.
- To generate criteria and an analysis procedure applicable to real cases.

- To highlight that the regulations currently do not cover the design of HRB, therefore articles from research committees must be used, in addition to extracting and combining concepts from regulations from different regions.
- To emphasize the need to expand the investigation of the dynamic effects of wind in HRB.

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THE ROLE OF FACTORS IMPACTING E-SUPPLY CHAIN MANAGEMENT OF A LARGE MANUFACTURING COMPANY IN KUWAIT AND ITS FUTURE PROSPECTS

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Keywords: *e-supply chain management; innovation; technology; logistic management; strategic innovation*

Abstract

Introduction: The pressure on organizations is increasing with time to improve their operational performance in the competitive marketplace globally. The intensive competition among the companies has led to an increase in demand for awareness of significant elements that contribute towards extraordinary performance [1], [2]. Innovation and management are two themes for sustainable development of enterprises [3]. Most of the entrepreneurs believe that innovation is led by successful adoption of technology. They also believe that businesses can only increase their profits and a sustainable competitive advantage is with innovation and technological reform. But, in fact, without any strategy, innovation can fail [4]. Supply Chain Management (SCM) has gained attention from practitioners and academics during the past years [5]. SCM is a vital component of productivity and necessitated a shift in paradigm the way it is carried out. A significant change in SCM is of adopting the latest technologies that enhances the agility, efficiency and flexibility of the overall supply chain. E-SCM has transformed e-business by allowing businesses to track better and have better visibility. New technologies allow the businesses to share information in real-time and monitor the overall activities of the supply chain, this enhances flexibility and enables better adjustment and increases level of responsiveness to manage uncertainty and risk all through the supply chain.
Objectives: The following objectives have been formulated to fulfill this research aim.

- To understand that concept and importance of e-supply chain management and the role it plays in improving operaonal perf ormance of a business.
- To cric ally evaluate the pracces of SCM of a manufacturing company in Kuwait
- To idenf y and assess the factors that hinder implementaon of E SCM
- To assess elements of ESCM that improves operaonal performance of the manufacturing company in Kuwait.
- To make recommendaons of how successfully implemented ESCM can lead to a superior performance of the company in future.

Methodology: A mixed methodology will be adopted to fulfill the aim of this research. A questionnaire will be conducted with the SCM managers of the manufacturing company

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in Kuwait and closed ended questions will be asked related to factors that impact their implementation and success of SCM. Furthermore, interviews will be carried out with the top management of the company to understand the initiatives the company is taking implement ESCM successfully and will discuss how important the company consider innovation, integration, technology, and other factors important for their success and improved operational performance.
Discussion: This paper will present a discussion on the factors such as innovation, creativity, integration, strategic management, technology, and logistics and their role in the successful implementation of ESCM. It will also discuss the benefits that these factors lead the SCM to and how they help improve the operational performance of the manufacturing company.
Results: The results of this research will discuss the opinions of the top management and managers related to the successful implementation of ESCM and how these factors they think would impact the operational performance of the company and its future endeavors.
Conclusions: The conclusion will present recommendations for further research, make recommendation for the large manufacturing company of Kuwait to successfully implement the ESCM and improve its operational performance.

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METHODOLOGY FOR THE DEVELOPMENT OF AN INTEGRATED BUILDING PROJECT MANAGEMENT MODEL AS A TECHNICAL GUIDANCE TOOL FOR STUDENTS AND YOUNG ARCHITECTS

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Keywords: *Building, methodology, project management, tool.*

Abstract

Effective management of building projects is essential to ensure success in the architecture industry; the efficient use of processes guarantees the fulfillment of objectives and the scope of the project. However, many students and young architects lack clear guidance on how to manage projects from inception to closure; throughout the architect training, design and implementation techniques are acquired, leaving to professional practice the challenge of managing their projects, the steps to follow to manage assigned resources and the necessary processes that guarantee the client's compliance and its benefits.

Based on this reality, a methodology is presented for the development of an integrated model of building project management specifically designed to satisfy the needs of this group of users, concentrating various elements to incorporate them as a tool that guide the integral development of the life cycle of their projects. The first stage in the development of this model involves conducting exhaustive research on best practices in building project management. Existing literature is reviewed, interviews are carried out with late-career students, graduates in recent years, and experienced professionals, and finally case studies are analyzed to identify common patterns, trends, and challenges in construction project management.

With the results obtained from the research carried out, the specific objectives of the model are defined and its scope is established. The needs and requirements of architecture students and young architects are identified in terms of building project management, and success criteria are established for the development of the model. A clear and detailed structure is designed for the integrated building project management model. Project phases, processes involved, roles and responsibilities, and recommended tools and techniques for each stage of the project are defined. Templates, forms and standard documents that can be used by users are also developed.

Once designed, the model is built following the structure and processes defined in the previous phase. The necessary tools and resources are developed, ensuring that the model is easy to understand and use for the target users. Pilot tests are carried out with real or simulated projects to evaluate the effectiveness and usability of the model.

Finally, the model is implemented in the training of new professionals in architecture, integrating it as part of the academic curriculum. Training on its use is provided and disseminated through publications, presentations and training so that it can be used by professionals in the field of architecture.

The methodology presented in this article offers a systematic and effective approach for the development of an integrated building project management model aimed at architecture students and young architects. By following this methodology, a model can be created to provide guidance and support to this user group, helping them to manage construction projects efficiently and successfully.

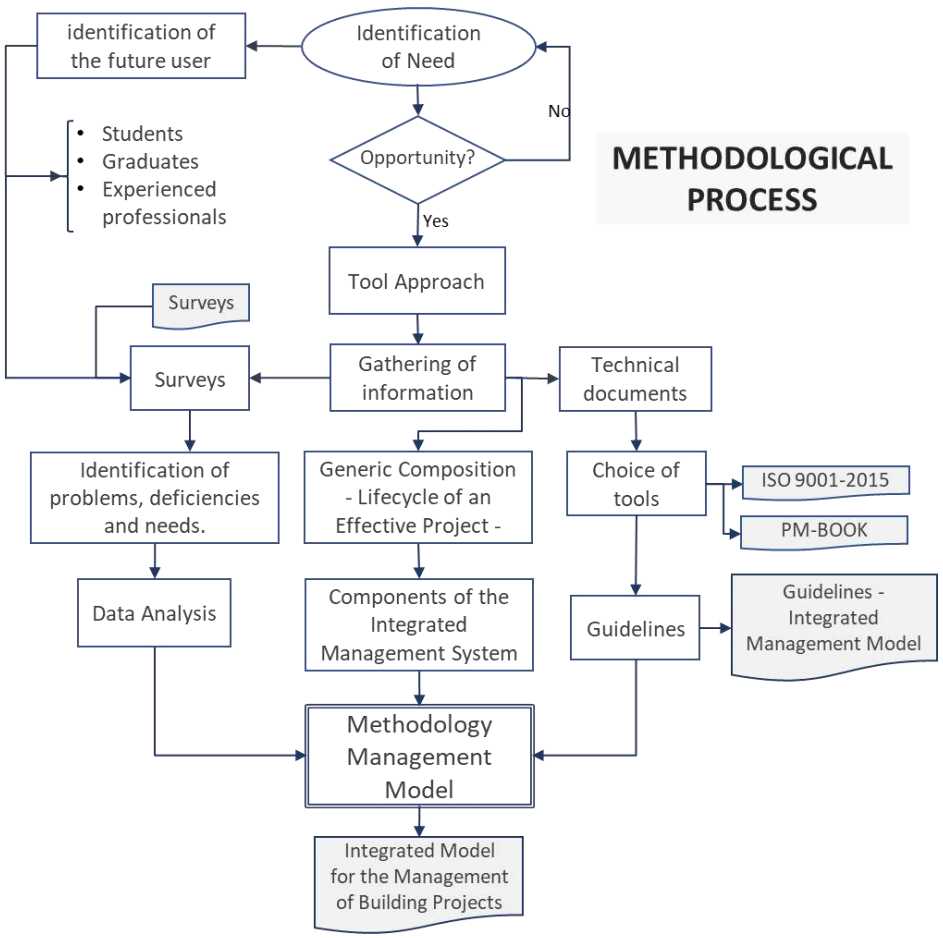

Figure 1: *Methodological Process. (Source: Prepared by the authors based on the analysis criteria.)*

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DUCTILE REINFORCEMENT OF ELEMENT CONCRETE EXTERNALLY REINFORCED WITH CARBON FIBERS

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Keywords: *Fibra de carbono, hormigón armado, ductilidad.*

Abstract

The use of carbon fiber used as structural reinforcement in concrete elements and structures is a knows, regulated technique and there are even recommendations for in use as much as design and installation [1-4].

It is known that, in elements subjected to flexion forces using carbon fiber adhered externally to the concrete surface, it is possible to increase the resistance of the element, as well as is know the fragile lineal elastic behavior of the carbon fiber when used as external reinforcement material [5]. This makes it a somewhat resistant material in countries with high seismicity because it is possible that the increase in resistance provided decreases or even eliminates the ductility of the reinforced element.

This work aims to show that through good design and installation of the reinforced concrete elements externally reinforced with carbon fiber the are subject to flexion force, it is possible to provide ductility and strength, so the use of carbon fiber materials would have reasonable limitation for elements with seismic liability.

For the above, nine beams have been designed and built in accordance with current codes to have ductile behavior. Six of these beams have been reinforced with two different types of carbon fiber, with the same mechanical properties but different thicknesses, both in shear and flexion, to guarantee ductile behavior while taking advantage of a high percentage of the reinforcement capacity. All beams, whit and without reinforcement, have been subjected to a flexion test, recording both the bending deformation, the unit strain of the carbon fiber reinforcement and the total force applied.

The force-deformation curves have compared, obtaining for the reinforced beams, significant increases in ultimate resistance and a plastic deformation capacity sufficient to provide ductility similar to that of the unreinforced beams, showing that, using theoretical models and appropriate design criteria it is possible to obtain satisfactory ductility despite the use of a brittle reinforcing material.

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APPLICATION OF MICROALGAE PHOTOBIOREACTORS IN BUILDING FACED FOR ENERGY EFFICIENCY

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Keywords: *photobioreactors, microalgae, energy efficiency, face Optimizing*

Abstract

Given the emphasis on urbanization, it's essential for societies to prioritize sustainability and eco-friendly strategies to tackle critical issues such as rapid population growth, escalating pollution risks, and economic imbalances, all while preserving their quality of life [1].

Recently, microalgae has gained attention not just for its traditional biotechnology uses, but also for its potential in sustainable design, ecology, well-being, and architecture [2]. This article aims to highlight how microalgae can contribute to energy efficiency and sustainability in buildings, while also emphasizing the importance of fostering solutions interested in creating eco-friendly built environments.

Due to the nature of glass, the high thermal transfer coefficient of glass makes this material resistant to the passage of heat and cold be the weakest building surfaces [3]. On the other hand, controlling the amount of transmitted light and shading are other important factors of these types of facades, It should be taken into consideration [4]. Using a glass wall combined with a photobioreactor, in a two-layer facade, in this research is presented as a sustainable alternative to the glass façade [5]. With library studies, coefficient values heat transfer from this type of facade according to different thicknesses of the details provided from the photobioreactor facade and optimized. The most heat transfer coefficient in order to evaluate the performance of the photobioreactor facade on the thermal and cooling performance in two facade modes, inclined and upright in comparison with the double-paned glass facade has been investigated. Simulation results by software Energyplus indicates the effectiveness of the photobioreactor facade in the inclined mode in reducing the cold load compared to the glass facades. It is a common double wall in the building so that the increase in heating load due to its slope can be ignored will be.

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BUILDING FOUNDATIONS IN MACROPOROUS VOLCANIC ROCKS

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Keywords: *bearing capacity, volcanic rock, pyroclastic rock, mechanical collapse, Discontinuity Layout Optimization*

Abstract

Active volcanic areas generate new materials that are part of the geological environment where the infrastructure and buildings of human settlements are developed. These materials can be of very diverse types and acquire very variable configurations of positioning and power in the lithotypes that contain them. A problem that is particularly complex geomechanically is associated with macroporous volcanic materials, that is, low density. These materials have a behavior that is clearly different from that of conventional rocks, which is characterized by the destructuring of the material, generating after this process a new material with different geomechanical properties and generally good characteristics. The main problem in constructions and particularly in buildings is that the destructuring process involves a collapse of the material that generates a sudden settlement that is normally not admissible by the structure of the building or its functionality.

In this research, an analysis of a shallow foundation is presented, corresponding to a building resting on pyroclastic material, for which: a) the main parameters that define the unique behavior of the material are described; b) a response law is proposed that considers the possibility of collapse of the material under specific loading conditions usually present in building works; c) the design and sizing solution for a shallow foundation on this type of material is shown.

Finally, the construction process is indicated that guarantees the safety of building foundations on macroporous materials and it is based on a double compaction method for the preparation of the support substrate.

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Materials and construction systems

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BEHAVIOR OF ELASTOMERIC MEMBRANES IN REINFORCED CONCRETE SLABS FACING NEW CRACKS

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Keywords: *Losas, hormigón armado, membranas elastoméricas.*

Abstract

In Chile, there are buildings that have water leaks in reinforced concrete slabs whose surfaces are waterproofed with elastomeric polyurethane membranes applied cold in exposed systems. Even though the specifications of polyurethane manufacturers in indicate that their products are capable of bridging cracks with a maximum thickness of 1.6 mm [1-3]; in practice, it has been noticed that concrete reinforcement elements waterproofed with this material present leaks, whit leads to an increase in post-sale costs for installers.

As a result of above, the behavior of cold-applied polyurethane elastomeric in exposed systems on reinforced concrete slabs without previous cracks is analyzed. This work aims to demonstrate the behavior of polyurethane, under ideal installations conditions, subjecting it to negative flexion forced at three points with cyclic loads which simulate the external loads to which the structure is subjected until the polyurethane membrane reaches the break.

Six 118x50x12 cm reinforced concrete slabs were built following current Chilean regulations, which were waterproofed with a single-phase polyurethane and the remaining three had a multiphase waterproofing applied.

Once tested, the slabs were subjected to cyclic bending loads to identify the behavior of the membrane. The results obtained from the tests were analyzed and compared, showing that an elastomeric membrane applied cold to reinforce concrete slabs when in service before losing its ability to waterproof th polyurethane supports a crack width of 0.33 – 1.94 mm, which indicates that products comply with what is established by the suppliers and installation manuals.

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DESIGN OF A MORTAR INCLUDING WASTE MATERIALS FOR INTERVENTION IN PUBLIC SPACES IN EXOMARINE AREAS IN COASTAL TOURIST TERRITORIES

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Keywords: *recicled mortar; waste; plastic waste; eco-efficient materials, coastal.*

Abstract

Annually, the oceans become the depositories of millions of tonnes of plastic waste, a global environmental crisis that has intensified over recent decades. This accumulation of marine plastics not only poses a significant threat to aquatic ecosystems but also emerges as a burgeoning challenge for waste management worldwide. In this context, the construction sector, as the principal consumer of resources and waste generator within the European Union, plays a pivotal role. This is particularly pertinent in the Canary Islands archipelago, due to its isolated condition, necessitating the incorporation of circular economy processes to mitigate material dependence from external sources for construction products, as no raw materials are manufactured or processed in the region [1].

This urban pressure is especially intense in exomarine areas of coastal tourist territories, where the alteration of materials due to proximity to the sea is quite pronounced, necessitating continual maintenance of civil structures along the coastal strip. These spaces are crucial for tourism development, as their appearance significantly influences this activity [4].

In these areas, mortar installations undergo substantial wear. Being an essential element in construction, a compound has been designed and tested, which includes, on a durable base with hydraulic phases, a mortar with a recycled component to enhance the physical, mechanical, and environmental properties of the base material to withstand harsh exomarine conditions, as well as to improve the perception of environmental responsibility for visitors. The innovation of this work lies in the use of marine plastics as aggregates in the production of eco-efficient mortars, thereby reducing marine pollution through the utilization of macro and microplastics [2].

Research has been conducted on the use of mortar waste as a partial or total substitute for conventional ingredients. However, the use of marine plastics in a recycled mortar matrix is a relatively unexplored field, owing to the challenge of surface treatment for achieving adequate adherence. In this study, waste mortar without heating from

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construction sites was used as the main complement matrix, and marine plastic waste (mechanically surface-treated microplastics) was incorporated as aggregates [3].

The findings indicated that the use of these wastes not only improves the lightness and sea spray resistance of the composites but also enhances the mechanical behavior of the mixtures at certain waste percentages, compared to traditional reference materials. This approach presents a valuable opportunity to address two critical challenges: marine plastic pollution and the need for more sustainable construction materials, thereby improving environmental commitment and, consequently, the image of these areas for tourism.

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THERMAL CHARACTERISATION OF FACADES FROM 1979 TO 2006 THROUGHT MONITORING IN EXTREMADURA

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Keywords: *Thermal characterisation, facades, residential buildings*

Abstract

The energy retrofitting of the housing stock is a current issue related to indoor thermal comfort and energy consumption. Public administrations are carrying out numerous initiatives both to analyse it and to apply improvement strategies through renovations to improve the energy efficiency of the building.

Although the number of dwellings built according to the NBE CT-79 standard in the period studied, 1979-2006, was less than in the 1970s, it also represents a pocket of consumption with buildings in which certain measures to limit energy demand through thermal resistance and form began to be taken into account.

There are works on this subject from previous periods and specific typologies, but the study of the contribution to the building stock of 30 years of buildings adapted to a basic regulation that initiated the regulation of hygrothermal conditions is considered sufficiently relevant.

The objectives of the study are, on the one hand, to characterise the façades of the residential buildings constructed during this period in Extremadura and, on the other hand, to analyse their energy qualities with a view to their rehabilitation and/or improvement due to their impact on demand.

This research provides the records of a housing stock monitored in Extremadura through a FEDER project on energy efficiency, with data on indoor and outdoor temperature and humidity since June 2020. The dwellings have both single-family and multi-family typologies and are distributed throughout Extremadura within a C4 Mediterranean climate, according to the current Technical Building Code.

The methodology used starts with a quality control of the data obtained from the monitoring of the building envelope, and then carries out a thermal characterisation of the different types of façade and their materials and classification.

As a result of the study, the contribution of the standard to energy savings compared to a non-insulated construction is estimated, as well as the constructive and economic interventions that could improve its qualities.

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MANUFACTURE AND LIGHT BEHAVIOR OF TRANSPARENT WOOD

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Keywords: *wood, transparent, manufacture, illuminance*

Abstract

Transparent wood is being studied to be used in a near future as a substitute for glass in various applications, such as cell phone screens, the external covering of solar panels and, especially, in the windows of building façades. In addition to requiring less energy to produce, transparent wood has a much lower thermal conductivity than glass, which improves its thermal behavior. The objective of this research work was to explore the manufacturing process of transparent wood, as well as analyzing the levels of transparency achieved by measuring the passage of sunlight through it (illuminance).

The test material consisted of three types of wood: low-density balsa wood (125 kg/m3), medium-density maple wood (570 kg/m3), and high-density oak wood (735 kg/m3). The manufacturing process of transparent wood consists of several steps (Chen *et al*.2020, Jia *et al*. 2019, Li *et al*. 2018). Initially, the wood is delignified, where the lignin chains of the plant tissue are broken. This process was performed with sodium chlorite. The next step consists of cleaning the wood with different types of alcohol to remove the lignin. After cleaning, the air present in the wood pores is removed using a vacuum chamber and then filled with epoxy resin. This resin allows to recover the rigidity lost after delignification but also improves the transparency of the final product.

Initially, the experimental process was carried out with balsa wood and later with maple and oak wood. After only one treatment, it was observed that the wood obtained a subtle white color, so the number of treatments was increased to 2, 3, 4 and 8; demonstrating that as the number of treatments increased, more lignin was eliminated. This progressive whitening was observed only in the balsa wood, not in the other types of wood, therefore the experimental phase continued only with this species, Figure 1.

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Figure 1: *Transparent balsa wood after 8 treatments (Source: Authors)*

In the second phase of the work, the illuminance was evaluated empirically. For this purpose, five models were built and placed on the roof of the Architecture School (ETSAM). In each of these models a 4x4 cm hole was made in the top cover, to place different materials and compare their illuminance: hollow (with nothing covering it), glass, balsa wood with 8 treatments, balsa wood with 4 treatments and untreated balsa wood. To measure the illuminance, six photometric sensors were placed, one inside each model and one outside. The illuminance values showed the expected results, Figure 2.

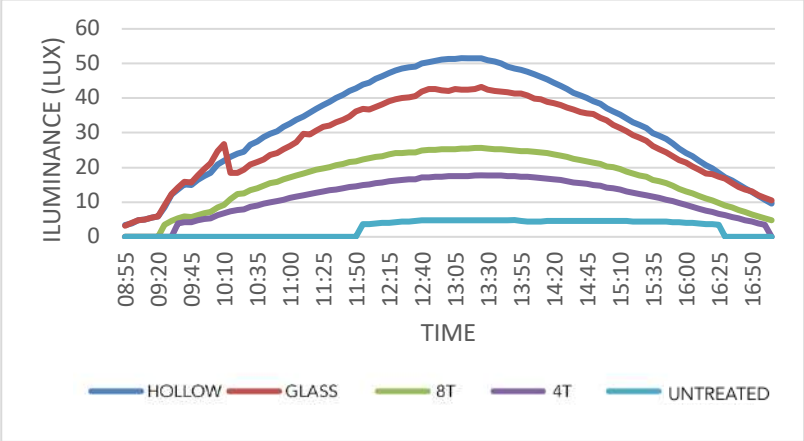

Figure 2: *Illuminance comparative of the five models (Source: Authors)*

Additionally, the influence of the direction of the wood grain in relation to the solar path was studied. It was found that there is a clear influence that shows that the illuminance increases when the grain and the solar path are parallel.

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BEHAVIOR OF REINFORCEMENTS IN THE EVENT OF A FIRE

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Keywords: *concrete, fire, buildings, temperature*

Abstract

The effect of elevated temperature on the reinforcement of reinforced concrete is a matter of great concern within the fields of civil and structural engineering. This concern has intensified in recent times, especially following catastrophic events such as fires in landmark structures, as recently occurred in a well-known building in Valencia [1]. Such incidents highlight the urgent need to delve into the study of the effects that high temperatures can have on reinforced concrete reinforcements, an aspect that until now has received relatively limited attention in research [2]. Given this need, a line of research has been initiated focused on B500SD carbon steel reinforcements of 12 mm diameter, subjected to different temperature ranges and various cooling processes. This approach seeks not only to understand the structural and mechanical changes that occur under extreme heat conditions but also to explore possible ways to improve the resilience of these structures in the face of adverse situations. The ductility of the reinforcements is one of the key parameters measured in this study, offering a broader view on how heat affects the material's ability to deform without fracturing. Analysing the similarities and differences in the results obtained allows for a deeper understanding of the variations in the behaviour of the reinforcements under thermal stress.

Preliminary findings from this study indicate a significant reduction in the modulus of elasticity of the reinforcements exposed to high temperatures, suggesting a decrease in their ability to resist loads without undergoing permanent deformations. Additionally, it was observed that the maximum stress (fs) and the deformation at the breaking point vary considerably depending on the cooling method applied after heat exposure. This underscores the importance of considering not only the exposure to heat but also the subsequent cooling process, as critical factors affecting the structural integrity of the reinforced concrete reinforcements. These preliminary results provide crucial evidence on the adverse effects of high temperatures on reinforced concrete structures and open the door to future investigations aimed at developing materials and construction techniques that improve the resistance and durability of the reinforcements against fires and other extreme conditions. Theobjective is to ensure the safety and integrity of civil structures and buildings, thereby protecting lives and property against unforeseen disasters.

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CASE STUDY ON THE USE OF LIGHTWEIGHT PRECAST CONCRETE WITH RECYCLED POLYURETHANE

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Keywords: *sustainability, polyurethane, service life, durability, prefabricated cement mortar cobblestones.*

Abstract

Increasing rate of urbanization and industrialization has led to over exploitation of natural resources such as river sand and gravels, which is giving rise to sustainability issues. Therefore, the search for alternatives that minimize the use of these materials has become an urgent necessity in the construction industry in recent years. [1]

On the other hand, polyurethane is a very versatile material used in many industries, the worldwide production of it generates several million tons of non-biodegradable waste [2]. Combining the two ideas would not only reduce the use of natural resources but would also promote the circular economy of polyurethane foams, in this case from vehicle roofs, which would be given a longer service life through their application in the construction industry. [3] However, the objectives should not be limited to that, but also to search materials that maintain their characteristics over time. At present, studies are mainly aimed at designing customized mortars, providing them with specific properties for each application. [4] Improving the durability of mortars is one of the main objectives in such research, as a result of increasing environmental concern. [5]

Based on these premises, the production of prefabricated cement mortar cobblestones and building blocks for outdoor use has been carried out. In them, the aggregate has been increasingly replaced by crushed polyurethane from vehicle roofs, in a ratio of 20%, 40% and 60%. Once the necessary characterization tests had been carried out and passed, they were considered suitable for outdoor installation, where they continued to be monitored in order to determine their stability against external weather conditions, in particular the testing of conductivity and durability.

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MULTI-CULM BAMBOO AXIAL ELEMENTS AS STRUCTURAL ALTERNATIVE FOR LARGE-SPAN AND MULTI-STOREY BUILDINGS

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Keywords: *Bamboo culms, International standards, Building codes, Structural design.*

Abstract

Decarbonisation of the building sector is key to combat global warming due to the prominent share of this industry to global carbon emissions and its high energy demand. Timber construction has demonstrated over the last decades that industrialized biological materials might be as reliable and efficient, if not more, as mineral-based building materials, such as concrete or steel [1]. Among bio-materials, there are some lign-cellulosic ones which potential as tool against global warming is higher: bamboos. Specially in its full-culm natural form, bamboo's (a word referring to a botanical subfamily, comprehending over 1,500 species; and some 50 of them are suitable for structural purposes in their natural form) potential is higher because of its life cycle (as they are grasses and not trees, bamboo culms reach their maturity 3 to 5 years after sprouting, whereas the fastest growing conifers take at least 15 years of growth to be useful for the timber industry) and how widespread it is around the world [2].

Starting in the XX century and going on along the XXI, there has been a rediscovery of bamboo culms as structural material, both in laboratory-based research and in experimental, practical, full-scale structures. These practices have led to a series of standardization documents [3, 4] and national building codes specifically including bamboo culms [5], with the Colombian building code pioneering and outstanding on this regard. However, the scope of these regulatory texts does not go beyond 2-storey or 7m high buildings of any kind.

Besides this, academic research has been conducted towards the development of load tables for design of full-culm bamboo [6] considering single-culm elements, and also on the performance of multi-culm bamboo axial elements with dowel-type connections [7].

Throughout three study cases of structures based on full-culm bamboo as primary material, having the largest bamboo free-spans recorded up to date, and being completed between 10 and 20 years ago, this paper provides insight on structural design premises and hypothesis related to multi-culm bamboo elements. The three study cases are the following: A walkway in Pereira (Colombia), 40m-long-free-span, completed in 2000 [8]; a walkway in Bogota city (Colombia), 46m-long-free-span, designed by the architect Simón Vélez and built in 2003 [9]; and a dome in Morelos state (Mexico), 30m-long-free-span, by the architect Isidro Velázquez in 2014.

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The present paper deepens on how full-culm bamboo arranged in multi-culm elements, either planar or bundles like, is a realistic and feasible alternative to mineral based materials as primary structural elements for large free-span and multi-storey buildings. Even considering fire-safety regulations in performance-based regulatory contexts, such as the structural Eurocodes [10] and the Spanish 'Código Técnico de la Edificación' [11].

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CERAMIC STRUCTURAL SHAPES: TIMBREL AND GAUSSIAN VAULTS. PONT DE SUERT CHURCH VERSUS ATLANTIDA CHURCH

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***Keywords**:* Eduardo Torroja, *Eladio Dieste, timbrel vaults, reinforced masonry, gaussian vaults.*

Abstract

In the 20th century, reinforced concrete became the ideal structural material to achieve shapes that were efficient and economical. However, ceramic structural sheets were widely used in areas where clay was the indigenous material, steel was limited and therefore expensive to use.

Thus, depending on the personality and training of the designer -engineer or architect-, constructive solutions achieved were numerous, although the final result of resistance through form was common.

There are two churches, the church of Pont de Suert in Lérida by the Spanish engineer Eduardo Torroja (1899 - 1961) and the church of Atlántida in Canelones by the Uruguayan engineer Eladio Dieste (1917 - 2000), which are often compared because they were built with ceramic material and steel, and some researchers can even see influences between engineers. For us they are two works that show two different conceptions of building ceramic structures (Figure 1).

In the church of Pont de Suert, traditional technique of timbrel vaults was used to reproduce the complicated geometry of the double-curved sheet. But due to their slenderness, these sheets could buckle, so Torroja determinated to cover the vaults with a sheet of reinforced concrete. The function of the reinforcement was to resist any traction that might occur due to local flexural strengths. The laying of the concrete was simple, since the vaults were used as formwork for the concrete sheet.

This mixed technique, which combines timbrel vaults and very thin concrete membranes, was used in the 1940s and 1950s in Spain.

In contrast, in the church of Atlántida, the so-called gaussian vaults were used. These is a double curvature vault created by Dieste, where the transversal section is a catenary that varies from a maximum at the keystone to zero at the starts, and the longitudinal

section is obtained by displacing this catenary, keeping the transversal span fixed and making the deflection variable (Figure 2).

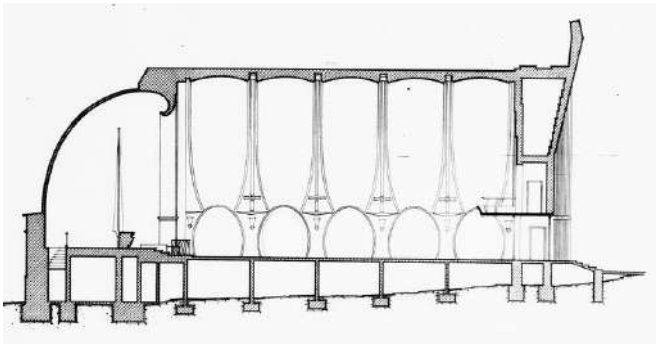
Ceramic pieces were placed aligned in both directions following catenary arches. By using catenaries, pieces were always subjected to compression, being able to stand alone, the vault being stable for its own weight, even for those loads that modified the line of pressures within certain limits.

As bricks are not perfectly shaped pieces, mortar was placed in the joints between bricks to transmit stresses in a regular way.

According to structural calculation, steel wires were placed in the transverse joints to support possible tensile stresses. Longitudinal reinforcement was also placed so that vault would work as a unit, as the deflections of the catenary arches were different, and the settlements were a different.

For building these vaults a complete formwork was needed, the width was the width of a vault. But as get mortar of the joints was the only material that had to harden, doing it in hours, this allowed vault to acquire necessary rigidity to be stripped quickly, reusing the same formwork by simply moving it.

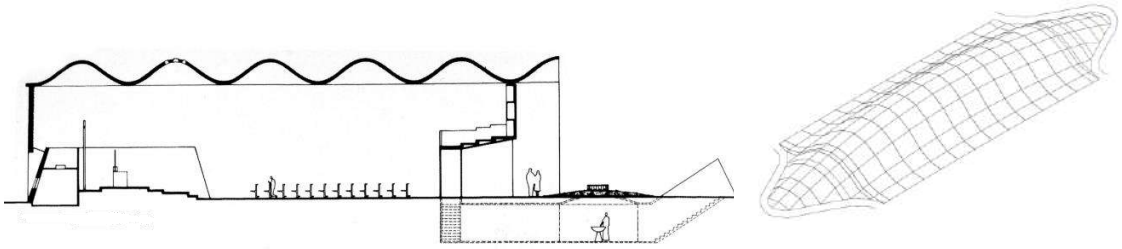
This technology was used in the second half of the 20th century in countries such as Uruguay (originating from Dieste), Argentina and southern Brazil.



A.

B.

Figure 1: *Church of Pont de Suert. A. Longitudinal section B. Lobe-shaped sheet with a decreasing transverse curvature from the keystone to the start where it joins another ellipsoid-shaped surface (Source: Instituto de Ciencias de la Construcción Eduardo Torroja. Cconsejo Superior de Investigaciones Cientificas, IETCC- CSIC)* [1].



A. B.

***Figure 2**: Church of Iglesia de Atlántida. A. Longitudinal section (Source: Facultad de Arquitectura. Universidad de la Republica)* [2]*. B. Gaussian vaults (Source: drawing by the A.M. Marín Palma)*

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PROMISING MATERIALS FOR THERMAL SUPERINSULATION IN BUILDINGS: POLYURETHANE AEROGELS AND DERIVED COMPOSITES

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Keywords: *aerogel; polyurethane; composite; superinsulation; scaffolding*

Abstract

The current challenges set by the European Union to address the each time more demanding normative regarding the climate change, energy regulations, and search for a sustainable future are only possible to be faced by developing novel and advanced materials with enhanced properties [1,2]. Thus, the scientific community is making great efforts to improve the traditional materials in order to fulfil these requirements. Among the possible candidates for this purpose, aerogels play a key role owing to their exceptional combination of properties. Aerogels are highly porous materials with an overall porosity above 90 % and pores in the nanoscale, what leads to huge specific surface areas, and excellent sound and thermal insulators among other interesting features. Thus, these materials gather most of the main demands for several sectors such as building, automotive, aeronautics, or energy management, among others [3–5].

Despite most research is focused on silica aerogels, aerogels composed by other matrixes such as polymers are being actively searched for since their brittleness is generally reduced. Thus, in this work organic aerogels based on polyisocyanurate-polyurethane are presented. These materials have been synthesized and characterized in detail reaching a thorough control of their porous structures through modifying the reaction kinetics [3]. The study of the structure-properties relationship revealed tunable properties such as mechanical stiffness and transparency, which was reached for the first time for this aerogel matrix. Moreover, thermal conductivities in the superinsulation range were reached, ranging from 24 mW/mK to values as low as 12 mW/mK, values much lower than the convectional thermal insulators (**Figure 1 left**). Therefore, these properties make them promising candidates for a broad spectrum of

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applications in the building sector such as glazing windows, automotive and aeronautical sectors, or even for energy management.

Additionally, other materials based on aerogels are herein reported. In this case, composites are produced based on the traditional polyurethane foams. These foams are noted by their cost-effectiveness and versatility, although their thermal conductivities lay in the range of 20 – 30 mW/mK [7,8], high values for the previously mentioned energy objectives. For these reasons, polyurethane foams have been employed in this study and their porous structure has been filled with polyurethane aerogel, leading to mono-material composites.

The produced PU-PU composites were fabricated by the employment of three different foams with a similar density that covered a wide range of pore sizes (4291, 1357, and 435 µm) in order to evaluate its effect. The final composites showed reductions in the thermal conductivity from 34.1, 40.3 and 50.6 mW/mK for the initial foams, to 15.8, 16.6 and 16.1 mW/mK for the composites thus reaching superinsulation by the aerogel inclusion. It should be noticed that both phases showed an excellent cohesion, and the mechanical stiffness of the final materials was remarkably higher than for the initial foams (**Figure 1 right**) [9].

Therefore, these composites are an interesting alternative to other convectional thermal insulators in the building sector, showing significantly better insulating properties.

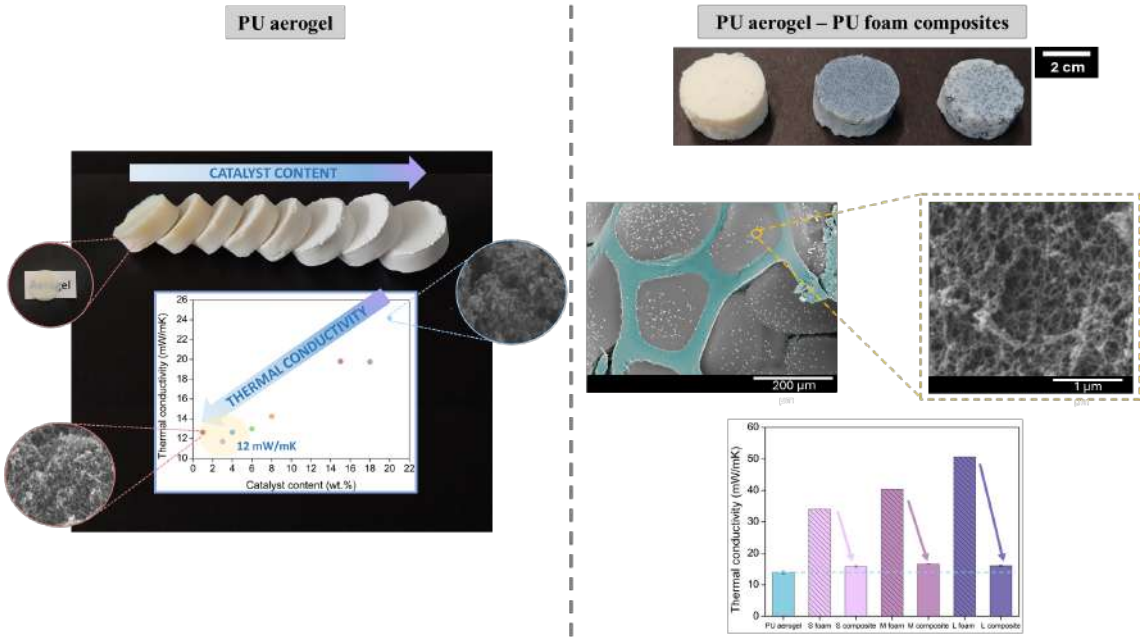

Figure 1: *Left: thermal conductivity of polyurethane aerogels as a function of the catalyst amount; Right: polyurethane aerogels-polyurethane foam composites, structure and thermal conductivities.*

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ASSESSING THE FRACTURE PERFORMANCE OF FIBER-REINFORCED CONCRETE SUBJECTED TO ELEVATED TEMPERATURE ENVIRONMENTS

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Keywords: bre reinforced concrete, high temperature, exural test, , fracture Mode I.

Abstract

Fibre-reinforced concrete (FRC) is a composite material that exhibits mechanical proper es, such as exural strength, duc lity, and toughness that are enhanced if they are, compared with the correspondent proper es of conven onal concrete. One of the ben ts that should be highlighted is obtaining an ve control of cracking [1]. These improvements are due to the incorpor on of bres which, with a structural character, can be made of steel, synth c polymers, or a combin on of both[1].

Fibres have the poten al to replace, par ally or fully, the reinforcement of steel bars in applic ons that require exural and shear strength, which can result in a signi cant reduc on in me, cost and weight of the structure. However, the mechanical proper es of FRC can be ected in situ ons where there is prolonged exposure to high temperatures, especially re. Under these condi ons, the phenomenon known as spalling can arise, which can cause signi cant damage to the structure, as well as a decrease in strength[2,3].

This research studies how temperature ects FRC structural elements. In this context, a series of experimental tests on FRC beams was carried out to compare the Mode I fracture behaviour of steel and polyol n bre-reinforced concrete subjected to various temperatures. The analysis of the results made it possible to determine the vari on in proper es and the reduc on of the strength capacity caused by the temperature increase.

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TENSILE PROPERTIES OF CARBON FIBRE-REINFORCED GYPSUM MATRIX COMPOSITES WITH COATED TEXTILE

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Keywords:*FibreReinforcedCementitiousMatrix;Tensilestrength;Flexuralstrength;Retrofitting system*

Abstract

Composite materials are increasingly employed for structural retrofitting purposes of both concrete and masonry. Within these materials, FRP are the most popular as they began their applications in construction more than 30 years ago. On the other hand, matrices based on cement or gypsum, resulting in FRCM or FRGM solutions, are more recent. Such matrices are more interesting for several applications, such as fire-resistance critical solutions or low stiff substrates, including historical buildings with masonry walls or vaulted structures [1–14]. To date, there is very scarce information in the literature regarding the mechanical properties of FRGM [15], which hinders their potential use on restoration projects. Also, it is worth noting that for FRCM, the existing guidelines as well as most authors suggest that basic mechanical characterization through tensile tests is essential to provide knowledge upon the performance of the reinforcements when applied to different substrates [16–20]. Under these assumptions, present research aims at characterizing the mechanical tensile properties of FRGM reinforcements with the objective of optimizing the compatibility between the original structure and the reinforcement. Gypsum mortars were preliminary characterized through compression and flexural testing [21]. The research comprised tensile tests performed on small specimens with a carbon fibre textile core and gypsum matrices. Three different matrices were compared: a conventional commercial gypsum and two traditional gypsum mortars designed specifically for restoration applications. Information regarding the stress-strain behaviour, the cracking pattern (spacing), and the failure was monitored by means of a Digital Image Correlation (DIC) system, which allowed better understanding of the differences between mortar types. From the results, it was concluded that FRGM is an apt retrofitting solutions for moderate tensile strength requirements, exhibiting differences in behaviour with respect to cementitious mortars which can be attributed to the higher tensile strength of gypsum-based materials.

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DETERMINATION OF THE DIFFERENCE IN TEMPERATURE AND EVAPORATION RATE OF WATER IN A SWIMMING POOL, DEPENDING ON THE COLOR OF THE GLASS COATIN

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Keywords: *Water temperature; Evaporation of water; Sustainable swimming pools; Heat absorption; Colorimetry test.*

Abstract

The temperature of the water in a pool is a key factor to guarantee its comfort range [1], although this information is very relative because it depends on the environmental conditions and the thermal tolerance of each person. In the case of babies, the water temperature should be as close to body temperature as possible, as is the case with people with reduced mobility. According to Royal Decree 742/2013, of September 27 [2], which establishes the technical-sanitary criteria for swimming pools, the ideal water temperature must be between 24ºC and 30ºC.

Depending on the use that is going to be given to the pool, one temperature or another is chosen [3]. In particular, swimming at very high temperatures causes dehydration, excessive fatigue and water imbalance due to increased sweating. On the other hand, when the water is very cold, the body undergoes a thermoregulation process that can lead to hypothermia, as occurs in older people.

Therefore, achieving an adequate water temperature not only leads to a feeling of well-being, but also offers the possibility of extending the bathing season for a period of time [4].

The origin of swimming pools arises from the need to bring areas of natural water closer to those places that lack it and, therefore, an alternative is sought to lower body

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temperature in the hottest months and areas. On the other hand, there is the sporting function originating from Ancient Rome, where swimming pools were created for “natatio”, which evolved into places of leisure and enjoyment for the upper classes of society [5].

Nowadays, the construction of personalized swimming pools for private use in single-family homes is very common, therefore, it is a market in continuous growth, since the client is increasingly more demanding [6].

Specifically, the black pool is the aesthetic novelty par excellence, which fulfills the function of integrating perfectly into the landscape environment throughout the year, achieving a natural effect, while providing elegance and sophistication to the environment, and being considered the most suffered color [7]. It should be noted that one of the most notable advantages of black pools is the increase in water temperature due to the scientific principle of refraction, which explains why light colors reflect light, while dark colors absorb it. Likewise, and based on the same principle, white pools are used in hotter areas, where the water temperature is more stable, and due to the Rayleigh dispersion effect, the water will always tend to be blue [8].

Apart from the color chosen for the coating of the pool [9], there are many factors that determine the temperature of the water in a pool, such as location, orientation, time zone, wind, ambient temperature, use, affluence, the geometry, the shadow projections of the adjacent elements, the material with which it is made [10] and its thermal transmittance with the terrain, etc.

In this case, a study is carried out to quantify the percentage of heat absorption of a pool and the speed of water evaporation, according to the colors chosen for the interior of the glass.

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DEVELOPMENT AND CHARACTERIZATION OF GYPSUM COMPOUNDS LIGHTENED WITH EXPANDED CLAY AND ADDITION OF TEXTILE FIBERS FROM END-OF-LIFE TIRES

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Keywords: *Gypsum Compounds, End-of-Life Tires, Expanded Clay, Sustainability, Circular Economy*

Abstract

The construction industry is at a crucial moment to assume its responsibility in reducing the consumption of natural resources and CO_2 emissions. The aim of this research is to contribute to the transition to a circular economy and the reduction of emissions in the sector. This is achieved by evaluating the viability of using end-of-life tire textile fibers (FTNFU) in combination with expanded clay (AE) in gypsum-based compounds, as a material applicable within the building sector.

In the first stage, the physical and mechanical properties (density, Shore C surface hardness, flexural strength, compressive strength, and dynamic modulus of elasticity) have been characterized. Gypsum compounds with 2.5%, 5.0%, and 7.5% replacements of AE, along with 0.5%, 1.0%, and 1.5% incorporations of FTNFU, were developed. The optimal substitutions that showed better results (5.0% AE-0.5% / 1.0% / 1.5% FTNFU) were selected for a second stage.

In this second stage, additional characteristics such as thermal conductivity, ductility, water resistance (water absorption by capillarity, total absorption, open porosity, water-stove cycles), and environmental impact were evaluated, considering the increase in productivity due to the reduction in the weight of prefabricated elements and their impact on transportation in terms of fuel consumption and CO_2 emissions.

The results obtained from the tested plates reveal improvements in the compounds, showing an increase of 10% and 6% in the flexural strength for the additions of 1% and 0.5% of FTNFU. The addition of FTNFU enhances the ductility and impact resistance of the plates, additionally, a reduction in the capillarity of the samples is observed, demonstrating increased water resistance of the original material. The lower density of the plates allows for a greater number of them to be transported in a single trip, implying fuel cost savings and the potential to transport up to 14% more product. These results suggest a possible application of these innovative gypsum compounds for the production of more sustainable construction prefabricates.

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Figure 1 shows an increase of 10% and 6% in the flexural strength for the additions of 1% and 0.5% of FTNFU.

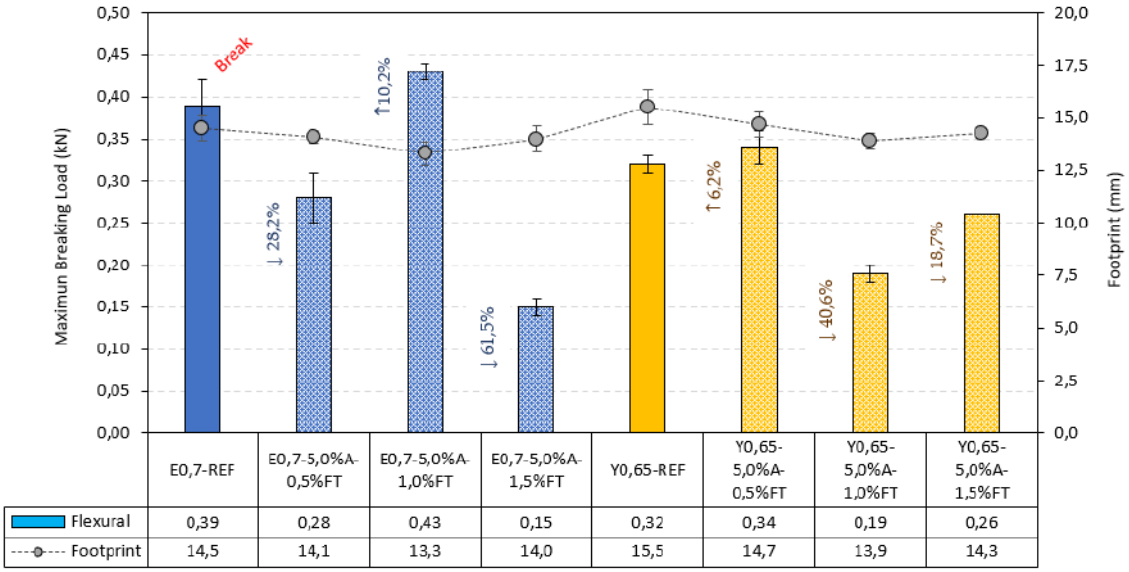

Figure 1: *Flexural Strength vs. Surface Hardness. (Source: Own Creation).*

Figure 2 shows the reduction in thermal conductivity, indicating the insulating capacity and heat flow resistance in relation to the decrease in density.

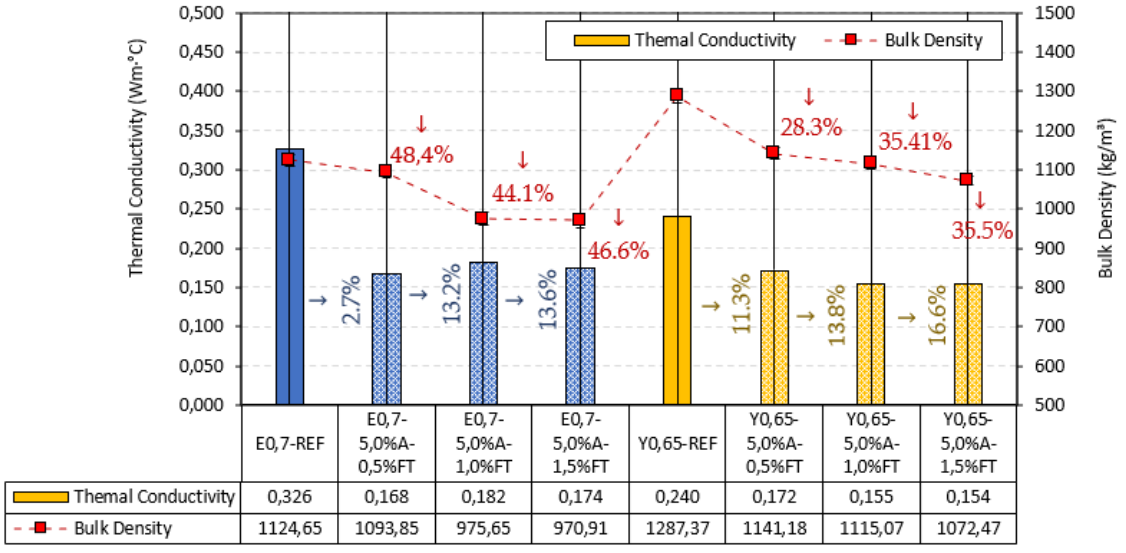

Figure 2: *Thermal Conductivity vs. Bulk Density. (Source: Own Creation)*

Future research lines include the evaluation of fire resistance (EN 13501-2) and emission of hazardous substances, airborne sound insulation (EN ISO 140-3, EN ISO 717-1), sound absorption (EN ISO 354), and design and characterization of prefabricated prototypes with developed materials.

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STUDY OF THE EFFECTS OF PARTIAL REPLACEMENT OF NATURAL SAND WITH WASTE FOUNDRY SAND ON THE STRENGTH, WORKABILITY, AND DENSITY OF CONCRETE

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Keywords: *waste foundry sand, sustainable construction, concrete production, Compressive Strength, tensile strength.*

Abstract

Natural sand, vital for concrete production, faces rapid depletion due to unsustainable extraction, leading to ecological issues such as habitat destruction, biodiversity loss, and altered riverbeds and coastlines, which heighten erosion and flood risks[1], [2]. This depletion not only poses ecological challenges but also infrastructural ones, jeopardizing the sustainability of construction projects dependent on concrete[3], [4]. Concurrently, the environmental implications of discarding waste foundry sand, a by-product of metal casting, cannot be overlooked. Frequently consigned to landfills, this practice not only occupies valuable land but also poses risks of soil and water contamination due to the potential leaching of harmful substances[5]. The continual accumulation of this industrial by-product underscores a significant missed opportunity for its reuse, thereby contributing to the environmental burden of the metal casting industry [6]. These interrelated challenges highlight the imperative for adopting sustainable and circular approaches in both construction and industrial practices. The broader context of sustainability in construction materials, coupled with the growing trend of incorporating industrial by-products in construction, offers a global perspective on this issue[7], [8]. This research examines the feasibility of substituting natural sand with waste foundry sand in concrete production, with the objective of addressing these environmental concerns and proposing a sustainable approach for material utilization in the construction sector. The study investigated a practical substitution strategy, evaluating the replacement of natural sand with waste foundry sand in concrete at varying proportions of 0%, 5%, 10%, 15%, 20%, 25%, and 30% by weight. This assessment focused on the impact on crucial concrete properties, such as workability, compressive strength at different curing periods, tensile strength, and the evolution of density. Additionally, advanced material characterization techniques such as X-ray Diffraction (XRD), Energy-Dispersive X-ray Spectroscopy (EDX), and Scanning Electron Microscopy (SEM) were employed to analyze the waste sand's compatibility with concrete mixtures. This integrative analysis was crucial for ensuring that the environmental goals align with maintaining the concrete's structural integrity and safety standards. The study concluded that replacing up to 10% of natural

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sand with waste foundry sand resulted in increased compressive and tensile strengths, along with higher density in concrete. Beyond this level, a decrease in density and workability was observed. These results demonstrate the potential of waste foundry sand as a sustainable substitute in concrete production. Future research should focus on the long-term performance and durability of concrete incorporating waste foundry sand. This will ensure its viability for sustainable construction practices.

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INFLUENCE OF HYDROTALCITES ON THE MECHANICAL PROPERTIES OF ORGANIC POWDER COATINGS

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Keywords: *Polyester powder coating, hydrotalcites, mechanical properties, wear resistance*

Abstract

Nowadays, organic powder coatings are receiving more attention due to their advantages compared to the conventional liquid coatings. Main one is their eco-friendly character, as they do not contain solvents in their composition. Organic powder coating formulations are actively under study in order to improve their properties to protect the materials on which they are applied. For example, the furniture industry is highly interested in low-cured powder coatings for its application on wood [1]. Moreover, their application on metals in construction (as structure or window frames) protects them from corrosion, ensuring their durability and service-life [2],[3]. Additions on powder coatings, such as hydrotalcites with a good anion-exchange ability, have the aim of increasing their wear resistance, together with keeping or enhancing the corrosion resistance. Therefore, the main objective of this study is to evaluate the influence of two different hydrotalcites on the mechanical properties of a polyester powder coating in order to extend its life in service, particularly for wear resistance.

In this work, two synthetic, commercial hydrotalcites (Al-Mg and Al-Mg-Zn, labelled DHT and ZHT respectively) have been selected to evaluate their effect on the mechanical behavior when added as a reinforcement in a polyester powder coating. The mixtures were performed in a hot mixer at 50°C for 15 min and then, the mixed powders were applied on degreased carbon steel sheets in a semi-industrial installation with an electrostatic spray gun. Afterwards, the coatings were cured in an oven according to the conditions given by the manufacturer (180 °C, 15 min). Eight coatings were obtained and evaluated, the polyester as-received (AR), the polyester AR passed through the mixing method (0%) and the reinforced polyester coatings with different hydrotalcite percentages (1%, 2% and 3% by wt.).

The evaluation of the mechanical properties of all coatings was focused on the hardness and wear resistance. Regarding the evaluation of the hardness behaviour, a universal hardness test was used with a load of 5 N. At least, 10 measurements were performed for each polyester coating. For the evaluation of wear resistance, the coatings were tested in a reciprocating tribometer to evaluate the sliding wear. A stainless-steel ball with a diameter of 6 mm was used to create the wear track under conditions of 10 N,

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2.5 Hz and a length of 5 mm. The tests were performed for 5 min under dry conditions and four tests were made for each coating. The depth and the width of the wear track were measured in an opto-digital microscope.

Figure 1 shows the result for the hardness behaviour (HU_{plast}). It is clearly seen that hydrotalcites can maintain (DHT) or increase (ZHT) the hardness of the coatings. On the other hand, the wear resistance test has shown that the addition of hydrotalcites in powder coatings can have the same or better resistance than the non-reinforced powder coatings.

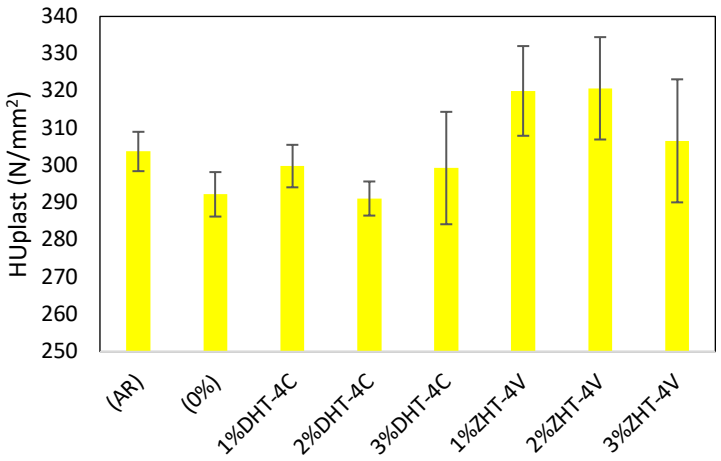

Figure 1: *Universal hardness (HU_{plast}) of* the polyester AR and the reinforced polyester coatings with hydrotalcites.

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RESEARCH OF CONCRETE WITH POLYPROPYLENE FIBER

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Keywords: *Concrete, Polypropylene Fiber, Material Engineering, Construction.*

Abstract

Involves a comprehensive summary of the key findings, methodologies, and implications of the research. The study centers on the innovative use of polypropylene fibers in concrete, aiming to enhance its mechanical properties and overall performance. The research is grounded in an extensive review and analysis of five scientific articles, offering a broad spectrum of perspectives ranging from the historical evolution of fiber-reinforced concretes to the latest computational methods for evaluating the addition of polypropylene fibers.

The main focus of the investigation is to understand how the integration of polypropylene fibers affects three critical variables of concrete: indirect tensile strength at 28 days (measured in MPa), modulus of elasticity (in GPa), and compressive strength at 28 days (also in MPa). These variables are crucial in determining the quality and durability of concrete structures. The study meticulously examines each of these aspects, drawing on a range of experimental data and theoretical analyses presented in the reviewed articles.

One significant aspect of the study is its historical overview of the development of fiber-reinforced concretes. This part of the research outlines the evolution of concrete reinforcement, highlighting how the incorporation of various types of fibers over the years has improved concrete's structural and functional characteristics. The study then narrows its focus to polypropylene fibers, exploring their unique properties and benefits. Polypropylene fibers are known for their strength, durability, and resistance to chemical and environmental stressors, making them ideal for reinforcing concrete.

The research also delves into the computational methods used to assess the impact of polypropylene fibers on concrete. These methods are critical for predicting the behavior of fiber-reinforced concrete under different stress conditions and for understanding how these fibers interact with the concrete matrix. The study examines various modeling techniques and simulations that provide insights into the mechanical behavior of polypropylene fiber-reinforced concrete.

In terms of practical implications, the research highlights how the use of polypropylene fibers can lead to significant improvements in the efficiency, durability, and overall performance of concrete structures. This is particularly relevant in the context of modern construction and infrastructure development, where the demand for high-performance building materials is constantly increasing. The study emphasizes that the integration of polypropylene fibers not only enhances the mechanical properties of concrete but also contributes to longer lifespan and reduced maintenance costs of concrete structures.

The author's aim in this research is to bridge the theoretical knowledge with practical applications, providing a detailed understanding of how the use of polypropylene fibers can revolutionize the construction industry. The study is a valuable contribution to the field of material engineering and construction, offering new perspectives and solutions for the challenges faced in these sectors.

In conclusion, this comprehensive research provides a thorough understanding of the role of polypropylene fibers in enhancing the properties of concrete. It underscores the potential of these fibers to create more durable, efficient, and sustainable concrete structures, paving the way for innovative applications in the field of construction and engineering.

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CEMENTITIOUS COMPOSITES IMPROVED WITH GRAPHENE OXIDE

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Keywords: *Graphene oxide, cementitious composites, dispersion, fresh properties.*

Abstract

Nowadays, nanomaterials are increasingly gaining popularity in all fields. In the same way, the construction industry has also joined this line by using nanomaterials as a perfect additive to achieve improved properties [1]. With the objective of seeking an improvement in the qualities of the materials, the use of graphene oxide (GO) as an additive has been proposed, for which and before starting with the preparation of the mixtures, it has been necessary to consider an optimal way to prepare and properly incorporate the GO to the rest of the materials.

According to several studies and their subsequent application, it was concluded that the most effective way to incorporate GO into the mixture is by dissolving it in water through a sonication process once the GO is incorporated into the water and by using a superplasticizer additive [2], exposing it to ultrasound for a period of time that varies between 15-120 min [3]. When proceeding to the mixing of the mortar, it was tested following the method set out in the current regulations, but in a two-stage process, which consists of dividing the mixture into two parts, the first half including the cement and aggregates without GO with its proportional part of water and the second half adding the GO dissolved in water in the remaining part of the mixture, having treated the GO as indicated above.

The results showed a homogeneous mix that, in terms of density, showed a decrease compared to the reference mortar (RM), which increased as more GO was incorporated into the mixture, with values of up to 3% variation with respect to the RM in some samples. The implementation of GO as a possible additive to cement mortars has shown improvements in the first trials, from which it is expected to see how this material can further increase the properties of current mortars.

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ANALYSIS AND MONITORING OF HYGROSCOPIC PROPERTIES OF MORTARS USING THERMOGRAPHY

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Keywords: *Thermography;* H*ygroscopic properties; Construction materials; Mortar.*

Abstract

Hygroscopy is the ability of some materials to absorb water from the environment, either in vapour or liquid form. Construction and building materials such as mortars and concretes are often exposed to high humidity conditions or even immersed in water. On the one hand, the presence of high humidity in the material can lead to a more aggressive effect, increasing the degradation processes and reducing its durability [1]. On the other hand, if the aggressive conditions are controlled, a higher humidity of the material can be of interest as a thermal mass or coolant [2].

Focusing on the second application related to cooling, a higher water absorption by the material allows the humidity of the indoor environment to be captured and transferred to the outside. Similarly, in very high temperature conditions, the absorption of moisture makes it possible to cool the infrastructures, as the water allows the stored heat to be dissipated for evaporation, thus contributing to the reduction of the heat island effect in cities that significantly alter the environmental stability of urban environments [3].

In order to improve this function of building materials, it is proposed to analyse the hygroscopic properties of mortars with additives. Tissue paper, cotton and hemp fibres were used as additives because of their high moisture absorption capacity. Mortar specimens were prepared with a small addition of these materials in the form of fibres in an attempt to improve their hygroscopic properties.

The study of the hygroscopic properties of mortars is based on experimental tests in which the interaction of the material with water is induced. In this study, tests are carried out to determine the sorption and desorption capacity both at ambient and high temperatures. Firstly, to determine the sorption capacity, mortar samples are used which have been dehumidified in a dryer. The underside of the samples is then immersed in water to obtain the sorption curve at room temperature. Secondly, once

saturated, the samples are exposed to high temperatures to evaluate the loss of moisture and to determine the desorption or drying capacity. Finally, the sorption test is repeated at elevated temperatures to analyse the sorption under these conditions and to evaluate the cooling capacity. The thermographic technique is used to analyse the surface temperature of the samples in relation to their moisture content (Figure 1). Thermal imaging allows the thermal profile to be analysed to determine the influence of humidity on the temperature of the samples.

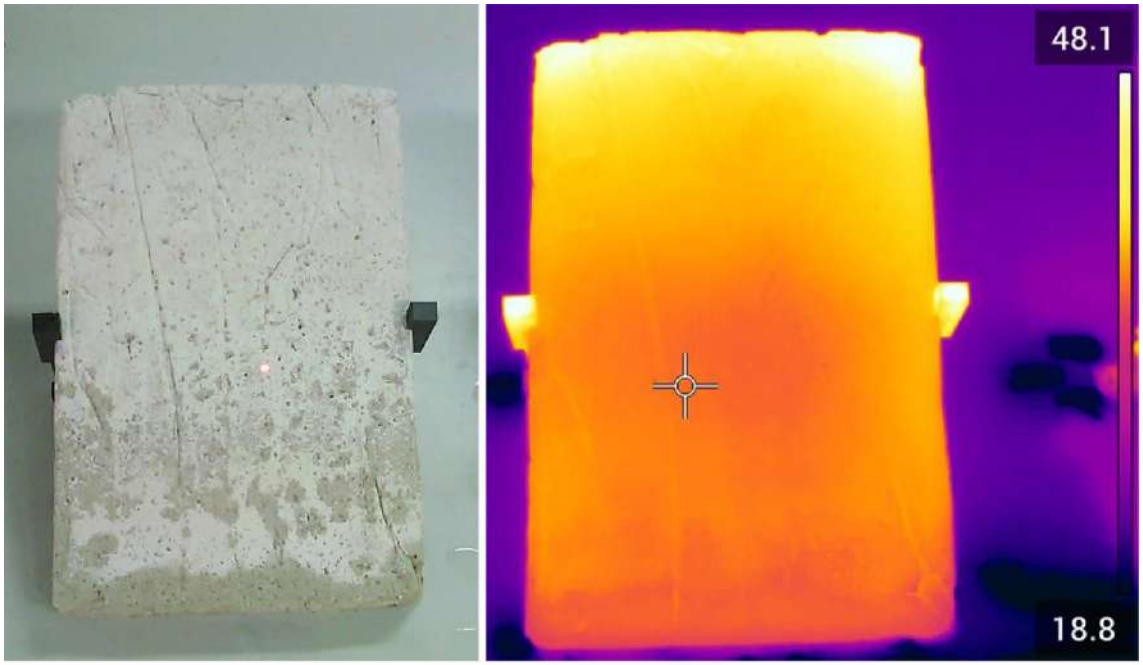

Figure 1: *Surface temperature monitoring in hygroscopic tests. (a) visible image; and (b) thermographic image.*

This work aims to characterise these mortars with additives in order to know their hygroscopic properties and to promote their use as coating mortars or for the construction of infrastructures and urban elements. Their placement in humid environments or partially immersed in water will allow them to be used with a cooling function to reduce the urban heat island effect due to the high accumulation of heat in infrastructures.

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ANALYSING THERMAL COMFORT IN RESIDENTIAL BUILDINGS WITH THIN REINFORCED CONCRETE WALLS AND ITS RELATIONSHIP WITH URBAN LAYOUT IN THE DOMINICAN REPUBLIC

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Keywords: *Thermal Comfort, Overheating, Thin Reinforced Concrete Walls (TRCW), Urban layout, Dominican Republic*

Abstract

Given the growing interest in understanding and improving the thermal conditions of homes in the Dominican Republic (DR), it is important to be aware of the characteristics of housing projects. However, most studies have focused on constructions using confined masonry [1]-[5], the most common construction method in the DR, leaving aside homes built with Thin Reinforced Concrete Walls (TRCW), which have experienced a significant growth and high replicability in social housing projects in recent decades.

The aim of this research is to evaluate the thermal comfort characteristic of these projects and their relationship with the urban layout[6] . For this purpose, 8 residential projects were studied as samples (P1, P2, P3, P4, P5, P6, P7, and P8) in Santo Domingo, DR. The samples were mapped in ArcGIS to analyze their urban composition and simulated in Design Builder to examine their thermal behavior. The results show that temperature variables are above 28°C throughout the year, with the most critical months being July and August. Sample P4 presents the most favorable values, while P7 exhibits the least favorable. P1, P2, P3, P5, P6, and P8 maintain average ranges; however, P2 performs better, especially during the summer season. Solar heat gains through windows exceed the 5,500 kWh average. P4, P5, and P7 exhibit the best seasonal behavior, although P4 has the lowest gain ranges. P1, P2, P3, P6, and P8 have the highest gains in summer. The heat flow through the walls has an average above -4,400 kWh. All samples show significant energy loss throughout the year, contrary to what happens with roofs where, in the warmer months, P1, P6, and P8 have lower

losses, while P2, P3, P4, P5, and P7 gain heat. These findings suggest that air temperature conditions and heat gains through windows cause overheating of interior spaces, affecting thermal comfort based on the comfort ranges of the ASHRAE 55 standard [7]. Although there is significant heat loss through walls and roofs, there is no proper balance, resulting in prolonged periods of discomfort. Additionally, the lack of passive strategies, both at the architectural and urban levels, to mitigate the impact of climate change is a determining factor. This deficiency contributes to internal discomfort and temperature stress while increasing the energy demand needed to air-condition spaces, which would require future energy rehabilitation interventions.

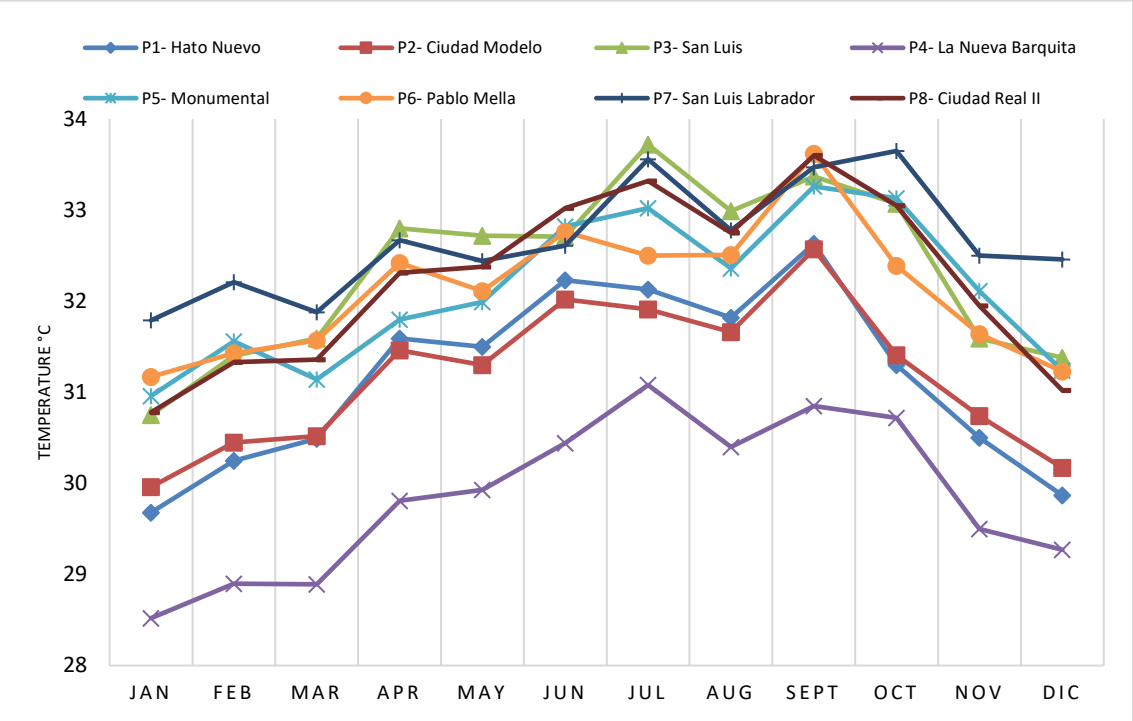

Figure 1: *Air temperature inside buildings. (Source: authors)*

Table 1: *Hours of discomfort inside buildings according ASHRAE 55 standard*

Residential Projects	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dic
P1- Hato Nuevo	740.87	672	736.44	720	744	720	744	744	720	744	719.87	744
P2- Ciudad Modelo	741.12	642	736.39	720	744	720	744	744	720	744	719.87	744
P3- San Luis	744	671.93	744	720	744	720	744	744	720	744	720	744
P4- La Nueva Barquita	744	671.93	744	720	744	720	744	744	720	744	720	744
P5- Monumental	740.14	668.54	744	720	744	720	744	744	720	744	720	744
P6- Pablo Mella	742.54	642	739.17	720	744	720	744	744	720	744	720	744
P7- San Luis Labrador	744	672	744	720	744	720	744	744	720	744	720	744
P8- Ciudad Real II	740.2	668.56	744	720	744	720	744	744	720	744	720	744

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RESEARCH ON CONCRETE WITH TITANIUM DIOXIDE

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Keywords: *Photocatalytic concrete; Mechanical properties; Titanium dioxide*

Abstract

Photocatalytic concrete has emerged as a promising solution in sustainable construction, offering environmental and performance benefits. Titanium oxide, which acts as a photocatalyst, that is, it accelerates a chemical reaction when exposed to light, specifically ultraviolet light in the presence of humid air, becomes active and begins to break down air pollutants, such as volatile organic compounds, nitrogen oxides and other harmful compounds, converting them into less harmful products, such as carbon dioxide and water. It will be significantly aligned with several Sustainable Development Goals (SDGs) set out in the United Nations 2030 Agenda for Sustainable Development.

Figure 1. ODS 09. Source: Guidelines for using the SDG logo.

Figure 2. ODS 11. Source: Guidelines for using the SDG logo.

Figure 3. ODS 13. Source: Guidelines for using the SDG logo.

In particular, photocatalytic concrete directly contributes to the achievement of key goals, such as SDG 11 Figure 1 (Sustainable Cities and Communities), SDG 9 (Industry, innovation and infrastructure) and SDG 13 (Climate action), while indirectly supporting other goals related to health, environment and social equity.

This research for EITC 2024, focuses on the analysis of 6 scientific articles of the last years on this type of concrete with titanium oxide admixture [1-2] and its mixture with some other substances such as bismuths and LHDs, [3] from a perspective of its mechanical properties to ensure its performance [1-6] . Valuable information is provided on the factors influencing the mechanical strengths, such as % material composition, type of aggregate, recycled or not, environmental conditions of a country like Russia [3] or like India [5]. By understanding the mechanical properties, it will be possible to guarantee its durability and structural reliability, which is crucial for its application in various infrastructures, as our structural concrete regulations do not yet regulate it. The study guides the development of new formulations and construction techniques to optimize the performance of

Figure 4. Concrete specimen compression test with TiO_2 before breaking. Source: https://doi.org/10.1016/j.matpr.2022.08.425

Figure 5. Concrete specimen compression test with TiO_2 after breaking breaking. Source: https://doi.org/10.1016/j.matpr.2022.08.425

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photocatalytic concrete, thus promoting its adoption in sustainability-oriented civil engineering and architectural projects.

To sum up, the scientific support for the mechanical properties of titanium oxide concrete, TiO_2, it is not only beneficial for triggering photocatalytic processes, but also strong, durable and structurally safe for this innovative material [1-6]

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DURABILITY OF CONCRETE BASED ON GLASS POWDER

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Keywords: *Durability, concrete, glass, environment, mechanical properties*

Abstract

Concrete is the most used construction material in the world, it is practically used in the different sectors of building and public works, its qualities and performances meet the different needs of construction while respecting safety requirements, and also of sustainability.
Several mineral additions are used in concrete today. They are used as an addition or replacement for part of the cement. The trend of using waste, industrial by-products and cementitious additions continues to increase, because it is an effective way for the cement industry to reduce its CO2 emissions. In addition, it contributes to recovery and recycling, while preserving the environment.
The durability of concrete depends on the characteristics of the material and the aggressiveness of its environment. A concrete element that undergoes loading and unloading or wetting and drying cycles can crack as a result of these cycles.
External aggressive agents will easily penetrate its matrix through the cracks formed and can react with the hydrates to further reduce the bearing capacity of the element.

The present work aims to study the durability of concretes based on glass waste (crushed glass and ground into powder) at different percentages as a partial replacement for cement. The different substitution percentages are: 0, 5, 10, 15, 20 and 25%.
The results of this research show that concretes with 10% glass powder are resistant to environments classified as chemically aggressive. The evolution of degradation and resistance to aggressive environments is monitored by X-ray diffraction and by observation with a Scanning Electron Microscope (SEM).

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DESIGN, ANALYSIS AND PROPOSAL FOR SUSTAINABLE ACOUSTIC PANELS BASED ON PLANT FIBRES FROM INVASIVE SPECIES AND RECYCLED MATERIALS. APPLICATION TO THE CASE OF *PENNISETUM SETACEUM*

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Keywords: *construction, material, acoustic conditioning, sustainable.*

Abstract

The climate emergency demands sustainable constructions for the care of our planet, calling for the substitution of conventional materials that are harmful to the environment [Figure 1] with new natural materials that respect the ecosystem [1]. The design of acoustic panels with vegetable fiber combined with recovered and recycled materials allows us to explore the development of a versatile and experimental ecological methodology [2]. The applicability of these materials would be related to fields such as architecture, music, engineering, education, health, etc., requiring controlled acoustic conditions, being a transversal and multidisciplinary project [3 y 4].

Figure 1: *examples of acoustic conditioning based on materials harmful to the ecosystem.*

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This project proposes the creation of acoustically effective materials based on materials and/or plant waste from invasive plants that affect ecosystems, allowing them to be controlled and reducing their environmental impact [5], mixed in different proportions with other residual and recycled materials [6]. The methodology consists of a process of creating prototypes of panels with different densities, fibre sizes and mixtures of materials for subsequent analysis of their acoustic characteristics (Figure 2) [7]. The results presented here are the tests carried out with the *Pennisetum setaceum*, known as cat's tail (Figure 2).

Figure 2: *Process, development and treatment of the acoustic and ecological material*

For the measurement of the sound absorption coefficient, the UNE-EN 12354-6 standard [8] was followed using an impedance tube - Kundt's tube - (Figure 3) equipped with a loudspeaker and two microphones (Figures 4 y 5) [9 y 10], inferential statistics tools and materials for the absorption of acoustic energy and other possible uses in closed enclosures according to the ASTM C384-98 standard [11].

Figure 3: *Kundt tube from the laboratory of the "Sonic Chrystal Technologies" research group of the UPV, Gandía.*

These vegetables allow the development of acoustic materials that constitute, on the one hand, an alternative to the classic materials used in construction (Figure 6) [12] and, on the other hand, offer an ecological solution to the problems related to invasive plants and environmental care.

Figure 4: *Traditional acoustic materials: rock wool, polyurethane foam and honeycomb foam.*

Tests carried out with various cellulosic materials and their combinations (Figure 5) desvelan, reveal, in some cases, an effective characteristics of acoustic absorption, improving the response of traditional materials (Figure 6) [13 y 14], ideal for the field of acoustic conditioning in construction [15].

Figure 5: *prototype samples with different ecological plant materials*

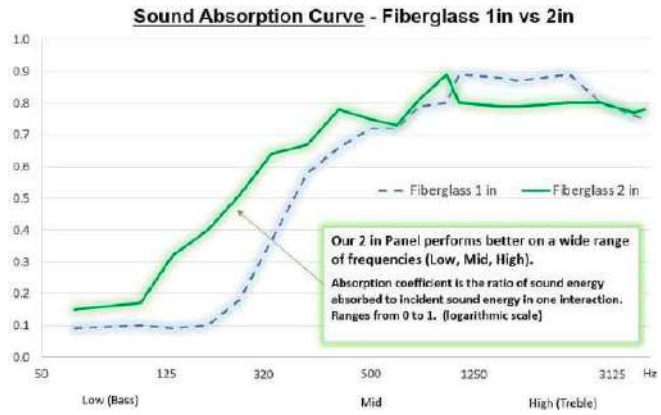

Figure 6: *Fibreglass sound absorption curve (5cm.)*

The most effective materials for acoustic absorption will be cat's tail, common reed and palm tree and their combinations, providing optimal results in their acoustic conditions [16], allowing to obtain a significant absorption coefficient at medium and high frequencies, depending on the cellulose material used, improving with whole and long fibres (Figure 7), the density of the material, preferably low, its porosity and its specific thickness.

Figure 7: *samples with plant materials and combined with stone materials.*

The results of the *pennisetum cetaseum* tests have been compared with conventional fibreglass panels, highlighting the good characteristics of the samples, with the M31 sample reaching an acoustic absorption value close to 0.9 as a result of the absorption coefficient at frequencies between 800 and 2000 Hz, and 0.8 between 2000 and 3150Hz (Figure 8) [12]. These samples, with low density and high porosity, show satisfactory results despite being 3cm thick, while conventional materials are 5cm thick. [17].

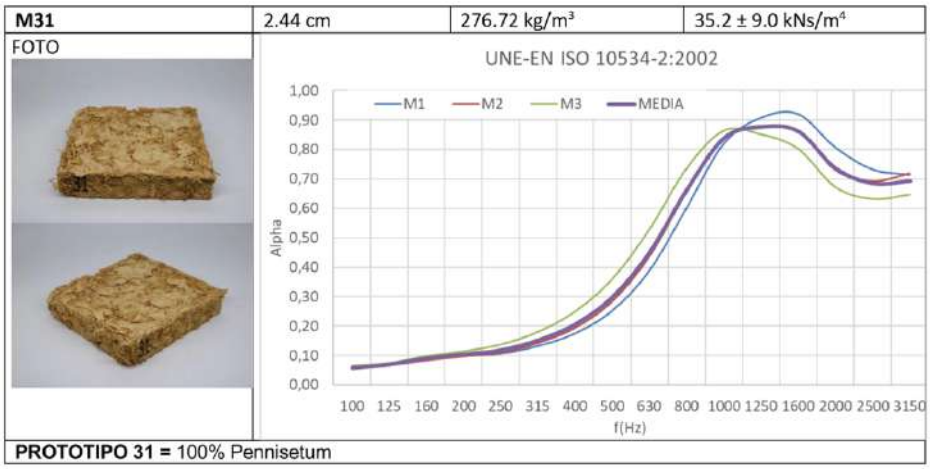

Figure 8: *Curves of Pennisetum setaceum*

Given the polyvalence and versatility of these composites, as well as the good results obtained with little mass and thickness, the next steps of this research project are the development of self-supporting acoustic panels that can be used in projects and deployable constructions [18] for the conditioning of fixed, changing, transformable and ephemeral closed spaces for both architectural and artistic installations [19].

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A REVIEW OF THE METHODS TO STRENGTHEN OR REINFORCE ADOBE-MASONRY SINGLE-STORY HOUSES

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Keywords: *adobe masonry houses; adobe self-construction; sustainable adobe construction; reinforcement of adobe masonry houses.*

Abstract

Adobe masonry single-story houses are prevalent architectural structures found in many regions worldwide, characterized by their historical significance and cultural heritage. However, these structures often face challenges related to structural integrity, vulnerability to seismic events, and susceptibility to moisture-induced deterioration. Self-construction of adobe-masonry houses by low-income families often lacks strength or durability features, then need to ensure their long-term stability and resilience. This study explores diverse methods to strengthen or reinforce adobe-masonry single-story houses, encompassing traditional techniques and innovative solutions such as fiber and geogrid reinforcing.

Common methods of seismic retrofitting may include the addition of reinforced concrete elements, such as integrating reinforced concrete bond beams, columns, or shear walls into existing adobe walls to improve lateral stability and resist seismic forces. In addition, strengthening roof-to-wall connections contributes to enhancing the overall resistance. This involves installing metal straps or bolts to strengthen connections between the roof and walls, preventing roof uplift and enhancing overall structural integrity during seismic events.

Moisture ingress poses a significant threat to adobe-masonry houses, leading to decay and structural weakening. Moisture protection measures comprise the application of breathable sealants or coatings and proper roof drainage systems. As regards the former, coatings effectively repel moisture while allowing trapped moisture within the walls to escape, preserving the adobe's integrity. Likewise, adequately designed roof drainage systems divert rainwater away from the structure, minimizing the risk of water-related damage.

Likewise, strengthening the foundation is essential for ensuring the stability and longevity of adobe-masonry houses. Techniques include underpinning, i.e., adding additional support to the foundation by extending or reinforcing existing footings,

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effectively distributing loads, and reducing settlement. It is sometimes useful to reinforce the foundation with concrete footings, which enhance load-bearing capacity and structural stability.

Fiber reinforcing involves incorporating fiberglass or carbon fibers into the adobe material to enhance tensile strength and ductility. Mixing fibers directly into the adobe mixture during construction improves overall structural performance. Also, the application of fiber-reinforced plaster or stucco to the exterior surface of adobe walls provides additional reinforcement and crack resistance.

Innovative approaches to adobe reinforcement include the incorporation of modern materials and technologies while respecting traditional building methods and aesthetics. Fiber-reinforced polymers (FRPs), for instance, offer lightweight and high-strength alternatives for reinforcing adobe walls without compromising their historic character. Geogrid reinforcing employs high-strength polymer grids embedded within adobe walls to provide structural support. Thus, horizontal embedding of geogrids within adobe walls enlarges tensile strength and prevents cracking. Vertical installation of geogrids between layers of adobe bricks enhances lateral stability and resists seismic forces.

Similarly, the use of seismic dampers or base isolators can reduce structural damage during earthquakes, providing solutions to enhance the seismic resilience of adobe masonry structures.

This work concludes that strengthening or reinforcing adobe-masonry single-story houses requires a multifaceted approach that addresses seismic vulnerability, moisture protection, and structural deficiencies. By integrating traditional techniques with innovative solutions like fiber reinforcing and geogrid reinforcing, the resilience and longevity of these architectural treasures can be significantly enhanced, ensuring their preservation for future generations.

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FINITE ELEMENT MODELS FOR COLD-FORMED STEEL STRUCTURES AND COMPOSITE SECTIONS

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Keywords: *Computational cost, Parametric study, Mesh sensitivity, Mass scaling, Concrete Damage Plasticity (CDP).*

Abstract

Various investigations about the cold-formed steel structures and composite sections have been developed by many researchers during the las twenty years. Within the steel structures industry, CFS profiles have multiple applications related to residential and industrial construction: small and medium-rise buildings, renovations, expansion of tourist buildings or even new constructions of small shopping centers are some of the examples where these profiles have been employed. The weightless of CFS profiles is a great advantage over conventional rolled steel profiles. However, the small thickness of their components become these profiles in one type of structures most affected by different type of buckling and torsional failure.

Researchers specialized in cold-formed profiles use to divide their investigation into four phases: i) construction and testing of experimental models, ii) development of finite element models, iii) parametrization and, finally, iv) numerical analysis. Regarding these four phases, the construction of physical models is by far the most expensive: it can consume a large number of materials and time. Furthermore, not all researchers have the budget, staff or laboratories to build and test their own physical models. This is the reason why more and more researchers mixed the construction of physical specimens with finite element models. Nowadays, two software dominate the finite element industry: ANSYS and ABAQUS.

In this article the authors present a selection of publications on Cold-Formed profiles and composite sections where Finite Element Models are included. The main objective of this paper is to know key parameters to model CFS profiles [1-7], connectors [8-14] and composite sections [15-21]. Based on the literature presented, the authors analyze how to transfer the data from the specimens tested to the finite element models. After this first process, the various methods used to calibrate the models and the results obtained are analyzed. Finally, the most common elements which a good parametrization can be generated are shown. Authors provide comparative tables of the literature reviewed.

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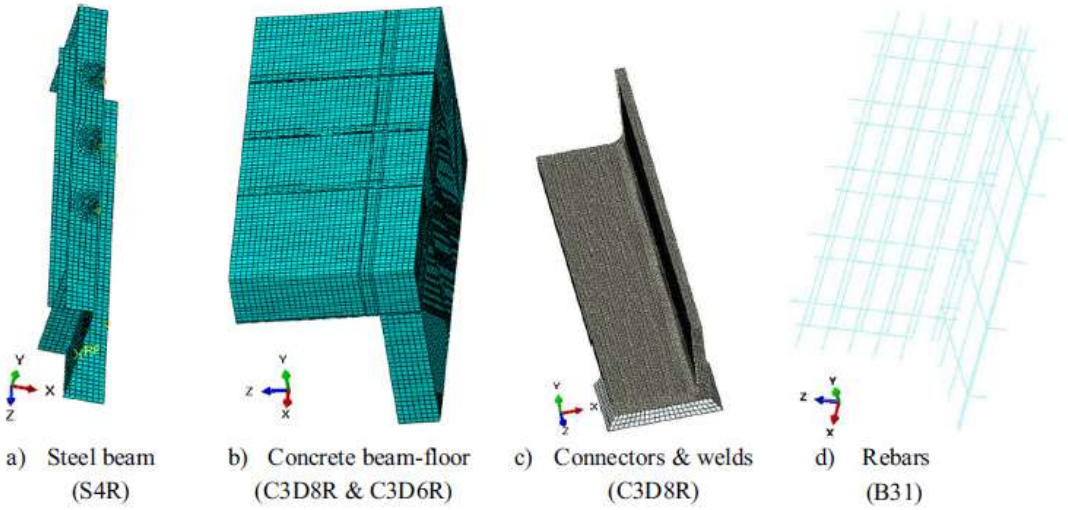

Figure 1: *Finite element model. (Source: P. Keo et al., 2018 [16])*

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EXPLORING CONCRETE IN THE CONTEXT OF SPAIN AND MEXICO

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Keywords: *Concrete, Compressive Strength, Comparative Analysis.*

Abstract

This study provides an in depth-comparative analysis of concrete in the cultural context of Spain and Mexico. To have a holistic foundation, the investigation initiates with the definition of *concrete* according to both Spanish and Mexican bibliographies. And then list the main mechanical properties of hardened concrete, with special emphasis on compressive strength, a cornerstone regarding the use and employment of this material since this property serves as a fundamental point to understand the behavior of the most used material in the construction industry.

The focus is on the comparison of the concrete classification based on compressive strength values and the recommendation of compressive strength values in structural elements tailored to specific exposure environments. All this considering the current regulations of each country, in the case of Mexico the Complementary Technical Standards for Design and Construction of Concrete Structures and in the case of Spain, the Structural Code. All this to observe the multiple considerations and standards that shape the use of concrete in each cultural context.

In addition to the normative landscape, the research also extends to an examination of the commercial dynamics surrounding concrete in both countries. Key players, such as manufacturing and supplier companies, market trends regarding innovation of this material and a brief analysis of prices within industry are explored, contributing to a comprehensive understanding of the business economy in these two cultural settings.

Furthermore, the research showcases iconic concrete structures in both countries. Examining these structures provides valuable insights into the practical application, reflecting the cultural and architectural nuances inherent in each country.

In conclusion this research offers an in-depth understanding of concrete in Spain and Mexico, ranging from compressive strength, normative frameworks, industry dynamics to iconic structures. By analyzing these elements together, the study allows us to observe the regulatory differences, as well as the cultural perspectives, that shape the use of concrete in construction.

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Table 1: *Comparison of recommended compressive strength values, depending on the exposure of the constructive element.*

Exhibition classification (NTC-C)[1]	**Exhibition classification (Structural Code)[2]**	**Minimum compressive strength (NTC-C). Represented in [MPa]**	**Minimum compressive strength (Structural Code). Represented in [MPa]**
Surfaces of members in indoor environments, in buildings or parts thereof where members may be subject to repeated wetting and drying.	Reinforced or prestressed concrete elements within closed spaces (such as buildings), with low air humidity.	20	25
Surfaces of members in water permanently submerged in water with more than 20,000 ppm chlorides.	Corrosion induced by chlorides of marine origin (permanently submerged in the sea).	25	30
Surfaces of members in contact with the ground, in non-aggressive soils.	Reinforced or prestressed concrete elements buried in non-aggressive soils.	20	25
Surfaces of members in water with more than 20,000 ppm chlorides, in wetting and drying zones.	Reinforced or prestressed concrete elements located in a tidal zone, affected by waves and splashes.	50	35
Surfaces of members in contact with the ground, protected by a waterproof membrane.	Reinforced or prestressed concrete elements on the outside, protected from the rain.	20	30

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ANALYSIS OF THE PROBLEM OF FIRE IN BUILDINGS WITH PATRIMONIAL VALUE DURING THE 21ST CENTURY IN VALPARAÍSO, CHILE

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Keywords: *Architectural heritage; Fire; Deterioration; World Heritage Site; Intervention.*

Abstract

Valparaíso, named the most developed city in 19th-20th century Chile, witnessed cultural syncretism in its architecture due to interactions between European/North American merchants and port inhabitants. This, combined with the city's unique geography, led to a UNESCO World Heritage Site designation in 2003. The entire city stands as a testament to its historical relevance, evident in preserved urban fabric and numerous buildings of significant historical, architectural, and heritage value. These structures also reflect the city's resilience to ongoing catastrophes, including earthquakes, landslides, and fires since 1842.

This problem continues and has intensified, damaging numerous properties, including heritage-protected areas, and causing deterioration in significant city sectors due to a lack of post-incident interventions. This research aims to analyze 21st-century fire- affected buildings with high heritage and historical value in the city. It seeks to determine their casuistry, assess their conservation states, and quantify them through a detailed registry.

The analysis recorded buildings affected during the specified period, totaling 30 properties (Figure 1). Data organization utilized two card models, Previous Studies and Current Conditions, to establish relationships between the obtained information.

Figure 1: *Location of the damaged properties in Valparaiso. (Source: Adapted from Google Earth, 2023)*

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The majority of damaged properties were early 20th-century structures with a mixed architectural program in Protection Zones. They largely held some level of heritage protection at the time of the incident.

Regarding post-accident properties, a significant portion remains unused, in various states of conservation, mostly in ruins or lacking rehabilitation work. In some cases, recovery occurred, but without clear intervention criteria (Figure 2).

Figure 2: *Comparison of the property before and after the fire. (Source: Left [https://www.bbc.com/mundo/noticias-america-latina].Right. Autora, 2023).*

Analyzing the architectural qualities, cataloging, use, and current conditions of the buildings led to the conclusion that most damaged properties persist for years in a state that poses a risk of partial loss or total disappearance. Additionally, a significant obstacle to recovery is the exclusive dependence on property owners. In terms of rehabilitation, the absence of established intervention criteria in the law or ordinances creates a potential for reconstruction without adequately safeguarding the fundamental values of the properties.

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PRELIMINARY ANALYSIS OF DWELLINGS TO BE REFURBISHED WITH PUBLIC FUNDS IN MADRID

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Keywords: *energy simulation, monitoring, energy rehabilitation, social housing, building diagnostics*

Abstract

Improving energy efficiency and comfort in urban dwellings is a significant yet essential challenge for modern cities, especially in the context of climate change and rising environmental awareness. A promising strategy to address this challenge is the refurbishment of the exterior facade of buildings, which can not only significantly enhance thermal insulation and energy efficiency but also optimize indoor comfort conditions by mitigating extreme temperature fluctuations. Detailed monitoring of dwellings through advanced sensors presents a unique opportunity to assess the actual impact of these refurbishments on energy consumption and indoor environment quality. By analyzing data collected before and after interventions, it is possible to precisely quantify the benefits of facade refurbishments, providing a solid empirical foundation for the development of public policies and the allocation of subsidies

This study presents a preliminary analysis of 46 dwellings in Madrid slated for refurbishment with public funds from the city council, aimed at understanding their current energy consumption and comfort levels. The dwellings were equipped with sensors to monitor electricity and gas usage (where applicable), as well as indoor environmental quality indicators such as temperature, humidity, and CO2 levels. The purpose of this monitoring was to gather data to inform the house conditions.

The methodology involved the installation of sensors in each dwelling for a continuous period, capturing data across different seasons to account for variations in energy use and comfort levels. The analysis focused on identifying patterns of energy consumption, particularly in relation to heating in winter and cooling needs during summer months.

Preliminary findings indicate a moderate use of heating during the winter months across the median of the monitored homes. However, a significant concern arose with the high indoor

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temperatures experienced during the summer, particularly in July. This finding highlights a critical area for intervention, where house insulation would prevent this summer overheating issue.

The implications of these findings are twofold. Firstly, they underscore the necessity of a refurbishment that considers both energy efficiency and thermal comfort. This is particularly relevant in the context of climate change, where rising temperatures are likely to exacerbate the problem of indoor overheating. Secondly, the study highlights the potential for using real- time monitoring data to inform and tailor refurbishment strategies to the specific needs of each dwelling.

This preliminary analysis sheds light on the current state of the dwellings in Madrid that are to be refurbished with public funds, revealing critical insights into their energy consumption patterns and comfort levels. The findings suggest a pressing need for refurbishment strategies that address both energy efficiency and thermal comfort, with a particular emphasis on mitigating high indoor temperatures during the summer months.

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ASSESSMENT OF THE TYPE OF RENDERS USED ON EARTH VERNACULAR ARCHITECTURE

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Keywords: *Earth building; Renders; Vernacular architecture; Preservation; Conservation.*

Abstract

Vernacular architecture of the Tierra de Campos region (Spain), keeps the traditional use of raw earth in the construction of its buildings. It was mainly owing to the locally availability of the resources. Construction techniques had been commonly adobe bricks and compacted earth walls.

Nowadays, there is a renewed effort to promote the use of earth as a tool to promote the revitalization of local economies as well as the recovery of this sustainable building material. Indeed, its low CO2 emission and its local source (km0) together with the thermal inertia promotes by its huge mass and capacity of storage energy, enhance the achievement of nearly zero energy consumption buildings, gaining particular importance in contemporary architecture. Indeed, construction materials made from raw earth have a very low environmental impact, both in their manufacturing process and throughout the material's lifespan.

However, the loss of skilled labor knowledgeable in the craft of building with earth, coupled with the lingering disdain from generations of older people who lived in those houses, jeopardizes the preservation of this vernacular architecture. The viability of these buildings is ensured, among other factors, by proper protection of their walls through a coating mortar that prevents the slow erosion caused by the action of rainwater and wind

Indeed, its absence can accelerate damages on the raw earth support, while its incorporation ensures its proper protection. One of the most challenging aspects is to consider the compatibility of the material used as a render on the original wall, thereby impacting the maintenance and preservation of this architecture. This research showcases the fieldwork conducted in five municipalities of the region, where around twenty buildings have been accounted for, featuring three different types of coatings: earth-based (RT), lime-based (RCA), and cement-based (RC).

Renders were analyzed based on their physical characterization and classified according to three variables: a) type of coating mortar, b) wall orientation, c) location of the coating on the wall's structure. Preliminary conclusions suggest that the most common practice is the combination of different types of mortars based on various areas of the wall.

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***Figure 1**.- Different examples of coatings on raw earth walls, Tierra de Campos region (Spain)*

At the bottom of the wall, cement renders are commonly used. On the contrary, earth renders are preferable in the upper parts. This circumstance can be justified by two reasons: first, the absence of bases or plinths in the vernacular earth architecture of the region, and second, the increased vulnerability of bases to the effects of rainwater, vegetation, or human activity.

However, based on the previous experiences as well as the work field, it can be asserted that the widespread use of cement at the bottom of the walls is provoking, among other issues, the concentration of moisture in the walls and compromising its stability. The aim of this research is to establish technical criteria for the execution of coatings on raw earth walls in the vernacular architecture of the region. The findings will be reflected in a guide of best practices, designed for widespread dissemination and easy understanding, with the aim of assisting in their conservation.

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IDENTIFYING THE MOST RELEVANT FACTORS IN RESIDENTIAL ENERGY EFFICIENCY USING MACHINE LEARNING ALGORITHMS

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Keywords: *machine learning, energy efficiency, energy performance certification, retrofitting, regression*

Abstract

One of the European Commission's priority actions to reduce energy consumption and CO_2 emissions in member countries is to act in the building sector, through the regulation of standards for new buildings, but also through policies for the rehabilitation of the building stock. Through this normative regulation, the aim is to reduce carbon dioxide emissions from buildings by improving energy efficiency. Urban areas play a crucial role in global energy demand and in policies aimed at mitigating climate change. Energy use in residential buildings is one of the main sources of greenhouse gas emissions in cities. In Spain, building regulations on residential energy efficiency have varied over time. Three stages can be distinguished: before 1980, between 1980 and 2007 with the Basic Building Standard on Thermal Conditions in Buildings (NBE CT-79), and after 2007 with the Technical Building Code (CTE). Statistical data on the building stock in Spain show that existing housing is not very energy efficient. For this reason, it is necessary to prioritize and concentrate efforts on the energy rehabilitation of these residential buildings, since they have a great potential for energy savings and CO_2 emission reduction. The objective of this research is to identify the most relevant factors to improve the energy efficiency of existing residential buildings, in order to determine the most effective energy rehabilitation measures to optimize the investment in energy efficiency of the building stock. Several architectural, design, construction systems and installation factors are studied, which can be very relevant when it comes to improving the energy efficiency of existing residential buildings in Spain. For this purpose, a large database is used, which contains georeferenced observations of energy certificates of houses located in Barcelona. From these certificates, it is possible to obtain for each property, information on energy consumption and CO_2 emissions, as well as the technical characteristics of the envelope and heating/cooling systems. Based on this information, and using automatic learning algorithms, several models are created to determine how energy consumption can be reduced by improving, for example, the envelope (opaque or glazed), the systems/installations, thermal bridges or sunlight, among other aspects. Machine learning techniques have been used to identify the most

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relevant variables affecting the energy consumption of dwellings, quantifying their relative importance in energy savings. The results reported should allow for establishing priorities or preferences in building interventions aimed at energy improvement, as well as estimating the energy savings of each measure individually or jointly.

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PROJECT FOR THE REHABILITATION OF AN OLD ABBEY FOR RESIDENTIAL USE IN SALAS DE BUREBA (BURGOS)

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Keywords: *circular economy, heritage, refurbishment, sustainability*

Abstract

This is an old abbey built by order of the Abbot Don Andrés del Castillo Pesquera in the 16th century. It has two rectangular bodies with two levels of semicircular arches that seem to indicate that the building was intended to be completed in a square cloister. At the intersection of the two bodies, a tower with openings, of rectangular proportion, rises a second level above the level of access.

Successive interventions over the centuries led to the destruction of several valuable building elements, such as the interior of the tower and the stone masonry. A considerable part of the staircase was also dismantled, removing balustrades, parapets and stone steps, now impossible to recover.

The state of the building at the time of acquisition required structural consolidation, complete reconstruction of the roof and the replacement of several sections of the floor slabs (Figure 1).

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Figure 1: *South and West façades of the building. Original condition 2022. (Source: Paula Montoya, Architect)*

The origin of the building makes the restitution of original typological elements and traditional construction procedures particularly sensitive. That will be transferred to current technology and procedures in an energy-efficient building.

It was essential to maintain this character with the construction language in stone masonry, as well as wooden structure in the floor trusses and slabs.

The arches of the old cloister are being restored to adapt them to a new enclosure, the complete restoration of the stone staircase covered with vaults, and the renovation of the wooden cladding in windows.

The original roof tiles of the building have been recovered and replaced on the new roof with rainwater collection, which will be channelled to a cistern in the lower part of the plot.

The insulation improves the overall building enclosure, facilitating the efficiency of the new underfloor heating system.

An aerothermal generation system with biomass support will be installed, replacing the old boiler and oil tanks.

The general volumetry of the building remains intact, and the reconstructed tower roof has improved the general appearance of the historic centre of the Village. In (Figure 2) the onsite works in January of 2024 is shown.

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Figure 2: *South and West façades of the building. Onsite works in January of 2024. (Source: Paula Montoya, Architect)*

The building's importance in the life of the village was clear from the beginning. For centuries, it was a meeting place for community activities for the villagers. The property's orchard, located on an adjoining plot of land to the north of the manor house up to the poplar grove is particularly relevant.

It is part of the project to recover its use for the organic cultivation of fruit trees and vegetable garden, in a permaculture strategy without pesticides and through the use of organic fertilisers.

The aim is to establish a testing ground for experimentation with these procedures, optimised irrigation systems and the recovery of old varieties of trees and vegetables better adapted to the changing climatic conditions of the area.

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CCORROSION BEHAVIOR OF AN ALKOXY SILANE-BASED IMPREGNATION INHIBITOR IN MORTAR SPECIMENS

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Keywords: corrosion inhibitors, electrochemical behavior, impregnation inhibitor, linear polarization resistance (LPR), impedance spectroscopy (EIS).

Abstract

Concrete is one of the most commonly used materials in the contemporary construction industry. Its versatility in achieved shapes, sizes, and quality of finishes, combined with its optimal mechanical properties, durability against adverse weather conditions and hostile environments, as well as its easy availability and affordable costs, position it as an ideal and economically viable option in this industry [1].

It is a heterogeneous material, composed of a matrix of porous structure generated by the hydration of cement, aggregates, and possible additions depending on its application. This matrix plays a crucial role in its durability and mechanical properties; durability is associated with the interconnection of the pore network, as it can be a pathway for aggressive agents if special control is not maintained during concrete preparation and low water-to-cement ratios are used. It exhibits excellent compressive strength but shows fragility under bending-tensile stresses, which is why amalgamation with steel arises, giving rise to reinforced concrete, which combines the advantages of both materials.

Reinforced concrete consists of a concrete matrix incorporating steel bars inside; concrete acts as a protective medium for the steel reinforcements, both as a stable physical barrier and in their passivation through a film of hydrated calcium oxides ($Ca(OH)_2$), a product of cement hydration reactions, maintaining a pH between 12.5 and 13.8 and being effective against corrosion[2] [3].

The possible rupture of the passive film as a result of the arrival of aggressive external agents such as seawater, freeze-thaw cycle salts, and high concentrations of CO_2 to the level of the reinforcement, causes corrosion and reduces the service life of the structures by decreasing steel quantities and lowering structural safety coefficients [2] [3] [4] [5] [6] [7].

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The onset of this corrosive process can trigger spalling, delaminations, and ultimately failures in structural elements, resulting in considerable economic losses in repairs and monitoring [1] [8] [9] [10].

The most common forms of corrosion in reinforced concrete elements are generalized (carbonation) and pitting (chloride ions) [11] [12]. To reduce the impact of this problem, various methods have been investigated, including epoxy-type protective coatings for steel [13], corrosion inhibitors [4] [14] [15] [16] [17], and electrochemical protection [18].

This study will investigate the effectiveness of a corrosion inhibitor applied as a surface rehabilitation treatment compared to a reference mortar. An inhibitor formulated based on Alkoxy Silane chemistry has been chosen. The electrochemical behavior was investigated using the linear polarization resistance (LPR) technique and electrochemical impedance spectroscopy (EIS).

The inhibitor under study has demonstrated good functional performance against corrosion.

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THE THERMAL BEHAVIOUR OF GREEN ROOFS INCORPORATED IN REHABILITATED BUILDINGS FROM THE LIFE MY BUILDING IS GREEN PROJECT

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Keywords: *Cubiertas vegetales, Olas de calor, Monitorización térmica, Soluciones basadas en la naturaleza, Rehabilitación energética*

Abstract

Climate change is causing an increase in heatwaves across the Iberian Peninsula. The high temperatures particularly affect the most vulnerable populations, including children. Many educational buildings in the region are not equipped to handle these thermal conditions due to their architectural and construction characteristics. The use of artificial climate control systems to create a comfortable or at least tolerable thermal environment leads to increased energy expenditure for these properties. Conversely, occupants of buildings without such systems must carry out their activities in thermally uncomfortable conditions, which can lead to health problems or affect work and academic performance. In this context, the LIFE My Building is Green project has sought to address this issue by incorporating Nature-Based Solutions (NBS), techniques that utilise the complex mechanisms of natural elements to combat climate change. As part of the project, three educational centres have been selected for rehabilitation through NBS, including Escola Basica do 1º CEB/Ji do Falcao located in Porto, Portugal, and Colegio Gabriela Mistral in Solana de los Barros, Badajoz, Spain. Several NBS, including green coverings, have been implemented in both buildings.

To gain an initial understanding of the thermal impact of green roofs, academic and administrative spaces within the aforementioned educational centres have been thermally monitored. In the Badajoz building, the thermal behaviour of three types of green roofs with different plant characteristics has been established. In the Porto building, the thermal behaviour of spaces and structures with vegetated and non- vegetated roofs has been compared. In both buildings, the results show notable differences in temperature traces, allowing for initial conjectures for future studies. In Badajoz, differences in the records of the green roofs may be linked to the varying density and height of the integrated plants. In Portugal, the existing differences between vegetated and non-vegetated roof types may be related to the climatic conditions during monitoring. Ultimately, the results allow us to infer the thermal impact derived from the characteristics and natural mechanisms of the substrate and vegetation.

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ANALYSIS OF TRAFFIC DATA FOR PREDICTING CO_2 CONCENTRATIONS IN CONCRETE CARBONATION STUDIES WITHIN THE URBAN TUNNELS OF MADRID CALLE 30

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Keywords: *concrete carbonation; carbon dioxide; Madrid Calle 30; traffic intensity; urban tunnels*

Abstract

Concrete carbonation is a phenomenon which is produced when the gaseous CO_2 enters the pore structure of the material. Its main consequence is the reduction of the concrete's pH (from approximately 12.6 to 8.3) which can lead to the reinforcement corrosion, as its passive layer is affected when the surrounding pH is 9 or lower [1, 2].

The analysis and prediction of the evolution of this process is essential in concrete urban tunnels, as the CO_2 concentrations inside these structures (coming from the circulating vehicles) is significantly higher than the atmospheric ones [3]. Also, it must be considered that most of the carbonation prediction models have CO_2 concentration as one of the main parameters which must be considered when simulating the carbonation process, so it is key to be able to determine the CO_2 concentrations at which the structure has been exposed and also to estimate the future concentrations.

Madrid Calle 30 is a significant infrastructure for the city of Madrid, a radial urban highway with a mean average daily traffic of 200,000 veh/day [4]. Its urban tunnels were built during the renovation that took place between the years 2004 and 2007, when its South-West Sector was buried [5]. The study was performed inside a ventilation gallery of these urban tunnels in order to be able to predict the evolution of concrete carbonation, so the calculation of CO_2 concentrations inside this gallery was essential [6].

The analysis performed to obtain the CO_2 concentrations inside the ventilation gallery was the following [7]: first, pollutant concentrations were measured inside the ventilation gallery for a period of 15 days. Then, this data was compared with the gas concentrations and traffic intensity measured by the permanent sensors located on the tunnel roads, so as to verify that the CO_2 concentrations inside the ventilation gallery could be obtained from traffic intensity data. Afterwards, a detailed traffic analysis was carried out to obtain the total traffic volume which flowed through the study area.

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This analysis of the main traffic parameters, along with a circulating fleet study, allows to obtain the CO_2 concentration at which the concrete inside the Calle 30 ventilation gallery has been exposed from its construction. Also, performing a prognosis of these variables it is also possible to estimate the CO_2 concentrations in the future, which allow to simulate the concrete carbonation evolution inside this structure during its service life.

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VERACRUZ, FROM SEA TO LAND

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Keywords: *VERACRUZ, MILITARY FORTRESS, CORAL, MUCA STONE, CONSERVATION.*

Abstract

The City and Port of Veracruz is located on the coast of the Gulf of Mexico, in the State of Veracruz de Ignacio de la Llave in the Mexican Republic, with coordinates 19°11'25"N 96°09'12"W. This city has stood out since its founding in the 16th century for being the main seaport in New Spain in establishing commercial relations with the rest of the world. Over time its relevance as such increased as a result of a project whose objective was to unite the Atlantic and Pacific seas, with the purpose of converting Mexico City into the commercial center of the Catholic Monarchy as a consequence of globalization and exchanges between Europe, Africa, America and Asia. Derived from the short distance between the ports of Acapulco and Veracruz, products from those distant regions could be moved more quickly to Europe. On the other hand, Veracruz has been declared heroic four times for having been the scene of important events in Mexican national history.

During the development stage of the city, the construction of civil buildings began with wood and tile, the first coming from the remains of sunken ships or from repairs to them and the second what served as ballast on the ships when they arrived from Europe empty. To build military fortifications, materials were required that guaranteed resistance to withstand the onslaught of pirates and other invading nations, however, the region does not have nearby quarries that would provide these elements. History identifies the Island of San Juan de Ulúa as one of the first places where contact was made between the indigenous people and the Spanish, who during the beginning of colonization found that the island and the reef system of which it is a part has species of madreporic coral. The coral was extracted and dried with the purpose of obtaining stone, since it is made up of calcium carbonate. They were master European stonemasons who, due to their experience in forging oyster sedimentary stone, transmitted the knowledge to the natives and slaves for the formation of ashlars, this being the way in which the City of Veracruz began to erect its fortress, bastions, and wall, giving rise to being used by the population for the development of civil buildings.

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It is for the above reasons that research work is carried out with the purpose of developing a material that replaces coral stone in properties that have been affected by erosion due to exposure to the elements, the lack of maintenance of buildings, as well as vandalism. The stone is currently protected and its extraction is prohibited as it is a marine biological element that forms reefs. This prevents the conservation of the buildings currently standing from being carried out in an economical and simple way. Among the main objectives of the work are to achieve chemical compatibility that does not compromise the other materials in the event of rejection, as well as, preserve the structural integrity of the materials surrounding the intervention.

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CRITICAL ANALYSIS OF GRAPHIC TECHNIQUES FOR DOCUMENTATION AND CONSERVATION OF HERITAGE: PHOTOGRAMMETRY

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Keywords: *cultural heritage, conservation, photogrammetry, heritage virtualization, technologies.*

Abstract

The work developed focuses on the evolution of technologies and graphic techniques employed for the meticulous documentation and enduring preservation of cultural heritage. The study encompasses a bibliometric and bibliographic analysis, delving into topics such as photogrammetry, 3D modeling, virtual reality, and 3D printing, along with their implications. Additionally, the research examines the limitations and contemporary challenges within this realm of study.

As one of the primary tools for documenting and preserving cultural heritage, the bibliographic and bibliometric analysis has underscored the significance of photogrammetry, a non-invasive technique that safeguards the integrity of cultural objects during documentation and analysis. It is widely acknowledged in various sources for its precision and versatility, ensuring geometric accuracy. Photogrammetry proves essential for conducting surveys, particularly in architecturally intricate or challenging- to-reach structures. The technique also plays a pivotal role in generating precise maps and 3D models through the stereoplotting process. Furthermore, photogrammetry has advanced to the radiometric level for surface analysis and material experimentation, a critical aspect in the study of urban-architectural heritage [1]. Despite its historical drawbacks, such as the time-intensive processing of point clouds and the expense associated with acquiring specialized tools and software, recent publications demonstrate the technique's remarkable versatility. The evolution of photogrammetry has enabled its application in outdoor mapping through unmanned aerial vehicles and 360° or panoramic photogrammetry. This evolution enhances the immersive experience within the captured environment. Additionally, the utilization of fisheye lenses and multi-camera systems has optimized surveys in confined interiors, addressing challenges in processing and integrating data into a comprehensive map [2].

One of the primary outcomes gleaned from the bibliometric study shows the widespread adoption of photogrammetry as a prominent technique in heritage conservation. This is evident in the keyword correlation map, where photogrammetry ranks as the fifth most frequently employed term in searches. It is closely associated with keywords like conservation and cultural heritage, holding the position with a linkage strength of 946. This robust correlation is based on 174 occurrences out of a total of 2177 links within the studied sample (refer to Figure 1).

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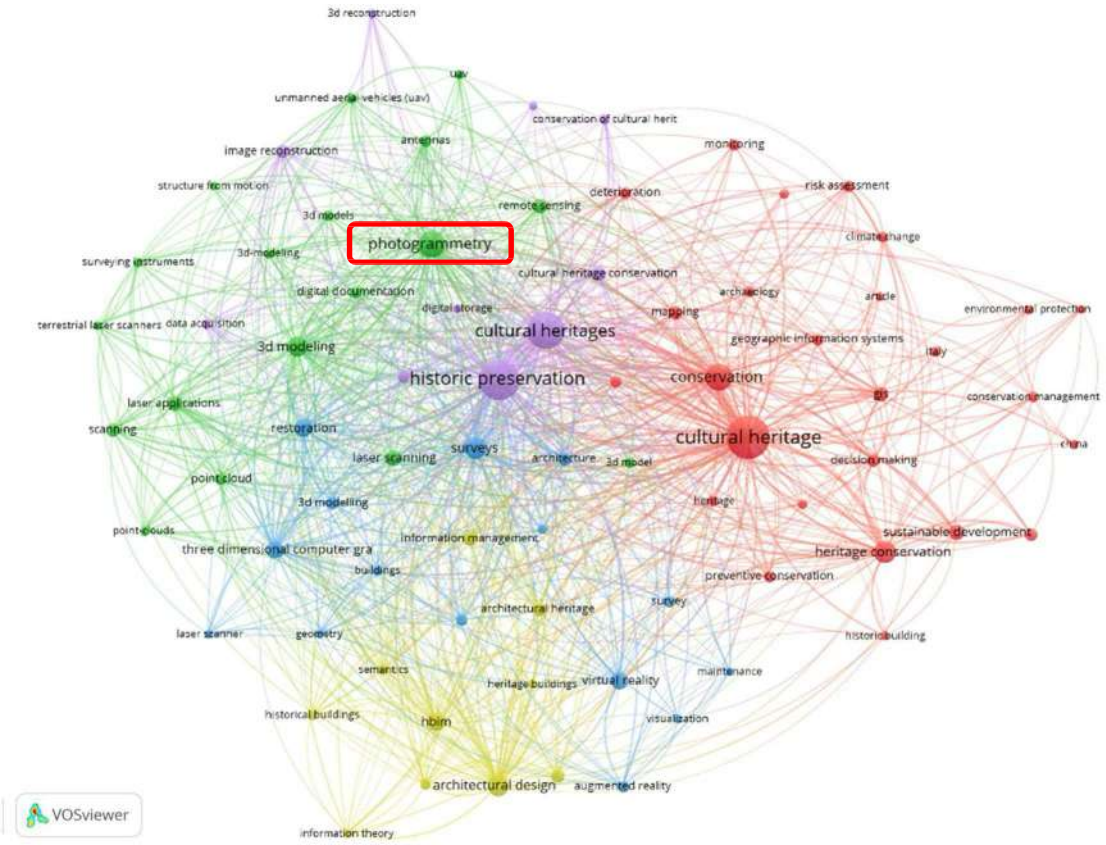

Figure 1: Co-occurrence map of keywords.

The conducted study has led to the conclusion that photogrammetry has firmly established itself as a crucial technique in the documentation and conservation of cultural heritage. Its applications span a wide spectrum, encompassing the generation of accurate 3D models, interactive maps, and in-depth analyses of textures and structures. Notably, photogrammetry exhibits adaptability to diverse needs and conditions across different fields and research projects.

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COMPREHENSIVE ANALYSIS OF THE THERMAL NEEDS IN FOUR VULNERABLE DWELLINGS IN MADRID

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Keywords: *energy simulation, monitoring, energy rehabilitation, social housing, building diagnostics*

Abstract

The calculation of thermal needs in the building stock is a fundamental first step to propose effective renovation strategies. The quantification and reduction of the energy needs or energy demand is doubly important in homes where energy poverty is found, as reducing the energy demand minimizes the effort needed to achieve indoor comfort for this households.

The inefficiency of buildings, together with high-energy prices and low incomes, is a key factor in the emergence of fuel poverty. Therefore, in order to achieve the objectives of reducing energy poverty indicators, it is necessary to determine the energy performance of dwellings in a situation of energy vulnerability. For this purpose, the accuracy and simplicity of simulation models is considered necessary. Thermal energy consumption and temperature monitoring are also useful tools to contrast these models with the building real performance.

In Spain simulation processes are simplified using very general data and archetypes that do not consider particular consumption patterns of vulnerable groups. Energy certification programs offer indicative values to define the quality of the building, disassociating themselves from the factors of use, applying standard user profiles. Although they serve as a guide for the definition of general policies, the current models for energy certification do not allow the introduction of changes due to different energy uses or energy efficiency measures in each dwelling, making energy vulnerable groups invisible in policies and strategies.

In this work, four houses in Madrid are analyzed comparing different simulation options and usage scenarios. The main simulation tools used are the Calener Unified Leader Tool (HULC) as a generalist certification tool and Openstudio, a tool that uses the Energyplus software. This will allow detecting key parameters to see the differences between the models as well as the simplification factors of the models. The results are also compared with real data obtained through measurements during one year.

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The main retrofit strategy proposed for these dwellings is the reduction of energy demand through the improvement of the envelope.

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INFLUENCE OF THE VARIABLES GOVERNING THE CONFINEMENT OF CARBON FIBER REINFORCED CONCRETE AT THE SPECIMEN AND PIECE LEVEL.

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Keywords: *concrete, CFRP, rehabilitation, structures.*

Abstract

Due to the aging of the European building stock and the growing concern about greenhouse gas emissions, the construction industry has turned to rehabilitation activities of existing buildings [1], however, due to updates in safety factors of current regulations and load cases, structural rehabilitation of buildings is nowadays necessary.

The main causes of intervention in a building to maintain it in a safe operating state have been identified, these are grouped into the following: Pathological problems, design or calculation errors, low quality of structural materials, durability problems, incorrect use and maintenance, actions of nature and remodeling of the building [2]. To cope with the new actions to be resisted by the structure, in recent years the use of fiber reinforced polymer composites or FRP (Fiber Reinforced Polymers) has gained relevance, although initially developed and developed for the aeronautical and space industry [3-4], since the late 80's it has been used as a reinforcement material for structural elements beams and columns.

For this reason, the possibilities and needs of the use of composite reinforcements for the rehabilitation of existing building structures, which require an improvement in their mechanical capacities to meet the safety criteria of their occupants, are analyzed.

For this purpose, 4 types of fiber reinforced polymer or FRP reinforcements were selected to know their theoretical mechanical behavior in different application cases, these cases are composed of elements with different geometric cross section and equivalent reinforcing steel area, including specimen type elements, generating for this study an analysis of 360 different combinations and the use of the recommendations given by the ACI 440 design bulletin.

During the development of this work we have been able to verify how the shape of the element at part level affects the performance that FRP composites can provide, the possible results to be obtained with different types of fiber in a concrete element, which will help us to broaden our criteria when recommending or evaluating the use of FRP reinforcement in the rehabilitation of structural elements subjected to compression considering their main mechanical characteristics such as their initial resistance, their amount of reinforcing steel and the geometric shape of the section, as shown in Figure 1, The performance of FRP reinforcement is conditioned by the geometric and mechanical characteristics of the element to be reinforced, being lower in elements with good structural composition.

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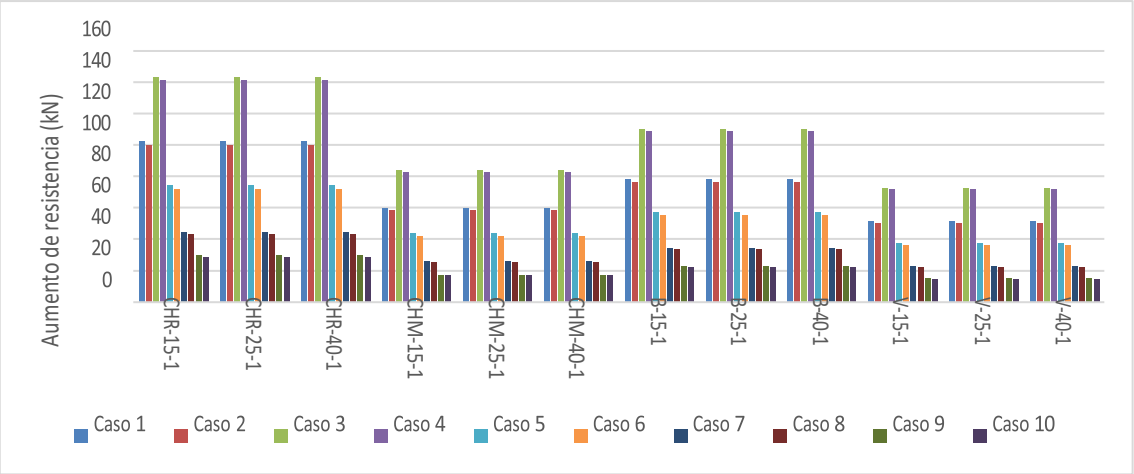

Figure 1: *Increased strength in case studies with a reinforcement layer.*

It was also observed that the mechanical characteristics of the type of fiber used influence the behavior of the stress-strain curve associated with the reinforcement design, since this curve is related to the influence of the increase in resistance capacity provided by the FRP and the initial resistance capacity of the element, as shown in Figure 2.

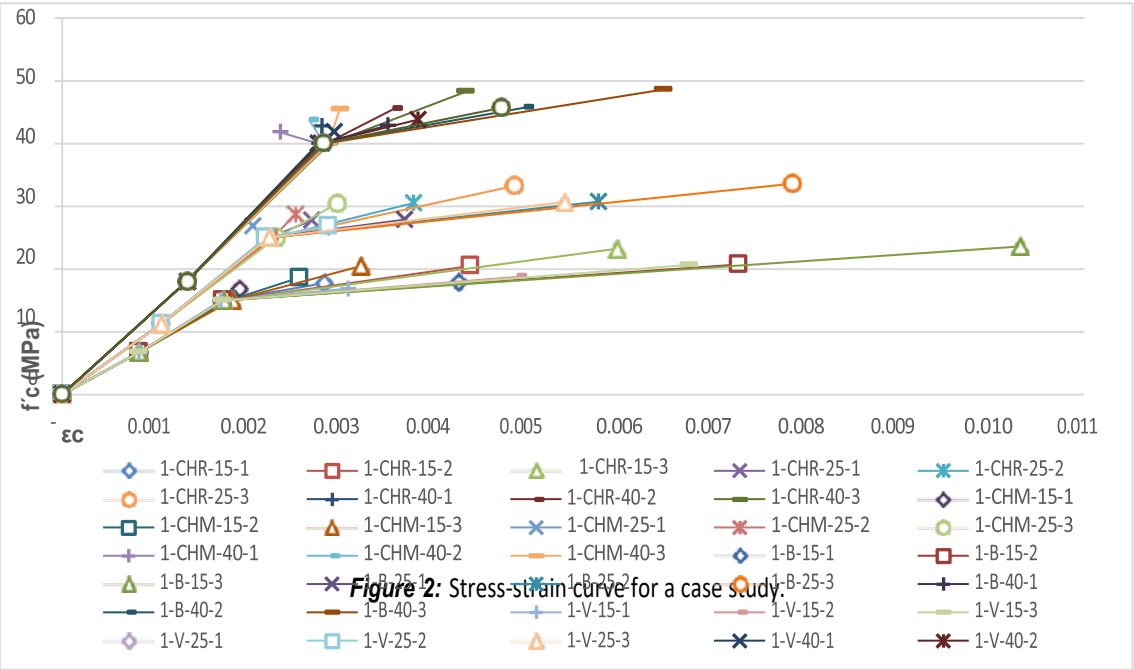

Figure 2: Stress-strain curve for a case study.

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AN EXAMPLE OF A MASONRY BRIDGE REHABILITATION

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Keywords: *Masonry, bridge, micropile, grout injection*

Abstract

This paper presents a real and innovative case of rehabilitation process of a masonry bridge that was damaged by flooding recently. The damage to the foundation caused a failure in the piles, which led to the appearance of a classic failure mechanisms with the formation of hinges in the masonry vaults.

This paper describes both the process of underpinning the foundation, necessary to guarantee the stability of the structure, and the internal shoring carried out to replace the set of damaged original factory vaults.

Finally, the result of the rehabilitation is the maintenance of the original masonry vaults as an envelope for a new inside concrete structure, in such a way that the final appearance of the set looks quite similar to the original and at the same time maintains the shape of the masonry generated after the foundation failure.

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REVITALIZING THE CANAL DE CASTILLA THROUGH URBAN PLANNING AND ENGINEERING STRATEGIES

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Keywords: *building, research, socio-economic impact, hydraulic*

Abstract

A study was conducted in Alar del Rey on the Canal de Castilla, comprising both online and in-person surveys targeting registered residents. A concerning issue related to the abandonment of the canal's iconic infrastructure, especially its locks, was identified. Over time, these structures have become obsolete and fallen into disuse, emphasizing the urgent need to address their deterioration and revitalize their functionality. This underscores the importance of investing in the restoration and maintenance of the locks to preserve heritage and promote tourism in the area [1].

The Canal de Castilla, a historical construction, has been a focal point for regional development and heritage conservation [2]. An understanding of its current state and potential for improvement is vital. In this context, a survey was conducted to gauge public opinion on three critical areas: the physical restoration of the building structure, the advancement of research related to the canal, and the socio-economic impact the canal has on the region. These areas are essential to justify the necessity of renovating and updating the canal to reflect its contemporary significance and benefits.

Figure 1: *Analysis results.*

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The results from the survey, Figure 1, indicate a strong recognition of the importance of these areas. For building restoration, a significant majority (87%) perceives it as highly to very highly important, underscoring a public consensus on the need for physical improvements. Research relevance is similarly viewed as high to very high by 84% of respondents, suggesting robust support for academic and scientific inquiry associated with the canal. Lastly, in terms of socio-economic impact, the perception of importance is more evenly spread, yet with a majority (48%) rating it as high or very high. This reflects a recognition of the canal's considerable influence on the regional economy and society, but with a more diverse range of opinions on the extent of this impact.

Survey feedback supports the Canal de Castilla's restoration, focusing on preserving history, introducing technology, and improving infrastructure. Respondents endorse using technology to enhance the canal experience, suggesting historical tours with technological insights, improved pathway maintenance, new recreational vessels, and area renovations for accessibility. The desire for tech-infused historical preservation indicates a preference for a modernized yet respectful approach to revitalization, aiming to make the canal a vibrant cultural and recreational hub that honors its heritage while serving current community needs.

The results underscore a clear public mandate for the restoration and modernization of the Canal de Castilla, with a special focus on its locks and the innovative use of water turbines. This vision aligns with sustainable development goals, marrying heritage conservation with the generation of renewable energy, and positions the canal as a beacon of sustainable engineering within the region.

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STUDY OF THE MECHANICAL BEHAVIOR OF HYDRAULIC LIME MORTARS WITH THE ADDITION OF RECYCLED CARBON FIBERS

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Keywords: *Hydraulic lime, carbon fiber, recycled, mortar*

Abstract

The gradual ageing of the building stock means that rehabilitation works are becoming increasingly important relative to new constructions [1-3]. In the case of historic buildings, the use of materials for restoration is a very delicate matter, as there have been numerous problems with the use of cement mortars, due to their incompatibility with the base material [4,5]. The use of hydraulic lime mortars improves some aspects and the addition of polypropylene fibres to these mortars increases their ductility [6,7], but it would be very interesting if this improvement occurred with the incorporation of a recycled material. The carbon fibre industry generates around 3,000 tonnes of carbon fibre composite waste in the United States and Europe, with an annual production of over 100,000 tonnes [8]. This recycled fibre is gaining recognition as a sustainable alternative in the construction industry, reducing the environmental impact associated with its production and promoting the circular economy, contributing to the achievement of the Sustainable Development Goals (SDGs) set by the United Nations (12). Taking into account the above premises, the aim of this study is to investigate the mechanical behaviour of lime mortars with the addition of recycled carbon fibres. For the tests, hydraulic lime NHL3.5 mortars, sand, and recycled carbon fibres from the reinforcement of a wooden structure were used in various dosages, on which mechanical tests were conducted (figure 1).

Figure 1: *Ensayo a flexión y compresión. (Source: propia)*

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The results obtained from flexural and compression tests can be seen in figure 2. As can be observed, in the mortars with recycled carbon fibres and 10mm in length, both in flexion and compression, the mortars with carbon fibres show improved performance compared to those without fibres, with the highest stresses being reached for the greatest amounts of fibres in the compression test.

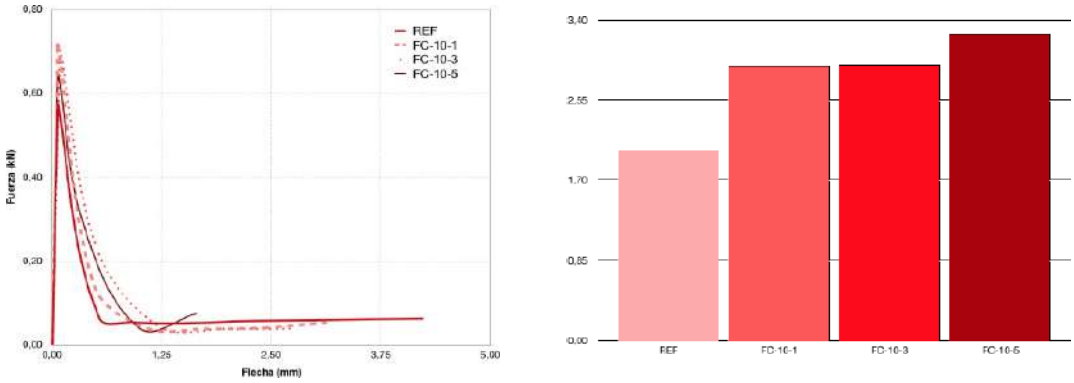

Figure 2: *Resultados del ensayo a flexión (a) y compresión (b). (Source: propia)*

The work conducted has concluded that hydraulic lime mortars with the addition of recycled carbon fibres improved their performance in both flexural and compressive tests compared to lime mortars without additives. Therefore, they can be considered a viable option from both a mechanical and sustainability standpoint.

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Buildings Technology

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DIGITAL TWIN IN THE WINDOW MANUFACTURING PROCESS

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Keywords: *Simulation, Discrete events, Production, Digital twin, FlexSim*

Abstract

The discrete event simulation and the digital twin concept are crucial tools in the optimization of industrial processes, and the FlexSim software has stood out as a versatile and powerful solution in this field. By applying FlexSim to window manufacturing for construction, a significant improvement in efficiency and decision-making is achieved. FlexSim allows modeling and simulating complex window manufacturing processes, taking into account variables such as material availability, production times, and workflows. The program's ability to represent discrete events, such as component assembly or inventory management, provides a detailed and realistic view of each step of the process.

In the context of window manufacturing, where precision and efficiency are paramount, FlexSim offers the possibility of conducting scenario analysis. This involves adjusting different parameters, such as production speed or equipment capacity, to evaluate how these changes affect overall performance. This approach enables the identification of bottlenecks, resource optimization, and informed decision-making to improve productivity. Discrete event simulation with FlexSim not only helps optimize manufacturing processes but also facilitates strategic planning. The ability to foresee potential issues and assess the impact of different strategies before implementing them in the real environment is essential to minimize costs and maximize efficiency.

Additionally, FlexSim provides an intuitive interface and advanced visualization tools that enable window manufacturing professionals to easily understand simulation results. This promotes clear and effective communication among production, engineering, and management teams, facilitating the implementation of data-driven improvements.

In summary, the integration of FlexSim into window manufacturing for construction provides a robust platform for process optimization and informed decision-making. Discrete event simulation offers a detailed and dynamic perspective on workflows, allowing professionals to identify areas for improvement, minimize risks, and increase operational efficiency. FlexSim is positioned as an indispensable tool for those seeking to drive innovation and efficiency in window manufacturing and similar processes.

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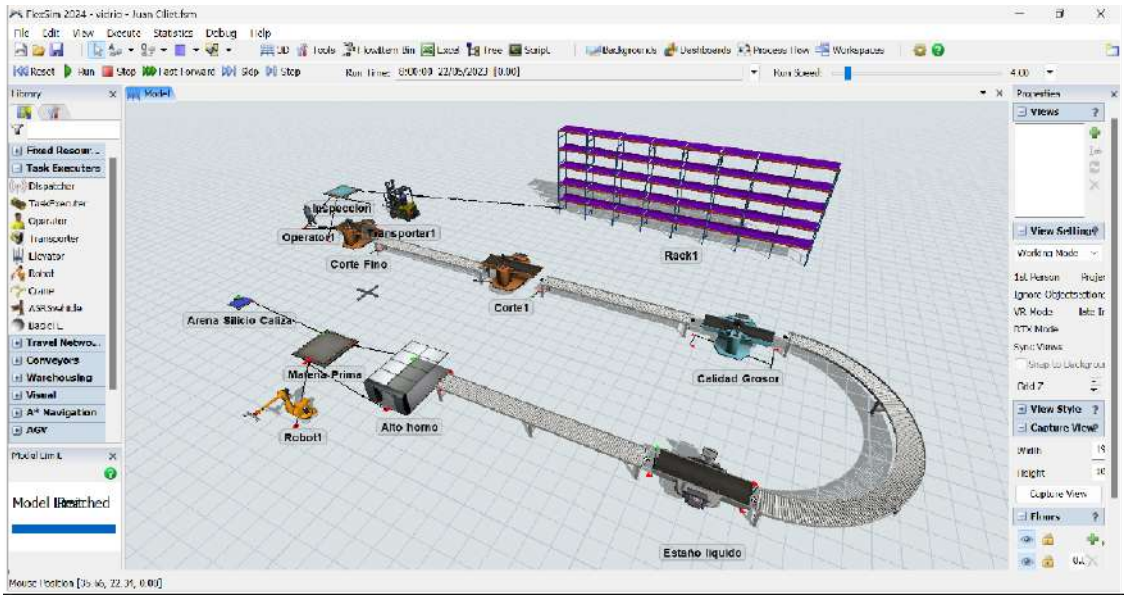

Figure 1. *Screenshot of simulation with FlexSim* ***(Source: Juan Oliet)***

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FACE-TO-FACE COLLABORATIVE SESSIONS AT CONSTRUCTION WORKSITE FOR DEVELOPMENT OF HUMAN-CENTERED TECHNOLOGIES

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Keywords: *BIM, Collaborative Robots, Exoskeletons, Autonomous navigation, Virtual Reality, Digital Twins*

Abstract

The European construction industry is facing three major challenges: improving its productivity, promoting safety and increasing the welfare of its workforce. To address these challenges adequately, the European research project (funded by the European Commission) "HumanTech" aims to develop disruptive and innovative technologies with a distinct human-centered approach. Each of the technologies to be developed within the framework of this project will be designed and conceived to coexist harmoniously with the end users and the most modern technology seen in the sector so far, without neglecting a more sustainable, efficient and safe transition between the modernization of the construction sector and the human being.

Following technologies are intended to be developed within the scope of the project:

-Robotic devices equipped with vision and intelligence that enable them to navigate autonomously and safely in highly unstructured environments, collaborate with humans, and dynamically update a semantic digital twin of the construction site they are in.

- Intelligent and unobtrusive worker support and protection equipment. From body sensor-activated exoskeletons for posture and strain to wearable cameras.

- XR glasses that provide real-time orientation and location of workers (generated by semantic digital twins) to perform their tasks efficiently and accurately.

HumanTech has the perfect blend of partners with diversity of expertise covering universities, R&D centers and institutes, SMEs, and large construction companies. To ensure a seamless connection between technology developers and their users, it was

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imperative to engage partners and especially construction companies from the project's inception and collect insights (including requirements) from their construction worksite. For this, ACCIONA Construction's technology and innovation division, one of partners in HumanTech project, organized two face-to-face collaborative sessions at its worksite, one in Alicante (Spain) and another in Zubieta (Spain), in year 2023. While selecting participants for these workshops, ACCIONA ensured a fair distribution across diverse employee profiles who would be directly or indirectly interfacing with and controlling HumanTech technologies in real-life situations—spanning gender diversity, professional roles such as construction and planning engineers, health and safety in-charges, site managers, as well as machine operators and workers.

For the time being and until these technologies are developed in the project, these face- to-face sessions allowed us to collect and compile design and improvement recommendations for each of the proposed technologies from an end-user point of view. They also provided us with a more generic/real vision to define and evaluate the ideas of the initial prototypes that are being integrated in the project.

This paper aims to presents the primary goals of HumanTech, current state of the art of different technologies such as collaborative robots, exoskeletons, and digital twins, briefly describe the objective of these two face-to-face sessions, methodology and approaches employed for conducting them and, finally provide a summary of the results obtained from these sessions.

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ARTIFICIAL INTELLIGENCE ALGORITHMS IN OPTIMIZING BUILDING ENERGY CONSUMPTION

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Keywords: *artificial intelligence, smart buildings, energy efficiency*

Abstract

The emerging concept of smart buildings, which requires the incorporation of sensors and big data (BD) and utilizes artificial intelligence [1], promises to usher in a new age of urban energy efficiency. By using AI technologies in smart buildings, energy consumption can be reduced through better control, improved reliability, and automation [2].

Designing buildings with high energy efficiency and identifying energy optimization methods not only reduces environmental pollution, but also reduces the need for non-renewable energy [3]. Using artificial intelligence is one of these methods. In this research, using artificial intelligence optimization algorithms and changing parameters in order to reduce energy consumption [4], this issue has been investigated. This method can provide more accurate results than other building energy simulation tools.

In this article, several algorithms for optimizing building energy consumption are presented. The purpose of this article is to identify accurate and widely used algorithms in this field. Algorithms that have high error rate, speed and accuracy in calculations. From the obtained results, it can be seen that the most used algorithms for optimizing energy consumption and predicting the energy performance of buildings are: genetic algorithm, artificial neural network and support vector machine. The optimization algorithm can be chosen depending on the given constraints and the general form of the problem. in addition to elaborating on the principles and applications of the AI-based model approaches widely used in building energy use prediction, an evaluation framework is introduced and used for assessing the recent research conducted in this field and across the major AI domains, including energy, comfort, design, and maintenance.

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ANALYSIS IF THE MECHANICAL BEHAVIOR OF GYPSUM COMPOUNDS CONTAINING SILICA FUME

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Keywords: *Plaster, recycled materials, ash waste, circular economy, silica fume*

Abstract

Nowadays, the use recycled materials for the production of new construction products is increasingly common, due to the social demand towards more sustainable and regenerative constructions. This contributes to reducing the impacts generated by consuming natural resources and reducing construction waste, which is highly harmful.

The persistence of achieving resistant and durable materials containing waste is today one of the key challenges of many companies and researchers in the sector. Therefore, the objective of this work is to reduce the environmental impact in the construction sector by developing gypsum composites containing silica fume waste. For this, an experimental pan was develop to add 0 – 35% of silica fume over the weight of gypsum, in order to evaluate the effect of adding silica fume in the mechanical properties of traditional gypsums.

All composites were subjected to dry bulk density, superficial hardness and mechanical resistances.

The results obtained in the research showed that it was possible to add silica fume to the plasters, improving the mechanical resistance of traditional gypsums. In particular, up to 35% of silica fume can be incorporated keeping workability and exceeded the minimum values required by the regulations.

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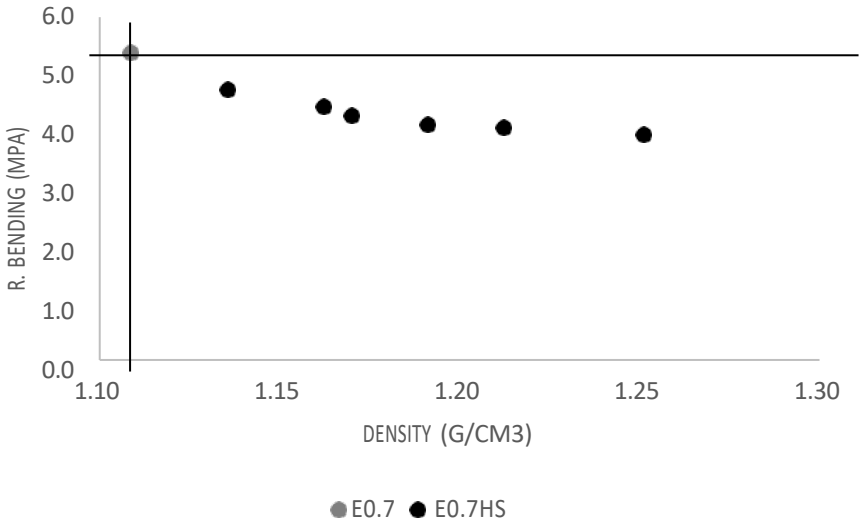

Figure 1: *Resistance to bending / density. (Source: Kevin René Chillán)*

Table 1: *Calibri 10, lower-case, italics*

Compuestos	Relación A/Y	Compuesto
0%	0,7	-
35%	0,7	HS

Compound reference A/Y

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EVALUATING THE THERMAL PERFORMANCE AND ENERGY EFFICIENCY OF A TROMBE WALL IN A LIGHTWEIGHT STEEL FRAME ENCLOSURE: EXPERIMENTAL AND NUMERICAL ANALYSIS

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Keywords: *passive solar; Trombe wall; light steel frame; thermal behaviour; energy efficiency.*

Abstract

Buildings are increasingly turning to renewable energy sources, such as solar power, and passive systems like Trombe walls. However, the effectiveness of Trombe walls depends on various factors. This study examines the thermal performance and energy efficiency of a Trombe wall within a lightweight steel frame compartment. Utilizing both *in situ* measurements and numerical simulations, we assessed its behavior under real-world conditions. The experiments were conducted within two identical cubic modules exposed to natural weather conditions, while simulations employed validated dynamic models.

We analyzed the Trombe wall's winter benefits, focusing on indoor temperature rise and reduction in heating energy consumption. Additionally, a parametric study of its thermal behavior was conducted. Key comparisons included variations in weather conditions (sunny vs. cloudy weeks), energy usage for different purposes (office vs. residential), heating set-points (20°C vs. 18°C), Trombe wall cavity thickness, thermal storage wall thickness, dimensions of interior vents, and material composition of the thermal storage wall.

Our findings reveal that a well-designed Trombe wall can significantly enhance thermal comfort and decrease heating energy demand. However, inadequate design or control measures, such as insufficient mitigation of nocturnal heat losses, may render the benefits negligible or even counterproductive.

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IMPLEMENTATION OF TOOLS FOR IMPROVEMENT AND OPTIMIZATION OF WORK PROCESSES WITH CAD SOFTWARE AND SPREADSHEETS FOR THE SUBJECT TECHNOLOGY PROJECTS WORKSHOP

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Keywords: *BIM, CAD, technical code, structures, software*

Abstract

Future architects must be able to choose and calculate the facilities, the construction system and the structural system of the building they design, integrating these disciplines into the architectural context of the buildings and acquiring a commitment to functionality, economy, aesthetics and environmental balance. This is why the Technology Projects Workshop subject in the 5th year of the Architecture degree has the following learning objectives:

- Apply specific technical regulations on technical disciplines in buildings.
- Plan, design, size and calculate the facilities, construction system and structural system.
- Develop capabilities and skills to be able to integrate technical disciplines and their influence on architectural design through design.

The workflow in architectural education with the integration of computer tools in design processes has been an area of growing interest and relevance [1 y 2]. In an increasingly digital world, understanding how these tools affect work processes is essential to prepare future architects for the challenges of contemporary design linked to the development of parametric architecture [3 y 4]. In this context, the present study presents a proposal for the introduction of tutorials to improve the processes of using spreadsheet tools integrated with CAD, BIM and GIS software to improve the efficiency and quality of the work developed by students in the subject:

1) AutoCAD, Structural Code and Excel (Figure 1).

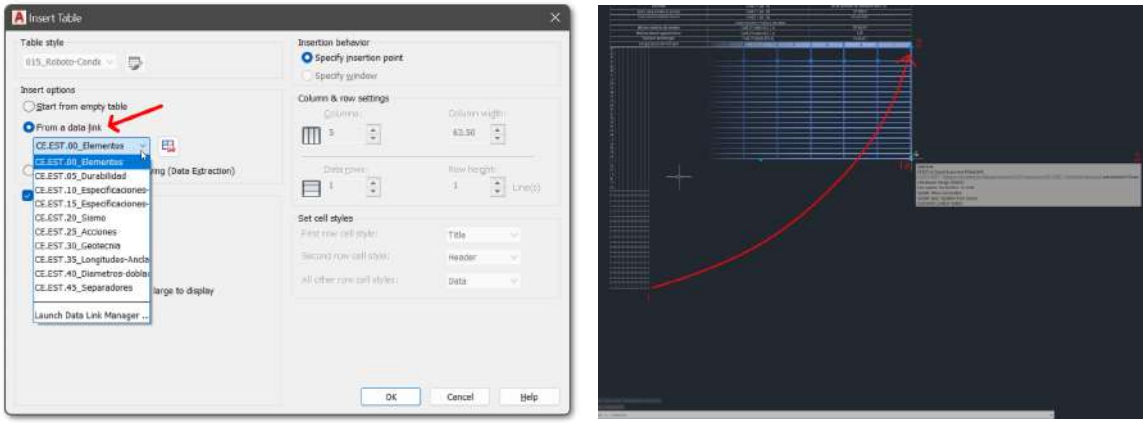

Figure 1. *Screenshots of the Autocad, Structural code and Excel tutorial.*

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2) AutoCAD: printing with precision (Figure 2).

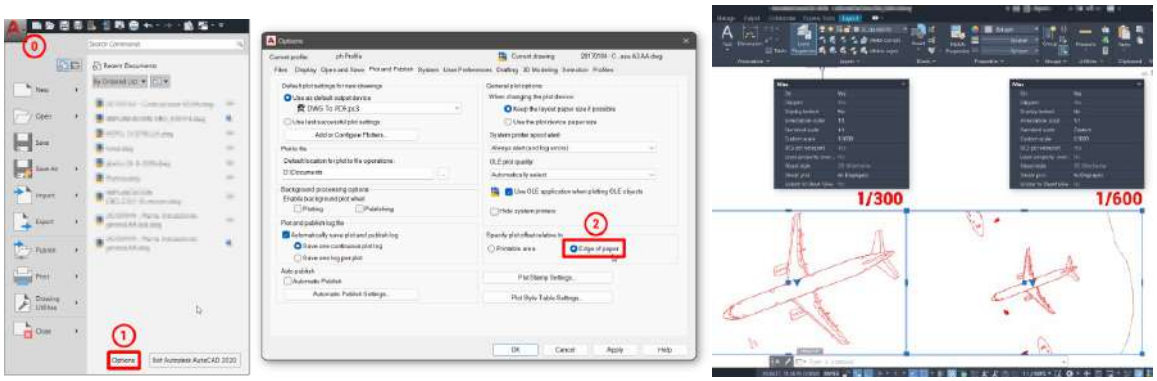

Figure 2. *Screenshots from the Autocad tutorial: Printing with precision.*

3) Automated Batch Renaming in AutoCAD (Figure 3).

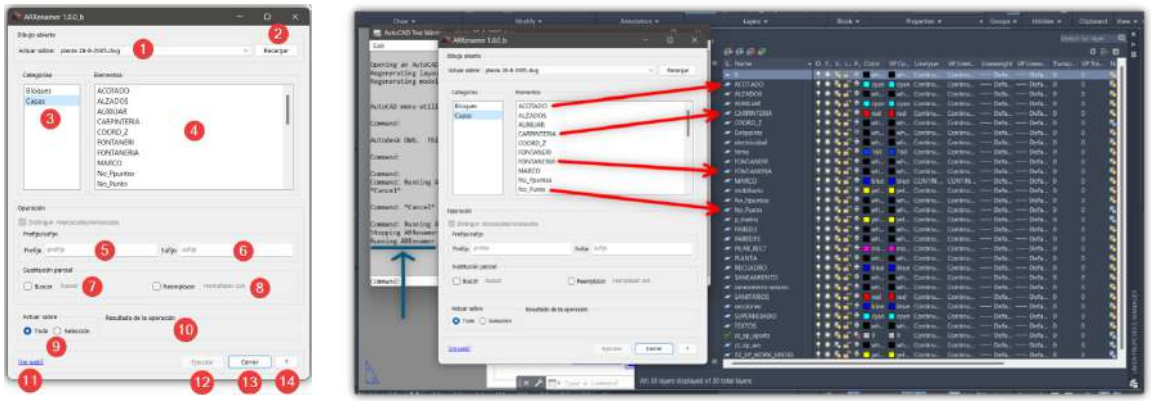

Figure 3. *Tutorial Screenshots: Automated Batch Renaming in AutoCAD.*

4) Express management of cadastral data using Excel (Figure 4).

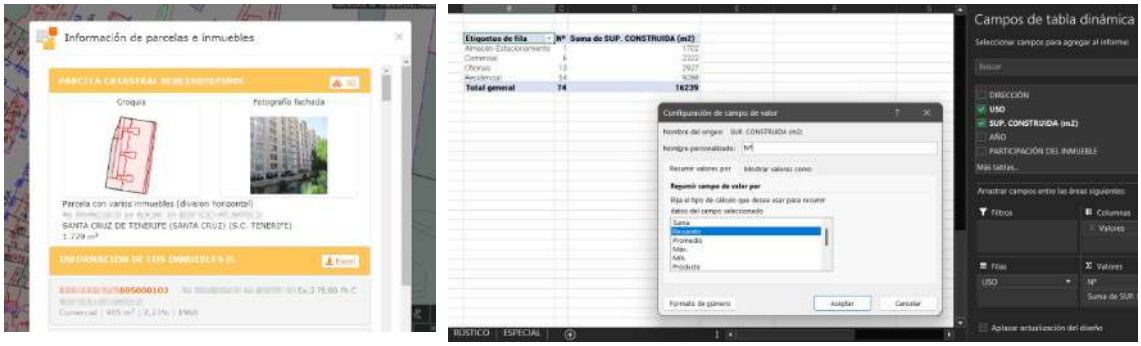

Figure 4. *Screenshots of the tutorial: Express management of cadastral data using Excel.*

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5) Automate the climate zone assignment of our projects using Excel (Figure 5).

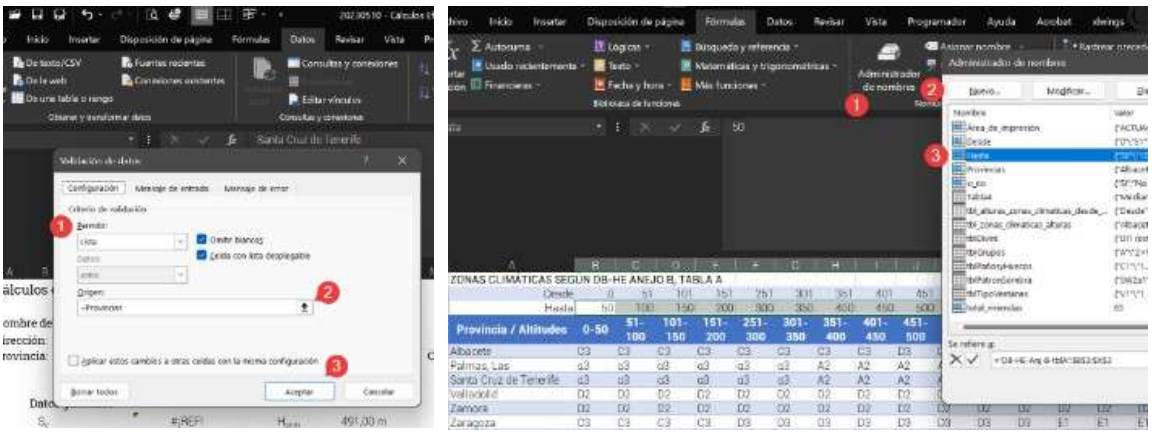

Figure 5. *Tutorial Screenshots: Automate Climate Zone Assignment.*

6) Work with QGIS and open data for the urban parameters of the project (Figure 6).

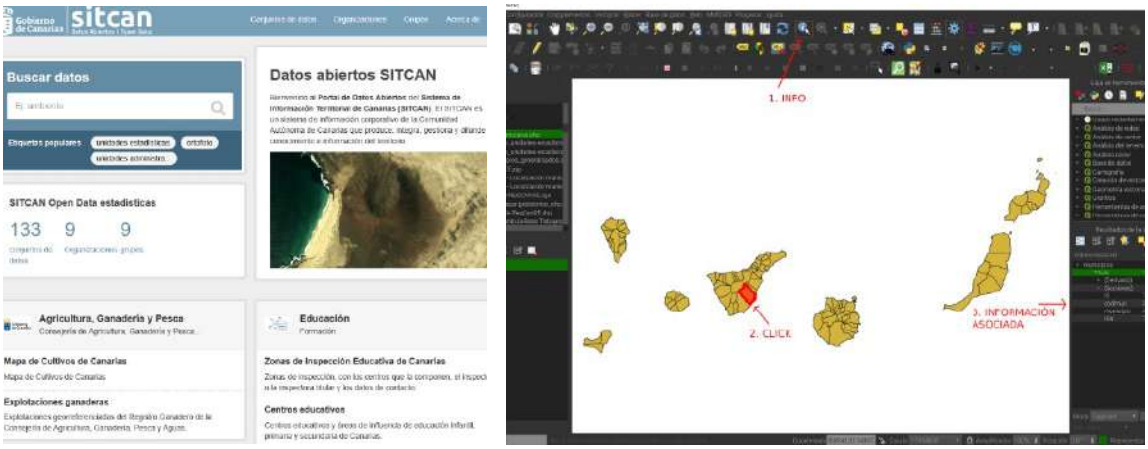

Figure 6. *Screenshots of the tutorial: Working with QGIS and open data.*

Several studies have highlighted how these tools contribute to three-dimensional visualization, efficient collaboration and data analysis in advanced architectural projects [5 y 6]. These studies suggest that the appropriate use of digital tools can improve creativity, problem solving, and preparation for the practical challenges of the profession [7 y 8]. However, it is also crucial to recognize the challenges and limitations associated with implementing these tools. These may include resistance to change, need for additional training, and the possibility of overreliance on technology [9].

In conclusion, the Implementation of tools to improve and optimize work processes with CAD, GIS, BIM and spreadsheet software for the Technology Projects Workshop subject is not only viable, but also highly beneficial, as it emerges as a strategy promising to enrich architectural training, optimizing work processes and improving the use made of the resources and possibilities of these applications. Although challenges have been identified, the potential benefits in terms of efficiency and design quality support the continued exploration and adaptation of these technologies in the educational field. Highlighting its importance for the development of practical and theoretical skills in future architects.

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Installations

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INTEGRATION OF WATER HARVESTING SYSTEMS, POWERED WITH ENERGY OVERPRODUCTION IN BUILDING

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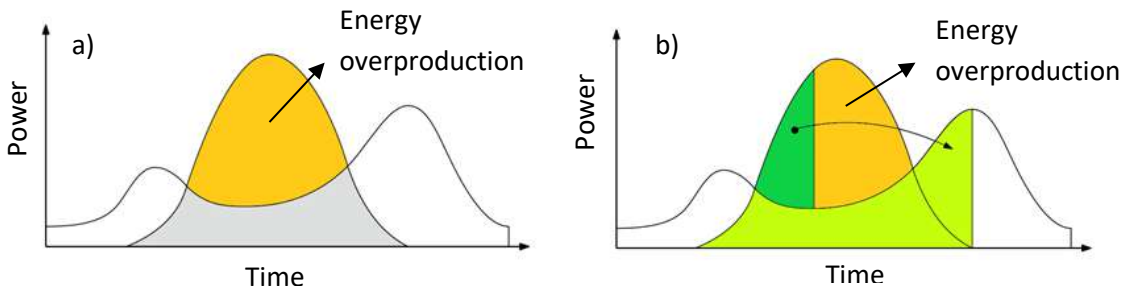
Keywords: *Smart Building; Integrated technologies; Vapor Compression Cycle; Sustainable Energies*

Abstract

Current trends in energy production are geared towards matching supply and demand in order to optimize the cost of energy production [1]. Therefore, there are different types of energy sources and technologies, each of them with different characteristics. These sources can be classified following different approaches. With regard to response capability, there are a number of technologies with a slow response but large capacity [2]. Traditionally, these technologies have been used to provide the baseload power required by the grid.

Applying this to microgrids and relating it to the integration with construction and building projects, this study proposes the implementation of integrated generation-consumption systems in microgrids in such a way that a synergy is created between construction methods and the procurement of commodities (energy and water) in new buildings and facilities, both urban and industrial.

Focusing on the use of different technologies, e.g., solar photovoltaic systems produce an excess of energy that in many cases is not consumed, as can be seen in Figure 1. This results in a reduction in productivity in the ratio (PG/PP), where PG is the generated power and PP is the consumed power [3].



While nuclear technologies are the most common systems with a large capacity for energy production despite a slow response, other technologies also come into play, such as biomass gasification with similar characteristics. The downside of this slow response

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is its inadaptability to demand. Traditionally, power discharge systems have been used to divert this excess to consumption systems such as dumping loads, which consume the excess power, avoiding possible problems in the microgrid. One way to increase the efficiency and adaptability of this technology to different consumption situations is to integrate power generation systems into the microgrid.

In line with this, this study proposes the integration of water production systems using Vapor Compression Cycle (VCC) systems combined with sustainable energy sources together in new constructions. Various studies comparing different Water Harvesting Technologies (WHT) highlight that among the different methods for extracting water from air humidity, the amount of water produced for compression technologies using VCC is more than other technologies [4, 5]. Condensation technologies can operate continuously and thus their WHRs are relatively high.

This type of system is particularly useful in smart microgrids, mainly in areas that are separated from the grid and do not have access to a water supply. In this way, not only is the urbanization and industrialization of areas that are a priori not favorable made possible, but the cost of investment is also reduced, which increases directly with the distance to the supply points.

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BUILDING CERTIFICATION IN SPAIN AND ITALY - A JOURNEY TOWARDS BUILT SUSTAINABILITY

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Keywords: *energy certification, sustainability,*

Abstract

This study collects, analyzes and researches on the different ways to manage, perform and get performance from energy certification in existing buildings. This research compares the processes that are carried out and regulated by the different regulations in Spain and Italy.

In Italy, energy certification of buildings has become a key element of national energy and environmental policy: Italy has partly anticipated and partly followed EU directives, implementing regulations aimed at both reducing consumption and improving energy efficiency. For some years now, it has been applying a series of specific tax incentives (Ecobonus, Sismabonus and, more recently, Superbonus) to stimulate the renovation of the Italian building stock. This initiative was introduced to implement the European Energy Efficiency Directive (2012/27/EU), which requires Member States to develop a regulatory framework to assess and improve the energy efficiency of buildings [1,2,3].

Energy certification in Italy is mainly regulated by Law no. 90/2013 and its subsequent amendments, which establishes the requirements and procedures for the assessment of the energy performance of buildings [4].

This legislation requires all buildings, both residential and commercial, to be subject to energy certification at the time of sale or rental. Energy certificates, known as APE are issued by certified technicians and provide a clear indication of the building's energy efficiency, expressing energy consumption in kWh/m² per year and assigning an energy class from A4 (most efficient) to G (least efficient).

Energy efficiency is an essential pillar in the fight against climate change and sustainable resource management. Energy efficiency is therefore a vital component in our transition to a more sustainable world. The Royal Decree on Energy Efficiency underlines this importance and seeks to create a framework in which energy is used as optimally as possible.

The Royal Decree on Energy Efficiency is emerging as a key tool for Spain, establishing guidelines; here we will analyse the most relevant points and how they affect both consumers and producers [5,6].

Currently, the entire energy efficiency standard is contained in Royal Decree 390/2021, of 1 June, which approves the basic procedure for the certification of the energy efficiency of buildings.

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Gender Perspective

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HOUSING OPTIONS FOR WOMEN VICTIMS OF VIOLENCE

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Keywords: *Violence, housing, quality, security, inclusion*

Abstract

Violence against women represents a serious public health problem in today's society with significant repercussions, considered a violation of human rights. Housing plays a key role in prevention, treatment, and rehabilitation for these women.

The objective of this study is to analyze the implementation of support measures for women victims of violence according to international and national documentation and their suitability to reality from the perspective of professionals who attend to them.

Existing regulations on violence are compiled, followed by a qualitative study through in-depth interviews with two professionals, each with over ten years of experience, responsible for two direct support resources, during the month of July 2023.

Among the legislation found regarding the regulation of violence, the World Conference on Human Rights (UN, 1993) (1) stands out, establishing the foundations for the elimination of violence against women. In 2011, the Council of Europe Convention on preventing and combating violence against women (2) was signed. In Spain, Organic Law 1/2004 includes a comprehensive response and the right of victims to comprehensive and multidisciplinary assistance (3). Law 13/2010 in Castilla y León (4) regulates measures to eradicate violence through society awareness, prevention, and attention to women to achieve their effective recovery. In-depth interviews provide detailed information on professionals' experiences. The collected data are classified into three categories: a) Women's needs, b) Services they receive, c) Proposals to improve care. In terms of housing, they point out the advantages and disadvantages of having an anonymous or public service.

In conclusion, it is crucial to emphasize the importance of ensuring the right to protective measures and support for women who suffer violence, as outlined in the normative systems integrated into international, European, national, and regional frameworks, with a focus on attention from housing and the environment. The goal is to seek accommodations that apply proactive approaches emphasizing individualized, unified, immediate, comprehensive, and professionalized care, tailored to their safety

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and personal autonomy needs, through resources that enable social inclusion in a violence-free environment.

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