Universidad Politécnica de Madrid

ESCUELA TÉCNICA SUPERIOR DE EDIFICACIÓN

5º Congreso Internacional de Gestión en Edificación (BIMIC)

5th Building and Management International Conference

Fundación General de la Universidad Politécnica de Madrid

Pastor, 3, Madrid, 28003, Madrid

Primera Edición :2021

ISBN: 978-84-18255-72-4

Depósito Legal: M-25385-2024

5th BUILDING AND MANAGEMENT INTERNATIONAL CONFERENCE

5º CONGRESO INTERNACIONAL DE GESTIÓN EN EDIFICACIÓN

BUILDING & MANAGEMENT

BIMIC

INTERNATIONAL CONFERENCE

MADRID
22-23-24
November
2023

PROCEEDING

ETSEM

UNIVERSIDAD POLITÉCNICA DE MADRID

Escuela Técnica Superior de Edificación
Universidad Politécnica de Madrid

Avda. Juan de Herrera, nº 6 - 28040 - Madrid

Colabora el Instituto Politécnico Da Guarda (Portugal)

4th BUILDING AND MANAGEMENT INTERNATIONAL CONFERENCE

4º CONGRESO INTERNACIONAL DE GESTIÓN EN EDIFICACIÓN

ESCUELA TÉCNICA SUPERIOR DE EDIFICACIÓN
Avenida Juan de Herrera, 6. 28040 – Madrid
Tel. 91 336 75 95 Fax: 91 336 76 44
Universidad Politécnica de Madrid

ORGANIZING COMMITEE / COMITÉ ORGANIZADOR

Capitán Gómez, José Ángel

Cobo Escamilla, Alfonso

Fernández Álvarez, Miguel

Llauradó Pérez, Nuria

Sanz Contreras, Mª Carmen

Valiente López, Mercedes

Vallejo Vicente, Celia

TECHNICAL SECRETARY / SECRETARÍA TÉCNICA

Aguilera Benito, Patricia

Díaz Fernández, Carlos

Esteban Pajares, Borja

Leal Matilla, Alberto

López Luengo, Silvia

Martínez Rodríguez, Mar

Martínez Ruano, Jesús

Piña Ramírez, Carolina

Villafranca Martín, María del Mar

SCIENTIFIC COMMITEE / COMITÉ CIÉNTIFICO

Aguilera Benito, Patricia
Albistur, Alejandro
Bautista Arija, Maria Asunción
Borrachia, Alejandro
Brioso Lescano, Xavier Max
Brizuela Valenzuela, Daniela
Cardoso Guedes, Joana
Carpio de los Pinos, Antonio José
Carretero Ayuso, Manuel Jesús
Cobo Escamilla, Alfonso
Da Silva Rodrigues, María Fernanda
De Pereda Fernández, Luís
Dufrasnes, Emmanuel
Flórez de la Colina, María Aurora
García López de la Osa, Gregorio
Gawryluk, Dorota
González García, María de las Nieves
Guarini, María Rosaria
Gunnigan, Louis
Hernández López, Héctor
Jankauskienė, Dainora
Lean Matilla, Alberto
Llauradó Pérez, Nuria
Martínez Pérez, Inmaculada
Piña Ramírez, Carolina
Poças Martins, João
Prieto Barrio, María Isabel
Romero Barriuso, Álvaro
Ruíz Román, José Manuel
Sánchez de la Muela, Alejandro
Santos Baptist, João
Sapienza, Vicenzo
Segarra Cañamares, María
Serrano Lanzarote, Begoña
Torre, Carmelo María
Valiente López, Mercedes
Valivonis, Juozas
Vázquez Jiménez, Sergio
Velasco López, Francisco Javier

PRESENTACIÓN

CONGRESO INTERNACIONAL DE GESTIÓN EN EDIFICACIÓN (BIMIC 2023)

22, 23 y 24 de noviembre de 2023

BIMIC nace con el **objetivo** de servir de plataforma a la difusión de los avances en el ámbito de la Gestión en la Edificación.

Este año la Conferencia está organizada por la ETS de Edificación junto al Instituto Politécnico Da Guarda, por lo que se celebra de manera simultánea en dos sedes, en **Madrid (España)** y en **Guarda (Portugal).**

Los temas de interés incluyen todos los avances teóricos, metodológicos y prácticos en la gestión de edificios dentro de cualquier fase de su vida: proyecto, construcción, uso, mantenimiento y fin de vida.

El **programa BIMIC 2023** está estructurado en conferencias invitadas, mesas redondas, comunicaciones orales, posters y talleres sobre la base de diferentes áreas temáticas, tales como Gestión de Accesibilidad, Gestión y Seguridad en la Construcción, Gestión de Evaluación de Riesgos, Rehabilitación, Patología y Mantenimiento de Edificios, Eficiencia Energética, Innovación en la Construcción, Gestión de Planificación Urbana, Gestión de la Construcción de Edificios.

Finalmente agradecer la siempre inestimable colaboración de la Cátedra-Empresa Proiescón y a la empresa INACOM Ingeniería Aplicada.

El Comité Organizador

INTRODUCTION

BUILDING AND MANAGEMENT INTERNATIONAL CONFERENCE (BIMIC 2023)

November 22-23-24, 2023

BIMIC was born with the **aim** of serving as a platform for the dissemination of advances in the field of Building Management.

This year the Conference is organized by the ETS de Edificación together with the Federal Institute of Pernambuco, so it is held simultaneously in two venues, in **Madrid (Spain)** and in **Recife (Brazil).**

Topics of interest include all theoretical, methodological and practical advances in building management within any phase of their life: design, construction, use, maintenance and end of life.

The **BIMIC 2023 program** is structured in invited lectures, round tables, oral communications, posters and workshops based on different thematic areas, such as Accessibility Management, Construction Management and Safety, Risk Assessment Management, Rehabilitation, Pathology and Building Maintenance, Energy Efficiency, Construction Innovation, Urban Planning Management, Building Construction Management.

Finally, we would like to thank the always invaluable collaboration of the Proiescón Chair-Company and the company INACOM Ingeniería Aplicada.

The Organizing Committee

TABLE OF CONTENTS BY TOPICS

BUILDING CONSTRUCTION MANAGMENT.....46

FACILITIES AND BUILDING SERVICES MANAGEMENT

ARTIFICIAL NEURAL NETWORKS FOR FORECASTING INDOOR AIR QUALITY IN HOSPITALS: A REVIEW

Antonio RIVERO-CACHO[a], Manuel BOTEJARA-ANTÚNEZ[b], Gonzalo SÁNCHEZ-BARROSO[c], Jaime GONZÁLEZ-DOMÍNGUEZ[d], Justo GARCÍA-SANZ-CALCEDO[e]

[a] *MSc, University of Extremadura, Department of graphical expression, Address: Av. de Elvas, 06006, Badajoz, Spain, antoniorc@unex.es*

[b] *MSc, University of Extremadura, Department of graphical expression, Address: Av. de Elvas, 06006, Badajoz, Spain, manuelba@unex.es*

[c] *PhD, University of Extremadura, Department of graphical expression, Address: Av. de Elvas, 06006, Badajoz, Spain, gsm@unex.es*

[d] *PhD, University of Extremadura, Department of graphical expression, Address: Av. de Elvas, 06006, Badajoz, Spain, jaimegd@unex.es*

[e] *PhD, University of Extremadura, Department of graphical expression, Address: Av. de Elvas, 06006, Badajoz, Spain, jgsanz@unex.es*

E-mail: jgsanz@unex.es (corresponding author)

Keywords: *Artificial Neural Networks, Healthcare Engineering, Indoor Air Quality, Forecasting.*

Abstract

The risk of nosocomial infection is related to the existence of particulate matter (PM) in hospital operating theatres. This problem is one of the main causes of increased costs in healthcare buildings due to longer patient stay times. Discretized monitoring over time through on-site audits does not allow continuous monitoring of the level of PM in the environment and adequate cleaning of the operating room. Therefore, this work proposes to discover types of artificial neural networks (ANN) to predict the existence of PM in hospital operating theatres from indoor environmental conditions. The advantages and disadvantages of a set of seven types of ANNs were evaluated. Factors such as training algorithm, convergence speed, the architecture of each ANN (number of layers and the neurons in each layer) and activation function were taken into account. Five ANNs were detected whose characteristics can be assimilated to the nature of the problem under study. In short, this work contributes to continuous monitoring of the PM level in operating theatres and, consequently, optimising audit plans in operating theatres and reducing the risk of nosocomial infection in these wards.

AIR-FLOW MOVEMENT IN TRADITIONAL ARCHITECTURE AND ITS EFFECT ON WELL-AIR-CONDITION

SEYEDEH MASOUMEH ABTAHI [a]

[a] *PH.D STUDENT, Universidad Politécnica de Madrid, Higher Technical School of Architecture, Address: Avenida Ramon y Cajal, 28016, MADRID, SPAIN , E-MAIL: Masoumeh.abtahi@alumnos.upm.es*

Keywords: *Air-Flow Movement, Iranian, Traditional Architecture, Building Form*

Abstract

In this research, the topic of searching about traditional architecture and air conditioning, investigating the geometrical conditions of traditional architecture, and communicating between the geometrical shapes used in the construction of Iranian architectural spaces and buildings has been addressed and an attempt has been made to find researches in which with use of simulator software has simulated the movement of air-lines, to finally achieve a suitable pattern for future designs. An analytical study has been made of selected architectural geometries, and not only the final form and its relationship with climatic behavior, but also considering the impact that criteria and typologies have had on the configuration of these forms have been researched. The conducted studies show that most of the architectural elements affecting air movement have been explored. The current research is based on the search of keywords in the most productive articles and books on the subject.

MULTI-VARIANTITY OF SOLAR CHIMNEY OPERATION

Marta GORTYCH[a], Piotr GRABAS[b], Zygmunt LIPNICKI[c]

[a] PhD eng., Uniwersity of Zielona Góra, Institute of Environmental Engineering, Address: 15 Szafrana, 65-516, Zielona Góra and Poland, "Piotr Grabas" <p.grabas@adm.uz.zgora.pl>;
[b] M.Sc., Uniwersity of Zielona Góra, Institute of Environmental Engineering, Address: 15 Szafrana, 65-516, Zielona Góra and Poland, p.grabas@adm.uz.zgora.pl
[c] Prof., Uniwersity of Zielona Góra, Institute of Environmental Engineering, Address: 15 Szafrana, 65-516, Zielona Góra and Poland, z.lipnicki@iis.uz.zgora.pl
E-mail: m.gortych@iis.uz.zgora.pl (corresponding author)

Keywords: *solar chimney, solidification of PCM, heat transfer coefficient, solar heating.*

Abstract

The paper presents concepts for the work of a solar chimney in three different variants: the use of solar radiation, the use of a heat exchanger and the use of the phenomenon of phase transformation of the PCM material (melting and solidification). Experimental studies were conducted to show how the heat transfer coefficient for turbulent air flow can be determined in a simple way. It was then shown that the value of this heat transfer coefficient can be used to calculate the heat transfer that occurs in the air gap of a solar chimney. The solar chimney presented in the paper works as a heat exchanger.

SIMULATION-BASED MULTI-OBJECTIVE OPTIMIZATION TO REDUCE TOTAL SITE BUILDING ENERGY CONSUMPTION, CO_2 EMISSIONS, THERMAL DISCOMFORT HOURS, VISUAL DISCOMFORT HOURS, AND IMPROVE INDOOR AIR QUALITY: CASE STUDY IN IRAN

Farshid DEHGHAN[a], César Porras-Amores[a]

[a] *Universidad Politécnica de Madrid, Escuela Técnica Superior de Edificación (ETSEM)*

Abstract

This paper aims to present a simulation-based multi-objective optimization of architectural specifications and control parameters. Simulations are carried out using EnergyPlus and OpenStudio sketchup plugin, objective functions, and decision-making parameters are identified by jEPlus, and multi-objective optimization is done by jEPlus + EA through NSGA-II. Also, in this software, Morris sensitivity analysis was used to determine how input variables affect particular objective functions. 30 design variables are considered, the most important of them are orientation, heating and cooling setpoint, air infiltration rate, activity level, U-value of materials, and shading control type. The annual total site building energy consumption, CO2 emissions, zone air CO2 concentration, thermal discomfort hours, and visual discomfort hours are considered as 5 objective functions minimized simultaneously. The weighted sum method is used to select the final answer from Pareto solutions. According to the results, based on the climate, and design variables, the proposed optimization method leads to a significant decrease in the annual total site building energy consumption compared to the initial design simultaneously with a reduction in CO2 emissions, zone air CO2 concentration, and thermal and visual discomfort hours indexes, respectively. The results clearly show how appropriate selection of the design variables specifications can significantly not only prevent energy losses and CO2 emissions but also provide better occupants' indoor air quality, and thermal and visual comfort. Also, the levels of additional pollutants (CH4, N2O, NOx, SO2, water environmental factors) that decreased were also examined.

INNOVATION IN BUILDING ENGINEERING

ENHANCING DURABILITY IN STRUCTURAL APPLICATIONS OF STEEL FIBER-REINFORCED CONCRETE

[1] Funes Martínez Jorge Marcelo; [1]Alberti Marcos G.; [1]Gálvez Jaime C.; [2] Picazo Álvaro [3] Vera José

[1] Departamento de Ingeniería Civil, Construcción, E.T.S de Ingenieros de Caminos, Canales y Puertos, Universidad Politécnica de Madrid, c/Profesor Aranguren, s/n, 28040 Madrid, España.
jm.funes@alumnos.upm.es, marcos.garcia@upm.es ,jaime.galvez@upm.es

[2] Departamento de Tecnología de la Edificación, E.T.S de Edificación, Universidad Politécnica de Madrid. Avda. Juan de Herrera, 6, 28040, Madrid, España.
[3] ACCIONA Construction S.A., Technological Center, Valportillo II n8, Madrid 28108, Spain.
jose.vera.agullo@acciona.com

Keywords: *Darability, fibre-reinforced concretes, concrete.*

Abstract

Concrete is a composite material. The main matrix of all types of concrete consists of Portland cement, water, coarse and fine aggregates. Over the last few decades, the evolution of materials has been constant, significantly improving the properties and performance of concrete. Among the various types of special concretes, fibre-reinforced concretes (HRF) stand out for their improved mechanical properties and durability, which make them ideal for a wide variety of projects.
One of the special characteristics of HRF is durability, which has a direct impact on the service life of the structure. Generally, physical, chemical and direct and indirect stresses and exposures on concrete are determining factors for the service life of a concrete. These stresses are closely related to the opening of cracks in the concrete.

The addition of fibres improves durability in concrete by partially preventing the formation and controlling the growth of cracks, achieving a ductile behaviour after cracking. However, cracks are taken for granted throughout the life of concrete, many of them imperceptible to the human eye.

Research on the use of fibres in concrete revealed promising results for the durability of the material. A very significant reduction in water penetration under pressure was obtained compared to conventional concrete. Electrical resistivity showed homogeneous values, although with some variations attributable to the conductivity of the steel fibres, which could have influenced the accuracy of the measurements.

The chloride migration test showed some corrosion on the surface fibres of the specimen, especially on the side closest to the sodium chloride solution, but this did not affect the mechanical and durability properties of the specimens as the rest of the fibres were protected inside the concrete. The gas permeability coefficient obtained is satisfactory and the concrete can be used in marine environments, which is an essential requirement in many construction applications.

Therefore, the results obtained support the viability and effectiveness of fibre-reinforced concretes for use as structural concrete, contributing positively to the durability of any structure that requires it.

USE OF SCIA SOFTWARE TO PREPARE THE STRUCTURAL DESIGN OF A METAL WAREHOUSE

José Atila AROUCHA[a], Valdileia LOPES[b],

[a] *Engenheiro Civil Mestre, Universidade Estadual do Maranhão, Construção Civil, Rua Deputado Raimundo Leal S/N – Condomínio Porto Belo, casa 14 – Jardim Eldorado, 65066-635, São Luís - Maranhão, e-mail: atilajunior415@gmail.com*

[b] *Engenheira Civil Mestre, Universidade Estadual do Maranhão Construção Civil, Rua Deputado Raimundo Leal S/N – Condomínio Porto Belo, casa 14 – Jardim Eldorado, 65066-635, São Luís - Maranhão, e-mail: valdielialopes38@gmail.com*

E-mail: atilajunior415@gmail.com

Keywords: *Structures; Sizing; Software.Scia; Buildings; Calculator.*

Abstract

The use of software for the preparation of structural projects for buildings allows for greater agility during their preparation, since the function of the calculator becomes more of a consultant, that is, the person carrying out an analysis of the way in which the structure will behave after the loads that must be supported by it are released. However, for the correct handling of the programs, it is essential that the calculation engineer has good theoretical knowledge about all the properties of the materials that will be used during the design of the structure to be made, with the aim of extracting all the necessary characteristics from the elements. for safe and economical structural design. Therefore, this work's main purpose is to carry out the design and structural detailing of a metal warehouse with the support of Scia software. For the entire development of the work to have the greatest possible technical basis, bibliographical research was carried out based on technical standards and bibliographies, to link all knowledge with practice and assist in decision-making during sizing.

USE OF NITINOL FIBERS IN THE REINFORCEMENT OF 3D CONCRETE PRINTING

Bahram AHADI[a], Mercedes VALIENTE LÓPEZ [b] , Farhad GOLMOHAMMADI DARYAKENARI[c]

[a] *PhD Student, Universidad Politécnica de Madrid, Escuela Técnica Superior De Edificación, Address: Juan de Herrera nº 6, 28040, Madrid, Spain, Bahram.ahadi@alumnos.upm.es*

[b] *Full Professor in Architecture, Universidad Politécnica de Madrid, Escuela Técnica Superior De Edificación, Address: Juan de Herrera nº 6, 28040, Madrid, Spain, mercedes.valiente@upm.es*

[c] *PhD Student, Universidad Politécnica de Madrid, Escuela Técnica Superior De Edificación, Address: Juan de Herrera nº 6, 28040, Madrid, Spain, farhad.golmohammadi@alumnos.upm.es*

E-mail: bahram.ahadi@alumnos.upm.es

Keywords: *3D concrete printing, 3DCP reinforcement, shape memory alloys, Nitinol, fiber reinforcement*

Abstract

The emerging field of 3D concrete printing has revolutionized the construction industry, offering unprecedented opportunities for speed, cost-effectiveness, and design flexibility. However, ensuring the structural integrity and durability of these printed concrete objects is crucial. To address this concern, researchers have been exploring innovative methods of reinforcing 3D printed concrete. Our proposed technique involves utilizing Nitinol fibers, an advanced shape memory alloy with exceptional mechanical properties. Shape memory alloys are smart materials that have memory and they can recover their first shape after deformation by applying a thermal load in shape memory effect behaviour and also, they can be elasticity deformed nearly to 8% strain. This paper delves into the potential implication and advantages of incorporating Nitinol fibers in the reinforcement of 3D printed concrete structures. To investigate effect of Nitinol shape memory alloy in 3D concrete printed structures, an analytical study was done. Five samples were modelled in Abaqus finite-element software and samples were analyzed by the three-point bending test. Nitinol-fibers reinforced sample, steel-fibers reinforced sample and an unreinforced sample were modelled. The maximum moment where each sample where failed was recorded and results were compared. Failure behaviour and crack propagation for Nitinol-fibers reinforced sample were studied and were compared with that of steel-fibers reinforced sample and also unreinforced sample.

DESIGN OF SUSTAINABLE STRUCTURAL MODULES FOR BIOCLIMATIC REGULATION SPACES.

Carlos Cesar MORALES GUZMÁN[a], Brenda BERENICE PÉREZ DEL ÁNGEL[b], Adonis Julián RODRIGUEZ HERRERA[c]

[a] *Doctor en Arquitectura y Doctor en Estructuras de la Edificación, Universidad Veracruzana, Facultad de Arquitectura, Avenida Venustiano Carranza s/n. Col. Revolución, A I M P, 93390 Poza Rica de Hidalgo, Ver., México, e-mail: dr,arqmorales@gmail.com*

[b] *Estudiante de Arquitectura, Universidad Veraccruzana, Facultad de Arquitectura, Avenida Venustiano Carranza s/n. Col. Revolución, A I M P, 93390 Poza Rica de Hidalgo, Ver., México, e-mail: berebren278@gmail.com*

[c] *Estudiante de Arquitectura, Universidad Veraccruzana, Facultad de Arquitectura, Avenida Venustiano Carranza s/n. Col. Revolución, A I M P, 93390 Poza Rica de Hidalgo, Ver., México, e-mail: zs19006302@estudiantes.uv.mx*

E-mail: dr.arqmorales@gmail.com (corresponding author)

Keywords: *Working model, Sustainable structure, Construction details*

Abstract

The present work developed the design of light roofs specifically in the area of tensegrity, since this type of structures can cover important spans, its design model will be studied to make an experimental prototype, which will be able to determine what type of joints can be manufactured in this structural system, it is simulated by the Robot Analysis Structural and Solid Work software, so this dissertation focused on the study of a design methodology to generate structural construction models, suitable for making tensegrity covers, therefore which a methodology was executed to build these systems and make them easier to design, with them we generated examples of application and use of this type of structural systems, so some academic cases that were developed in the design workshops of the degree are presented. of Architecture and the type of modeled roofs that can generate practical use.

EXPERIMENTAL STUDY OF USING MASONRY TECHNOLOGY WITH UNINSULATED SLAB-ON-GRADE TO PREVENT BUILDING OVERHEATING

Anna STASZCZUK[a], Tadeusz KUCZYŃSKI[b]

[a]Assoc. Prof., PhD, Eng., University of Zielona Góra, Institute of Civil Engineering, Szafrana Street 1, 65-516, Zielona Góra, Poland, A.Staszczuk@ib.uz.zgora.pl
[b]Full Prof., DSc, PhD, Eng., University of Zielona Góra, Institute of Civil Engineering, Szafrana Street 15, 65-516, Zielona Góra, Poland, T.Kuczynski@iis.uz.zgora.pl

E-mail: A.Staszczuk@ib.uz.zgora.pl (corresponding author)

Keywords: *thermal mass, energy storage, heat wave, overheating, climate change.*

Abstract

This paper proposes passive cooling method originate from the vernacular architectural tradition to which based on increase the thermal mass of the walls and remove the horizontal floor insulation of a single-storey detached house in order to reduce the excessively high air temperatures that occur in the building during heat waves. The study was conducted in two experimental free-standing residential buildings in west-central Poland from 1 June to 31 August 2019. During this period, the average temperatures in the bedrooms of the test building were 4.3°C lower and in the living room 5.7°C lower than in the reference building. In the reference building, the temperatures in the 3 bedrooms and living room were exceeded for 80% of the time. The temperature in the bedrooms and living room of the test building never exceeded 26ºC and 28ºC respectively. Thus, by removing the floor insulation and increasing the thermal mass of the walls from light to medium, the need for mechanical cooling was eliminated. An analysis of the temperature of the ground beneath the two buildings was carried out. The significantly higher ground temperatures under the building without floor insulation indicate that the ground in this case acts as a large heat accumulator, improving thermal comfort in summer and at the same time reducing heat loss from the building to the ground during the heating period. The actual energy consumption of the experimental building was 12% higher than that of the reference building. Meeting the increased heating demand of the building due to the removal of the floor insulation is possible by using a photovoltaic system of about 0.75 kWp.

THE PROPERTIES OF FRESH AND HARDENED CEMENT PASTE WITH WASTE SILICA FUME USED AS CEMENT REPLACEMENT

Vilma VAICEKAUSKIENE[a], Dzigita NAGROCKIENE[b], Ina PUNDIENE[c]

[a] *PhD Student, Vilnius Gediminas Technical University, Sauletekio 11, Vilnius LT-10223, Lithuania, vilma.vaicekauskiene@vilniustech.lt*
[b] *Professor PhD., Vilnius Gediminas Technical University, Sauletekio 11, Vilnius LT-10223, Lithuania, dzigita.nagrockiene@vilniustech.lt*
[c] *PhD., Vilnius Gediminas Technical University, Sauletekio 11, Vilnius LT-10223, Lithuania, ina.puidiene@vilniustech.lt*

E-mail: vilma.vaicekauskiene@vilniustech.lt (corresponding author)

Keywords: *silica fume, hardened cement paste, compressive strength, flexural strength, water absorption, water porosity, heat evolution.*

Abstract

The study analyses the size, physical properties and structure of waste silica fume particles generated during the production of silicon and ferrosilicon alloys. The results of the chemical analysis of silica fume show that silica prevails in the composition, up to 93.8%. The bulk density of silica fume is 480 kg/m^3, and the density of the particles is 2580 kg/m^3. The specific surface area of the particles is 1644 cm^2/g. The determined average size of silica fume particles is 1.6 times larger than that of cement particles and reaches 24.95 µm. SEM analysis confirms the presence of large agglomerates in silica fume. XRD analysis of the structure of silica fume revealed that amorphous phase and the mineral quartz prevail in the sample.

The influence of silica fume on the properties of hardened cement paste was investigated. Six batches of samples, where cement was replaced with silica fume in the following proportions: 0%, 1%, 2%, 3%, 4%, 5%, were analysed. It was determined that when up to 5% of cement was replaced with silica fume EXO peak duration increased by 38% and EXO peak temperature fell to 2.6%. The ultrasonic pulse velocity, compressive and flexural strengths, porosity and water absorption values of the 28-day-hardened cement paste samples showed that 2% is the most optimal substitution of cement with silica fume. When 2% of cement is replaced with silica fume, the density and ultrasonic pulse velocity of the samples increased by 1%, the values of compressive and flexural strength are 72% and 42% higher than in the control sample. Porosity and water absorption are the lowest compared to other samples. Silica fume can be used in the production of high-quality concrete when cement is replaced with 2% of silica fume.

MECHANICAL BEHAVIOR OF CONCRETE WITH REPLACEMENT OF FINE AGGREGATE WITH RECYCLED RUBBER

Maria Concetta COCCHIARA[a], Alfonso COBO ESCAMILLA[b], María Isabel PRIETO BARRIO[c]

[a] *Alumna de doctorado, Escuela Técnica Superior de Edificación (UPM), Avda. Juan de Herrera 6, 28040, Madrid, España, mariaconcetta.cocchiara@alumnos.upm.es*
[b] *Doctor, Escuela Técnica Superior de Edificación (UPM), Avda. Juan de Herrera 6, 28040, Madrid, España, alfonso.cobo@upm.es*
[c] *Doctor, Escuela Técnica Superior de Edificación (UPM), Avda. Juan de Herrera 6, 28040, Madrid, España; mariaisabel.prieto@upm.es*

E-mail: mariaconcetta.cocchiara@alumnos.upm.es (corresponding author)

Keywords: *concrete; rubber; disused tires; compression; sustainability.*

Abstract

The objective of this research is to study the behavior of a more sustainable construction material that can contribute to the circular economy: recycled rubber concrete (RuC). For this purpose, the fine aggregate was replaced by rubber, in percentages: 0% (reference), 10%, 20% and 30% in volume, testing a total of 24 cylindrical specimens and evaluating their mechanical properties. This type of material tends to have a better impact resistance than normal concrete, although the results show that it has a tendency to decrease in resistance with a higher percentage of rubber. From 20%, the substitution does not influence the average compressive strength values, although the elongation at break value continues to decrease on average. Concrete with rubber is a valid alternative as a non-structural construction material.

BIM METHODOLOGY BASED ON COMPLEX SYSTEMS AND BIOMATERIALS APPLIED TO URBAN METABOLISM AND THE DECARBONIZATION OF BUILDINGS. CASE STUDIES: JALISCO AND QUERETARO, MEX.

Fabiola COLMENERO FONSECA [a]; J.C.C. Javier CÁRCEL-CARRASCO [b] Juana PERLAZA RODRÍGUEZ [c]; Juan Francisco PALOMINO BERNAL [d]; Ramiro RODRÍGUEZ PÉREZ [e]

[a] *Postdoctoral Research. Universitat Politècnica de València, Institute of Materials Technology, 46022 Valencia, Spain; fcolfon@upvnet.upv.es*

[b] *Research. Dr. University Professor. Universitat Politècnica de València, Institute of Materials Technology, 46022 Valencia, Spain; fracarc1@csa.upv.es*

[c] *P.h.D. Student. Università degli Studi della Basilicata. Department of European Mediterranean Cultures: Architecture, Environment and Cultural Heritage. Via Lanera 20, Matera, Italia; juana.perlaza@unibas.it*

[d] *P.h.D. Student. Universitat Politècnica de València, 46022 Valencia, Spain; jfpalber@doctor.upv.es*

[e] *P.h.D. Student. Universitat Politècnica de València, 46022 Valencia, Spain; rrodper@doctor.upv.es*
E-mail: fcolfon@upvnet.upv.es (corresponding author)

Keywords: *BIM/BEM, Multi-Scale Analysis of Society and Ecosystem Metabolism (MuSIASEM), Circular Urbanism, Green Building, material passports*

Abstract

This article explores how the construction sector can significantly contribute to minimizing its environmental impact through reuse and recycling practices, whether in retrofit or new construction projects. This research focuses on the implementation of BIM methodology, supported by the use of biomaterials, 3D modeling, and digitization, all aligned with the Green Building Construction approach. Through a comparative analysis, two case studies located in Jalisco and Querétaro, Mexico are examined. In these, the operational energy consumption is evaluated about the materials used in their construction. The simulations are carried out in different geographical areas and using two different construction systems. The results show clear advantages in the use of biomaterials instead of traditional materials, such as concrete, by achieving a significant reduction in operating energy consumption. In addition, from an economic point of view, benefits in energy costs and a significant reduction in CO2 emissions are observed. In conclusion, both the models, simulations, and the Toolkit underline the superiorities of biomaterials over conventional industrial materials.

COMPARATIVE STUDY BETWEEN CONSTRUCTION SYSTEMS: LIGHT STEEL FRAMING VS TRADITIONAL CONSTRUCTION

Micheli NASCIMENTO[a], José ALMEIDA[b], Laura SANTOS[c], Fernando MACHADO[d]

[a] Licentiate, Instituto Politécnico Guarda, Civil Engineering, Address: Av. Dr. Francisco Sá Carneiro 50, 6300-559, Guarda, Portugal, micheli.nt@hotmail.com
[b] PhD, Instituto Politécnico da Guarda, Civil Engineering, Address: Av. Dr. Francisco Sá Carneiro 50, 6300-559, Guarda, Portugal, jcalmeida@ipg.pt
[c] Licentiate, S² Projetos e Construção, Lda, Civil Engineering, Address: Rua Vasco da Gama 23 2ºE, 6300-722, Guarda, Portugal, s2projetoseconstrucao@gmail.com
[d] PhD, Instituto Federal do Sul de Minas Gerais, Civil Engineering, Address: Av. Maria da Conceição Santos 900, 37550-000, Pouso Alegre, Brasil, fernando.scheffer@ifsuldeminas.edu.br

E-mail: micheli.nt@hotmail.com

Keywords: *Costs; Time; Light Steel Frame; Traditional Construction.*

Abstract

One of the sectors that most impacts the environment is traditional construction, as it consumes a lot of energy and produces many wastes. With the aim of updating the civil construction market, which with the pandemic and the emergence of various difficulties, especially the increase in the cost of the work in general, both in relation to labour and the costs of materials, a study is proposed to compare costs and construction time between the traditional construction system and Light Steel Framing (L.S.F.). Studies carried out since then present a cost/benefit reality that may be altered, according to the current market reality.

According to in July 2022, it is estimated that the construction costs of new housing have increased by 13.4% in homologous terms, plus 0.9 percentage points than observed in the previous month. The price of materials and the cost of labour presented, respectively, homologous variations of 17.5% and 7.7%.

In this article, the L.S.F. is historically contextualized, and, through three case studies, a comparison is shown between the traditional construction system and the L.S.F. system in terms of costs and construction time.

COMPARISON OF CONCRETE DURABILITY BASED ON EHE-08 AND THE STRUCTURAL CODE.

Julie DELGRANGE[a], Leonardo SANCHEZ ACEVEDO[b],

[a] *Universidad Politécnica de Madrid, Escuela Técnica Superior de Edificación, Avenida Juan de Herrera 6, 28040, Madrid, Spain, julie.delgrange@alumnos.ups.es*
[b] *Universidad Politécnica de Madrid, Escuela Técnica Superior de Edificación, Avenida Juan de Herrera 6, 28040, Madrid, Spain,, leonardo.sanchez@alumnos.upm.es*

E-mail: Leonardo.sanchez@alumnos.upm.es (corresponding author)

Keywords: *Durability, carbon fibers, steel fibers, natural fibers, eco-frienfly concrete*

Abstract

In many European countries, such as France and Germany, the structural code applied is the Eurocode. The Eurocode is a European standard that aims to harmonize the methods of design and justification of building and civil engineering structures. The Eurocodes are accompanied by specific national annexes for each country. In Spain, the Eurocodes are used, but the mandatory code for all structures using concrete is the Spanish Structural Concrete Instruction (EHE-08) [1]. This code was repealed in the BOE and replaced by the Structural Code [2] on 10 November 2021. The latter establishes a link between Eurocode 2 [3] and EHE-08 [1], with the aim of gradually moving the country towards the automatic use of Eurocodes, as in neighboring countries. To highlight the different changes developed by the new structural code, it will be interesting to make a comparison of the durability strategy between EHE-08 [1] and the structural code [2]. The durability of concrete can be improved in different ways, such as by adding fibers that can be natural or carbon fibers. However, to reduce the ecological footprint, other options must be considered. A comparison between fiber concrete and green concrete will highlight their advantages and disadvantages. Natural fiber concrete offers a more environmentally friendly option due to its renewable and biodegradable components, although it may have limitations in terms of strength. Carbon fiber reinforced concrete offers high strength and durability but has a greater environmental impact. Green concrete, on the other hand, emphasizes sustainable production practices and materials to reduce the overall ecological footprint. The choice between these options should consider specific project requirements and sustainability objectives.

MORTAR MADE FROM KRAFT PAPER COMPOSITE CONTAMINATED WITH PORTLAND CEMENT

Ricardo C SOARES[a], Poliana BELLEI[b]

[a] *Professor with master's degree in engineering, Federal Institute of Alagoas, Department of Civil Engineering, St. Ferroviário, 57020-600, Maceió, Alagoas, Brazil, ricardo.soares@ifal.edu.br*

[b] *Ph.D. student in engineering, Lisbon University, Institution, Instituto Superior Tecnico, Avenue Rovisco Pais 1, 1049-001, Lisbon, Portugal, poliana.bellei@ulisboa.tecnico.pt*

E-mail: ricardo.soares@ifal.edu.br (corresponding author)

Keywords: *Mortar, solid waste, reuse, cement bags.*

Abstract

Given the possibility of sand depletion, improper disposal of solid waste in construction, and, most importantly, the pursuit of strategies to reduce the emission of gases such as CO_2, this study presents a methodology aimed at minimizing the environmental impact caused by the disposal of kraft paper bags contaminated with Portland cement. This is achieved through treatment with sodium hydroxide (NaOH), processing, and transformation into a low-granularity composite, partially replacing sand in mortar. The composite material obtained was characterized and introduced into the mortar at proportions of 2% and 4% relative to the sand mass. The mortar was observed to evaluate its properties in both the fresh and hardened states. The results demonstrate that the use of treated kraft paper can reduce sand consumption, providing an alternative for the disposal of bags contaminated with Portland cement and offering a sustainable and technical alternative. In the current phase of the study, a reduction in bulk density and an increase in flowability of 5.4% and 2%, respectively, were observed. Additionally, a method for the disposal of bags contaminated with Portland cement was established, saving sand consumption. In the current scenario, cement bags are still indispensable, and this study is a contribution to their sustainable disposal.

ANALYTICAL STUDIES OF THE BUCKLING PROBLEM FROM MUSSCHENBROEK TO BAUSCHINGER

Álvaro COBO GONZÁLEZ
Escuela Técnica Superior de Ingeniería Aeronáutica y del Espacio.
Universidad Politécnica de Madrid

Keywords: *buckling, instability, structures, strength of materials*

Abstract

The use of ferrous materials in structural elements in the last quarter of the 18th century led to a decrease in the cross-sections used due to the higher strength of these materials. However, when these elements are subjected to compression, failure can occur due to instability before their yield strength is reached. This is particularly important in industries such as aeronautics where the weight of the structures is a determining factor and section thicknesses must be limited to the minimum possible.
In this work, an analysis is made of the historical evolution of the first analytical and experimental studies carried out on the buckling problem.
The study begins with the experimental work carried out by Musschenbroek, which constitutes the first experimental campaign with slender wooden bars subjected to compression, in which he concludes that in rectangular section elements with sides bxh and h being the side on which the buckling plane occurs, the critical load Pcr varies inversely proportional to the square of the span of the element l and directly proportional to the side b and the square of side h. This law, which is not correct in its entirety, precedes Euler's formula by 15 years.

Euler approached the problem from an exclusively analytical point of view, arriving at his well-known equation for the critical load that produces failure in a compressed element of a material with modulus of elasticity E and moment of inertia *I*: $P_{cr} = \frac{\pi^2 EI}{L^2}$.

In 1840, Hodgkinson showed the Royal Society the results of his experiments with cast iron bars subjected to compression. He concludes that when slender elements are tested, the results coincide with those obtained by means of Euler's equation, obtaining an ultimate load proportional to d^4/L^2 where d is the diameter of the element tested. He also found, what would be a constant from now on, that in elements of small slenderness the Euler expression did not give satisfactory results.

In the mid-19th century, Lamarle carried out a very interesting analytical work on buckling in which, for the first time, a slenderness limit was established in order to be able to apply Euler's formula. He concludes that the limit is obtained from the equation $\frac{L^2}{i^2} = \frac{\pi^2 E}{\sigma_{yp}}$ where σyp is the elastic limit of the material.

Finally, at the end of the 19th century, Bauschinger carried out the first rigorous experimental campaign on buckling of columns. By means of devices he was able to articulate the ends of the elements and to centre the acting load. His results were very close to those deduced from Euler's formula when the slenderness was not small.
From this time on, Tetmajer and other scientists and engineers continued their analytical and experimental work up to the present day.

THERMAL CONDUCTIVITY COEFFICIENT IN SUSTAINABLE PLASTERS

[a]Alejandra VIDALES BARRIGUETE; Eva BARREIRA; [b]Susana GOMES DÍAS

[a] Departamento de Tecnología de la Edificación; Escuela Técnica Superior de Edificación; Universidad Politécnica de Madrid (España); alejandra.vidales@upm.es
[b] CONSTRUCT-LFC, University of Porto; Faculty of Engineering (FEUP); Civil Engineering Department (Portugal)

Keywords: *Plaster, Thermal Conductivity coefficient, Sustainable materials*

Abstract

The requirements regarding energy efficiency of residential buildings are becoming more and more demanding. The official mechanism, both at national and European level, to evaluate and compare energy efficiency between buildings is the Energy Rating. The calculation of this parameter depends not only on the energy consumption in installations such as heating or domestic hot water, but also on the characteristics of the thermal envelope. That is why it is mandatory to highlight the importance that passive construction systems play in buildings.
The energy efficiency of a building concerning its passive constructive systems depend on different variables: orientation, design, characteristics of the materials, etc. There are many researchers who are committed to the latter and carry out their studies to ensure that traditional materials see their properties modified in order to reduce their thermal conductivity coefficients and contribute to this.

This is the specific case of this communication in which a gypsum material with plastic waste from electrical cables is presented and its thermal properties are assessed.
The experimental campaign included two methods for evaluating thermal conductivity coefficient: the heat flux method, at the “Eduardo Torroja” Institute of Construction Sciences (Spain) and follow the standard UNE-EN 12667:2002 “Determination of thermal resistance by the hot plate method and the heat flux method. High and medium thermal resistance products”; and the modified transient plane source technique, that was carried out at the Laboratory of Building Physics of the Faculty of Engineering of the University of Porto (Portugal).

The results show a decrease in the thermal conductivity coefficient of this new material by approximately 40%, when compared to a generic high-hardness gypsum (900-1200 kg/m3). Therefore, it represents a thermal improvement when compared to traditional plaster since it presents an increase in the thermal resistance, which makes it more energy efficient. Furthermore, the use of waste in its manufacturing makes it a more sustainable material that contributes to the circular economy and sustainability in the construction sector.

IMPACT OF GRAPHENE OXIDE ON CEMENTITIOUS MICROSTRUCTURE AND CONCRETE DURABILITY

[a] Djenaoucine LOUNIS

[a] Researcher PHD Student; Universidad Politécnica de Madrid (España)

Abstract

This research explores the potential of Graphene Oxide (GO), a promising nanomaterial, in augmenting the performance of cementitious materials within the construction industry. The study meticulously examines the impact of GO on the durability of concrete and the microstructure of cement paste. This is achieved by formulating three distinct concrete mixes: one devoid of GO and two others incorporating GO at minimal and subminimal concentrations. The durability of these concrete mixes was assessed through a series of tests, including electrical resistivity, chloride diffusion, and water permeability. To further comprehend the influence of GO on microstructural properties, the microstructure of the cement paste was characterized using Scanning Electron Microscopy (SEM). The findings reveal a notable enhancement in the durability of the GO-modified concrete mixes. This is substantiated by a decrease in the coefficient of diffusion of chloride ions, an increase in electrical resistivity, and observable alterations in the cement paste microstructure as evidenced through SEM analysis. These results suggest that integrating GO into cementitious materials presents a viable and multifaceted approach to improving both the durability and microstructure of concrete structures. This contributes significantly to advancing sustainable construction practices, thereby underscoring the potential of GO as a strengthening element within the construction industry.

STRUCTURAL RESTORATION OF BUILDINGS IN THE HISTORIC CENTRE OF SÃO LUÍS DO MARANHÃO/BRAZIL

[a] Marcos F. MARQUES; [b]Jose Carlos ALMEIDA; [c]Márcia Tereza CAMPOS MARQUES

[a] Universidade Estadual do Maranhão
[b] CISE - Electromechatronic Systems Research Centre, Instituto Politécnico da Guarda
[c] Universidade Estadual do Maranhão

Abstract

This article investigates the possibility of using steel structures in the structural recovery process of historic buildings in the historic centre of São Luís do Maranhão/Brazil. São Luís has been a UNESCO World Heritage Site since 1997. Over time, the houses in this area have undergone modifications to adapt them to contemporary uses. With this in mind, this article aims to present steel structures as a possible material for the structural recovery of historic buildings. The object of study was building no. 93, on Rua do Giz, in the centre of São Luís do Maranhão. A study was carried out into structural restoration using wood, a material traditionally used in these buildings, as well as a study into structural restoration using steel. The aim of this research is that the results can contribute to future interventions in buildings of historical interest using steel structures, minimising the excessive use of wood in the preservation of historical buildings.

PATHOLOGIES OF LISTED BUILDINGS: REHABILITATION OF THE MERCÊS CONVENT

[a] Wadson MAYCKEL CARVALHO; [b]Jose Carlos ALMEIDA; [c]Márcia Tereza CAMPOS MARQUES

[a] Instituto Politécnico da Guarda
[b] CISE - Electromechatronic Systems Research Centre, Instituto Politécnico da Guarda
[c] Universidade Estadual do Maranhão

Abstract

This article presents the concepts, methodology and details adopted in the rehabilitation of the Convento das Mercês, a historic building constructed in 1654 which, due to its arches and mortared stone structure, faithfully represents the architecture of the time. It is part of the Brazilian Historical and Cultural Heritage in São Luís, in the state of Maranhão. The main pathologies and degradation mechanisms that led to the building's deterioration are described. Drainage deficiencies stand out, as the building is located halfway up a slope facing the sea. This situation is unfavourable to the preservation of the building, due to the percolation of water into the subsoil, carrying particles of soil supporting part of its foundation. There is also disintegration of the cloister pillars and cracks in the arches due to movements of the structure. The intervention work and the various techniques used will be presented, such as jack-hammering the damaged pillars and injections of hydrated lime grout into the cracks, which resulted in increased structural safety.

SERVICE LEARNING: A PRACTICAL PROPOSAL FOR WORKING ON THE CIRCULAR ECONOMY AND CORPORATE SOCIAL RESPONSIBILITY IN BUILDING AND BUSINESS ADMINISTRATION AND MANAGEMENT

Rafael MARCOS-SANCHEZ[a], Daniel FERRÁNDEZ VEGA[b]

[a] *Profesor Contratado Doctor, Universidad Internacional de La Rioja, Departamento de Didáctica de las Matemáticas y de las Ciencias Experimentales, Facultad de Educación, 26006, Logroño, España, rafael.marcos@unir.net*

[b] *Profesor Contratado Doctor, Universidad Politécnica de Madrid, Departamento de Tecnología de la Edificación, Escuela Superior de Edificación, Av. De Juan de Herrera, 6, 28040, Madrid, España, daniel.fvega@upm.es*

E-mail: rafael.marcos@unir.net (corresponding author)

Keywords: Sustainable Development Goals (SDG), circular economy, corporate social responsibility, building, sectoral policy, service learning.

Abstract

In 2015, the UN established the 2030 Agenda for Sustainable Development, which includes 17 Sustainable Development Goals (SDGs) that must be achieved to achieve a livable world. In 2017, the Education for Sustainable Development document was developed to incorporate the SDGs into countries' education systems. Service learning is a methodology that combines curricular content with classroom experience to solve real problems in the community and foster social engagement. The SDGs have reshaped the management of corporate social responsibility and boosted the circular economy. The objective of the paper proposes to integrate, through a practical proposal, the SDGs in the subjects of Sustainable Construction and Sectoral Policies through the service learning methodology to develop proposals that integrate the circular economy and corporate social responsibility in sustainable building and in the different projects. The results expected to be achieved are the integration of the SDGs in the curricular content of the subjects and to put forward proposals that integrate product reuse, circular economy and corporate social responsibility in sustainable building and in the sectoral policies of the different projects. In short, the work raises the commitment of education to train people in critical thinking, care for the environment and involvement in the community in which they live.

SUSTAINABILITY, ENVIRONMENT AND ACCESIBILITY

METHODS ANALYSIS FOR ENERGY CONSUMPTION FORECASTING IN HEALTHCARE BUILDINGS: A REVIEW

Alejandro PRIETO-FERNÁNDEZ[a], Antonio Rivero Cacho[b], Manuel BOTEJARA-ANTÚNEZ[c], Gonzalo SÁNCHEZ-BARROSO-MORENO[d], Jaime GONZÁLEZ-DOMÍNGUEZ [e], Justo GARCÍA-SANZ-CALCEDO[f]

[a] PhD candidate, University of Extremadura, Department of graphical expression, Address: Av. de Elvas, 06006, Badajoz, Spain, apf@unex.es
[b] PhD candidate, University of Extremadura, Department of graphical expression, Address: Av. de Elvas, 06006, Badajoz, Spain, antoniorc@unex.es
[c] PhD candidate, University of Extremadura, Department of graphical expression, Address: Av. de Elvas, 06006, Badajoz, Spain, manuelba@unex.es
[d] PhD, University of Extremadura, Department of graphical expression, Address: Av. de Elvas, 06006, Badajoz, Spain, gsm@unex.es
[e] PhD, University of Extremadura, Department of graphical expression, Address: Av. de Elvas, 06006, Badajoz, Spain, jaimegd@unex.es
[f] PhD, University of Extremadura, Department of graphical expression, Address: Av. de Elvas, 06006, Badajoz, Spain, jgsanz@unex.es

E-mail: jgsanz@unex.es (corresponding author)

Keywords: Healthcare buildings; energy consumption forecasting; artificial intelligence; prediction

Abstract

Buildings are one of the main points of final energy consumption worldwide and greenhouse gas emissions in the energy sector, requiring the implementation of measures to optimise energy efficiency and reduce the environmental impact of buildings, which is essential in healthcare buildings due to their high energy consumption, complexity, and importance. Therefore, it is necessary to generate models that predict the energy consumption of such buildings, although this is a problem due to the large number of factors that influence it. This research reviews the scientific literature to compile the different methods for forecasting buildings' energy consumption, aiming to analyse their applicability to healthcare buildings. The predictive methods analysed are classified into engineering, statistical, artificial intelligence, and hybrid methods. Each method has its advantages and disadvantages depending on the purpose of the prediction, the available data, the time horizon of the forecast and the building parameters.

ENVIRONMENTAL GAPS OF ENERGETIC CERTIFICATIONS - COMPARATIVE ANALYSIS OF BRAZIL AND PORTUGAL

André Luiz Lopes Toledo[a] , Gabriel Constantino de Lima[b], José Carlos Almeida[c], Renato Samuel Barbosa de Araújo[d] and Charline Cibele da Silva[e]

[a] Doctor, Federal Institute of Education, Science and Technology (IFRN), Civil Construction Academic Department, Address: Av. Sen. Salgado Filho, 59015-000, Natal - RN, Brasil, andre.lopes@ifrn.edu.br

[b] Doctor, Federal Institute of Education, Science and Technology (IFRN), Civil Construction Academic Department, Address: Av. Sen. Salgado Filho, 59015-000, Natal - RN, Brasil, gabriel.constantino@ifrn.edu.br

[c] Doctor, Polytechnic Institute of Guarda, CISE - Electromechatronic Systems Research Centre, Address: 6300-559 Guarda, Portugal, jcalmeida@ipg.pt

[d] Doctor, Federal Institute of Education, Science and Technology (IFRN), Civil Construction Academic Department, Address: Av. Sen. Salgado Filho, 59015-000, Natal - RN, Brasil, renato.samuel@escolar.ifrn.edu.br

[e]Academic in civil engineering, Federal Institute of Education, Science and Technology (IFRN), Civil Construction Academic Department, Address: Av. Sen. Salgado Filho, 59015-000, Natal - RN, Brasil, cibele.charline@escolar.ifrn.edu.br

E-mail: andre.lopes@ifrn.edu.br (corresponding author)

Keywords: Energy certifications, environmental impacts, Brazil energy certification, Portugal energy certification.

Abstract

Energy certifications are mandatory or voluntary tools for buildings with varying requirements across countries. Energy certifications have a strong synergy with the environmental requirements of buildings, as several policies to improve energy efficiency are based on initiatives to mitigate environmental externalities. On the other hand, an energy certification system that does not analyse its environmental impacts in depth may end up promoting the adoption of environmentally negative measures. Previous studies have already identified that in the case of Brazilian certification, which is voluntary, there is a positive score for projects that adopt photovoltaic solar systems, even if these systems eventually present a higher emission factor (kgCO2/kWh) in their life cycle than the national interconnected system. The EU has compulsory certification for several segments of buildings, which makes it imperative to critically analyse the possible negative environmental impacts of adopting these certifications.

The first legislation produced in Portugal results from the transposition of the European Parliament Directive 2022/91/EC. The main purpose of this directive was to reduce CO2 emissions associated with the energy consumption of buildings, which obliged member states to ensure the effective implementation of minimum regulatory requirements for energy performance. In the case of Portugal, energy certification has been mandatory since 2006. This study aims to identify gaps in the analysis of environmental externalities of existing energy certifications in force in both countries in order to mitigate possible negative impacts. The methodology used will be a comparative analysis between energy certification systems and their forms of bonus and punctuation. Then, a critical review will be presented on the gaps presented in the two certification systems, characterizing the possible negative environmental impacts that can be generated. Weaknesses in energy certification systems in the countries analysed are identified, contributing to deeper research into their environmental impacts.

MONITORING AS A TOOL TO DETERMINE THE INFLUENCE OF THERMAL INERTIA ON THE INTERIOR HYGROTHERMAL BEHAVIOR IN A CAVE HOUSE IN ALMERIA

[a]Luis JIMÉNEZ LÓPEZ; [b]Inmaculada MARTÍNEZ PÉREZ; [c] Jose A CAPITÁN GÓMEZ

[a] *Doctorando en Innovación Tecnológica de Edificación* l.jimenezl@alumnos.upm.es
[b] *Departamento de Construcciones Arquitectónicas y su Control, Escuela Técnica Superior de Edificación de Madrid. UPM. i.martinez@upm.es*
[c]*Departamento de Matemática Aplicada, Escuela Técnica Superior de Edificación de Madrid. UPM. ja.capitan@upm.es*

Keywords: cave house, monitoring, thermal inertia, thermal comfort.

Abstract

In articles and magazines on traditional or vernacular architecture, it is indicated that the walls of very thick traditional constructions have great thermal inertia. It has always been commented that, in an excavated cave house, the interior climate remains within the limits of thermal comfort.
Thermal inertia is the property that indicates the amount of heat that a body can retain and the speed with which it gives up or absorbs it with the environment. Therefore, it depends on the mass or density ρ of the wall material, its specific heat Ce, the thermal conductivity coefficient λ, as well as the its geometry (thickness).

It is assumed that the interior temperature is constant and the winters are mild inside, since during the summer it absorbs heat and this is released during the cold seasons, which "allows savings on heating and air conditioning".
The case study of a Cave house in the province of Almería (model used for research for the doctoral thesis), in which hygrothermal monitoring has been carried out in different interior areas (including the interior part of the façade walls) and exterior, in a study period of time, between August 13, 2021 and November 8, 2021, it has been observed how the thermal inertia of its walls has facilitated the maintenance of the interior temperature practically the same in the three months and within the comfort margins established in the RITE, with respect to variations in outdoor temperature and the influence of solar radiation.

The greater the inertia of an enclosure, the greater the “phase gap” and the more “damping” of the thermal radiation wave that is produced. When the outer layer of the

enclosure in a façade wall has heated up, due to the joint action of the incidence of solar radiation and the outside temperature, the transfer of heat to layers begins, due to the effect of the physical phenomenon of conduction interiors. The time (h) it takes for the heat wave to cross the wall, which is the “thermal wave phase shift”.
This phase shift depends on the thermal conductivity, density, wall thickness and specific heat and the study time period (generally it is done every 24 hours). Therefore, the type of terrain where the cave house is excavated must also be determined to determine the conductivity and specific heat. The part of the heat that accumulates inside the wall has to find a thermal outlet to the outside, producing a rebound of the heat wave, called “damping of the thermal wave”.

In conclusion, thanks to hygrothermal monitoring and its comparative study [4], it has been possible to verify the influence of thermal inertia on indoor hygrothermal conditions and how this favors their uniformity (see graph figure 1), especially the temperature. interior, often commented on, but not rehearsed over long periods of time.

INNOVATIVE BUILDING TECHNOLOGIES FOR THE REVITALIZATION OF HISTORIC SITES IN FRAGILE CONTEXT. HIGHER EDUCATION EXPERIENCES IN AEOLIAN ISLANDS.

Vincenzo SAPIENZA

Full Professor, University of Catania, Department of Civil Engineering and Architecture,
Address: via Santa Sofia, 64 - Città Universitaria, 95125, Catania - Italy

E-mail: Vincenzo.sapienza@unict.it (corresponding author)

Keywords: integrated design, digital design, rapid prototyping, high education.

Abstract

The historic sites are indubitably an additional value that forms a strategic resource for the society, so they must be adequately preserved and valorized. In fragile areas or in rural contexts, this kind of approach could contribute to the revitalization of the place. In addition, to consolidate the renovation building technologies, it is mandatory to develop knowledge and competence in the field of innovation, such as the energy requalification, the seismic improvement, the integrated interventions and so on. It is also necessary to image new ways to realize enlargement or additions of the existent buildings, in order to adequate the existent buildings to new uses and new standards, or also to have new micro-architectures, to provide new functions or new facilities in the surrounding areas.
To get this achievement, it could be useful to provide a series of higher education activities addressed to who deal with it, such as university students and young freelancers, in the field of Architecture, Engineering, Construction sector (AEC). Recently, a research group formed in the Department of Civil Engineering and Architecture of the University of Catania have begun these kinds of actions, on the thematic of the requalification of the historical architecture. All events have assumed as open-air laboratory the Aeolian Islands, because of the interesting peculiarity of the local declination of the Mediterranean architecture, which is the Aeolian House. In particular, Filicudi has been chosen among the other isles of the archipelago. In fact, it has preserved the features of the local architecture, thanks to the isolation of the place.

In the paper that will be presented, the author develops a description of the mentioned activities and shares some considerations about this topic, on the base of the acquired experiences.

ANALYSIS OF CHEMICAL AND PHYSICAL DEGRADATION PHENOMENA OF CULTURAL HERITAGE MATERIALS AND THE DEVELOPMENT OF INNOVATIVE TECHNOLOGIES FOR THEIR PROTECTION AND CONSERVATION: PRELIMINARY STUDY

Alessia VERNIERO[a], Barbara LIGUORI[b], Roberto CASTELLUCCIO[c], Domenico CAPUTO[b]

[a] PhD st. Department of Classics, University of Rome La Sapienza, Piazzale Aldo Moro 5, Rome 00185, Italy, alessia.verniero@uniroma1.it
[b] Professor, ACLabs - Applied Chemistry Labs, Department of Chemical, Materials and Industrial Production Engineering, University of Naples Federico II, P.le Tecchio 80, Naples 80125, Italy, barbara.liguori@unina.it
[c] Professor, Department of Civil, Building and Environmental Engineering, University of Naples Federico II, P.le Tecchio 80, Naples 80126, Italy, roberto.castelluccio@unina.it
[b] Professor, ACLabs - Applied Chemistry Labs, Department of Chemical, Materials and Industrial Production Engineering, University of Naples Federico II, P.le Tecchio 80, Naples 80125, Italy, domenico.caputo@unina.it

Keywords: Cultural Heritage, geopolymers, secondary raw materials, waste reuse, sustainable buildings.

Abstract

Nowadays the main challenge in the field of Cultural Heritage restoration is to develop new materials or optimise existing ones, respecting the principles of compatibility, reversibility, and minimum intervention and at the same time, reducing energy consumption during production, greenhouse gas emissions and environmental impact. In this context, the present study focuses on the evaluation of conservation status of the buildings in the Historic Centre of Naples, one of the largest in Europe. Archival research pays particular attention to cataloguing the state of chemical and physical degradation of the plasters present in the sites/construction sites analyzed. The main topic is the relationship between Neapolitan Yellow Tuff, a type of natural stone widespread in the region, and the corresponding recovery interventions, evaluating and interpreting their medium/long term outcomes. In recent decades, in fact, the use of cement has been extensive in the field of plaster restoration, causing often irreversible damage to our historical heritage. At the same time, there has been a great development of a new type of binders called 'geopolymers', alumina-silicate based materials, characterised by a three-dimensional cross-linked structure. What characterises and distinguishes this

innovative binder from Portland cement is lower production's temperatures and an 80% lower CO_2 emission. Moreover, geopolymers can be obtained not only from raw materials, such as pozzolan and synthetic metakaolin, but also from secondary raw materials, such as industrial waste, as well as demolition waste materials. The aim of this research is to validate geopolymer based binders in Cultural Heritage restoration and conservation application by comparing laboratory preliminary results obtained with archival data and/or diagnostic analysis on collected samples.
The paper has the twofold aim of analyzing the conservation status of historic buildings, with a specific focus on the lithotypes of Naples, and developing intervention techniques based on geopolymers, innovative materials compatible with the stone substrates, to promote a transition towards a sustainable and circular economy, also in cultural heritage sector.

IMPLICATIONS PSYCHO-EMOTIONAL FOR SMALL SPACES

[a]José Antonio RODRÍGUEZ LÓPEZ; [b]Karina MARTÍNEZ MORALES; [c]Gustavo Adolfo CASTILLO RAMÍREZ

[a] Programa de Doctorado en Innovación Tecnológica en Edificación; Escuela Técnica Superior de Edificación; Universidad Politécnica de Madrid (España); ja.rlopez@alumnos.upm.es
[b] Programa Ingeniería Industrial; Facultad de Ingeniería; Benemérita Universidad Autónoma de Puebla (México); karina.martinezmo@correo.buap.mx
[c] Programa Ingeniería Civil; Facultad de Ingeniería; Benemérita Universidad Autónoma de Puebla (México); gustavocastilloramirez@gmail.com

Keywords: *Psycho-Emotional, Housing conditions, Environmental Psychology*

World Health Organization establishes in its Principles of Housing Hygiene that "An adequate home is one that provides protection against communicable diseases, trauma, poisoning and chronic diseases, therefore, it must have non-toxic materials, correct waterproofing and climate protection". Likewise, its spaces must guarantee to minimize psychological and social stress, being a place of rest. For its part, the United Nations also dictates the universal right to adequate housing. Thus, people need appropriate physical and psychological environments to develop.
Currently, housing spaces are designed in such a way that their construction is more economical and is a business, leaving aside the well-being of the families who purchase the homes. Given these circumstances, generally in this type of housing, invasion of privacy is encouraged, motivating the aggressiveness of its inhabitants and favoring domestic violence because they defend their space, their territory. This especially affects children in terms of learning.
Housing conditions largely determine the level of quality of life of the population; very enclosed spaces can generate stress, which has negative effects on people's physical and emotional health, leading to pathologies. Of the latter, in inappropriate conditions in a home the inhabitants can become neurotic, present anxiety disorders, phobias and even serious illnesses that may require psychiatric treatment. On the other hand, relations with neighbors become hostile in defense of spaces, since people become too territorial.
The branch of psychology called *Environmental Psychology* and has as its main objective the study and analysis of the interrelationship between people and the real physical environments that they occupy. Psychologists have proven that the environment affects people's behavior. According to psychology theory, the environment is the way in which spaces are perceived by an individual, a simple design can become a generator of psychological stress, which promotes feelings of anxiety, helplessness and hopelessness in individuals.
Nowadays, housing is recognized as the first environment of human beings. Hence the importance of the study and knowledge of the spatial factors that affect well-being and development, to improve designs, structures, shapes, dimensions, distributions and architectural interactions, since the quality of life of the occupants depends on it. Comfort in a space is directly related to the consequences of its functionality, whether for productivity in an office, learning in a classroom or relaxation in a home.
The greater the capacity in the spaces to allow breadth in the activities of each person, the level of functionality, comfort, privacy and security increases, having a positive value judgment, promoting health and benefiting the social environment of the residents.

ENERGY AND ENVIRONMENTAL PERFORMANCE OF A FAMILY HOUSE IN URUGUAY: IMPROVEMENT STRATEGIES

Jimena BONINO FERNÁNDEZ[a], César PORRAS AMORES[b], M. Alejandro PEDREÑO ROJAS[b]

[a] Master Gestión en Edificación, Universidad Politécnica de Madrid, Address: Juan de Herrera 6, 28040, Madrid, Spain, jimena.bonino@alumnos.upm.es
[b] Grupo de Tecnología Edificatoria y Medio Ambiente (TEMA). Universidad Politécnica de Madrid, Address: Juan de Herrera 6, 28040, Madrid, Spain. c.porras@upm.es alejandro.pedreno@upm.es
E-mail: jimena.bonino@alumnos.upm.es (corresponding author)

Keywords: *sustainability, climate change, BREEAM, energy efficiency, environmental impact.*

The construction industry is one of the biggest contributors to the consumption of global energy and limited material resources, worsening the climate change and thus environmental degradation. This has upraised significant concerns regarding the impact of the buildings and the increasing interest in sustainable building practices. The aim of the paper is to determine the current level of sustainability of a project, using the BREEAM method and additional programmes, to mitigate environmental impact of the building.

To this purpose, a family home located in Uruguay has been analysed. The analysis considered the energy consumption of the building, water usage, pollution, and health and wellbeing. The assessment uses various methods, including energy modelling and a detailed study about the building shell. The results reveal that the energy and the resources consumption of the building has room for improvement.

Additionally, findings show that more sustainable conditions could be achieved by implementing equipment that is more efficient in terms of energy consumption. It is suggested the implementation of irrigation methods taking advantage of the rain, changing the heat pump to a more efficient one, and changing glasses to reduce energy loss.

The research concludes that implementing sustainable building practices is crucial in addressing the urgent issue of climate change. By adopting environmentally friendly changes in the building, we can significantly reduce our contribution to climate change and create a more sustainable future for generations to come. Sustainable building practices not only mitigate the negative impact on the environment but also promote energy efficiency and resource conservation.

BUILDING CONSTRUCTION MANAGMENT

THE TERRACED WALLS IN SPAIN. SPECIAL REFERENCE TO THOSE IN THE AREAS OF CATALONIA, VALENCIA, AND MALLORCA.

Pilar C. IZQUIERDO GRACIA[a], Gregorio GARCÍA LOPEZ DE LA OSA[b]

[a] a PhD,Universidad Poliécnica de Madrid, Escuela Técnica Superior de Edificación, Departamento de Construcciones Arquitectónicas y su Control, Avenida de Juan de Herrera nº 6, Madrid 28040,España- e-mail: pilarcristina.izquierdo@upm.es

[b] PhD,Universidad Poliécnica de Madrid, Escuela Técnica Superior de Edificación, Departamento de Construcciones Arquitectónicas y su Control, Avenida de Juan de Herrera nº 6, Madrid 28040,España- e-mail: g.garcia.lopezosa@upm.es

Keywords: *vernacular construction, dry stone, legislation, protection/ Construcción vernacular, piedra seca, legislación, protección.*

Abstract

The vernacular construction technique of dry stone has been used by man for millennia, transmitting knowledge about how it should be carried out in a practical way from specialized workers to apprentices.
This technique therefore requires specialized knowledge and has great advantages from an environmental point of view, among which we can mention the fact that it prevents the loss of fertile soils and stops desertification. However, currently, large areas of dry stone walls dedicated to agriculture have been lost due to abandonment, among several reasons, due to the shortage of specialized labor, which makes the recovery of the works carried out using the technique of Dry Stone.
The fact that this technique has been included by UNESCO in the Representative List of Intangible Cultural Heritage has been a strong boost for the protection and valorization of the technique both by administrations and by citizens themselves.
This work analyzes the efforts and innovative actions carried out in certain areas of Spain, developed jointly, both by the administrations and by citizens, in order to obtain results that are not only effective but even profitable, taking into account the value that tourism has been acquiring in the areas studied and especially that which is practiced while being respectful of the Environment.

RELATIONSHIPS BETWEEN ENERGY EFFICIENCY, RELIABILITY AND MAINTAINABILITY: IMPROVEMENT WITH KNOWLEDGE MANAGEMENT TECHNIQUES

Javier CÁRCEL-CARRASCO[a], Fabiola COLMENERO-FONSECA[a], Consuelo GÓMEZ-GÓMEZ [a] Carmen CARNERO[a] , Jose Antonio CARCEL CARRASCO[a] ,Juan PALOMINO BERNAL[a] ,Ramiro RODRÍGUEZ PÉREZ[a], Kevin ECHEVERRY BUCURU[a]

[a] *Universitat Politècnica de València; email: fracarc1@csa.upv.es*

Keywords: *Energy efficiency; Industrial maintenance; Knowledge management; Operational performance*

Abstract

Ensuring consistent availability and reliability of the equipment or machinery is a strategic aspect in big buildings and installations. They are integral in these structures, designed to serve the intended purpose. Conventionally, the concept of "energy efficiency" aspect is studied separately, considered as an economic factor that affects the operating cost of that building. However, it is increasingly evident that reliability, maintainability, and energy efficiency are closely related and help achieve functional optimization of a building.

Following a relevant literature review, this article tries to capture the relationship between these three factors. It investigates not only how improvements in one dimension can yield synergic outcomes but also how these factors mutually influence each other. Furthermore, their interaction and the improvements in each aspect can result in their exploitation. This is discussed along with the application of knowledge management techniques. In complex scenarios, the exchange and sharing of information with the implementation of a common knowledge management system, can lead to substantial improvements. The most common drawback noticed in this study is the lack of integration of tacit internal strategic knowledge. The conclusions of the study are beneficial to decision-makers and practitioners aiming to maximise operational performance and minimize costs in this domain.

ANALYSIS OF THE CONSTRUCTION MANAGER'S MOTIVATION IN THE CONSTRUCTION INDUSTRY

Marcelo VILLENA MANZANARES[a], Francisco VILLENA MANZANARES[b]

[a] Profesor Asociado, Universidad Loyola, Address: Avda. de las Universidades, 2, Dos Hermanas, 41704 Sevilla, España. Doctorando en UCAM

[b] Profesor Contratado Doctor, Universidad de Sevilla, Departamento Ingeniería del Diseño, Escuela Politécnica Superior, C/ Virgen de África, 7, 41011, Sevilla (España), fvillena@us.es E-mail:fvillena@us.es (autor de correspondencia)

Keywords: *Construction Management, Labor Motivation, Construction Manager, Labor Productivity*

Abstract

Construction management is concerned with the production of the built environment, from the relationships between the contracting parties, to the design and management at any stage of the infrastructure life cycle. In the execution phase of the project, and from the perspective of the construction company, construction management is in the hands of the construction manager. Therefore, the construction manager becomes the most responsible for the execution of the project on site. On the other hand, the literature shows that motivation and satisfaction are key factors that stimulate individuals to improve their productivity. Therefore, the motivation of the construction manager can become a key factor in the success or failure in the execution of a construction project. A survey of 118 construction managers in the AEC (Architecture, Engineering and Construction) sector was carried out by means of a questionnaire developed by the authors. Subsequently, a descriptive analysis of the results was carried out in order to draw conclusions about the current state of the construction manager's motivation in the construction industry.

THE DEVELOPER IN THE FACE OF SAFETY AND HEALTH INSPECTION

Manuel Bartolomé Alonso[a], Antonio Ros Serrano[b]

[a] *Universidad Politécnica de Madrid, ETS de Edificación, Departamento de Construcciones Arquitectónicas y su Control*

E-mail: manuel.bartolome@upm.es

[b] *Universidad Politécnica de Madrid, ETS de Edificación, Departamento de Construcciones Arquitectónicas y su Control*

E-mail: antonio.ross@upm.es

Keywords: *construction, developer, prevention, safety and health, law*

Abstract

The situation in which a Developer initiates a construction project is determined by a series of administrative procedures, contracts, and business prospects. Currently, concerning obligations and more specifically, in relation to compliance with the law on occupational risk prevention and the law on offenses and sanctions in the social order, they become involved in non-compliance leading to infringement reports, penalties, and in most cases, legal proceedings, in any area of law.

This presentation aims to clarify precisely, accurately, and in accordance with current legislation in this matter, defining the obligations of the Developer through legal theory and the common practices that various jurisprudences have raised in cases where construction projects undergo inspections due to accidents or during inspection visits.

Real-life situations will be presented in which a Developer has been "held responsible" for various actions by different parties involved in the project, for risk situations, or technical details related to their obligations. Legal judgments will be presented and analyzed, both in the criminal and social jurisdiction, where the Developer is the subject of investigation.

We emphasize the need to address these situations aimed at enhancing the formation of the Developer, the agents involved in the construction process, and the necessary information that must be generated, both at the beginning and during the subsequent development of the project.

Often, in the context of safety and health in construction, we think about the risks generated by the project itself and overlook good practices in the design phases and the management that various parties must undertake. In the case of the Developer, the

actions that fall under the coordinator's responsibilities for safety and health during the project and construction phases will be discussed.

Let's illustrate with examples and real cases the need to understand the obligations of each agent and because of the incapacity or inhability of others are held responsible those who obey the law.

RELATIONSHIPS BETWEEN ENERGY EFFICIENCY, RELIABILITY AND MAINTAINABILITY: IMPROVEMENT WITH KNOWLEDGE MANAGEMENT TECHNIQUES

Javier CÁRCEL-CARRASCO [a], Fabiola COLMENERO-FONSECA [a], Consuelo GÓMEZ-GÓMEZ [a] Carmen CARNERO [a] , Jose Antonio CARCEL CARRASCO[a] ,Juan PALOMINO BERNAL[a] ,Ramiro RODRÍGUEZ PÉREZ[a], Kevin ECHEVERRY BUCURU[a]

[a] Universitat Politècnica de València; email: fracarc1@csa.upv.es

Keywords: *Energy efficiency; Industrial maintenance; Knowledge management; Operational performance*

Abstract

Ensuring consistent availability and reliability of the equipment or machinery is a strategic aspect in big buildings and installations. They are integral in these structures, designed to serve the intended purpose. Conventionally, the concept of "energy efficiency" aspect is studied separately, considered as an economic factor that affects the operating cost of that building. However, it is increasingly evident that reliability, maintainability, and energy efficiency are closely related and help achieve functional optimization of a building.

Following a relevant literature review, this article tries to capture the relationship between these three factors. It investigates not only how improvements in one dimension can yield synergic outcomes but also how these factors mutually influence each other. Furthermore, their interaction and the improvements in each aspect can result in their exploitation. This is discussed along with the application of knowledge management techniques. In complex scenarios, the exchange and sharing of information with the implementation of a common knowledge management system, can lead to substantial improvements. The most common drawback noticed in this study is the lack of integration of tacit internal strategic knowledge. The conclusions of the study are beneficial to decision-makers and practitioners aiming to maximise operational performance and minimize costs in this domain.

MAINTENANCE MANAGEMENT OF THE NATIONAL LIBRARY OF PORTUGAL

João MESTRE[a], Susana LUCAS[b],

[a] *MSc, IPS/ESTBarreiro, Department Civil Engineer, Address: Rua Américo da Silva Marinho, 2839-001 Lavradio*
[b] *2PhD, IPS/ESTBarreiro, Department Civil Engineer, Address: Rua Américo da Silva Marinho, 2839-001 Lavradio*

E-mail: susana.lucas@estbarreiro.ips.pt (corresponding author)

Keywords: *Maintenance, Management, Heritage, Public Building.*

Abstract

The concept of building maintenance management covers several management-related activities; where there will be defined objectives, strategies to implement and functions & responsibilities; for maintenance where it is intended to ensure the best conditions for the use of building spaces.
The National Library of Portugal presents itself as a building or set of buildings with more than 53000 m2 of gross construction area, in a plot of about 5 and a half hectares, with more than 50 years of use.

A maintenance management model was developed for the case study - National Library of Portugal, based on the existing information systems, integrating information in order to develop a preventive maintenance plan, improvement of the building maintenance processes as well as optimization of associated costs.
The work was initiated by the characterization of the building and patio, development of inspection sheets and reports, evaluation of the state of conservation and maintenance management plan. All the information was hosted on the same platform in order to be able to track the information, as well as to monitor and control the maintenance of the technicians involved.

Buildings are a functional basis of society and being public have a significant social component. The state of conservation of a building - in particular public - can be a social and financial indicator of a country. Also an adequate conservation of a public building allows the improvement of behaviors of its users, as well as in a broader way the urban renewal and even regeneration points of the cities.

The building of the National Library of Portugal was built more than 50 years ago, but still has a solid construction, with excellent guidance of sun exposure and using equipment that for the height of its construction were already advanced technology to achieve the objectives for which they were designed.

Over the years, new systems have been replaced and implemented that improve their sustainability and reduce consumption costs. There are proposals to be implemented, such as the use of rainwater for the irrigation system of green spaces, replacement of glazed spans to reduce losses and thermal gains, the placement of photovoltaic panels for the production of electricity, among others; no doubt that the National Library of Portugal would reduce on a large scale the consumptions that this is the correct path for sustainability and for the reduction of the ecological footprint.

USE OF DIGITAL TWINS APPLIED TO CIVIL ENGINEERING PROJECTS – CASE STUDY OF RESTORATION OF A HEADQUARTERS HOUSE OF A RURAL SETTLEMENT IN SÃO JOSÉ DO SERIDÓ/BRAZIL

André TOLEDO[a], Maria CLEIDE[b], Arthur ARAÚJO[c], Karen PEREIRA[d], Luciano DE FRANÇA[e], Leidjane SOUTO[f]

[a] Doctor, Federal Institute of Education, Science and Technology, IFRN, DIACON, Address:Av. Sen.Salgado Filho, 59015-000, Natal/RN, Brasil, andre.lopes@escolar.ifrn.edu.br
[b] Mestre, Federal Institute of Education, Science and Technology, IFRN, DIACON, Address:Av. Sen.Salgado Filho, 59015-000, Natal/RN, Brasil, cleide.oliveira@escolar.ifrn.edu.br
[c] Academic of civil engeneering, IFRN, DIACON, Address:Av. Sen. Salgado Filho,59015-000, Natal/RN, Brasil, arthur.araujo1@escolar.ifrn.edu.br
[d] Academic of civil engeneering, IFRN, DIACON, Address:Av. Sen. Salgado Filho, 59015-000, Natal/RN, Brasil, karen.ellen@escolar.ifrn.edu.br
[e] Academic of civil engeneering, IFRN, DIACON, Address:Av. Sen. Salgado Filho, 59015-000, Natal/RN, Brasil, luciano.neto@escolar.ifrn.edu.br
[f] Academic of civil engeneering, IFRN, DIACON, Address:Av. Sen. Salgado Filho, 59015-000, Natal/RN, Brasil, leidjane.souto@escolar.ifrn.edu.br

Keywords: *Technical Research, Digital Twins, Historic Building and Engineering Projects.*

Abstract

The process of technical registration of an already built building, usually known as “as built”, involves mobilization of teams for photographic recording, measuring environments, topographical surveys and characterization of construction systems. This data capture process becomes more complex when it involves buildings with historical interest and using construction techniques from the period. In this context, the Mais Incra Project was developed, an extension project that involved students and teachers of the Civil Engineering course at the IFRN and the National Institute of Colonization and Agrarian Reform (INCRA), with the objective of preparing technical proposals for use for existing buildings in selected INCRA settlements in Rio Grande do Norte. The selected buildings were old houses of rural properties, which started to have a use that was not adequate to the needs of the constituted rural settlements. This article presents the design optimization tool for a building called digital twins applied to an old farmhouse, located in a rural settlement Caatinga Grande in the city of São José do Seridó, Rio Grande do Norte. A digital model of the built environment was created, obtained through the Matterport platform for generating digital twins, using a 360º camera and its native image processing software. The digital model of the built

environment made it possible to reduce the number of visits and to improve the technical reports and plans generated once the building object of the projects is in a rural area, difficult to access, and approximately 250 km away from NEPPCON, which is located in Natal/RN. This article presents the characteristics of the project and the insertion of the computational process optimization tool, allowing gains in efficiency in the preparation of building characterization projects.

EXPLORING MARS DATA: A PATH TO HUMAN HABITATION

Amirhossein JAVAHERIKHAH[a], Mercedes VALIENTE LOPEZ[b], Shabnam MOHAMMADI[c]

[a] *phd student, University polytechnic Madrid, Etsem, Address: Torrelaguna, 28029, Madrid and Spain, amirhossein.javaheri@alumnos.upm.es*
[b] *Doctor Arquitecto, University polytechnic Madrid, Etsem, Address: de Juan de Herrera, 28040, Madrid and Spain, mercedes.valiente@upm.es*
[c] *bachelor's degree, University soore, Art Department, Address: karaj, Iran virouhome@gmail.com*

E-mail: amirhossein.javaheri@alumnos.upm.es (Amirhossein Javaherikhah)

Keywords: *Mars, Smart Building, Materials, Habitation, Management*

Abstract

The colonization of Mars is a subject of rising interest among space enthusiasts and scientists. Creating suitable dwellings for settlers is one of the most important challenges as humanity ponder a permanent presence on Mars. Mars has unique construction obstacles, such as a lack of atmosphere and significant temperature changes. Yet, recent technical advances have led to the development of novel ideas for Martian structures that might possibly shelter people for lengthy periods of time. This Article will examine some of the existing concepts for Martian architecture, as well as the difficulties connected with constructing on Mars, such as limited resources and extreme climatic conditions. The concepts described in this Article offer a glimpse of what may be feasible for future space exploration and colonization, despite the fact that there is still much work to be done in building usable and sustainable living environments on Mars.

EXPLORING THE GEOGRAPHICAL, STRUCTURAL MATERIALS, AND CONSTRUCTION TECHNIQUES ON MARS

Amirhossein JAVAHERIKHAH[a], Mercedes VALIENTE LOPEZ[b]

[a] *phd student, University polytechnic Madrid, Etsem, Address: Torrelaguna, 28029, Madrid and Spain, amirhossein.javaheri@alumnos.upm.es*
[b] *Doctor Arquitecto, University polytechnic Madrid, Etsem, Address: de Juan de Herrera, 28040, Madrid and Spain, mercedes.valiente@upm.es*

E-mail: amirhossein.javaheri@alumnos.upm.es (Amirhossein Javaherikhah)

Keywords: *Material, Technology, Construction, Resource, Location*

Abstract

Due to the limited resources available on Mars, careful consideration of the location of each building and the use of materials readily available on the planet is essential. One possible building material is the ice found on Mars, which could provide both structural support and radiation protection. Another option is to use Martian soil known as shillite, which can be pressed into a solid building material. In addition to choosing the right materials, it is important to use construction technology that can withstand the harsh environment of Mars. This may include 3D printing technology that can quickly and efficiently construct buildings using local materials. It is also important to consider the location of any buildings on Mars. Factors such as proximity to resources, terrain, and weather patterns must be considered when choosing a building site to ensure the safety and sustainability of any structure built on the planet. In addition, any building on Mars must be designed to withstand the planet's extreme temperatures and dust storms. One potential solution to achieving long-term sustainability on Mars is to design buildings that can be easily expanded or renovated. In this article, we examine these important factors using library sources and previous research.

CHALLENGES OF CONSTRUCTION 4.0 IN CIRCULAR CONSTRUCTION: THE ROLE OF STAKEHOLDERS AS BARRIERS OR DRIVERS FOR CHANGE

Antonia PACIOS ALVAREZ, Joaquín ORDIERES MERÉ, Mercedes GRIJALVO, Diego FOGACA, Angel PARÍS LOREIRO

Universidad Politécnica de Madrid

Keywords: *construction 4.0, digital transformation, BIM, sustainability, circular economy, stakeholders management organizations, ecosystem*

Abstract

The sector of Architecture, Engineering and Construction (AEC) has particular characteristics that have made the digital transition to "Construction 4.0" slower than in other industrial sectors. The construction industry is a perfect example of an interorganizational project, where value is created jointly for agents from different organizations. The adoption of the required new technologies goes beyond the search for efficiency. It has been identified in recent literature that the transformation in the AEC sector is closely linked to the inclusion of practices, by all stakeholders, that improve sustainability and embrace circular economy strategies, as is the case in other industrial sectors. A sector-specific characteristic that impacts digital transformation is the highly fragmented decision-making processes, due to the number of stakeholders involved, the poor communication and collaboration between stakeholders and the difficulties in managing and sharing the information and knowledge. Therefore, the integration of those practices is still limited.

BIM methodologies were adopted as a driving force for changing the construction system, management methodologies by promoting collaboration throughout the value chain that enables accurate, well-informed decisions to be made throughout the lifecycle, as well as bringing the opportunity for integration of all of digital information (Pacios Álvarez et al., 2021) (Pacios Alvarez et al., 2020).

Based on LEVEL(s) document (EC, 2020), which presents a voluntary framework that addresses the principles of circular design where the stakeholders experience along the building value chain is collected, the role of the actors involved in building throughout the life cycle will be reviewed. The pillars of the Level(s) framework are three basic principles of circular economy: durability, adaptability and waste reduction, as well as facilitating the quality management of waste.

Therefore, the purpose of this study is to answer the following research question: how can the 'stakeholders' management framework accelerate the transition towards the circular construction? The purpose of this article is to review the extent to which the role of all stakeholders, technical, economic and legal, can contribute to meet these circular objectives or basic principles in a collaborative work. An exploratory research approach was used, which consisted of a systematic scientific literature review on the stakeholders management framework and the stakeholders' role and responsibilities in addressing circular construction, using Scopus, Web of Science and Google Scholar databases. The results are analyzed.

PROPOSAL FOR THE APPLICATION OF THE CBA METHOD FOR THE SELECTION OF THE BEST ALTERNATIVE FOR SCHEDULING THE CONSTRUCTION OF A PUBLIC SCHOOL USING LAST PLANNER SYSTEM AND BIM MODELS.

Claudia ARIAS[a], Caleb ZAMORA[b], Xavier BRIOSO[c]

a Ingeniera Civil, Pontificia Universidad Católica del Perú, Departamento de Ingeniería, Grupo de Investigación GETEC, Av. Universitaria 1801, San Miguel 15088, Lima, Perú,
rossana.arias@pucp.pe
b Ingeniero Civil, Pontificia Universidad Católica del Perú, Departamento de Ingeniería, Grupo de Investigación GETEC, Av. Universitaria 1801, San Miguel 15088, Lima, Perú
caleb.zamora@pucp.edu.pe
c Doctor, Pontificia Universidad Católica del Perú, Departamento de Ingeniería, Grupo de Investigación GETEC, Av. Universitaria 1801, San Miguel 15088, Lima, Perú
xbrioso@pucp.edu.pe

Keywords: *Last Planner System, Lean Construction, construction of schools, Choosing by Advantages, Building Information Modeling, decision making.*

Abstract

In mid-March 2020, the Peruvian Government declared a total quarantine due to the COVID-19 pandemic, which implied the halt of construction works. Fort the resumption of activities, the health protocol had to be considered in the planning and scheduling of the work, processes that are typically poorly planned, leading to delays, cost overruns, and non-conformities in the final product. To improve these aspects, in recent years, the implementation of collaborative methodologies and technologies that optimize the control and monitoring of projects, such as the Last Planner System (LPS) and Building Information Modeling (BIM), has been promoted. On the other hand, multi-criteria decisión-making methods such as Choosing By Advantages (CBA) have also been successfully applied. CBA allows a group of experts to collaboratively select the best option among various alternatives by analyzing their advantages.

Therefore, the purpose of this article is to present a proposal for the application of the CBA method for the selection of the best work scheduling alternative in the construction of a Peruvian public school implementing LPS and BIM. For this purpose, a bibliographic review of the LPS, CBA, and BIM methodologies was carried out, the best practices of the contracting companies with the indicated methodologies were analyzed, and a method that integrates these tools was proposed, considering that it will be

implemented in Peruvian public schools. Finally, the proposed method was validated through surveys to representative stakeholders of the construction, concluding that the application of CBA in projects implementing LPS and BIM will be efficient for optimizing resources and phase times in the scheduling of construction activities, improving the understanding of each activity and reducing interferences between specialties.

ANALYSIS OF THE INFLUENCE OF COLLABORATIVE CONTRACTS ON THE EXECUTION PERIOD OF CONSTRUCTION WORKS

Carolina PIÑA RAMÍREZ; Gemma CACHERO ALONSO; Víctor SARDÁ MARTÍN, Raúl FUENTE JURÍDIAS

Universidad Politécnica de Madrid, Escuela Técnica Superior de Edificación, Departamento de Construcciones Arquitectónicas y su Control, Spain.

Keywords: *Lean Construction, Implementation, Change Management, Construction sector*

In Spain, residential building developers' main objectives are to achieve costs, deadlines, and quality, which is why they must promote teams with high participation in integrated practices and highly cohesive work groups if they want to achieve these objectives. One of the factors that influence the behavior of the parties and defines their roles and responsibilities in the construction of a work is the acquisition process that the promoter decides to carry out.

These developers would be more likely to achieve success in their construction projects by using other more integrated contracting strategies, in which teams with high participation in integrated practices and highly cohesive work groups are developed. These strategies, such as collaborative contracts, allow early participation of the core project team, greater transparency in cost accounting, and strong participation in the establishment of objectives by all team members. Collaborative contracts present higher levels of both team integration and group cohesion and are more likely to achieve deadline, cost, and quality objectives.

According to the bibliography consulted, it is shown that a higher level of group cohesion could be achieved through the use in early phases, such as in contract bidding, of a procedure in which promoters invite bids from companies with which they have already worked. had previous work experiences and carry out the selection of team members based on an award based on several criteria, that is, in addition to price, quality, deadlines and technical proposal, the previous experience of each was also considered one of the team members in similar jobs. Using non-price scoring criteria and repetitive work with team members will lead to better results. In most cases, the relationships established between the agents involved in the entire process or life cycle of the infrastructure are conflictive, mainly the relationships established between the promoter and the builder, which leads, in many cases, to an increase in the costs and deadlines of the works or to a low quality of the final product. These antagonistic relationships are attributed to a conflict of interests of the different parties: the

promoter wants the works to meet quality requirements, be completed on time and within an established budget, while the builder mainly hopes to obtain economic benefits. These relationships are also attributed to the fragmentation in the team selection process, which results from considering design and construction activities separately, often leading to the development of relationships of conflict, mistrust, and lack of transparency.

IMPLEMENTATION LEVEL AND STATE OF LEAN IN THE CONSTRUCTION SECTOR

[a]Patricia AGUILERA BENITO; [b]Carolina PIÑA RAMÍREZ; [c]Mª Jesús LLEDÓ PARDO; [c]Fernando CERVERÓ ROMERO; [d]Marta PARRILLA NAVAMUEL; [e]Fernando TORTAJADA RODES; [f]Celia ESTEBAN HERRANZ

[a] Universidad Politécnica de Madrid, Escuela Técnica Superior de Edificación, Departamento de Construcciones Arquitectónicas y su Control, España.

[b] Universidad Politécnica de Madrid, Escuela Técnica Superior de Edificación, Departamento de Construcciones Arquitectónicas y su Control, España.

[C] Think PRODUCTIVITY

[d] CULMIA

[e]Binarq Arquitectos

[f] Arpada

Keywords: *Lean Construction, Implementation, Change Management, Construction sector*

The construction sector is experiencing times of innovation where technological advances are helping us to have more sustainable, efficient, healthy, comfortable buildings, etc., and with which we can also build in a more efficient way and with an optimized use of resources, both human and material.

One of these advances comes from the hand of “Lean Construction”, a philosophy that allows improving the productivity and competitiveness of organizations when managing construction works, making project members work together effectively and present a high predisposition to collaborate with the team.

However, although the implementation of “Lean Construction” on construction sites has been shown to provide a better understanding of all processes and collaborations, involving them in a continuous improvement plan that is beneficial for real estate development, the construction industry is often reluctant to adopt changes in management forms.

Motivated by all the above, this research aims to be a point of reflection open to debate on the state of implementation of the “Lean Construction” philosophy in Spain. To this end, different aspects to be considered related to “Lean Construction” have been analyzed, such as digitalization, industrialization, BIM, collaborative contracts, and sustainability, in their application in both new construction and rehabilitation.

A survey has been carried out on different companies in the sector to be able to analyze in depth the degree of knowledge and implementation of the Lean philosophy, applied to the construction sector and its tools in Spain.

The results have shown that the Lean methodology implies advantages such as increased productivity, improved quality, increased sales or product value, etc

The survey carried out in the research shows us that the knowledge that exists on the subject, in companies in the construction sector, is minimal. But there is a global interest in trying to know and develop it, even though it is known where the limitations and the items to improve come from.

On the other hand, digital transformation involves a necessary business mindset change that focuses on a more agile, customer-centric, data-driven mindset, aided by the BIM methodology, and oriented toward innovation.

Also, the understanding of the Lean philosophy and its principles helps a systemic and systematic application of industrialization and processes, techniques, methodologies, and tools, adding an orderly application aligned with the objectives of each project.

In this sense, the Lean philosophy and its principles provide a toolbox that promotes a transformation in the mentality of workers. This fosters a vision of adding value to the customer, optimizing processes to be more agile, and practicing continuous improvement and innovation.

Regarding collaborative contracts, it is a method to apply from the early phases of the project and throughout its life cycle.

It is finally demonstrated that Lean Construction and sustainability are strongly linked, and the more “Lean” methods are applied in a project, the more it is controlled that benefits are achieved in better identification of waste, greater energy efficiency and reduction of environmental impact.

SAFETY CONDITIONS IN THE APPLICATION OF ACRYLIC RESINS AND SOLVENTSCONSTRUCCIÓN

Jesús Manuel BALLESTEROS ÁLVAREZ[a], Álvaro ROMERO BARRIUSO[b], B. María VILLENA ESCRIBANO[c], Ángel RODRIGEZ SAIZ[d], Cristina GONZÁLEZ GAYA[e]

[a] *University of Burgos, Department of Architectural Constructions & Construction and Land Engineering, Burgos, Spain. E-mail: jba1017@alu.ubu.es*

[b] *Universidad Isabel I, Faculty of Science and Technology, Burgos, Spain. E-mail: alvaro.romero.barriuso@ui1.es*
[c] *Departmet of Construction and Manufacturing Engineering, Universidad Nacional de Educación a Distancia, Madrid (UNED), Spain. E-mail: mvillena@ind.uned.es*
[d] *University of Burgos, Department of Architectural Constructions & Construction and Land Engineering, Burgos, Spain. E-mail: arsaizmc@ubu.es*
[e] *Departmet of Construction and Manufacturing Engineering, Universidad Nacional de Educación a Distancia, Madrid (UNED), Spain. E-mail: cggaya@ind.uned.es*

Abstract

The use of acrylic resins in architecture and construction is widespread due to their protective, sealing, flexibility, and elasticity properties. However, their application involves inherent risks, including the possible presence of explosive atmospheres (ATEX), since almost half of the content of commercial preparations corresponds to solvents.

The objective is to establish the maximum application area, minimum drying time, and maximum yields for both the resin preparations and its solvent, so as not to generate a hazardous site.

The methodology is based on the use of European Standards and publications of recognized prestige specific to ATEX. The process followed consists of quantifying the evaporation and dilution that occurs during drying, thus determining the necessary conditions so that the atmospheric vapor concentration corresponds to a theoretical zone of negligible extension, a non-hazardous zone. The drying time corresponds to the residence time of the vapor. From the maximum application surface and the minimum drying time, the maximum yield is obtained.

When the surface is subjected to a low-intensity air flow, the two calculation lines show similar results, but as the air velocity increases, its incidence of evaporation varies.

The results are given for both indoor and outdoor applications as a function of the available air velocity, characteristic values are also determined for each working área.

The study concludes that the maximum resin application speed is between 0.5 and 1.5 m^2/h, depending on the characteristics of the area, avoiding the generation of areas classified as fire or explosion risk.

INFOGRAPHIC DESIGN AS AN EFFECTIVE LEARNING TOOL TO UNDERSTAND AND CONVEY THE CIRCULAR ECONOMY MANAGEMENT CONCEPTS AND DATA

Imge AKCAKAYA WAITE[a], María Aurora FLÓREZ DE LA COLINA[b], Eda ÜNLÜ YÜCESOY[c], Domenico MECCA[d]

[a] *Associate Professor, Istanbul Technical University, Faculty of Architecture, Department of Urban and Regional Planning*

[b] *P.T.U. Professor, Universidad Politécnica de Madrid, ETSEM-Building Construction School, Department of Building Technology*

[c] Associate Professor, Istanbul Technical University, Faculty of Architecture, Department of Urban and Regional Planning

[d] *Research fellow, Sant'Anna School of Advanced Studies, Institute of Management*

Abstract

Could infographic design be considered as an effective learning tool to understand and convey circular economy management concepts and data? As it will be explained, the answer was clear after the three workshops planned and the seven infographics developed online, via Zoom, by the Circular EELISA Community, as a part of the "Circular in Play" project supported by the European Engineering Learning Innovation and Science Alliance (EELISA) and organized between September 2022 and March 2023.

The methodology applied to these workshops was the creation of several international and interdisciplinary teams, with members from partner universities: Istanbul Technical University, ITU, from Turkey; Universidad Politécnica de Madrid, UPM, from Spain; National University of Science and Technology Politehnica Bucharest, NUSTPB, from Romania; and Scuola Superiore Sant'Anna-Pisa, from Italy. Each of these infographic design groups consisted of one professor or researcher, one "graphic design facilitator" (an undergraduate student in a member university) and two or three interested students from the abovementioned partner universities or others beyond EELISA. The aim of each of these teams was a topic, chosen by students, and related with what they considered an important management aspect to change our economies, from linear to circular. On a selected week, following each of the three open workshops of "Circular in Play", they held 2 or 3 online meetings, to develop an original infographic design to convey the selected circular economy concepts and data. The themes of those infographics were: "The circular city", "Circular rural lifestyles", "Green technology", "Green hydrogen", "Reuse in the domestic kitchen", "Fashion reuse", and "Plastic recycling".

The final designs done by those teams were adapted to different social mediums, to be disseminated through institutional and private media channels, such as EELISA websites and its participating institutions' websites. As a result of these workshops, the students worked as a well-coordinated team and achieved a more comprehensive understanding on these issues, while the "facilitators" acquired a stronger confidence in their graphic design abilities as an important tool to transmit new ideas to society, and professors or researchers found a new effective strategy to motivate students. It is important to highlight that the participation in those workshops was voluntary and free of charge, only rewarded by what have been learned, as well as an EELISA credential and a certificate of participation.

As conclusions of this innovative teaching and learning practice, we might consider that it is important to give to students a more active role in developing their own capacities, using the new technologies and media, to motivate them and to create effective changes in key issues for our future. A more precise assessment of the effectiveness of those teams' infographics towards obtaining changes in society, not only in the university context where they were created and tested, could be tested by further research.

CALIBRATION OF SITE EFFECT PARAMETERS AND ATTENUATION COEFFICIENTS IN GMPM BSSA 14 FOR THE REGION OF SPAIN

Carlos A. González a, Francisco Martínez

[a] *Escuela de Ingenieros de Caminos, Canales y Puertos, Universidad Politécnica de Madrid, carlosalejandro.gonzalezj@alumnos.upm.es*
[b] *Dep. Mecánica Medios Continuos y Teoría de Estructuras, Escuela de Ingenieros de Caminos, Canales y Puertos, Universidad Politécnica de Madrid, Franciscomartinez@upm.es*

Keywords: *PSHA, Pseudo Spectro, GMPM, GMPE.*

Abstract

In any case, seismic activity represents a danger for society due to the different effects it can have on buildings and infrastructure, and therefore on the lives of the living beings that coexist in them. In order to prevent disasters related to this type of events, a series of analyses have been created to help prevent the areas with greater seismic affectation, as well as the approximate values of acceleration that will occur in the different zones.

One of the ways to make a possible prediction to the seismic actions that may exist in a region is through the use of statistical methodologies that are used to establish a probability of action of such events according to the return period that is established in the analysis, as for example, the probabilistic seismic risk analysis (PSHA), being a probabilistic analysis that is estimated by applying all possible locations of the hypocenter and the seismic magnitude that can generate the movement.

This probabilistic analysis works from prediction equations that have been created based on seismic metadata collected in different regions. These equations form models that are used to describe the response of the 5% damped pseudo spectra for the different zones taking into account some easily known input parameters. The major problem in creating these models requires data with large robust statistics to support the results, such as the database required to create the “NGA-West2” model. \left . There are different places where this type of information is not available, so the use of alternative methodologies helps to achieve adjustments to different seismic prediction models.

By using these residual methodologies proposed by Abrahamson and Youngs in 1992 [2] and using the seismic data provided by the National Geographic Institute of Spain, it has been possible to calibrate the BSSA 14 seismic prediction model proposed by Stewart, J. P., Boore, D. M., Seyhan, E., & Atkinson, for the region of Spain. Improving the seismic response of the response spectrum for the different periods analyzed, having the best efficiency results for periods longer than 3 seconds.

USE OF SCIA SOFTWARE TO PREPARE THE STRUCTURAL DESIGN OF A METAL WAREHOUSE

José Atila AROUCHA[a], Valdileia LOPES[b],

[a] *Engenheiro Civil Mestre, Universidade Estadual do Maranhão, Construção Civil, Rua Deputado Raimundo Leal S/N – Condomínio Porto Belo, casa 14 – Jardim Eldorado, 65066-635, São Luís - Maranhão, e-mail: atilajunior415@gmail.com*

[b] *Engenheira Civil Mestre, Universidade Estadual do Maranhão Construção Civil, Rua Deputado Raimundo Leal S/N – Condomínio Porto Belo, casa 14 – Jardim Eldorado, 65066-635, São Luís - Maranhão, e-mail: valdielialopes38@gmail.com*

E-mail: atilajunior415@gmail.com

Keywords: *Structures; Sizing; Software.Scia; Buildings; Calculator.*

Abstract

The use of software for the preparation of structural projects for buildings allows for greater agility during their preparation, since the function of the calculator becomes more of a consultant, that is, the person carrying out an analysis of the way in which the structure will behave after the loads that must be supported by it are released. However, for the correct handling of the programs, it is essential that the calculation engineer has good theoretical knowledge about all the properties of the materials that will be used during the design of the structure to be made, with the aim of extracting all the necessary characteristics from the elements. for safe and economical structural design. Therefore, this work's main purpose is to carry out the design and structural detailing of a metal warehouse with the support of Scia software. For the entire development of the work to have the greatest possible technical basis, bibliographical research was carried out based on technical standards and bibliographies, to link all knowledge with practice and assist in decision-making during sizing.

PARTITIONED ROOFS FOR DESIGNING COMFORTABLE AND SUSTAINABLE SPACES

Carlos Cesar MORALES GUZMAN [a], Brenda Berenice PÉREZ DEL ÁNGEL [b]

[a] Research professor, Veracruz University, Architecture faculty, Address: Poza Rica, city Poza Rica, Veracruz, México, dr.arqmorales@gmail.com (corresponding author)

[b] Architecture student, Veracruz University, Architecture faculty, Address: Poza Rica, city Poza Rica, Veracruz, México, aimehndz@gmail.com
E-mail: berebren278@gmail.com

Keywords: *Partitioned, Covered, Loads, Reactivation, Traditional technique.*

Abstract

This research aims to analyse the development of partitioned roofs in a reduced climb, and in a first phase find the elements that determine the design of this type of roof, as well as verify the bearing capacity of the partitioned vault and what its shape is like, its span, thickness (number of layers), the existence of stiffening tabs, filling of spandrels, etc. This will be addressed from the perspective: analytical and experimental.
Historically, different construction and analytical techniques used throughout history are known, so it is worth reactivating this construction system in the northern area of Veracruz, where the annealed red partition is traditionally used a lot, which is why models are made. graphics and computer forecasting of how to carry out the geometric adaptation or transition of these vaults. The construction procedures used in this dissertation are methods that are carried out in the area and in the field of construction. The results obtained in the experimentation will be to promote the design and construction of this type of roof, thus evaluating their degree of success and suitability as a construction procedure for this first stage of the research. (López, 2012) (Quintero & Morales, 2021)
It is well known that there are advances that have allowed more precise calculations and designs in the development of vaulted geometries, which at the moment have not been applied in this study since a simple construction method is proposed here to enhance the applicability of an ancient technique. how are you doing. What is proposed here is, on the one hand, to verify the main characteristics of the construction and geometrization in the construction design of the vaults, and thus enhance the applicability of this construction technique in architectural projects in the area.
Experimentally, five vaults have been built, to contrast the results obtained analytically in practical experience and later in another phase apply realization on a 1:1 scale and subject them to load tests and structural analysis of said forms, subsequently it is planned to develop organic parametric of this material.
"...effective construction invention that is the partitioned vault; because, with screeds and plaster or quick cement, a skilled bricklayer is capable of making, in a few hours, the most varied resistant shapes, without any other tools than a drawer and trowel..." (Torroja, 2017)

The first step to understand how to apply this construction system in architecture is to define that this construction system is technical and that due to its characteristics it has very good resistance for construction and that it had been applied for a long time in the area, with the entry of industrialized materials, this product was no longer used in roofs, supports and walls, since they are economically cheaper and relatively more sustainable than other industrial materials that require greater processes for their production, so this research will focus on understanding the process. and construction design model of this technique of partitioned roofs but with a scale of 1:20 to be able to verify its design in the spaces.

Construction system

Firstly, partitioned vaults are made with bricks and binder (plaster, cement, mortar); Normally, thin bricks are used, almost always laid flat, configured in one or several layers (the first, depending on the technique, is received with plaster) joined together by two, three or more layers, made without formwork. As soon as they are closed, the fastening of the bricks is achieved by the adhesion of the quick-setting mortar with the previous arches or brick rings already finished that serve as guides, or with a previous placement of edge walls, if applicable.

These covers are built with very small thicknesses. The common thing is that they have two sheets (about 10 cm in total, including the intermediate layer of mortar and the coatings), but they are also found with one sheet (about 5 cm). The slenderness, with the relationship between the radius of curvature and the span, is frequently over 100 units, but can be made with much more slender (Huerta, 2006)

The curves that are made with this technique are various, with directrix (of revolution, intersection among others), ruled surfaces, catenary, parabola, etc. With this, the construction process is simple and inexpensive within the framework of pre-industrial techniques: a vault without falsework and quickly executed that could be easily erected.

Typically, the brick vault has been used to cover roofs, covers; to form stairs, etc. It is a technique that we find in both popular construction and large constructions: country houses, homes, industrial warehouses, palaces, churches, libraries, etc. (Almagro, 2001) (Huerta, 2004)

PROPOSAL FOR THE APPLICATION OF THE CBA METHOD FOR THE SELECTION OF THE BEST ALTERNATIVE FOR SCHEDULING THE CONSTRUCTION OF A PUBLIC SCHOOL USING LAST PLANNER SYSTEM AND BIM MODELS.

Claudia ARIASa, Caleb ZAMORAb, Xavier BRIOSOc

[a] *Ingeniera Civil, Pontificia Universidad Católica del Perú, Departamento de Ingeniería, Grupo de Investigación GETEC, Av. Universitaria 1801, San Miguel 15088, Lima, Perú, rossana.arias@pucp.pe*

[b] *Ingeniero Civil, Pontificia Universidad Católica del Perú, Departamento de Ingeniería, Grupo de Investigación GETEC, Av. Universitaria 1801, San Miguel 15088, Lima, Perú caleb.zamora@pucp.edu.pe*

[c] *Doctor, Pontificia Universidad Católica del Perú, Departamento de Ingeniería, Grupo de Investigación GETEC, Av. Universitaria 1801, San Miguel 15088, Lima, Perú xbrioso@pucp.edu.pe*

Keywords: *Last Planner System, Lean Construction, construction of schools, Choosing by Advantages, Building Information Modeling, decision making.*

Abstract

In mid-March 2020, the Peruvian Government declared a total quarantine due to the COVID-19 pandemic, which implied the halt of construction works. Fort the resumption of activities, the health protocol had to be considered in the planning and scheduling of the work, processes that are typically poorly planned, leading to delays, cost overruns, and non-conformities in the final product. To improve these aspects, in recent years, the implementation of collaborative methodologies and technologies that optimize the control and monitoring of projects, such as the Last Planner System (LPS) and Building Information Modeling (BIM), has been promoted. On the other hand, multi-criteria decisión-making methods such as Choosing By Advantages (CBA) have also been successfully applied. CBA allows a group of experts to collaboratively select the best option among various alternatives by analyzing their advantages. Therefore, the purpose of this article is to present a proposal for the application of the CBA method for the selection of the best work scheduling alternative in the construction of a Peruvian public school implementing LPS and BIM. For this purpose, a bibliographic review of the LPS, CBA, and BIM methodologies was carried out, the best practices of the contracting companies with the indicated methodologies were analyzed, and a method that integrates these tools was proposed, considering that it will be implemented in Peruvian public schools. Finally, the proposed method was validated through surveys to

representative stakeholders of the construction, concluding that the application of CBA in projects implementing LPS and BIM will be efficient for optimizing resources and phase times in the scheduling of construction activities, improving the understanding of each activity and reducing interferences between specialties

COMPARISON OF STRATEGIES OF DURABILITY BETWEEN EHE-08 AND THE STRUCTURAL CODE

Luca Autorea[a], Eleonora Amato[b], Alberto Leal Matilla[c], Alfonso Cobo Escamillad[d]

[a] Grado en Edificación, Escuela Politecnica de Madrid, ETSEM, Av. de Juan Herrero, 28040, Madrid, Spain, luca.autore@alumnos.upm.es
[b]Grado en Edificación, Escuela Politecnica de Madrid, ETSEM, Av. de Juan Herrero, 28040, Madrid, Spain, eleonora.amato@alumnos.upm.es
[c,d]Dpto. Tecnología de la Edificación, Escuela Técnica Superior de Edificación,, Universidad Politecnica de Madrid, ETSEM, Av. de Juan Herrero, 28040, Madrid, Spain E-mail: alberto.leal.matilla@upm.es alfonso.cobo@upm.es

Keywords: *Durability, materials, improvements, environmental factor, requirements*

Abstract

The approval of the Structural Code (June 2021) marked a significant shift in Spain's construction standards as it replaced the previous "EHE-08" code with a more European-oriented one. This transition brought notable changes in the construction industry, particularly in the realm of reinforced concrete durability. Both codes aim to the same goal: establish some requirements and directions in the designing and planning structural elements. But while the objective is common, the strategies that are used by the two codes are different and in this paper we are going to analyse these differences. We are going to focus on durability objectives, classification of the exposition, design of the coverage of concrete, requirements about the quality of materials, maintenance and repair. In order to do so we are going to have the “Codigo Estructural” and the “EHE-08” as a constant reference. Additionally, we will leverage existing studies and comparisons conducted by experts and organizations in the field to complement our findings and provide a comprehensive understanding of the evolving landscape in the construction industry, particularly concerning the durability of reinforced concrete structures.

ANALYSIS OF THE TRANSPORT OF PREFABRICATED ELEMENTS: PROBLEMS AND FUTURE DEVELOPMENTS

Manuela Lucia Spisso[a], Alberto Leal Matilla[b], Alfonso Cobo Escamilla[c]

[a]Grado en Edificación, Universidad Politecnica de Madrid, ETSEM, Av. de Juan Herrero, 28040, Madrid, Spain E-mail: manuelaspisso29@gmail.com
[b,c] Dpto. Tecnología de la Edificación, Escuela Técnica Superior de Edificación,, Universidad Politecnica de Madrid, ETSEM, Av. de Juan Herrero, 28040, Madrid, Spain E-mail: alberto.leal.matilla@upm.es alfonso.cobo@upm.es

Keywords: *Prefabrication, supplying, transportation, planning.*

Abstract

Prefabricated construction is gaining more and more popularity globally as a sustainable method to increase production efficiency and mitigate the negative environmental and societal impacts associated with conventional building practices. In recent decades, a considerable number of studies from renowned international journals have focused on the management of prefabricated constructions, addressing the management challenges associated with this innovative construction method.

Management issues also include transport, logistics and procurement of elements. What challenges might arise during management in these phases? In the context of this work, we examine the issues related to these phases, which, in general, play a crucial role in the construction process, impacting costs, times and the overall sustainability of the construction site. It is also crucial to consider the challenges associated with the procurement and transportation phases, as these directly affect operational efficiency and project success.

Decisions made around transportation route, materials management, and supply chain optimization have a significant impact on the smoothness of operations and the ability to meet schedules. In addition, the analysis of these phases can provide valuable insights to improve the overall sustainability of the project, considering aspects such as energy efficiency in transport and the sustainable management of material resources. Addressing and solving challenges at these stages is essential to ensure efficient, cost-effective, and environmentally friendly construction.

MANAGEMENT OF A BUSINESS PLAN FOR PREFABRICATED PRODUCTS FOR NATURAL DISASTER SITUATIONS

Manuel ÁLVAREZ* [a], Daniel FERRÁNDEZ [a], Alicia ZARAGOZA-BENZAL [a], Silvia LÓPEZ LUENGO [a], Paulo SANTOS[b]

a PhD, Universidad Politécnica de Madrid, Departamento de Tecnología de la edificación, Avda Juan de Herrera, 6 28040. Madrid. Manuel.alvarezd@upm.es Daniel.fvega@upm.es Alicia.zaragoza@upm.es; silvia.lopez.luengo@alumnos.upm.es
b University of Coimbra, ISISE, ARISE, Department of Civil Engineering, Rua Luís Reis Santos - Polo II da Universidade, 3030 - 788, Coimbra, Portugal. pfsantos@dec,uc.pt

Keywords: *Modular Panel, emergency, business plan, sustainability, recycled, manufacturing, market analysis.*

Abstract

In recent years, the rising frequency of natural disasters, coupled with ongoing conflicts, has led to societal challenges. The pressing issue of housing shortage for affected individuals demands attention. This project concentrates on exploring the use of prefabricated modular panels crafted from recycled materials in emergency scenarios to offer temporary, sustainable shelter solutions.

The primary objective is to assess the viability of a comprehensive business plan, including strategic, marketing, operational, human resources, and economic-financial aspects, to establish a company specializing in these recyclable modular panels. While recognizing that the full execution of this plan may not be immediate, it offers a foundation for future development if deemed viable.

The endeavour involved an analysis of the environmental context at macro and micro levels to comprehend the dynamics of catastrophes and the competitive market. Additionally, various factors affecting the business's feasibility were examined. Notably, the company aligns with the Sustainable Development Goals of the 2030 Agenda, emphasizing sustainability by employing recycled materials and responsible waste management.

The product's value proposition lies in speed, efficiency, resilience, and sustainability, with customization options catering to users' needs and preferences. Funding will be sought from investment funds within the construction sector, further enhanced by the product's sustainability focus.


ESCUELA TÉCNICA SUPERIOR
EDIFICACIÓN
UNIVERSIDAD POLITÉCNICA DE MADRID


PROiescon
Experiencia Tradición Confianza


GESTION EN EDIFICACION
B&M
BUILDING & MANAGEMENT


inacon
Ingeniería aplicada
Teléf. 91 230 03 44
info@inaconingenieria.es


POLITÉCNICA

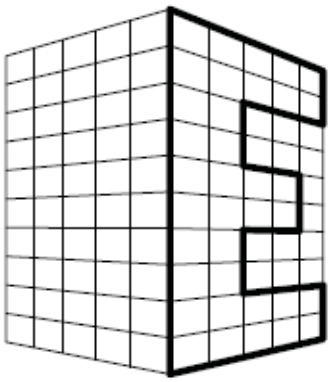

IPG


LOCAL


European University

Universidad Politécnica de Madrid

ESCUELA TÉCNICA SUPERIOR DE EDIFICACIÓN



Universidad Politécnica de Madrid

ESCUELA TÉCNICA SUPERIOR DE EDIFICACIÓN

Avda. Juan de Herrera 6, 28040 MADRID