LIBRO DE ABSTRACTS
BOOK OF ABSTRACTS

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Javier Cárcel Carrasco
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UNIVERSITAT POLITÈCNICA DE VALÈNCIA

I INTERNATIONAL CONFERENCE
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ÍNDICE DE CONTENIDOS

AGRADECIMIENTOS

En el presente libro se encuentran las ponencias resumidas y presentades al congreso internacional “International Conference on sustainable construction and demolition” celebrado los días 17 y 18 de Noviembre de 2021 dentro de las instalaciones de la Universitat Politècnica de València, tres pasar un proceso de revisión por pares anónimos.

Es de agradecer el apoyo mostrado por diferentes Instituciones, empresas e investigadores del sector, especialmente el apoyo de la Universitat Politècnica de València, y las E.T.S. de Arquitectura, E.T.S. de Ingeniería de Edificación, E.T.S. de Ingeniería Industrial y la E.T.S de Ingeniería de Caminos Canales y Puertos. Así mismo hemos contado con la colaboración de los principales colegios profesionales e importantes empresas del sector, que han dado relevancia a este congreso.

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Esta conferencia ha obtenido la financiación de la Generalitat Valenciana dentro del programa de I+D+i para SUBVENCIONES PARA LA ORGANIZACIÓN Y DIFUSIÓN DE CONGRESOS, JORNADAS Y REUNIONES CIENTÍFICAS, TECNOLÓGICAS, HUMANÍSTICAS O ARTÍSTICAS DE CARÁCTER INTERNACIONAL, con clave AORG/2021/023

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In this book are the summarized presentations to the international conference "International Conference on sustainable construction and demolition" held on November 17 and 18, 2021 within the facilities of the Polytechnic University of Valencia, whith a review process by anonymous peers.

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Mention of gratitude to all the important invited speakers who have participated in the different sessions of the conference, and especially to Professor Dr. Edward S. Rubin, for the inaugural conference of the conference entitled “The role of universities in sustainability”.

This conference has obtained funding from the Generalitat Valenciana within the R + D + i program for GRANTS FOR THE ORGANIZATION AND DISSEMINATION OF CONGRESSES, CONFERENCES AND SCIENTIFIC, TECHNOLOGICAL, HUMANISTIC OR ARTISTIC MEETINGS OF INTERNATIONAL CHARACTER, with code AORG / 023/2021

PRESENTATION/INTRODUCTION

This document summarizes the Proceedings of the 1st International Conference of Sustainable Construction and Demolition held in Valencia, Spain on 17-18 November 2021.

This conference seeks to disseminate the current situation from a perspective of improvement in the construction sector, where technological advances need to be constantly revised in order to manage its evolution efficiently and sustainably.

The conference deals with Sustainability in Construction, Technology, Energy, Environment, Circular Economy and Life-cycle analysis are being discussed in an international forum with innovative contributions that, without doubt, will give positive results in an immediate future.

The Conference has been a platform for the contributions with an established academic community in collaboration with the professional world and the business sector to present and discuss new and current work. That has resulted in making the Conference as successful as it has been.

All the full-length papers and abstracts were submitted to a review process by reviewers from the scientific committees, external reviewers and members depending on the corresponding subject matter of the paper. After the rigorous review process, the papers were selected based on their originality, relevance, and clarity for the purpose of the conference presentation.

Furthermore, these Proceedings will serve the researchers worldwide with an adequate information as a reference book. The organisers are sure that this will bring forth more focus and further studies and research regarding these research areas.

TOPICS

Sustainability has been crossing boundaries in all areas of human activities and development. Without losing sight of the three basic pillars (environment, economy and social equity), we have divided this first Conference in three large blocks focused on Construction activity.

The conference is divided into three main categories to discuss in the most complete way possible the concepts of sustainable construction and demolition; the three branches include different topics related to the treated area.

SUSTAINABILITY AND CONSTRUCTION: PROJECT, MAINTENANCE, AND RETROFITTING

The aim of this topic is sustainability applied to the different areas of construction: urban planning, architecture, civil engineering, building on site, etc.

This issue is opened to all different stages, from programming, design development, construction documents and administration.

Special attention to the maintenance and conservation of infrastructures, building retrofitting and heritage preservation.

TECHNOLOGY, ENERGY AND ENVIRONMENT: REGULATIONS, CERTIFICATION AND HEALTHY BUILDINGS

This issue is focused in different technologies applied to assessment and evaluation of sustainable construction and energy-efficient buildings, facilities and installations, etc.

The topic also considers environmental friendly materials, operational maintenance using advanced green technologies.

CIRCULAR ECONOMY AND LIFE-CYCLE ANALYSIS: PLANNING, DISMANTLING, DEMOLITION, REUSE AND RECYCLING

In this area we will carry on main aspects on Circular Economy applied to infrastructures, buildings and their facilities.

The LCA from the early beginning of the pre-design and material choose options to the final recovery and reuse of them.

SUSTAINABILITY IN CONSTRUCTION

A POSSIBLE ROLE FOR BUILDINGS IN THE SEARCH FOR A SUSTAINABLE TRANSPORTATION IN UNIVERSITY CAMPUSES

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ABSTRACT

Higher education institutions are increasingly striving to become fully sustainable organizations The search for sustain ability in university campuses includes zero carbon transportation that implies the use of electric vehicles (EV) and their recharge with electricity from renewable sources. Nevertheless, this requirement is normally considered only for displacements inside the campus; but, for a real sustainable approach, the displacements from and to the campus of the involved EVs should be also taken into account. Therefore, there is a need to supply EVs in the campus with enough clean electricity to recharge them for the consumption generated in these total displacements. Buildings in the campuses usually have parking spaces that could allocate the needed recharge points. Additionally, they can accommodate renewable sources, either PV panels and/or wind generators that could provide the clean electricity needed for the recharges. Therefore, a methodology has been developed to take into account all these aspects: EVs displacements, recharge capabilities, system design and economic viability. Simulation of this methodology for a university campus located in the Valencia area is addressed and detailed planning for application to a specific building of the UPV is outlined.

Keywords: Sustainable transport, electric vehicles, recharge, university campus, buildings, renewable energy.

INTRODUCTION

The need to reduce greenhouse gas emissions (GHG) (IPPC,2009) requires significant actions on the transport sector, given this demand sector is responsible for approximately 28% of the total GHG emissions (Sims, *et al*., 2014) Electric vehicles (EV) have been considered as the most promising alternative to internal combustion ones, given their null tail pipe emissions and, in consequence, EV acceptance is

gaining momentum, both at the public and the political levels (Müller et. al, 2019; Jingwen, 2019). Nevertheless, EV could generate GHG emissions when their batteries recharge is taken into account, so emphasis should be put to assure the use of renewable sources for the electricity required in that recharge process in order to reach the goal of a smart mobility, which is an important requirement for the EVdiffusion in sustainable districts (Chellaswamy et.al, 2017; Miceli, 2017).

Higher education institutions are increasingly striving to become fully sustainable institutions (Miceli, 2017). There is a strong movement for universities to become leaders in driving society towards a more sustainable future, through improving the sustainability of the built environment and their practices and operations, and through their education al, research and wider community engagement missions (Filho et.al, 2019). Given the need to actively address the challenges of climate change, university leaders have a growing interest in reducing their campuses environmental impact. This implies to promote the efficient use of energy and other resources on the university campuses (Almeida et.al, 2018). Sustainability initiatives are vastly described in literature, especially for the operational phase, including some initiative failures (Amaral et.al, 2021). Campuses are normally constituted by a large number of buildings that are responsible for a high energy demand. Therefore, they could become demonstration sites for new technologies and systems to improve energy efficiency and clean generation.

The search for campus sustainability includes looking for sustainable transportation, which should imply that the transportation requirements of campus users do not generate any environmental impact (Pouria, 2019). Therefore, they should be carried out with vehicles that do not emit emissions and that the necessary recharges are carried out with clean electricity sources (WeiRu Chang *et al*.,2009; Mingrui Zhang *et al*.2019; Anastasiadis, 2017). These recharges should be covering the consumption made by the users of the campus, (professors, students, administrators, etc.) not only in their displacement inside the campus but also in their movement between their place of residence and the campus, in both ways: going to the campus and coming back to their residence place. Given that many buildings include parking spaces, the design of new buildings, or the adaptation of existing ones, looking for sustainability must have the possibility of covering the recharging of the vehicles parked in them with enough installed power to guaran tee a full coverage of the above-described consumption.

In this work, a methodology is presented for the design of the recharging system in a building that guarantees the sustainability of the transport of the vehicles that use its parking. The possibility of injection into the building network, or in the main grid, of the electricity surpluses is included, and the economic viability of this approach to sustainable transport on a university campus is analyzed. Simulation of the methodology application to a standard campus and detail planning for the design of the system to install in a building in the Universitat of Valencia are also included in this paper.

CONCLUSION

Transportation sustainability is an important item to include in the search for university campus sustainability. These campuses are normally constituted by a large number of buildings that are responsible for a high energy demand. Therefore, these buildings could become demonstration sites for new technologies and systems to improve energy efficiency and clean generation, but they can also play a role in the transportation sustainability, by accommodating in their designs the needed recharge systems and the renewable sources to supply them. In this paper, a campus is considered sustainable from the transportation point of view once there are provisions to recharge EVs not only in their displacement inside the campus but also in their movement in both ways between their place of residence and the campus.

A methodology to take into account all the requirements for building parking areas to this goal of transport sustainability has been developed and the simulation of its application to the Valencia area, using average values for the entire year, shows that it is possible to recharge the EV needs with the support of the main grid or an storage system, but with a net zero balance by using the surplus of electricity generation in the main hours of the daytime. This implies to increase in a factor 2,5 the nominal power required by the estimated EV recharge demand. Detailed planning for the application of this approach to a specific building in the UPV campus is proposed.

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DESIGN OF A GEOPOLYMER FOR CONSTRUCTION 3D PRINTING

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ABSTRACT

In this research, the mixture designs are exposed to achieve a geopolymer mortar suitable for 3D printing. Both the fresh appearance and the influence on the strength of dosage variations are evaluated to determine a mixture that meets all the requirements for additive manufacturing.

Keywords: 3DCP, 3D Print, geopolymers, asd.

INTRODUCTION

Building with 3D printing is one of the great upgrade opportunities in the construction industry. Likewise, the combination of this technology with the incorporation of low carbon footprint materials such as geopolymers opens the door to sustainability for the entire industry.

CONCLUSION

It is concluded that the increase in the content of the solution of water with soda directly intervenes in the properties of fresh state and resistance.

An increase of dissolution can improve the properties of fresh state to adapt them to 3D printing, however it produces a direct impact on the reduction of mechanical resistance.

On the other hand, the reduction of water dissolution with activator content improves the mechanical properties modifying the workability of the mixture in a fresh state.

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CURRENT SITUATION AND FUTURE OUTLOOK FOR CONSTRUCTION WASTE IN NEW BUILDINGS

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ABSTRACT

Since construction is one of the oldest trades in the world, so is the waste produced in this industry. However, it was over time that some of these elements started to become a social problem specifically when they began to generate a negative environmental impact. In this article, we review some strategies focused on mitigating environmental damage such as waste regulation, optimization of construction processes, and waste reuse (for construction and non-construction purposes). We will see some examples and difficulties in such strategies to capture a perspective on construction waste in new buildings.

Keywords: Deconstruction, heritage materials, circular economy, heritage conservation, materials life

INTRODUCTION

In its beginnings, the art of building was an activity with little pollution and relatively controlled waste. This is because the materials used, such as stone, did not require complex manufacturing processes and returned to the ground almost identically (Reixach, *et al*., 2000).

However, as society evolved, new materials, construction processes, and building systems were also developed. Therefore, at present, the final disposal of various construction and demolition wastes can generate negative environmental impacts such as soil degradation and erosion, destruction of vegetation, and/or loss of environmental services (Mejía, *et al*., 2015).

Similarly, these wastes have been increasing due to population growth, the pursuit of economic development as well as their mismanagement (Reixach, *et al*., 2000; Pinzón and Cortes, 2019). This leads to the existence of few disposals are as, high management costs, and disposal in places that are not conditioned for this purpose, which occurs particularly in larger cities (Mejía, *et al*., 2015).

The recycling of construction materials indeed occurred long before the concern for the environment began, such as when the Carolingians, the Arabs, the Romanesque, and the Renaissance took advantage of the Roman ruins that existed everywhere to carry out their works (Reixach, *et al*., 2000). Similarly, in some periods the incorporation of substances leftover from other industries (straw, bones, skins) into the construction sector has also been observed (Reixach, *et al*., 2000). This strategy has also worked in the opposite direction when construction waste is used in non-construction processes such as soil bioremediation (Mejía, *et al*., 2015).

However, it has been in recent periods that such strategies, as well as waste management strategies and optimization of construction processes, have been used for environmental purposes, although there are still certain difficulties in their implementation (Reixach, *et al*., 2000; Pinzón and Cortes, 2019; Suárez, *et al*., 2019).

This shows a global trend towards the reduction of the negative impacts of construction waste on the environment, although there is still a need for greater linkage and environmental sensitivity among the different actors involved in the construction process. The circular design of new buildings according to the guidelines recently adopted in the European Union introduce a new vision in the way of building and involves all stakeholders, also opening new horizons in the field of heritage conservation.

CONCLUSION

It can be observed that throughout history there has always been construction waste; however, it has been more recent that such waste is having negative impacts on the environment due to the heterogeneity of the elements in a construction system, the use of non-endemic materials and complex manufacturing. Currently, environmental solutions have been sought that we can classify as waste reduction (either through normative regulations or through the optimization of materials) and the reuse of the elements (either for constructive or non-constructive purposes).

In perspective, and despite the alarming levels of pollution, there is a tendency for society to become aware of the importance of the proper management of construction waste and to coordinate its efforts to make the best possible use of it. However, it is still necessary that there is a link between the different actors involved in the construction process and that they in turn are endowed with sensitivity, knowledge and coordination capacity for the proper treatment of construction waste. The circular design of buildings introduces a new vision of construction that is reduced to a set of functional components and parts, easily assembled and disassembled. The digitization of information supported by BIM makes it possible to create a passport for the building and the individual materials that compose it, in which all the performance characteristics and transformations undergone during the entire life cycle are recorded.

The digital identity of materials together with innovative deconstruction practices make it possible to extend the life of materials beyond the useful life of the building, which at the end of its life becomes a source of materials for new construction. The cyclic regeneration of the material maintains its initial value with minimal energy requirement and minimal waste generation according to the good practice of up-cycling. The extension of the useful life of materials in circular design allows the integration of the needs of architectural heritage conservation and sustainable construction. The architectural heritage in ruins can become a source of materials for the creative design of new sustainable buildings according to a new transversal ethic of conservation and sustainability based on the mitigation of resource consumption and the reduction of the amount of demolition waste.

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EDILIZIA ECOSOSTENIBILE: L'USO INTELLIGENTE DI PANNELLI DECORATIVI CON MATERIALI RICICLABILI

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ABSTRACT

Al giorno d'oggi il settore edile deve affrontare un'importante sfida: saper gestire l'intero patrimonio edilizio presente nel mondo; negli ultimi anni, infatti, non si è stati in grado di rispettare i requisiti minimi per avere un ambiente ecosostenibile e funzionale, avvalendosi, inoltre, del continuo sviluppo della tecnologia e dell'innovazione. Ormai da qualche decennio l'uso di alcuni materiali ha contribuito all'incremento dell'inquinamento, al tempo stesso le analisi condotte in modo innovativo dei materiali PIÙ COMUNI, la produzione di nuovi, il riuso attraverso il riciclo (in alcuni casi parziale in altri totale), hanno aperto prospettive che coniugano ecologia, tecnologia e sicurezza.

Keywords: Sustainable Construction; Decorative panels; Building Recycling; Innovation; Green building.

INTRODUCTION

L'idea fondante è quella di offrire un contributo di studio all'analisi di alcuni materiali utilizzati per la produzione di pannelli decorativi, suscettibili di riutilizzo, una volta concluso il loro ciclo di vita; tutto ciò nasce dalla constatazione di un ripetuto impiego di materie prime non sfruttate adeguatamente e di un utilizzo controproducente di risorse non rinnovabili, nocive per l'ambiente e per l'ecosistema. Lo scopo dei pannelli di finitura è di personalizzare l'aspetto dell'involucro edilizio ottenendo effetti estetici creativi, difficili da proporre con il tradizionale intonaco. I prodotti ed i materiali da rivestimento devono sì garantire un buon impatto visivo, ma devono anche rispettare requisiti minimi indispensabili nei confronti degli agenti atmosferici (raggi solari, pioggia, umidità, gelo, calore) fino alle intemperie, della corrosione, del fuoco, garantendo longevità fisica e meccanica, con limitate operazioni di manutenzione e pulizia, e semplificazione degli eventuali interventi di riparazione; a tutte queste caratteristiche oggi necessariamente si affianca quella della sostenibilità, che si esplica anche attraverso l'uso di materiali riciclati, riciclabili epossibilmente leggeri. Un rivestimento di facciata avrà un notevole impatto architettonico, caratter-

izzando fortemente l'edificio, ma soprattutto un grande impatto ambientale. E' possibile scegliere diverse soluzioni di rivestimenti di origine vegetale (legno, sughero, BAMBÙ), minerale naturale (pietra), artificiale (ceramica, vetro, alluminio), sintetica (plastica), a cui dobbiamo aggiungere materiali innovativi come polimeri naturali, Etfe e materiali biomimetici.

Per esplicitare in forma comparativa,le prestazioni principali dei materiali qui analizzati è stata predisposta un tabella comprendente: origine (naturale, artificiale e riciclato); durabilità (secondo la EN 350); peso proprio (unità di misura); messa in opera (facile, media e difficile); certificazione (FSC, EPD, C2C, LEED, CE, BREEAM, ecc.); classe di utilizzo (secondo la EN 335); resistenza al fuoco (D.M. 26/06/1984, EN 13501-1 da A a F); riciclabilità a fine vita(%) e costo (m^2).

CONCLUSION

In definitiva negli ultimi anni, così come emerge da quanto studiato, molti sono gli interventi eseguiti su edifici nuovi o recuperati, utilizzando queste nuove tecnologie che sempe più catturano non solo l'interesse dei tecnici ma anche dell'utente; gli interventi nei settori dell' ecosostenibilità si sono sempre più perfezionati a tal punto da trovare una giusta collocazione nel panorama edilizio internazionale. Volano di questi studi risultano essere anche i provedimenti legislativi, che i vari stati hanno varato, negli ultimi anni, a tutela dell'ambiente, profondamente colpito dallo sconsiderato smaltimento dei rifiuti edili.

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PROPOSAL OF AN INTERNATIONAL CHARTER FOR THE VALORISATION AND SUSTAINABLE DEVELOPMENT OF SMALL TOWNS IN INLAND AREAS: THE "SALERNO CHARTER"

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ABSTRACT

The depopulation of small towns in inland areas, caused by the social, economic and cultural dynamics of contemporary society, is leading to the impoverishment of the tangible and intangible assets of these settlements, as well as a demographic imbalance in which cities are becoming increasingly crowded, and small municipalities are becoming abandoned. Therefore, it is necessary to propose strategies and guidelines in order to promote their sustainable devel opment so that their unexpressed potential can be exploited. There are many aspects to be taken into account in a systemic framework of territorial development, with it being necessary, in this context, to provide or implement essential services and infrastructures in order to avoid discomfort, especially to the new generations, while also introducing any all-innovative tools and systems to facilitate decentralised living and working.

The aim of the "Salerno Charter" is, therefore, to outline the strategic guidelines to mitigate the depopulation of entire fragile geographical areas and to avoid the risk of the impoverishment of the building, landscape and cultural heritage; to reduce the exodus of the inhabitants of many small municipalities towards the cities, or to contrast the fleeing of the current guardians of the territory, so as to preserve the heritage of ancient knowledge and traditions by keeping the identity and memory alive.

The built, landscape, and cultural heritage in small towns is a resource that belongs to everyone and is an expression of the diversity of societies through history. The "Salerno Charter" aims to define the principles, goals, methods and tools to valorise the authentic features of the civilisation that characterises the identity of settlements in inland areas, supporting the permanence of inhabitants as the main actors in the preservation of knowledge and in actions of sustainable growth and development.

Keywords: : Small towns, International charter, valorisation, landscape heritage, cultural heritage.

INTRODUCTION

The issue of small towns depopulation in inland areas has attracted the interest of scholars and researchers in recent decades, who have proposed strategies to stem a phenomenon that is affecting not only many European Countries but also marginal geographical areas all over the world.

At the same time, the landscape, environmental and cultural importance of these territories has been noted: they are complementary places to the city, green lungs where the air is healthy, there is a richness of artistic, architectural and archaeological heritage, and ancient knowledge and traditions (handed down through generations) are kept alive, treasures of memory and identity (Fiore *et Al*., 2019).

However, the decline of small settlements is gradually taking on significant proportions, with repercussions in the social, economic and cultural spheres: there is an increasingly intense demographic centralisation in medium-sized cities and metropolises, which, according to the most reliable projections (Department of Economic and Social Affairs, Population Division, United Nations, 2019), is destined to increase over the next thirty years, leading to widespread land degradation and the consequent gradual disappearance of the signs that characterise small-scale landscapes. As reported in the United Nations World Urbanization Prospects 2018: "Globally, more people live in urban areas than in rural areas, with 55 per cent of the world's population residing in urban areas in 2018. In 1950, 30 per cent of the world's population was urban, and by 2050, 68 per cent of the world's population is projected to be urban". These data are certainly significant and show, on the basis of statistical analyses, the constant de-marginalisation of inland areas and small towns. The issue is extremely complex and has different dynamics. There are many causes, including the contingent economic crisis, the geographical isolation typical of marginal areas, the lack of work that forces young people to move away to find employment, the shortage of efficient infrastructures and services (education, health, transport), the scarcity of places for leisure and sport, and changes in lifestyles and consumption that tend to be standardised and conditioned by big commercial brands (D'Andria *et Al*. 2020).

The risk is that small towns may become places of oblivion, where the features of a centuries old civilisation are lost, linked not only to artefacts but also to traces and elements of intangible culture. Small towns are a valuable heritage of cultural identity that must be safeguarded, as the International Charter of Krakow (2000) clearly un-

derlines: “Each community, through its collective memory and awareness of its past, is responsible for identifying and managing its heritage. The individual elements of this heritage carry many values, which may change over time. From this process of change, each community develops a conscience and an awareness of the need to protect the values of its common heritage”. In most of the investigated areas, many significant elements characterising the places are still preserved, such as the ancient system of settlements, the historical structure of cultivations, the organisation of rural routes, the original relationship between built-up areas and territory, but also religious traditions, recipes referring to products partly forgotten, knowledge in the field of traditional building, tailoring and crafts in general.

Although the phenomenon in question is ongoing and increasing, in recent years, there has been greater attention and interest in tackling these issues, not only because of the risk of “desertification” of entire geographical areas but also because of the opportunities that the resources available there may offer, as well as for a more balanced and sustainable demographic distribution within the framework of territorial systems. There are a number of relevant studies investigating the relationship between small towns and their territorial areas, analysing social, institutional and economic aspects on a broader scale. Among these, there is Small and medium sized towns in their functional territorial context (Servillo *et Al*., 2014) which examines the role of small towns in connection with neighbouring cities, outlining their development potential as part of specific governance dynamics.

The ESPON ESCAPE (European Shrinking Rural Areas: Challenges, Actions and Perspectives for Territorial Governance) project investigates the causes and consequences of the depopulation of inland areas, providing indications about valid strategies and actions that have as a starting point the peculiarities of each small reality (Copus *et Al*., 2020).

H2020 ROBUST (Rural-Urban Outlooks: Unlocking Synergies) addresses rural contexts and municipalities in more detail, identifying, supporting and strengthening policies aimed at enhancing mutually beneficial linkages between urban, peri-urban and rural areas. It, therefore, highlights the importance of rebuilding the city-countryside interdependence, given that “the city can be the right ally for the villages, creating links and developing new entrepreneurship with them” (Berizzi *et Al*. 2019).

The attention for small towns has also increased due to the greater common sensitivity to cultural heritage, landscape values, history and environmental quality, all factors that can be used to encourage investment, tourism and land consumption.

Therefore, the regeneration of villages in inland areas is a vast field on which a new idea of conservation and revitalisation can be based, producing added value, growth and rebirth in contexts undergoing depopulation.

To this end, the definition of guidelines is of crucial importance, with it being necessary to: contemplate safeguard and development, i.e. the protection of tangible and intangible assets together with economic growth; envisage factors leading to the welcome of those who settle (or re-settle) permanently and aspire to a higher level of services and quality of life; define actions aimed at safeguarding the settlements' historical structure and economic and social development in line with the progress and models of contemporary society.

The "Salerno Charter" was drawn up in the wake of an International Conference entitled Small Towns...from problem to resource. Sustainable Strategies for the valorization of building, landscape and cultural heritage in inland areas held at the University of Salerno on 19-20 September 2019, whose scientific results were collected in a volume (open access e-book) published by Franco Angeli Editore.

Starting from the considerations on the topics discussed during the Conference, thanks to the researchers of the Department of Civil Engineering at the University of Salerno (www.unisa.it) and with the collaboration of the universities of Valencia (www.upv.es) and Tirana (www.upt.al) represented by the authors, a series of reflections and in-depth studies were carried out, which constituted the basis for the development of common awareness, i.e. the need to propose a method aimed at guiding experts in the safeguarding and valorisation of small towns in inland areas by using specific guidelines.

In this perspective, the "Salerno Charter" sets itself as a reference for the revitalisation of the built environment, the strengthening of infrastructures, the reorganisation of the territory and, at the same time, the sustainable recovery of identities and cultural assets and, more generally, of resources. The aim is to revive the inland areas so that in the complex panorama of today's society, the small towns in the vast area can represent not a problem but rather a resource; in other words, they can play a role in relaunching the territory.

It is true, as already mentioned that these 'small' settlements lack services and infrastructures, that work is scarce (especially for young people), and that opportunities for meetings and exchanges are very limited. However, they are 'human-scale' places, where the air is healthy, the discomforts of anthropic concentration are reduced,

where ancient knowledge and traditions (protected and handed down from generation to generation) characterise the identity and represent a treasure of knowledge and memory for a lifestyle in harmony with the rhythms and cycles of nature.

Along with these considerations, it is also worth mentioning that in small towns there is a concentration of handicrafts, excellent agri-food production, as well as unique natural resources such as woods, hills, waterways and crops that characterise the places. These are all factors that can develop unexplored 'economies' with a high added value, able to produce wealth, safeguard the territory and ensure sustainable economic development.

It is necessary to take into account the dynamics of the global economy, the technological revolutions underway, the use of increasingly autonomous machines that tend to replace man at work, and the demand for more and more advanced services: in short, it is necessary to take into account the dynamics and speed of the changes that characterise our time and the influence that these dynamics may have on the transformation of settlements, in the consciousness that innovation, as in the past, will certainly lead in the future to an evolution of our models of living and repositioning of man in the territory. It will also be necessary to be prepared in order to manage changes quickly, to understand their developments and to avoid or, at least, reduce the probability of the risks that may arise (Fiore *et Al*. 2019).

For this reason, it is essential to know small settlements in detail, "intimately and profoundly", as Angelo Sofo (2010) states, it is necessary to "place ourselves in a situation of listening, trying to perceive the invisible behind the visible in order to come into contact with the essence of that small fragment of the Earth on which we are called to act". Regaining possession of marginal areas means setting up a knowledge culture that can reveal their history, fragility and potential, even before planning actions and interventions.

The loss of ability to recognise the marks of the place can lead to the uprooting of the individual, the severing of the relationship between man and the environment, with the consequent affirmation of the logic of a demagogic economic power that upsets, destroys and erases the traces of time, in the name of a feared progress.

Looking at the territory's settlements in these terms means considering them as products that speak of people and to the people who live and transform them in constant interaction with the environment. According to this meaning, the expression 'place', even if used to indicate a materially delimited portion of space, in re-

ality, goes beyond the mere spatiality and material extension, having its own and well-defined character that involves a wider sphere, the cultural, social, ethical and aesthetic one.

There are elements of experience that are inserted in the sphere of traditions, craftsmanship, subsistence economy, social relations, etc. that strongly connote the built environment and reveal its meaning; grasping the signs of the place's meaning signifies "giving aesthetic value to social facts" (Mukarovsky, 1971). Therefore, it is important to emphasise the most negligible, even apparently insignificant details, and the seemingly marginal details that sometimes turn out to be revealing. Even if the spatial elements are carefully sifted with analytical criteria, it is important not to forget the "small discernments", as Winkelmann said, i.e., identifying all the clues that can be traced back to the identity framework of the places.

The initiatives aimed at recovering and valorising small towns, therefore, require an integrated approach with an analysis of factors relating not only to the more technical aspects but also to those models of reinhabitation in which space and time have values linked to identity, memory and traditions; the place is so because it is "inhabited, humanised, recognised, periodically refounded by the people who are part of it or feel part of it [...] the places are social and cultural constructions, the result of a continuous production by the inhabitants" (Teti, 2017).

The "Salerno Charter", therefore, intends to outline strategic guidelines to contrast the migration of inhabitants from small towns and to encourage communities and territories to become increasingly aware of the value of the ancient knowledge, traditions, culture and memory heritage. The intention is to define the principles, goals, methods and tools for valorising the authentic features that characterise the identity of small settlements, promoting the permanence of the last guardians, who are the main actors in the maintenance of the cultural heritage and, at the same time, of the growth and development actions, but also the possibility for the new generations to find employment opportunities, social improvement and quality of life.

International Charter for the Valorisation and Sustainable Development of Small Towns in Inland Areas - Preamble

Considering the different international documents on the protection, conservation, regeneration, valorisation and management of land and settlements;

Concerned about the depopulation and abandonment of small towns in inland areas due to various social, economic and cultural dynamics of contemporary society;

It is necessary to implement actions in order to rebalance human settlements in the territory, with a view to a better organisation and interaction between cities and small municipalities, for a more balanced consumption of land and resources.

Considering that the heritage of tangible and intangible assets of these places represents a resource, belonging to all individuals and societies, and runs the risk of being impoverished. the parties hereby agree as follows:

Art.1 - The object of this guideline Charter are small settlements located in inland areas, i.e. in peripheral and fragile areas characterised by progressive depopulation and at risk of degradation and abandonment, with consequent effects on the territory (countryside-landscape relationship) and cultural heritage (material and immaterial).

Art. 2 - A systemic vision and the implementation of coordinated actions are basic factors for achieving the goals of economic, social and cultural growth of the settlements under consideration.

Art. 3- The heritage of cultural and natural assets must be safeguarded and valorised so that it can represent an in come for the protection and development.

Art. 4- The relationship between man-building-environment has to be strengthened and rebalanced through actions aiming at the redevelopment of built-up areas, the revitalisation of the countryside, the promotion of landscape culture, the protection of the environment, the reduction of land consumption.

Art. 5- It is essential to safeguard and promote the resources available: protected natural areas, regional and national parks, historical town centres and historical-artistic assets, archaeological sites, villages and castles, museums and small libraries, churches, religious presidia and shrines, proto-industrial artefacts, rural/vernacular architecture, the agricultural landscape, historical paths and pilgrimage routes, geosites, watercourses, sheep tracks and ancient roads, as well as any other significant testimony to the memory and identity of places and collective culture.

Art. 6 - Demo-ethno-anthropological assets, as well as ancient knowledge and trades handed down from generation to generation, should be detected, surveyed

and valorised in order to preserve the intergenerational identity and the sense of belonging to the place.

Art. 7 - Through the construction of services, infrastructures and new transport networks, with public and/or private investment, it will be possible to satisfy needs that consolidate the permanence of the inhabitants. Residence in small towns is an essential requirement for keeping alive local knowledge, traditions and know-how, as well as safeguarding the environment and preventing hydrogeological risks.

Art. 8- An organisation associated and/or in consortium form can guarantee the sustainability and efficiency of services. The different forms of association envisaged by national regulations, through inter-municipal aggregation processes, with the aim of reorganising and distributing services and equipment in a balanced manner, are extremely important.

Art. 9- The use of flexible and digital distance working is one of the tools useful to reduce costly and polluting commuting to the cities and to maintain a continuous daily presence in small municipalities able to support local economies as well as social and community life.

Art. 10- Forms of cultural, religious and experiential tourism are essential for the growth of inland areas. They can be suitably developed in such a way as to reconcile economic and social development with the need to safeguard the authenticity and protection of the territory's resources.

Art. 11- Food and wine tourism can be developed through an organic action promoting the supply chains and brands of typical products. The demand for hotel accommodation can be met through the creation of 'Albergo Diffusi', agritourism and bad and breakfasts, preferably using disused buildings (old mills, cottages, farms, abandoned buildings or sections of historical centres, etc.).

Art. 12- Greater media attention to the positive aspects of these territories is desirable in order to highlight the potential of new sustainable models of economic development, centred on the green economy production paradigm, on the values of social/community cohesion and health benefits (air, water, soil quality). The promotion (communication) can be carried out both through traditional information media (television, radio, newspapers) and through new tools such as social networks, but also using innovative knowledge systems like cultural heritage information system, GIS, augmented reality technology, etc.

Art. 13 - A reversal of the urbanisation trend may lead to a gradual decongestion/ depollution of cities and metropolises, also in line with the goals proposed in the European climate programmes. Healthier living conditions, a diet based on zero-km products, greater contact with nature and with open spaces can promote the relocation and rebalancing of territorial human activity.

Art. 14 - Appropriate measures in favour of youth employment and the creation of new enterprises and cooperatives, also by means of a significant reduction in bureaucracy and tax exemptions, are desirable in order to avoid the departure of the new generations from their native places and to prevent the consequent ageing of the population.

Art.15 - The recovery and revitalisation of historical centres are desirable (with attention not only to prestigious buildings but also to all the artefacts and pertinence with testimonial-historical and choral value). In any case, an improvement in the comfort and quality of housing should be envisaged (upgrading, energy efficiency, domotics, etc.) in order to make buildings as responsive as possible to users' expectations.

Art. 16 - The traditional local handicrafts, the cultivation of autochthonous plant species, the production and transformation of typical products are of great interest. Schools of arts and crafts should be encouraged, involving local artisans, who are holders of manual skills and practices handed down from generation to generation.

Art. 17 - The most advanced technologies will be able to improve agricultural work, the care of forests, the balanced production of products, and encourage young and/ or female entrepreneurs. In this way, it will be possible to guarantee a higher quality of production, environmental protection and control of the territory's needs.

Art. 18 - The bottom-up processes for citizen participation in urban governance and management are necessary for the active collaboration of residents in planning and transformation choices.

Art.19 - The awareness of the cultural, environmental and identity issues highlighted in this document should be encouraged by all means and strongly addressed to young people, starting from primary school education. In this context, education should be promoted in the rediscovery of environmental values, the beauty of natural assets and art, and the knowledge of community spirit and traditions.

Art. 20 - It is believed that all the actions outlined above can help achieve harmonious, balanced, efficient and sustainable territorial development. The goal to be pursued can be summarised as a gradual and effective contrast of the current phenomena that see the inland areas marginalised and characterised by: loss of population, reduction of collective services, the decline in employment and land use, hydrogeological instability, environmental degradation, impoverishment of the historical-artistic heritage, loss of ancient knowledge and local traditions.

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EVALUACIÓN DE LA ALTURA DE DEFECTOS INTERNOS DE SOLDADURA MEDIANTE TÉCNICAS RADIOGRÁFICAS. APLICACIÓN AL CONTROL DE ESTRUCTURAS METÁLICAS

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ABSTRACT

The present paper proposes a working method for determining the height of defects in the welds of metal constructions using radiographic techniques. First, the problems associated with the detection of defects in metal welding are briefly exposed, as well as some of the techniques commonly used. Next, the fundamentals and procedure of the proposed method are described. All this is accompanied by a practical case as an example and experimental validation, to finish with the conclusions and the advantages derived from the application of the method to the control and execution on site of welded joints.

Keywords: Radiological inspection, defects metal welding, construction, welded structures.

INTRODUCTION

Durante la ejecución de las uniones soldadas realizadas sobre estructuras metálicas se recurre habitualmente a la inspección visual, mediante la cual es factible controlar eficazmente gran parte del proceso. Adicionalmente, también se precisan otras técnicas de inspección capaces de determinar y evaluar posibles defectos internos presentes en una soldadura. Dichos defectos, SEGÚN la normativa vigente, pueden ser determinantes para la aceptación o rechazo de las soldaduras efectuadas. De ahí la importancia de la fiabilidad en los métodos de detección que, también deben ser viables técnica y económicamente para facilitar y extender su utilización.

CONCLUSION

Tal y como se ha demostrado para el caso de uniones soldadas, el método propuesto permite realizar un dimensionado tridimensional aproximado de las discontinuidades (defectos) mediante la técnica de inspección radiográfica. El método es fiable y fácil de llevar a la práctica; los resultados, que son numéricos y muy simples, no conllevan problemas de interpretación; y no se precisa de un equipamiento adicional al necesario para efectuar una inspección radiográfica convencional.

Por todo ello, se concluye que este método es de interés para la caracterización de defectos de soldadura en general y, particularmente, para las uniones soldadas presentes en la estructura metálica de cualquier tipo de construcción civil. Ya sea para determinar el grado de cumplimiento de la normativa de seguridad que les aplica y/o para valorar el riesgo asociado a su estado y nivel de defectos durante las operaciones de construcción, revisión, mantenimiento, demolición o desescombro.

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ECO RESTYLING VIRTUOSO E VIRTUALE DELL'ESISTENTE

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ABSTRACT

Il controllo della forma nelle strutture architettoniche è una caratteristica naturale della pratica dell'ingegneria e della progettazione architettonica. La conoscenza necessaria per il suo sviluppo si basa su due fondamenti: il primo, l'approfondita conoscenza dell'esistente, fa sì che le prestazioni e la funzione dell'edificio siano intimamente connessi alla forma degli spazi costruiti; il secondo dà un'idea relativamente nuova, considerando il sistema di cal colo impiegato per controllare i dispositivi in modo autonomo, attraverso i principi igroscopici. Quando combinati, ciascun tipo di conoscenza può essere utilizzata per approfondire l'architettura e l'ingegneria sia a livello teorico che a livello metodologico. Il controllo della forma è di grande interesse all'interno dell'architettura perché è l'ingrediente primario necessario per produrre involucri edilizi che cambiano forma. Le strutture architettoniche reattive richiedono una rivalutazione delle nozioni esistenti di creazione dello spazio, in pratica, questi sistemi richiedono una rivalutazione delle metodologie costruttive e progettuali sia in ambito ingegneristico che architettonico. In questo articolo viene approfondita.

Keywords: Eco restyling; Hygroscopic actuation; Responsive architecture; Wooden structures; Lightweight marble structures.

INTRODUCTION

In questo articolo viene presentata una ricerca sui sistemi architettonici in biopietra, che alleggeriscono il rivestimento esterno dell'edificio, e in elementi lignei naturali reattivi; tanto la biopietra quanto gli elementi lignei, in modo autonomo si adattano ai cambiamenti ambientali, sfruttando le diverse proprietà che tali materiali manifestano a livello chimico, elettrico e fisico-meccanico. Oltre alla pietra utilizzata per rivestimenti esterni e interni, le nuove tecniche e il progresso in campo edile hanno permesso la progettazione e produzione di prodotti in marmo alleggerito, che forniscono all'edificio soluzioni sia tecniche che estetiche. Combinato con l'alluminio, lo strato sottile della pietra supera i limiti del peso e può essere utilizzato in diversi formati in base alle applicazioni.

La ricerca presentata segue una strategia integrativa, che può essere considerata no-tech, che si basa sui principi biologici piuttosto che meccanici. In natura alcuni vegetali impiegano diversi sistemi per rispondere ai cambiamenti ambientali. Un modo particolarmente interessante passa attraverso la risposta igroscopica, in quanto vi sono piante che forniscono, per il loro funzionamento a livello metabolico, un modello interessante per avere un movimento autonomo e reattività passiva. Il documento presenta un'idea di eco restyling esterno di un edificio esistente, attraverso l'utilizzo di pannelli in pietra alleggerita ad alto contenuto tecnologico e in lamelle di legno che seguono il principio igroscopico.

CONCLUSION

Sebbene la ricerca su questi materiali e l'applicazione ipotizzata rispondono ad un criterio di dimensioni ridotte del componente ligneo, è plausibile ipotizzare che attraverso meccanismi di produzione industriale si potranno incorporare proprietà prestazionali aggiuntive e superare le limitazioni delle dimensioni del pannello.

Il lavoro presentato illustra come questa interdipendenza tra il sistema e il suo ambiente possa essere sfruttata al meglio quando serve ad un analogo scopo, come nel caso del rapporto tra legno e condizioni atmosferiche, otra marmo e peso proprio. Qui, il sistema materiale è stato fortemente caratterizzato a livello morfologico, per lascare il segno di una nuova estetica e di una nuova tecnologia in un ambiente costruito fortemente degradato.

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SOSTENIBILIDAD EN LA CONSTRUCCIÓN: CASO DE INSTALACIÓN FOTOVOLTAICA EN INFRAESTRUCTURA AUXILIAR DE UNA PLANTA DE RESIDUOS NO PELIGROSOS

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ABSTRACT

Los sistemas de gestión de la calidad y medioambiente permiten la mejora continua de los procesos en industrias y en empresas de construcción. Partiendo de la ISO 14001 de medioambiente y la búsqueda de objetivos de mejora, se estudia la viabilidad de una instalación fotovoltaica para abastecer una de las infraestructuras auxiliares de la planta de Residuos No Peligrosos (RNP). Se establecen los factores clave que permiten implantarla mejorando todos los aspectos sostenibles de la instalación.

Keywords: ISO 14001, infraestructura auxiliar, instalación fotovoltaica, sistema de gestión, sostenibilidad.

INTRODUCTION

En la actualidad existen numerosos criterios y herramientas de evaluación de la sostenibilidad en infraestructuras y edificación que abarcan MÚLTIPLES enfoques como son la evaluación del proyecto y diseño, de la construcción, del comportamiento social, de la demanda energética, de los productos y materiales para la construcción, etc. (Gómez, 2019). Además, es importante ampliar este marco de trabajo desde el enfoque de la gestión durante la vida útil, detectando las mejoras posibles en el proceso de utilización de las infraestructuras y los edificios.

La cultura de mejora continua que los sistemas de gestión proporcionan a las empresas, así como la aparición de incentivos en España han impulsado la búsqueda de nuevos objetivos para elevar el desempeño ambiental de las empresas a través de las energías renovables.

Según Martí Casadesús (2009) "se puede definir la estandarización o normalización de forma genérica como la actividad encaminada a poner orden en aplicaciones repetitivas que se desarrollan en el ámbito de la industria, la tecnología, la ciencia y la economía".

Este artículo trata de mostrar como la aplicación de los sistemas de gestión puede mejorar el ASPECTO ECONÓMICO Y AMBIENTAL en el funcionamiento y mantenimiento de infraestructuras auxiliares en un caso concreto.

CONCLUSION

Las empresas que tienen una cultura arraigada en sistemas de gestión valoran positivamente la irrupción en el mercado de las energías renovables y, aunque la inversión es alta en comparación con los equipos tradicionales, hay que analizar cada caso de forma individual ya que se pueden establecer objetivos de mejora muy ambiciosos.

En este caso el factor clave y determinante para la instalación de la planta fotovoltaica es la VIDA ÚTIL restante de la planta de Residuos No Peligrosos (suficiente para poder amortizar la inversión) así como su UBICACIÓN que determina la imposibilidad de conexión a la red eléctrica. Otros factores positivos en este caso es la FACILIDAD DE MONTAJE Y DESMONTAJE de la instalación con la posibilidad de ser trasladada a otra ubicación, así como la mejora sustancial en la emisión de CO2 y ruidos al entorno natural.

El Sistema de Gestión Medioambiental ISO 14001 impulsa la SOSTENIBILIDAD gracias a la consecución de unos objetivos medibles y una planificación ordenada de los mismos, contribuyendo de forma sustancial a la implantación de energías renovables en gran variedad de usos e infraestructuras. Las energías renovables suponen para la empresa un AHORRO ECONÓMICO Y AMBIENTAL, pero, además, una mejora para la SOCIEDAD.

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LA TUTELA DEI VALORI MATERIALI E IMMATERIALI NEL RETROFIT DELL'ARCHITETTURA INDUSTRIALE DI VALENCIA (PARTE 1)

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ABSTRACT

In questo lavoro vengono presentate le principali caratteristiche costruttive dell'architettura industriale valenciana sulla cui base si propone una catalogazione. La catalogazione per caratteristiche tipologiche e tecniche costruttive ha consentito di valutare le metodiche di riuso per categorie omogenee di edifici attraverso la compilazione di apposite schede intervento. Lo studio svolto ha consentito di misurare la diffusione degli interventi applicati e la loro tipologia. I dati raccolti sono funzionali alla stesura di una metodologia di retrofit attenta alla protezione e valorizzazione dei beni materiali e immateriali del patrimonio industriale di Valencia.

Keywords: Riuso, Retrofit, Architettura Industriale, Valorizzazione Sostenibile, Valencia.

INTRODUCTION

L'industrializzazione spagnola si è sviluppata attraverso varie fasi alle quali corrispondono, architettonicamente, le caratteristiche che contraddistinguono gli edifici industriali nei diversi periodi produttivi: ciò è dipeso sia da esigenze socio-culturali ed economiche, anch'esse in evoluzione, che dai materiali da costruzione e dalle tecniche costruttive in uso. Nel libro Metodología para la recuperación y puesta en valor del padrimonio industrial arquitectónico viene descritta accuratamente l'evoluzione degli stili architettonici negli anni della rivoluzione industriale: Diana Sánchez distingue cinque periodi fondamentali, definendo per ognuno le tipologie costruttive e le caratteristiche salienti degli edifici realizzati.

Nel periodo pre-industriale, e fino al XVIII secolo, per attività produttive si intendono per di PIÙ laboratori artigianali, ubicati all'interno della vivienda, l'abitazione dell'artigiano. Durante il periodo medievale vennero costruiti i primi edifici destinati al commercio las lonjas e los mercados luoghi dove mercati e commercianti si riuni-

vano e svolgevano anche funzioni amministrative. Nella città di Valencia è possibile ammirare la Lonja de la Seda Fig. 1, costruita intorno al 1483, e dichiarata

Figure 1. Valencia, Lonja de la Seda, XV secolo, vista della facciata principale e vista interna della Sala de Contratacion Source. Massari, G. (2020)

Patrimonio dell'Umanità dall'UNESCO nel 1996, esempio di architettura tardo-gotica con decorazioni sgargianti, porte monumentali e pilastri scultorei. Rappresenta l'antica prosperità di Valencia, un tempo una delle città mercantili PIÙ potenti del Mediterraneo. È composta da quattro ambienti principali: la Torre – luogo di detenzione per i ladri di seta e i mercanti disonesti la Sala del Consulado del Mar, il Patio de los Naranjos e la Sala de Contratacion. Quest'ultima è un'ampia sala al piano terra, costituita da colonne elicoidali che sostengono la copertura a volte, mentre con una monumentale scalinata in pietra, passando per il giardino, si accede alla sala del mare, ornata da un tetto in legno, in cui è rappresentato lo stemma della città.

Bisogna attendere il 1700 per veder costruire quelle che vengono considerate come le prime vere fabbriche spagnole, ispirate ai grandi palazzi reali francesi: le Reales Fabricas. Sono edifici in stile classico che imponenti, simulando le residenze reali, proponevano la simmetria in facciata e il patio centrale. Erano fabbriche in cui si producevano principalmente armi, monete, tabacco, ceramica, carta e beni di prima necessità per la nazione tutta. Citiamo la Fábrica Real de Tabacos di Siviglia, costruita in circa 40 anni dal 1728 al 1763 la PIÙ grande di tutta la Spagna-, la Real Fábrica de Tapices di Madrid del 1721 in cui si producevano arazzi e la Fábrica de Armas di Toledo, che iniziò la sua produzione di spade nel 1761.

Il periodo della rivoluzione industriale (XIX sec.) è invece caratterizzato dalla disconnessione della fabbrica dal luogo in cui si trovano le materie prime, generando così

dei nuclei industriali a se stanti. Edifici simbolo di questo periodo furono le stazioni ferroviarie come la Estación de las Delicias di Madrid, costruita del 1880, e la Estación de Norte di Valencia, realizzata agli inizi del 1900 dal noto architetto Demetrio Ribes.

Patrimonio dell'Umanità dall'UNESCO nel 1996, esempio di architettura tardo-gotica con decorazioni sgargianti, porte monumentali e pilastri scultorei. Rappresenta l'antica prosperità di Valencia, un tempo una delle città mercantili PIÙ potenti del Mediterraneo. È composta da quattro ambienti principali: la Torre – luogo di detenzione per i ladri di seta e i mercanti disonesti la Sala del Consulado del Mar, il Patio de los Naranjos e la Sala de Contratacion. Quest'ultima è un'ampia sala al piano terra, costituita da colonne elicoidali che sostengono la copertura a volte, mentre con una monumentale scalinata in pietra, passando per il giardino, si accede alla sala del mare, ornata da un tetto in legno, in cui è rappresentato lo stemma della città.

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In tutta la storia architettonica industriale spagnola si possono individuare due principali tipologie costruttive che, ancora oggi, nel paese vengono identificate con lo svolgersi di attività produttive. Queste sono:

- *La Fábrica de pisos*: edifici sviluppati in altezza, con pianta rettangolare e uno stile assimilabile alle viviendas. Avevano un carattere severo, con aperture ripetute e modulari e facciate scarsamente decorate. I materiali PIÙ utilizzati erano il legno, la muratura e la pietra.

- *La Fábrica-nave*: edifici a pianta rettangolare e un solo livello. La copertura era in capriate lignee o metalliche. Questa tipologia consentiva ampie luci, libertà distributiva interna e quindi una grande flessibilità nell'utilizzo della struttura e nell'organizzazione del lavoro.

Figure 8. Sheda del riuso redatta per la fabbrica Bombas Gens
Source: Massari, G. (2020)

CONCLUSION

Il lavoro presentato ha messo in luce come nel riuso del patrimonio industriale sono diversi i filoni tematici che meritano ulteriore approfondimento da parte della ricerca scientifica, tutti interdipendenti tra loro. Questi riguardano la conservazione e tutela del patrimonio di architettura industriale attraverso l'individuazione di metodologie di recupero compatibili con i valori mobili e immobili; la possibilità di valorizzare tale patrimonio attraverso un riuso sostenibile; la possibilità di contribuire al miglioramento prestazionale degli edifice della città di Valencia attraverso il retrofit di un'ingente porzione di patrimonio.

lo sviluppo delle analisi descritte, consultabile in "La tutela dei valori materiali e immateriali nel retrofit dell'architettura industriale di Valencia (parte 2)", sarà l'individuazione di una metodologia volta alla riqualificazione dei siti industriali che vertono ancora in stato di grave danno e abbandono. Infatti l'architettura industriale della città di Valencia, per la cospicua presenza di manufatti in disuso e grazie ai sempre PIÙ numerosi interventi di riuso, si presenta come una delle leve strategiche per il rilancio socio-economico della città attraverso l'applicazione di un retrofit multidisciplinare e multiobiettivo.

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LA TUTELA DEI VALORI MATERIALI E IMMATERIALI NEL RETROFIT DELL'ARCHITETTURA INDUSTRIALE DI VALENCIA (PARTE 2)

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ABSTRACT

Il riuso dell'architettura industriale è divenuto in breve tempo una delle leve strategiche per il rilancio di città e territori con benefici di natura economica e sociale. Nella città spagnola di Valencia il processo di recupero e riuso di questo patrimonio ha avuto un grande impatto sull'assetto urbano e ha contribuito a modificare sostanzialmente la vita socio-culturale della popolazione. Questo paper porta ad esempio alcuni edifici, recuperati o in fase di restauro, simbolo del passato industriale della città di Valencia: qui la storia dei luoghi e delle tecniche costruttive del tempo hanno lasciato un'eredità forte che prepotentemente riecheggia in un'architettura storicizzata e allo stesso tempo resa contemporanea dal riuso per mezzo di interventi dal gravoso impatto estetico, materiale ed economico. Tali caratteristiche rendono l'oggetto della ricerca uno stimolante campo di indagine in cui è necessario l'approccio multidisciplinare al retrofit con la finalità del cambio di uso. La progettazione consapevole deve essere guidata dagli obiettivi della tutela dei valori, materiali e immateriali, e della sostenibilità dell'intervento. A tale scopo in questo lavoro si presenta una metodologia di intervento da applicare in coerenza con l'attuale Plan Nacional de Patrimonio Industrial.

Keywords: Riuso, Retrofit, Architettura Industriale, Valorizzazione Sostenibile, Valencia.

INTRODUCTION

Il concetto di patrimonio industriale è stato definito nella Carta di Nizhny Tagil nel Luglio del 2003: "Il patrimonio industriale è costituito da resti di cultura industriale di valore storico, tecnologico, sociale, architettonico o scientifico. Questi resti sono costituiti da edifici e macchinari, officine, mulini e fabbriche, miniere e siti per la lavorazione e la raffinazione, magazzini e negozi, luoghi in cui viene generata energia, trasmessa e utilizzata, trasporti e tutte le sue infrastrutture, nonché luoghi utilizzati

per attività sociali legati all'industria come l'alloggio, il culto religioso e l'istruzione" (Olivares, 1996).

In Spagna, tra il 2011 e 2012, è stato messo a punto e attuato il Piano Nazionale per il Patrimonio Industriale, che ha come obiettivo quello di preservare e conservare l'eredità storica dell'industrializzazione presente sull'intera nazione. Nel PNPI, il patrimonio industriale viene definito come segue: "Il patrimonio industriale è inteso come l'insieme di sistemi mobili, immobili e di socialità legati alla cultura del lavoro che sono stati generati dalle attività di estrazione, trasformazione, trasporto, distribuzione e gestione derivate dal sistema economico emerso durante la "rivoluzione industriale". Questi beni dovrebbero essere intesi come un insieme integrale composto dal paesaggio in cui sono inseriti, dalle relazioni industriali in cui sono strutturati, dalle architetture che li caratterizzano, dalle tecniche utilizzate nelle loro procedure, dai file generati durante la loro attività e dalle loro pratiche." (Martinez Pino, 2018).

Il concetto di "Patrimonio Industriale" si presenta dunque come molto ampio, includendo nelle realtà produttive di interesse anche le relative infrastrutture e i luoghi di produzione, oltre al contesto, territoriale e culturale, necessario all'attività di lavorazione.

Il Plan Nacional de Patrimonio Industrial è dunque il principale strumento normativo spagnolo per la conservazione del vasto patrimonio industriale presente sul territorio nazionale. El Instituto de Patrimonio Cultural de Espana, nel 1999, iniziò a redigerlo in seguito alla progressiva perdita di una parte di patrimonio: l'obiettivo del Piano era quello di preservarlo in tutte le sue forme e di diffonderne la conoscenza. Nel 2011 la revisione del PNPI, attualizzata poi nel 2016, è atta a promuovere gli studi sulla storia dell'industrializzazione, il turismo industriale, la valorizzazione dei beni e la rigenerazione dei quartieri su cui tali beni insistono. Approcciare la valorizzazione rese necessario affrontare la definizione dei valori da tutelare prima e potenziare poi, elencando quali fossero i beni immobili, mobili e immateriali oggetto del Piano.

Nei beni immobili troviamo:

- Elementos industriales (elementi industriali): possono essere resti di complessi industriali o elementi nati isolati chetestimoniano un'attività produttiva passata (ad esempio le ciminiere);
- Conjuntos industriales (complessi industriali): sono le fabbriche di cui sono conservati la maggior parte degli elementi caratteristici;

- Paisaje Industrial (paesaggio industriale): è il territorio dove si conservano gli elementi essenziali ad esempio lematerie prime di un processo industriale;
- Sistemas y redes industriales (sistemi e reti industriali): sono la testimonianza della pianificazione territoriale per il trasporto di materie prime.
- I beni mobili si distinguono in quattro categorie:
- Artefactos (artefatti): dispositivi atti a ottenere, trasformare e produrre energia per l'attività produttiva;
- Utillajes (strumenti): tutti gli strumenti necessari all'esecuzione del lavoro associato all'attività produttiva;
- Moliliario y accesorios (attrezzature e accessori): tutte le attrezzature e il mobilio degli ambienti legati al luogo di lavoro;
- Archivos (documenti): i registri e i documenti generati per le attività economiche.
- Infine, nei beni immateriali troviamo:
- Entidades de memoria de industria (memoria dell'attività industriale): tradizioni, tecniche e testimonianze legateal mondo dell'industria.
- Nel Piano vengono definiti alcuni aspetti metodologici individuando area tematiche, criteri di intervento, fasi di attuazione e inserendo allegati, aggiornati nella revisione del 2016, con la lista di tutti gli oggetti di riferimento del piano, la normativa specifica e gli interventi già realizzati.

Nel Piano vengono definiti alcuni aspetti metodologici individuando area tematiche, criteri di intervento, fasi di attuazione e inserendo allegati, aggiornati nella revisione del 2016, con la lista di tutti gli oggetti di riferimento del piano, la normativa specifica e gli interventi già realizzati.

Sulla base della normativa vigente si attende, dunque, nella città di Valencia, un recupero del patrimonio industriale orientato alla tutela dei valori materiali e immateriali citati dalla norma. Di contro, dalle analisi effettuate sulle principali architetture industriali della città, recuperate e non, si è rilevato come, sebbene si evidenzi un'attenzione al recupero dei valori culturali, la progettazione manca di una metodologia condivisa per la valorizzazione degli stessi con uno sguardo alla sostenibilità e alla reversibilità degli interventi.

CONCLUSION

Il lavoro di ricerca svolto sul patrimonio industriale ha evidenziato la necessità di far convivere, nella riqualificazione e nel riuso delle architetture industriali, i diversi approcci progettuali legati al restauro e al potenziamento prestazionale. Scopo del lavoro, tutt'ora in corso, è quello di dimostrare, attraverso una metodologia, coerente agli obbiettivi dei diversi approcci, come l'intervento di riuso sostenibile possa garantire tanto la tutela dei valori espressi dal patrimonio quanto la valorizzazione degli stessi. In questo senso, la sostenibilità del retrofit non dovrebbe essere volta al mero miglioramento prestazionale delle strutture oggetto di intervento, bensì ad una programmazione oculata del ciclo di vita dell'edificio e dei suoi componenti, originari e di nuova introduzione. L'obiettivo di un riuso che possa avere il minor impatto materiale sul bene e il maggior beneficio in termini di sfruttamento delle risorse impiegate nel retrofit è in questo modo PIÙ facilmente perseguibile.

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Il lavoro di ricerca nasce dalla collaborazione tra il Dipartimento di Ingegneria Civile, Edile-Architettura e Ambientale dell'Università degli Studi dell'Aquila, l'Istituto per le Tecnologie della Costruzione del CNR e l'Università Politecnica di Valencia. In particolare la ricerca presentata è stata svolta grazie al finanziamento Short Term Mobility 2019 fruitore post-doc fellow Mariangela De Vita e al finanziamento Fondazione Filauro 2019/2020 – fruitore Ing. Giulia Massari.

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THE INTRINSIC TECHNIQUES OF TRADITIONAL ARCHITECTURE. CASE STUDY OF SMALL VILLAGES IN A MEDITERRANEAN REGION

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ABSTRACT

Traditional architecture represents the majority of the architectural heritage that surrounds any territory. This architecture is linked to a tradition, a link with the natural environment and knowledge that are part of the intangible heritage of any community. However, it is currently marked by abandonment, changes in use and the loss of the traditional trades that built it or made it evolve. This article is part of a larger project that highlights the more modest architecture of a region in the western Mediterranean Sea. The article outlines how popular knowledge directly related to construction techniques and the evolution of modest historical centres has been recovered. It studies the links with the heritage of the local population and artisans. It explains how a search for traditional trades has been carried out, the lessons they have taught researchers and the prospects that this heritage can have through participation and collective management.

Keywords: Traditional building techniques, historic centres, heritage values.

INTRODUCTION

Traditional architecture has shaped the landscapes and scenery of our history. In its enormous diversity, dazzling creativity, and perfect harmony with the natural environment, one of the richest and most varied areas of heritage. Its importance is enormous as an expression of a society, a reflection of geographical conditions, and a support for intangible heritage (IPCE, 2015).

However, traditional architecture has been abandoned for many decades (Marull *et al*., 2014), transformed and disappearing. Studies and research have been numerous for decades (Fuentes, 2010; García Hernández *et al*., 2017; Mualam and Alterman, 2020), but the process of disappearance of properties in cities, towns, villages and isolated nuclei is still a topical issue.

Historic centres have an important history to tell, highly influenced by the successive layers of each place's socioeconomic and cultural evolution. If we look at the building typologies in historical centres, the result is a very rich and diversified space. Throughout their history, the different societies that have passed through them have left their mark, giving rise to a harmoniously varied ensemble (Yildirim, 2012). The perception, appreciation, and recreation of abandoned cultural landscapes are based on the transmission of knowledge (Kastenholz *et al*., 2012). Since the landscape is a concept to be constructed, both physically and intellectually, knowing and helping others identify how a current layer responds to previous layers and the framework for subsequent changes will directly affect how a historic centre is managed. Indeed, one of the many ways to understand the history of landscape change is to recognize that change itself is a part of the landscape (Fairclough, 2012), even though change means abandonment.

Recent international studies on historic centres (UNESCO, 2011; English Heritage, 2010) posit them as areas resulting from an overlay of cultural and natural values and attributes that go beyond the notion of a historic centre or ensemble (Rey-Pérez and Siguencia, 2017). They aim to include a broader urban context and environment based on participation, knowledge, planning, current legislation, and places' traditional economic or financial tools (Ginzarly *et al*., 2019). In this regard, Ginzarly *et al*. (2019) conduct a systematic study of the management of historic centres through literature and cases evaluated over eight years and demonstrate that, while the debate is focused mainly on values, the implementation of an approach based on the values themselves analyzed is still lacking, as it is not fully contextualized concerning local heritage discourses and the dynamics of heritage management.

In many rural villages, social and cultural imbalances have led to abandonment, underutilization, or incompatible uses in the built environment (Ribera *et al*., 2020). On the other hand, historic areas in towns and cities are part of memory and have meaning because of their essential elements linked to tradition (Wang, 2012). As Ruda (1998) explains, in this area, attention should be paid to the specific techniques, materials and architectural details characteristic of the historic environment, being, at the same time, symbols of identity and evidence of knowledge of past technologies that speak of previous ways of life.

This study is located in a small region on the east coast of Spain, a rural area to the Mediterranean Sea (Fig. 1). The study includes ten municipalities with common characteristics: demography, economy, society, problems and constraints. Through

the specific fieldwork of this and previous research directly related to this project, we present the hidden knowledge that remains in these small towns and how they would benefit the local heritage.

To study the link that continues to exist between artisans and the construction techniques that built the historic centres, the following hypotheses are put forward:

- Traditional architecture generates a link inseparable from the craftsmen who built it.
- There is a latent concern in the conservation of the historic centres of small mountain municipalities.
- It is possible to revalue the hidden intangible heritage through citizen participation.

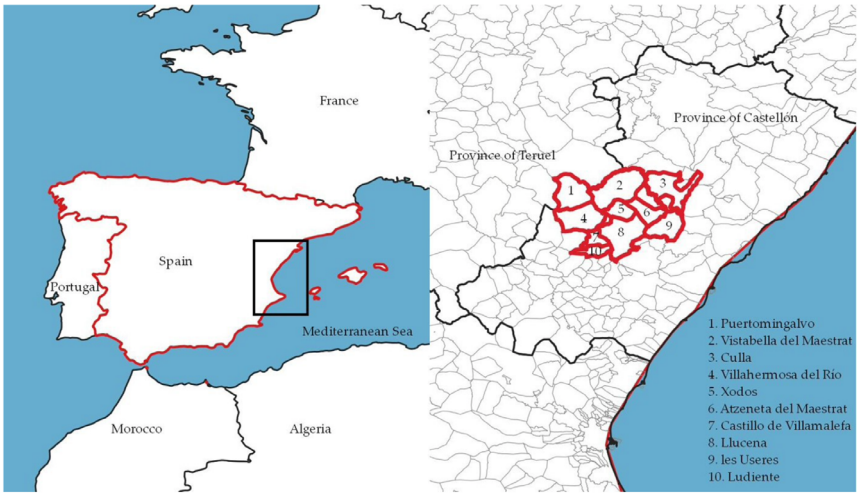

Figure 1. Study area.
Source. Authors.

DISCUSSION AND CONCLUSIONS

This work is an intermediate point of other parallel investigations in the same area. In this case, it shows a brushstroke of the much information acquired in the fieldwork. In this study, it has obtained evidence that there is still interest in conserving construction techniques and historical centres of small mountain villages.

In many cases, traditional architecture has been the driving force, together with other activities of the small villages. It is associated with many trades: masons, stone-

masons, carpenters, blacksmiths, mountain workers, and from the 20th century onwards, other works related to installations.

In the small municipalities covered by this study, the heritage is still preserved and recreated by the population. The inhabitants account for how the different cultural values have been maintained and transmitted through the generations. In line with Beel *et al*. (2017), they have allowed us to clearly describe a set of relationships and connections that continue to maintain these cultural values today. The resilience of rural communities and their understanding of heritage has enabled the enhancement of local culture. It is based on the idea of resilient preservation, which is reflected in the concepts of esteem and attachment to places (Hammitt *et al*., 2009).

The work of interviewing retired artisans or those who have dedicated most of their lives to a craft reflects the evolution of these trades. For example, techniques have been modernized, new sources of materials, greater job security, and decoupling what was considered a craft from what is merely a job.

In this sense, the concern in this area is worth mentioning for the abandonment of the modest heritage that historic centres represent. In the same way, it is faced in the line of objectives that reflect both the Historical Urban Landscape (UNESCO, 2011), Historic Area Assessments (English Heritage, 2010) and the National Plan for Traditional Architecture (IPCE, 2015) seeking citizen participation, research and the enhancement of a heritage hidden for most of the citizenship.

Finally, we should highlight the paradigm shift that participation in municipalities with few inhabitants implies. Bringing the population the concerns and knowledge of those who have been part of the dynamic evolution of local heritage is a turning point both for the people and for heritage managers. This means recognizing that the historic environment is linked to popular culture and humble contemporary minorities. Therefore, connecting citizens to this reality has created authentic and meaningful practices in which tangible and intangible heritage act to unify interests and expectations.

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DESIGN AND CONSTRUCTION OF LARGE SUSTAINABLE INDUSTRIAL PLANTS: A CASE STUDY

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ABSTRACT

This article is based on the case study of an industrial plant with design based on parameters such as the improvement of reliability, maintainence and efficient operation, as well as energy efficiency and environmental concerns. Key decisions like the reliability of facilities, and installations, cutting down time intervals, energy efficiency and environmental impact analysis impact the design of a new industrial plant. The prominent steps are listed by the Directorate of Engineering and Maintenance, supported by the President and the General Direction of the industry. The factory has set a benchmark for the industry and currently is one of the first companies in its sector in the national and European level.

Keywords: Industrial plant, industrial management, energy efficiency, environmental management.

INTRODUCTION

In the industrial construction sector, planning new industries mainly depend on the economic factor (in the short term), avoiding factors that promote the best exploitation and maintenance of the industry, a higher degree reliability, as well as proposing a greater number of actions to improve respect for the environment for a longer term.

This industrial sector faces constant transformations towards better quality actions, economy in production and user acceptance with challenges that have a greater incidence on processes compared to other types of manufacturing industries.When a process of building new industrial plants is proposed in order to increase the level of production or service, the decisions made marks the trajectory of the company in the medium and long term. In this article, the facilities, experiences and decisions taken are presented, and proposed by the company's own engineering and mainte-

nance management, and supported by the president and general management of the company. In the implementation of an industrial complex, with a goal oriented towards the proper operation and maintenance (Cárcel *et al*., 2021a; Cárcel *et al*., 2021b), with a fundamental commitment to appropriate maintainance, operational and energy efficiency and respect for the environment. In this case study, some of the main decisions to realize a model industrial plant are shown, which demonstrates an advance with respect to the typical solutions for this domain. The authors of this article argue their experience, given that they have participated directly in the design of this plant, the design was analyzed for the reliability and improvement of operational maintenance.

CONCLUSION

The general principles of a new industrial plant implantation have been described, where decisions and considerations taken at first by the awareness and decision of a general management, with criteria of quality, efficiency and medium-term views, have achieved an industrial implantation which sets a benchmark in the food industry.

Starting from fundamental principles that seek maximum efficiency, with a design based on reliability, maintainability, energy efficiency and alternative energies, respect for the environment and information-based design and knowledge management, an industry has been achieved, which, fulfilling all production expectations (a fundamental requirement in any industrial plant), has gone one step further, fulfilling the conditions of effective maintainability in the future, along with respect for the environment.

The synergy with the bodies involved in the execution of the industrial plant, together with the determination and commitment of the engineering management of the company itself, have been decisive to achieve, at an appropriate level of investment and costs, to achieve a plant with capacity improvement and economic profitability, control of information and knowledge, for future operations and maintenance functions that must be fulfilled.

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DESIGN FOR DISASSEMBLY AND PLASTIC RECYCLING AGGREGATES: COMPARISON OF PERFORMANCE LEVELS

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ABSTRACT

In recent years there has been a strong advancement of research in the recycling sector. Experimentation has concerned both individual materials and their assembly with raw materials, in particular for concrete for the study of mixes with plastic aggregates. Similarly, important studies on construction systems that can be dismantled at the end of their useful life have encouraged the criterion of circularity that characterises this specific sector in function of a technological synthesis with prefabrication criteria. The results obtained have brought recycling technology to advanced performance levels, making it necessary for researchers to start a performance comparison to determine which of these possibilities has a greater capacity for design application. The paper compares the Design for Disassembly with concrete using plastic recycling aggregates in place of fine mineral aggregates, identifying the need for further study in order to improve performance levels.

Keywords: Circularity, plastic aggregates, sustainability.

INTRODUCTION

Environment, territory and sustainability, three themes around which institutions, both at national and European level, universities, the world of research and operators' orbit, in order to promote, disseminate the culture of innovation and undertake initiatives to ensure sustainable development capable of improving the quality of life. These are the key words to build a quality development, which can be reconciled with economic and employment growth, with social and cultural improvement, but above all with environmental protection.

At a time in history, such as the one we are living through, characterised by the uncertainty of the world economy, the theme of reusing and recycling materials seems to be a valid alternative for the world of architecture and for economic growth. While the development of research and industry has led to innovative and economic progress, it has also resulted in the increasing use of natural resources to the detriment

of the quality of the environmental system, not least because of the lack of adequate laws to protect it. Widespread environmental degradation has led to the proliferation of laws and measures of various kinds and origins that now constitute modern environmental law. Italy's membership of the European Union has undoubtedly contributed to the growth of regulations that dictate obligations and quality standards that must be complied with.

It is clear that a heterogeneous mix of different materials (from windows, to rubble, to plastic pipes) cannot be recycled without the aid of separation and treatment of each of them with the appropriate techniques to obtain recycled products that can have a useful use. It is also clear that, in this case, the separation of these materials is not only difficult but also very costly, which is why it cannot be done at a later stage and independently of demolition.

The demolition of the building shall be carried out in such a way as to keep the materials that are progressively removed as separate as possible, and to collect them in an orderly manner. Recovering the maximum possible amount of materials therefore depends directly on demolition techniques and site organisation. Obviously, the homogeneity to be achieved should not be understood as the separation of all materials into all their basic "ingredients". This would be unnecessarily complex and costly, as well as often technically impossible, since each element of a building is the result of a series of processes that have combined different materials, in many cases using techniques that make the process irreversible. For example, once a mortar has set, it is no longer possible to separate the sand and cement that have been mixed together to form it.

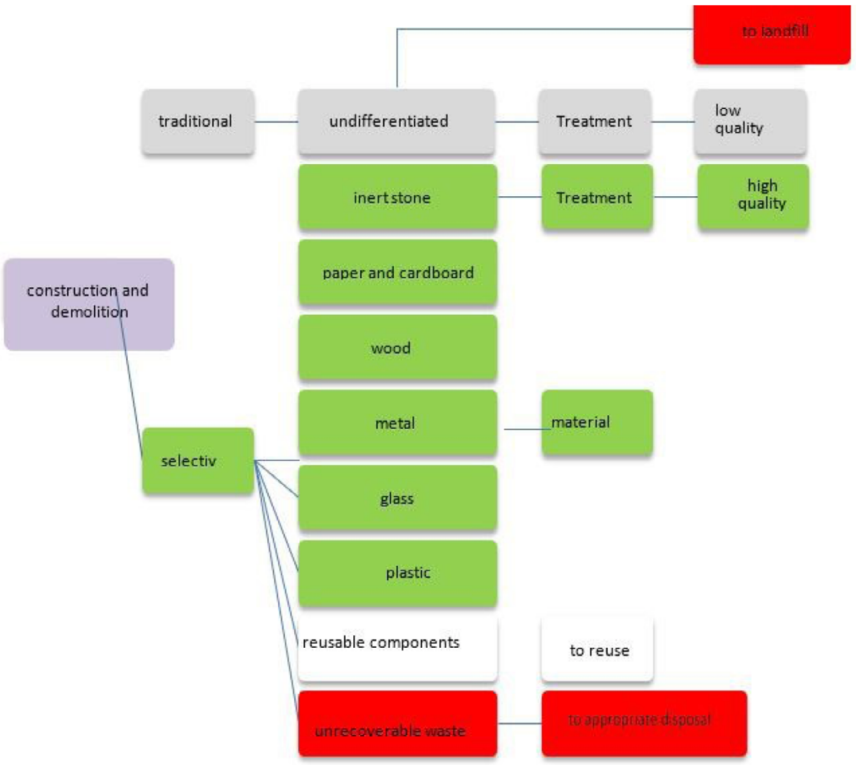

Figure 1: Construction and demolition waste management scheme

A realistic and efficient concept is the one proposed by the differentiation of materials, residues divided into as many different types as there are possible recoveries to be made. A preliminary investigation should be carried out, in agreement with the client, planners, owners, etc., to assess:

- The type and characteristics of the structure being addressed.
- The activities carried out in the facility to verify whether and how they affected the quality characteristics of the materials being demolished.
- Characteristics of the site and the surrounding area (e.g., access spaces, proximity of houses and other buildings, possibility of handling and storage on site, etc.).
- The presence of possible criticalities caused, for example, by the presence of asbestos, underground tanks, pipelines, installations, abandoned hazardous and non-hazardous waste, etc.

CONCLUSION

For some time now, the re-use of building demolition materials has been one of the most important research areas in terms of its impact on the economy and the environment. So-called “selective demolition”, to be planned with scientific and applied research criteria, makes it possible to “dismantle” parts of buildings to be demolished for reuse on others undergoing renovation, with cost savings for both contracting authorities and construction companies. Another possible and very popular application is the recycling of demolished concrete mixes with the recovery of inert material and reinforcing bars. This procedure makes it possible to produce new concretes that can be used, for example, for industrial flooring or airport runways, but are still too limited in terms of structure. The aim is to find ways of perfecting the criteria of selective demolition and the use of mixes made in this way in the static field as well, through the study of specialised grain size curves. Now, it appears that circularity is widely verified in the field of “Design for Disassembly” in which wood is the only material to verify the feasibility of this technology. On the other hand, in the case of the reuse of recycled aggregates, despite the great progress achieved by the research also for structures in seismic areas, to produce concretes it appears to be a sector still to be investigated both from the point of view of mechanical resistance and rheological behaviour.

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ASSESSMENT OF ECO-TOXICITY AND HUMAN HEALTH RELATED ASPECTS OF CONSTRUCTION MATERIALS IN EPDS AND PEFS

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ABSTRACT

Modern buildings face various and interdependent challenges in terms of innovation, design, energy and resource efficiency, sustainable materials and construction, durability and potential for waste recovery and recycling. Construction materials play an important role in the assessment of building's sustainability and their significance is recognized by the intensive development and use of the methodology for environmental product declarations (EPDs). In addition to that, the European commission published guidance and category rules on product environmental footprint assessment (PEFs) that also address environmental and toxicological issues.

This paper discusses the health-related indicators in EPDs and PEFs and their application to some construction materials. An overview is done on the nature of the indicators and the approaches for their assessment and applicability in EPDs and PEFs. While EPDs of construction products are prepared based on a well-developed methodology and specific standard (EN 15804) that act as core product category rules (PCR) for all types of products, PEF guidelines treat each product separately and their scope is quite limited in terms of construction materials. This study outlines both the common features of both approaches for assessment eco-toxicity and human health impacts and provides a discussion on their relevant fields of application, including on construction and demolition waste (CDW) management.

Keywords: Sustainable materials, life cycle assessment (LCA), EPD, PEF, CDW.

INTRODUCTION

Selection of construction products is a task that meets multiple challenging requirements for technical properties, aesthetics, ease of use, durability, maintenance and cost. Nowadays, building materials need to respond also to the increased concern about environmental performance and sustainability, including in terms of CDW management at the end of the product's life cycle. The environmental impacts of

materials are assessed by various indicators: CO2 emissions, ozone depletion, smog creation, eutrophication, acidification, radiation, toxicity, etc. and the primary impacts are known to be occurring during the manufacturing stage. The use of resources is a significant issue for construction materials since around 50% of all extracted natural resources are transformed and consumed by the construction industry (Petrović, Vale, & Zari, 2017). This determines the huge and various types of CDW – more than a third of all generated waste in the EU (EC) and underlines the need for proper attitude towards this waste by exploiting the potential for reuse, recycling and recovery.

Whether we consider the material itself during production and use or the waste formed by this material when the building is demolished, the issue with toxicity to humans and natural habitats needs to be addressed. Toxicity of construction materials can be presented and declared either by an environmental production declaration (EPD) or by a certificate of the product environmental footprint (PEF).

This paper provides a summarised overview on the methodologies for toxicity evaluation used in EPDs and PEFs, and their relevance to construction materials and CDW. The better understanding of toxicological mechanisms can help us outline potential hotspots in the health-related issues of construction materials and recovery of CDW.

CONCLUSION

The paper presents an overview of the impact categories and indicators assessing toxicological effects for humans and aquatic ecosystems and other health-related issues. The models describing and estimating these impacts are the outcome of continuous research, so they have strong scientific background, and their reliability is claimed sufficient. The inclusion of toxicological impacts in EPDs, even as optional indicators, allows for a more comprehensive application of the assessment methods and would help for improving the calculation procedures. This, combined with the expected launching of new PEFCRs for construction products over the next few years would probably define the mandatory status of these indicators in time.

The setting of uniform prerequisites for various products under the same PEFCR makes the study largely controlled but, on the other hand, it sets the ground for possible comparisons of products because the differences would be mostly in the sourcing of raw materials and production process. Nevertheless, there would still be limitations to comparisons of construction products by their PEFs because it would only be relevant at building level when the product is part of a system. In this case, a

reasonable basis for comparison demands a suitable reference about the application which means that PEFs would hardly be used as a direct comparison basis soon.

It is important to emphasise that the purpose of health-related impacts is to allow relative comparisons between products rather than being used to extrapolate and calculate health risk and potential disease occurrence. The assessment of toxicity and other health and ecosystem indicators is a serious step forward to drawing the attention to the hazardous substances in construction materials and to the accumulation and dispersion processes. This is particularly significant for the characterisation procedure of CDW so that end-of-life activities can be responsibly and safely implemented.

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CONSTRUCTION OF A FAÇADE WITH GEOPOLYMER

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ABSTRACT

This research explains the process of building a large-scale prototype with geopolymers for the manufacture of an 80m2 facade through pieces of more than 7m in length. This article describes the process that went into manufacturing, pouring, lifting, and installation.

Keywords: Sustainable materials, life cycle assessment (LCA), EPD, PEF, CDW.

INTRODUCTION

The alkaline activated cements known as geopolymers can be the answer to the demands of sustainability in the construction sector. The reduction of the environmental impact due to not using clinker as well as the use of waste promoting the circular economy make this material a firm bet to develop on an industrial scale.

On the other hand, prefabrication is increasingly present in the sector due to the multiple advantages it presents in terms of significant improvements in the process and quality, as well as the reduction of the carbon footprint.

However, although there are multiple precedents for the use of geopolymers in construction, this research has sought to combine geopolymers with prefabrication to achieve pieces of more than 7 m and understand the real behaviour of this material in the construction process and its subsequent evolution.

CONCLUSION

Geopolymer materials are a viable substitute for ordinary Portland concrete. The ease of integration into the conventional workflow together with the results assimilable to conventional concrete make this material a sustainable alternative to the demands of reducing the environmental impact of construction.

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DEMOLITION AND COLLAPSE DEBRIS MANAGEMENT OF HISTORICAL BUILDINGS DUE TO EARTHQUAKES

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ABSTRACT

Most of historical buildings around the world have been constructed of different materials depending on their structural configuration, components, use and geographical location. This has led to a great variety of construction materials for the vertical resistant system, slabs and roof. These buildings are extremely vulnerable to suffer strong damage against earthquakes due to different factors regarding geometrical configuration and features, materials, total height, use, location, recent rehabilitations, conservation state, etc. This type of buildings may present in case of an earthquake partial or global collapses and generate different types of demolition and collapse debris depending on rehabilitations and damage degree. The main debris comes from collapses and demolitions with a variation of construction materials such as mud, masonry elements, mortar, concrete ties that serve to confine the masonry elements, furniture, plastic hoses, piping, dry-walls and garbage. This paper is objected at describing the main typologies of historical constructions that are commonly located around the world, structural configuration and architectonic features, construction materials, common seismic damage, and interventions, as well as waste management procedures and strategies. These strategies would be of great help for constructors and authorities to follow a better management procedure regarding the debris volume estimation, separation of waste, reuse, and recycling.

Keywords: Demolition, collapsed buildings, waste management, historical buildings, earthquakes, Introduction.

INTRODUCTION

Most of historical buildings (see Fig. 1) around the world have been constructed of different materials depending on their structural configuration, components and use (e.g. bell-towers, Cathedrals, minarets, naves, mosques and other monumental buildings), as well as their geographical location. This has led to a great variety of construction materials for the vertical resistant system (e.g. walls, columns, etc.), slabs and roof .

a) b)

Figure 1. Some historical bell-towers and buildings around the world: a) the lined tower of Pisa, Italy, Source: Preciado (2011), and b) The Tlajomulco´s Church in Jalisco, Mexico, **Source**: Preciado and Colmenero (2021).

Figure 2. Different construction materials from demolitions and collapses.

This paper is objected at describing the main typologies of historical buildings that are commonly located around the world, structural configuration and architectonic features, construction materials, common seismic damage and interventions, as well as waste management procedures and strategies. This would be of great help for constructors and authorities to follow a better management procedure regarding the separation of debris, reuse and recycling.

CONCLUSION

The waste management of patrimonial buildings represents a complicated task due to it could be generated by different situations such as partial demolitions by rehabilitations or restorations, as well as by local collapse of some elements or the complete collapse by seismic action or static instability. The complexity in waste management is represented by the great diversity and heterogeneity of materials that conform the different structural elements (walls, arches, columns, vaults, domes, etc.), geometrical features, irregularities in plan and height, great thickness, heavy mass and structural vulnerability, furniture, decorations and so on. Moreover, the seismic vulnerability is increased by inclinations and slenderness of tall bell towers and façades, large openings attracting seismic damage, corners and intersections of walls and contact zones among elements. These vulnerability aspects may induce different damage degree and collapses depending on the structural element and intrinsic materials.

Masonry patrimonial buildings of carved stone and brick work are very likely to present partial or total collapses in case of an earthquake, but earthen buildings are the most vulnerable to present a complete collapse due to the brittleness of this material. The damage degree and intrinsic structural material are key components to decide about the rehabilitation/restoration materials and partial demolitions. These materials used in the rehabilitation works along with the partial or total collapse debris play an important role in the proposal of effective waste management procedures and strategies. In this paper, it is proposed the first stage of a procedure to classify the historical buildings in structural elements representing the vertical and horizontal resisting system, materials and level of expected damage in case of different seismic intensities in the MMI scale. These seismic damage scenarios are helpful to estimate the level of expected damage and debris volume depending on the geometry and type of structural element and materials. These strategies would be of great help for constructors and authorities to follow a better management procedure regarding the separation of debris, volume estimation, reuse and recycling. In further stages of this research project it will be studied the possibility of adding to the proposed strategy with the expected debris volume due to rehabilitation and restoration works by including common used materials and waste percentage in these interventions. Moreover, some practical examples will be also presented in an extended version of this paper regarding the application of the proposed waste management procedure in different case studies such as churches and bell-towers.

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TECHNOLOGY, ENERGY, AND ENVIRONMENT IN CONSTRUCTION

METHODOLOGY TO EVALUATE THE FEASIBILITY OF LOCAL BIOMASS RESOURCES AS A FUEL FOR BUILDING BOILERS. APPLICATION TO A MEDITERRANEAN AREA

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ABSTRACT

The massive implementation of distributed energy resources based on biofuels requires a complex methodology to assess the optimal energy valorization options and economic feasibility. This paper has focused on producing pellets for boilers. The work focuses on the residential and commercial sectors. To consume local biomass, it must be considered the availability of potential customers, biomass availability, properties, and dispersion to evaluate transport cost. The developed methodology was applied to three different counties of the Valencian Community (typical of Mediterranean areas). Biomass resources for different counties have been quantified and characterized regarding key issues as heating value and ash content. Considering every evaluated area (the typical total area in the range 600 to 1800 km2) as a biomass management unit, the impact of pellet production plant size and biomass transport costs for three different counties was evaluated. However, different balances between biomass resources availability and self-consumption potentials are obtained, the economic feasibility of pellet plants was acceptable in the three cases with payback periods from 5 to 6 years.

Keywords: Renewable energy, Biomass, Pellet, Cogeneration, Distributed Energy Resources.

INTRODUCTION

The massive implementation of distributed energy resources is a key strategy to increase energy efficiency and reliability of supply. Biomass applications imply large savings in harmful emissions to the atmosphere taking advantage of local resources, sustainably, with competitive costs. The rapid deployment of biomass installations requires the development of a general methodology to:

- Evaluate the quantity, quality, and availability of these residues in the area of interest.
- Determine demand segmentation and identification of segments with high potential to use biofuels (pellets, wood chips)
- Develop an optimal logistic strategy to minimize the harvesting, collecting, and distribution costs and environmental impact.
- Analyze available technologies for biomass pretreatment (drying, grinding, and densification) and combined heat and power generation.

This methodology is based on the figure of the transfer centers. These installations are located in strategic points to optimize the logistic process and present different morphologies; they include storage areas and have a pretreatment system and/or a cogeneration system. In these centers, biomass can be converted into electricity, heat and /or standardized biofuels (pellets).

Cogeneration systems can cover the biomass pretreatment process's thermal and electrical needs (drying, grinding, pelletization) (Zailan, *et al*., 2021) When installed in the transfer center, there are several advantages because biomass is a heterogeneous resource. There are many types with different properties; it is possible to produce standard biofuels with higher quality biomass (i.e., low ash content) and consume low-quality biomass in the cogeneration system to produce valuable energy products as heat and electricity with competitive costs.

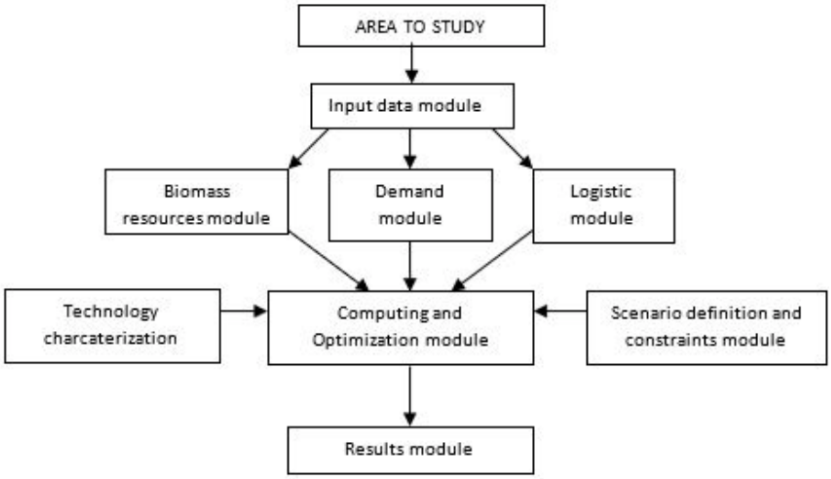

Figure 1: Scheme of methodology to assess the optimal energy valorization of biomass resources.

CONCLUSION

Distributed Biomass resources management requires a complex multicriteria methodology where logistic strategy is the main factor in performing the optimization for a selected scenario. However, other features must also be considered: scale, cogeneration system capabilities, biomass availability, and properties and potential consumers.

A methodology fulfilling all these requirements has been developed. It is based on flexible biomass transfer centers with multiple possible energy products as biofuels, electricity, and heat.

Preliminary application of the methodology showed big differences between counties, from counties with high demand as 4,600 L´Horta (grouped small counties around Valencia city) but without including city demand) which could consume three times the available biomass, to big counties as 4,620 La Plana de Utiel-Requena, with high biomass availability (due to the higher agricultural/forestry sources) but with very limited demand so consuming only 3% of available biomass. Using the county as management, biomass properties, quantity, and feasibility analysis for pellet production plants were adequate.

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ISOLANTI TERMICI NANOTECNOLOGICI: OPPORTUNITÀ O INADEGUATEZZA PER LA RIQUALIFICAZIONE ENERGETICA DELL'ESISTENTE

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ABSTRACT

La qualità energetico-ambientale dell'ecosistema ha richiesto riflessioni rivoluzionarie in campo politico, progettuale, produttivo, esecutivo e di validazione. Il contributo fornito dall'isolamento termico degli edifici evidenzia come occorra una sinergia che negli ultimi anni è stata individuata nella predisposizione di incentivi statali, nella concezione di sistemi a cappotto quali soluzioni trainanti nella progettazione dell'intervento di riqualificazione energetica, nella innovazione tecnologica dei prodotti di coibentazione, nella predisposizione di protocolli di esecuzione e verifica. La nostra indagine ha riguardato gli isolanti non convenzionali, ricercando soluzioni per cappotti che si avvalgono di nanotecnologie, rispondono ai criteri ambientali minimi (CAM) e a specifiche normative in termini di prestazione. Il censimento condotto ha quindi riguardato nano/micro cappotti che si avvalgono di principi attivi differenti in VIRTÙ della loro concezione, noti come VIP (Vacuum Insulation Panel), Aerogels e rivestimenti termoriflettenti. Sull'efficacia della capacità isolante di queste categorie di prodotti, reclamizzate anche per i minimi ingombri, abbiamo rilevato posizioni di scetticismo motivate sulla base delle conoscenze fisico-tecniche sinora acquisite: è messa in dubbio la possibilità di eguagliare in pochi millimetri (5-30) l'efficacia garantita da diversi centimetri (4-16) di soluzioni convenzionali. I prodotti di punta, campionati sulla base delle migliori prestazioni attestate, sono stati applicati nell'ipotesi di efficientamento energetico di un blocco del quartere INA CASA a Messina realizzato su progetto di Fiippo Rovigo negli anni '50, con tecniche costruttive tradizionali e una chiusura verticale in mattoni forati fra le maglie di una struttura in cemento armato. La validazione delle prestazioni che, per l'accesso all'eco-incentivo, deve garantire il salto di due classi energetiche, è stata effettuata con Termus, un applicativo BIM dell'ACCA. I risultati offrono parte della risposta agli interrogativi di efficacia posti per questo spaccato di innovazione tecnologica.

Keywords: Isolanti nanotecnologici, Superbonus 110%, Classificazione energetica, BIM (Building Information Modelling), INA Casa

INTRODUCTION

Alla ricerca di nuove soluzioni per la riqualificazione energetica: il dibattito aperto

Il patrimonio edilizio realizzato nel secondo dopoguerra ha nei confronti della riqualificazione energetica una predisposizione naturale. Nell'attesa delle prime norme sul risparmio energetico degli anni '70, ma anche nel ventennio successivo, la concezione di un involucro non rispondeva PIÙ alla trasmissione del calore in VIRTÙ dell'inerzia, come avveniva con i sistemi costruttivi in muratura, non beneficiava della sperimentazione del primo Novecento (pur con i limiti manifesti) e doveva "standardizzarsi" per sopperire velocemente all'urgenza di ricostruzioni ed espansioni urbane. Nelle maglie dei sistemi intelaiati ormai diffusi si ricorreva a murature in laterizio forato o con intercapedine, ritenendo questa stratificazione minimale garanzia di benessere termoigrometrico. Nonostante i concetti di qualità ambientale cominciassero a circolare, le soluzioni non erano certo raffinate e polimateriche. L'aria, quale miglior isolante, era l'unico presidio che si riteneva inglobato nella parete a fronte delle dispersioni invernali; per il comportamento estivo, l'inerzia era superata da pareti leggere di spessore dettato dalla produzione di blocchi forati. Sebbene i primi impieghi di strati isolanti risalgano agli anni '30-'40 [Bertolazzi, 2017], occorrerà attendere l'ultimo ventennio del secolo per assistere a un'adozione diffusa. Nel contempo il benessere termoigrometrico, prevalentemente invernale, veniva garantito da impianti di riscaldamento che si diffusero in modo capillare.

Le incentivazioni promosse dal 2020, nel rilanciare il settore dell'edilizia, hanno quindi lo scopo di favorire l'adeguamento termico del patrimonio edilizio, in primo luogo quello dell'intervallo temporale 1945-1970, per assenza di coibentazione, ma altresì quello realizzato fra il 1970 e le normative che hanno fissato soglie per i parametri fisico-tecnici (ANIT,2020), inadeguato a rispettarne i valori prescritti. Questo spaccato architettonico sembra non essere investito da dibattiti sul valore storico-architettonico e su problemi di conservazione per cui la proposta di applicare un sistema a cappotto all'involucro potrebbe non essere interdetta da dichiarazioni di interesse culturale con conseguente apposizione di vincolo. Ma anche laddove la qualità architettonica non fosse incompatibile con gli interventi trainanti previsti per accedere agli incentivi statali, pensare di minimizzare le opere edili potrebbe comunque essere un'opportunità da contemplare.

Avendo affrontato lo studio del quartiere di edilizia popolare INA Casa realizzato a Messina, sul sedime del Fondo Basile, negli anni '50 a firma autorevole di Filippo

Rovigo, le precedenti riflessioni hanno trovato un banco di prova per confrontare soluzioni tradizionali o innovative, non prima di aver attraversato il dibattito aperto fra sistemi a cappotto e le diverse alternative che si stanno addensando sul panorama delle opzioni possibili. Un modello BIM metterà in evidenza lo stato dell'arte tecnico-costruttivo dell'involucro, punto di partenza per valutare PIÙ SCENARI di riqualificazione energetica nell'accezione richiesta dagli incentivi statali (Fig. 1).

La ricerca di nuove soluzioni di isolamento termico si è imbattuta nella confusione attualmente esistente fra le diverse denominazioni "commerciali" e "propagandistiche" riferite a microcappotti, nanocappotti, cappotti sottili e/o nanotecnologici, VIP, nanorivestimenti termoriflettenti, rasanti/pitture/vernici/materiali isolanti nanotecnologici proposti come sinonimi o comunque senza alcuna chiarezza espositiva e prestazionale

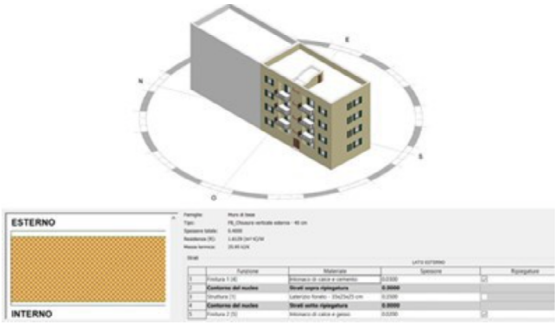

Figure 1. Quartiere INA CASA dell'ex Fondo Basile (Messina): dal modello BIM l'originaria stratigrafia dell'involucro.
Source: Elaborazione delle autrici

Si è imposta quindi l'esigenza di comprendere l'origine di ciascuna espressione e di giungere a una classificazione per questi prodotti analogamente a quanto fatto per gli isolanti che trovano applicazione nei sistemi a cappotto "convenzionali", così intendendo tutto ciò che ha superato lo scetticismo degli operatori edili ed è stato sistematizzato sulla base della derivazione composizionale: vegetale, animale, minerale, sintetica.

A questo spaccato produttivo, infatti, a partire dai primi anni del XXI secolo, si sono affiancati prototipi a basso spessore, definiti "non convenzionali" in VIRTÙ di tecnologie sperimentali e a costi sostenuti finalizzate a ridurre la trasmissione del calore per conduzioni e/o convezione e/o irraggiamento. Pochi hanno varcato la soglia della produzione industriale ma, negli ultimi anni, sono stati fondamentali per lo sviluppo di ulteriori ricerche volte alla miniaturizzazione delle particelle e/o dei pori, rivolu-

zionando il panorama prestazionale con l'introduzione di principi termofisici non ancora recepiti a pieno per valutarne il funzionamento, vero o presunto, effettivo o soltanto dichiarato [Bjorn, 2011; Duca, Ronzoni, 2018].

In tal senso si è attraversato il dibattito che attualmente vede contrapposti produttori e consorzi di isolanti "convenzionali" ai "non convenzionali", senza prendere parte ma solo provando ad adottare gli strumenti "ingegneristici", requisiti, normative, comparazioni virtuali, sperimentazioni, per contribuire alla comprensione di questo nuovo upgrade tecnologico.

CONCLUSIÓN

Potenzialità e limiti in vista di un programma sperimentale

Le analisi condotte possono sintetizzarsi nel prospetto tecnico-economico (Tab. 3), che evidenziano attraverso un calcolo numerico le potenzialità degli isolanti non convenzionali: una risposta energetica efficace a fronte di spessori ridotti, nel rispetto di CAM e delle normative predisposte per gli incentivi statali; a fronte di questo risultato si annota una maggiorazione dei costi non irrilevante, a cui dovrebbe per correttezza sottrarsi il mancato onere di opere edili per ripristinare vani finestre e balconi, accessi e pertinenze.

Il percorso effettuato sulla comparazione di cappotti termici, convenzionali e non, è giunto per gli isolanti termici nanotecnologici a due risultati: la scelta fra quelli filtrati, con esito positivo, dalle norme italiane non è ancora ampia con la conseguente riduzione delle applicazioni anche per i costi elevati cui si può far fronte attualmente grazie all'ecobonus 110%; la diffidenza, dovuta alla confusione terminologica, alle formulazioni miracolistiche e alla campagna denigratoria dei produttori di isolanti convenzionali, non aiuta a comprendere quanto, la nanotecnologia abbia davvero innovato il settore. A valle di queste considerazioni si ritiene opportuno predisporre, dopo l'applicazione numerica, un programma sperimentale per una conferma o un disallineamento dei dati, e per comprendere appieno il comportamento termofisico dei cappotti non convenzionali.

	Prodotto Dimensioni Azienda	Principio $\lambda_{D\ isolante}$ [W/mK]	$S_{isolante}$ [cm] S_{parete} [cm]	U_{parete} [W/m²K] <0.38 W/m²K (zona B - ME)	APE convenzionale $EP_{gl,nren}$ [kWh/m²anno]	Risparmio energetico	€/mq[1]
SDF	/	/	/ 40	0.79 non verificata	Classe E 63.5004	/	/
SIMUL. 1	Eco POR G031 1000x500 mm	EPS grigio	10	0.24	Classe C	26,8%	12,12
	Isolconfort	0.031	49.9	verificata	46.4799		
SIMUL. 2	Vacunanex cappotto 1000x600 mm 600x500 mm 600x100 mm 200x100 mm	VIP	2.6* *3+20+3mm	0.16	Classe C	30.5%	 145,00 170,00 350,00 700,00
	Bifire	0.004	43.6	verificata	44.1200		
SIMUL. 3	Aeropan 1400x720 mm	Aerogel	4	0.25	Classe C	26.2%	329.70
	Ama Nanotech	0.015	45	verificata	46.8684		
SIMUL. 4	Manticeramic ad alta densità	Rivestimento termoriflettente	1	0.15	Classe C	30.8%	129.00
	Műszer Automatika	0.0019	41	verificata	43.9392		

Acronimo SDF (Stato di fatto) **Nota** [1] Costo valutato per lo spessore che ha garantito il salto di due classi energetiche.

Tabella 3. Prospetto tecnico-economico delle simulazioni ipotizzate

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[1] *La prima legge in materia di isolamento termico degli edifici fu la 373/1976, seguita dalla 10/1991. Quest'ultima, all'art. 30, introdusse la certificazione energetica ma non fu mai emanato un decreto attuativo; a tal fine servì attendere il DL 192/2005 quale recepimento della Direttiva 2002/91/CE. Da allora il quadro legislativo è variato per accogliere le esigenze di sostenibilità del settore edile. Con riferimento alla valutazione della prestazione energetica, adesso vige il DL 48/2020 che attua la Direttiva UE 844/2018.*

ANALYSIS AND BEHAVIOR OF DIFFERENT MATERIALS IN SUSTAINABLE CONSTRUCTION AND THEIR ALTERNATIVES FOR THE IMPROVEMENT OF THE ENVIRONMENT

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ABSTRACT

The construction sector is widely known for its growing activity and its impact on the environment. The use of different materials within the world of construction has evolved over the years. Thus, thanks to technology, it has been possible to achieve an improvement in the behaviour of certain materials in the world of construction. In this article, different materials from this sector are analysed in order to achieve an improvement and awareness towards a more sustainable construction. The focus has been on the study of the behaviour of these materials and their responses to the phases of construction. As analysed, it has been possible to demonstrate that the controlled evolution of certain materials such as the use of clinker or cementite, significantly improves the context of sustainable construction. On the other hand, by replacing cement by other materials such as fly ash or slag can improve the durability by 50% which is a high figure related to the sustainable point of view, thus can reduce the impact on the environment.

Keywords: Sustainability, construction, ecological materials.

INTRODUCTION

Currently there are many activities that turn out to be unfavorable for the environment, however those that stand out are from the industrial sector, transport along with the construction sector (Wieser *et al*., 2021), which through several factors ends up affecting the environment in a negative way. On the other hand, it is worth mentioning the awareness of the environment in recent years, and this can be seen by increasing studies aimed exclusively at factors that affect the environment, therefore it can be said that the perception regarding traditional construction is changing towards a more ecological and sustainable future (del Río Merino *et al*., 2009). De-

spite understanding the negative effect, it is still necessary to implement measures and regulations that regulate the current system of materials management within the field of construction and demolition. The world of construction is also known for its impact on the environment both by the process of building and the materials used (Coelho and de Brito, 2012). This article analyzes the various building materials and their impact on the environment along with the study of how to improve the current system.

In the case of Spain, the field of construction and demolition is one of the economic engines (Duarte and Bielsa, 2011), it is so much that the economy of this country is linked to the trends of the construction sector, which has been verified after the crisis of 2006. The negative points related to the field of construction are due to several factors, being the most important the use of the materials used in it and the final stage of them (Sandin *et al*., 2014). This last point is mainly due to the demolition phase where the materials are deposited mostly untreated for other use. The result of the unfavorable impact of the construction sector can be seen in climate change, deforestation, loss of biodiversity ("EU Biodiversity Strategy for 2030").

These effects on the environment are mostly due to the use of materials along with the energy used in the process. In order to reduce these impacts on the environment, it is necessary to understand the concept of sustainable materials, since they are those that generate less environmental impact (Miller and Ip, 2013). Being materials, whose origin is natural, it makes them both materials with high potential to be recycled. This virtue makes its impact not as serious as traditional materials. Sustainable materials also have a low amount of energy used both in the extraction process and throughout the life of the materials (Xundi *et al*., 2010). Energy waste is found mainly in materials that are heavily handled and have little recycling potential.

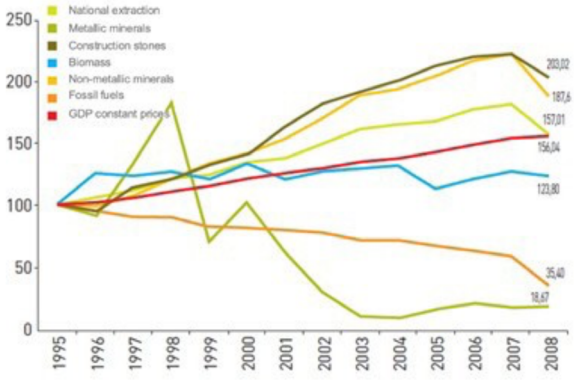

Figure 1. Evolution of National extraction and other factors represented in a period of time of 14 years.
Source: OBSE (Spanish Observatory of Sustainability) (Miller and Ip, 2013).

CONCLUSION

The use of energy for the extraction of materials occurs in high quantities. This point makes that in some cases this type of practice manifests itself in an unsustainable way (Xundi *et al*., 2010). In the case of Spain, it has been possible to see the evolution of the extraction of materials through the Observatory of Sustainability of Spain (Miller and Ip, 2013).

Sustainable constructions are analyzed in order to mitigate the environmental impacts that take place in cities with greater economic and social growth. Along with these growths, it is also worth noting the increase in pollution by air pollutants and the degradation of the ozone layer along with other impacts described in this article. Then the study of the materials is also carried out in order to be able to know the opportunities in the current system of construction and demolition waste management, in addition to promoting and reinforcing the use of green or sustainable materials to encourage the use of these in current and future constructions. Thus, this article analyzes the most appropriate materials to create a sustainable cycle within the field of construction, therefore it begins by describing the chosen materials and then analyze the behaviors of these materials. Factors such as different types of materials along with their impact on the environment have been considered for the analysis. With the study of these factors, results are reached where the sustainable side of each material and influence on the sustainable cycle are also shown.

ACKNOWLEDGEMENT

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DISEÑO ÓPTIMO DE UN SISTEMA HÍBRIDO RENOVABLE APLICADO A CAMPUS UNIVERSITARIO EN MÉXICO

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ABSTRACT

This article shows the application of a methodology for the optimization of a renewable hybrid system applied to the Veracruz campus of the National Technology of Mexico. An algorithm was developed in MATLAB that integrates data from renewable resources, campus demand, and economic information from system components. Two configurations were obtained, one for economic optimization and one for environmental optimization. Of the optimal configurations for the system, the technically most sustainable one increases its cost by 15.6% but reduces CO2 emissions by 23.5% compared to the most economical system.

Keywords: Optimization, hybrid renewable system, MATLAB

INTRODUCTION

Varios estudios se han llevado a cabo a nivel nacional en la BÚSQUEDA de nuevas opciones para la diversificación energética en México. Muchos de estos estudios afirman que el país tiene una gran variedad de alternativas para facilitar una transición energética basada en expandir ampliamente el desarrollo de fuentes renovables tales como la hidroeléctrica y la eólica (Cancino-Solórzano *et al*., 2016).

Hasta antes de la pandemia por COVID-19, las grandes instituciones de educación superior, en sus diferentes campus, como el Tecnológico Nacional de México, campus Veracruz, presentaron elevados consumos de electricidad que se reflejaron en sus facturas correspondientes. Lo anterior ha llevado a buscar soluciones que

permitan satisfacer las necesidades parciales o totales de electricidad de los campus universitarios, reduciendo así los consumos de la red. Para contrarrestar los efectos de los altos consumos de electricidad en los costes de la facturación y en las emisiones de gases de efecto invernadero asociadas, los sistemas híbridos renovables se presentan como una solución que debe considerarse para tal fin. Varios trabajos sobre la aplicación de sistemas híbridos renovables en escuelas, principalmente de zonas rurales, pueden encontrarse en la literatura (Glaisa, Elayeb & Shetwan, 2014) (Lamnadi, Trihi & Boulezhar, 2016).

Un sistema híbrido renovable puede definirse como una combinación de dos o más fuentes de energía renovable/ no renovable. Sus componentes básicos incluyen fuentes de energía (CA/CD), sistema de almacenamiento, convertidores electrónicos de potencia de CA/CD y cargas, como se muestra en la figura 1.

Un sistema híbrido renovable requiere un diseño óptimo en el dimensionado de sus componentes para cumplir con los requerimientos de manera económica, fiable y eficiente. Para la optimización del sistema existen técnicas clásicas como la programación lineal (PL), la programación no lineal (PNL) y la programación dinámica (PD). Las técnicas metaheurísticas aplican algoritmos inspirados en la naturaleza, como los algoritmos genéticos (GA), optimización por enjambre de partículas (PSO), recocido simulado (SA) y colonia de hormigas (AC). También existen técnicas híbridas que combinan dos o más de las antes mencionadas (Ghofrani & Hosseini, 2016).

Se pueden encontrar también herramientas de software que facilitan la tarea de optimizar un sistema híbrido renovable. Una de ellas y quizá la más utilizada es HOMER, un modelo de ordenador desarrollado por el Laboratorio Nacional de Energía Renovable (NREL) de los Estados Unidos para asistir en el diseño de sistemas de micro generación y facilitar la comparación de tecnologías de generación a través de un amplio rango de aplicaciones (Lambert, T. *et al*., 2006).

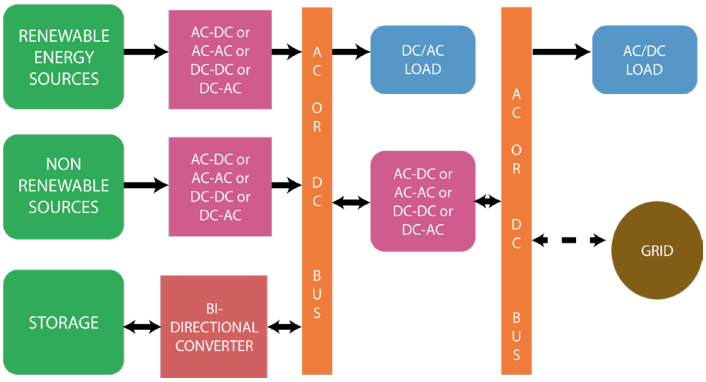

Figure 1. Componentes de un sistema híbrido renovable
Fuente: (Krishna & Kumar, 2015)

CONCLUSION

El diseño óptimo de un sistema híbrido renovable es una tarea compleja y a la vez estimulante, debido al NÚMERO de variables que intervienen. Se expuso en este artículo una metodología para el diseño de un sistema híbrido renovable aplicado al campus Veracruz del Tecnológico Nacional de México.

Pudo observarse que una vez concluido el proceso de optimización, la selección del sistema óptimo estará relacionado con el tipo de indicador seleccionado. Se vio que para el sistema óptimo más económico, la fracción renovable es prácticamente despreciable. Por otra parte, el sistema técnicamente más sustentable, incrementa su coste en un 15,6%, pero reduce las emisiones de CO2 en 23,5% respecto al sistema más económico.

Se concluye que los resultados del proceso de optimización deben analizarse cuidadosamente para buscar una combinación de componentes que cuente con un equilibrio entre economía y emisiones, resultando así más atractivo a los inversionistas.

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EL COVID-19, LA NORMATIVA DE VENTILACIÓN Y SU IMPACTO AMBIENTAL EN LAS UNIVERSIDADES EN MÉXICO

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ABSTRACT

This paper analyses the increase in energy consumption caused by COVID-19 containment measures in university classrooms in Mexico, particularly in hot humid areas where the use of air conditioning units is required. The effect of ventilation on classroom temperature, student comfort and air conditioning equipment consumption are analysed.

Keywords: COVID-19, ventilation, energy consumption.

INTRODUCTION

Uno de las principales estrategias en la lucha contra el COVID-19 es la ventilación adecuada de los espacios. MÚLTIPLES gobiernos y organismos internacionales (UNICEF, 2020) (Ministerio de Sanidad, 2020) han establecido reglamentos y recomendaciones aplicables a los sistemas de ventilación. Todas ellas coinciden en la importancia de la renovación del aire en los espacios cerrados para disminuir el riesgo de contagio entre los usuarios.

En la primera parte del trabajo se compara la normativa relativa a la ventilación en España y México. Posteriormente se analiza el impacto de la ventilación en el Tecnológico Nacional de México campus Veracruz considerando las condiciones climáticas, los consumos de electricidad anteriores y durante la pandemia. En la siguiente etapa se EVALÚAN diferentes escenarios ventilación/consumo energético con el programa Trnsys. En el apartado final se presentan las conclusiones.

CONCLUSION

La vuelta a la presencialidad en el TecNM campus Veracruz presenta un gran reto en lo referente a la ventilación adecuada de los espacios, debido principalmente a las características constructivas de los edificios de aulas y laboratorios, la temperatura y humedad del entorno. En el campus Veracruz, con elevado consumo energético en climatización, la instalación de un sistema de ventilación con extractores presenta un mejor equilibrio entre consumo energético adicional e inversión requerida.

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PLANIFICACIÓN DE DISTRITOS DE ENERGÍA POSITIVA EN FRENTES MARÍTIMOS URBANOS DEL MEDITERRÁNEO.

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ABSTRACT

Los Distritos de Energía Positiva (DEP) se consideran herramientas innovadoras para alcanzar la neutralidad energética y climática en las ciudades. Los DEP son regiones o barrios con un balance energético anual positivo, conseguido principalmente mediante la eficiencia energética y la generación de energía a partir de renovables. Dada su novedad y la falta de metodologías previas, este trabajo pretende aportar una metodología desarrollada para diseñar PEDs en ciudades mediterráneas. Se realiza una auditoría energética para evaluar el rendimiento pasado del distrito. Para el estudio de recursos, se estudian los recursos y el espacio disponibles, así como la madurez de la tecnología y sus costes. A continuación, se obtiene la producción potencial de las tecnologías seleccionadas. Una vez conocida esta información, se plantean las acciones propuestas. Las propuestas conducen a la creación del escenario estratégico que será simulado. Además, se realiza un análisis de sensibilidad para evaluar la influencia de los posibles cambios en diferentes parámetros.

Keywords: Distrito de Energía Positiva; La Marina de València.

INTRODUCTION

Las ciudades consumen dos tercios del suministro energético, y el 70% de las emisiones de CO_2 provienen de entornos urbanos, convirtienendo a las ciudades en un agente clave en la transición energética (IEA, 2016). En las estrategias de planificación en las ciudades se están promoviendo los Distritos de Energía Positiva (DEP) para abordar dicha transición. El objetivo de los DEP es lograr un balance energético anual positivo.

Este trabajo aborda las características de los frentes marítimos urbanos (FMU) que los diferencian de otros espacios y su potencial como DEP. Se han analizado los avances en sostenibilidad y eficiencia energética de algunos puertos (Valencia (Autoridad Portuaria de Valencia, 2020), Hamburgo (Acciaro, Ghiara, & Cusano, 2014),

Amsterdam (Port of Amsterdam, 2017) y Roterdam (Port of Rotterdam, 2019) como entornos con puntos en COMÚN con los FMU. Además, se han incluido dos FMU: V&A Waterfront (2019) y Torre Annunziata (Gravagnuolo & Angrisano 2013). Respecto a los puertos, en todos se busca la reducción de las emisiones de CO_2 para alinearse con los objetivos europeos del Plan Climat Target. Todos recurren a la producción de energía, ya que en términos de espacio y recursos, suelen ser entornos ricos. Las tecnologías líderes son los paneles fotovoltaicos y los aerogeneradores. La eficiencia está presente, pero no con la misma importancia en todos los casos; además, el interés por la movilidad eléctrica y los combustibles alternativos toman cada vez más relevancia. Además, en la revisión bibliográfica no se ha encontrado una metodología específica.

CONCLUSION

En este trabajo, presentamos una metodología para planificar y prever diferentes escenarios para lograr la DEP. El método considera la recopilación de datos, el análisis de la demanda, un estudio de la capacidad de energía renovable factible y la simulación tecno-económica de los diferentes escenarios. El método se valida en el FMU de la ciudad de València. Los FMU son distritos particularmente interesantes de las ciudades, ya que a diferencia de la mayoría de los distritos urbanos, tienen grandes espacios para la generación renovable. Los resultados muestran una trayectoria una combinación de medidas de eficiencia de la demanda (iluminación LED) y la instalación de energía solar fotovoltaica para la obtención de un DEP en un escenario estratégico de mínimo coste. Si bien la inclusión de un aerogenerador no resulta la más óptima en caso de que se produjera una disminución del consumo o de el precio de la electricidad. Reduciendose el consumo podría prescindirse del aerogenerador y las condiciones seguirían siendo las de un DEP, sin embargo si manteniendo el consumo no se incluye el generador la producción in situ quedaría por debajo del consumo en el balance anual.

Salvo el escenario de bajada del precio de la electricidad, la configuración optima de los escenarios supone un balance positivo de energía que se vertería a la red y produciría ahorrros de emisiones debídos a la misma y ahorros económicos para LMDV.

El análisis de sensibilidad muestra cómo los escenarios se ven afectados por la incertidumbre. La inclusión de otras medidas depende de la evolución de los parámetros susceptibles de cambiar con el tiempo, pero las medidas comunes son el punto de partida de la estrategia energética en el FMU.

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DIAGNÓSTICO DE LA VENTILACIÓN DE UN LABORATORIO DOCENTE DE LA ETSIE DE LA UPV

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ABSTRACT

The study of the safety conditions in the ventilation against the transmission of SARS-Cov-2 in a teaching laboratory, starts from the fulfillment of the norms and recommendations, but requires the verification by means of computational calculation by fluid dynamics to guarantee the flow. of air, the number of renewals and the absence of vortex formation in order to determine the safe areas within the enclosure and to quantify the adequate real capacity.

Keywords: SARS-CoV-2, Natural ventilation, forced ventilation, degree of comfort, teaching.

INTRODUCTION

Con motivo de la pandemia del Covid-19, se hizo necesario realizar el diagnóstico de la ventilación de la zona 1 del laboratorio de Instalaciones de la Escuela Técnica Superior de Ingeniería de Edificación (ETSIE) de la UPV donde se imparte docencia analizando las condiciones de ventilación existentes. En el estudio se ha tenido en cuenta la legislación vigente y las recomendaciones de la UPV, organismos oficiales y normativa alemana en materia de ventilación y renovación del aire.

El estudio se ha basado en el cálculo computacional por dinámica de fluidos (CFD) en el que se recoge dos tipos de ventilación, natural y forzada. Con respecto a la ventilación natural ante la dificultad de predecir la diferencia de presión barométrica entre la entrada y la salida a través de las ventanas del laboratorio, se ha estimado un mínimo de 1 Pa. Con respecto a la ventilación forzada, se han seleccionado 3 casos después de haber optimizado todos los diseños posibles en función del espacio que dispone el laboratorio, por seguridad y economía.

Finalmente, de los resultados de las simulaciones computacionales se exponen los problemas encontrados en cada una de las ventilaciones a estudio, así como la solución más adecuada que se encuentra en el apartado de conclusiones.

CONCLUSION

Para poder afirmar que una ventilación es desde el punto de vista de la seguridad válida, no basta con cumplir la normativa oficial, es necesario realizar simulaciones mediante cálculo dinámico computacional para comprobar la dirección de las líneas de corriente, existencia de vórtices, remansos, velocidad del viento, caudales, NÚMERO de renovaciones del aire, eficiencia del sistema, etc.

La ventilación natural estudiada no es segura para poder impartir docencia por la formación de vórtices y bajas velocidades del aire. Sería necesario una diferencia presión natural mínima de 160 Pa para obtener valores que pudieran ser aceptables, y esto físicamente es imposible de obtener.

La ventilación forzada más adecuada es la ventilación forzada 3, aunque sigue siendo preocupante la escasa velocidad entre los paneles técnicos. Se recomienda instalar 3 extractores de 1.70 m^3/s cada uno instalados en la parte central de las ventanas de la cara SW. Además, sería necesario que los motores electromecánicos estuvieran equipados por variadores de frecuencia, de esta forma se podría regular en función del aforo y de las condiciones de temperatura y humedad el caudal de los extractores.

Se recomienda que los extractores fuesen de corriente alterna trifásica, con la finalidad de disminuir la potencia consumida y en consecuencia la huella de carbono. Se debe tener muy en cuenta que el nivel sonoro de los extractores no genere interferencias sonoras mientras el profesor imparte la clase. Se recomienda instalar en el laboratorio, aparatos de medición y almacenamiento de datos de la temperatura, humedad y concentración de CO2. Los aparatos deberán de estar conectados a un autómata de control programable PLC, y este a un ordenador y a los variadores de frecuencia a través de un bus de comunicación.

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FEASIBILITY OF USING GREEN ROOF AND SHADING DEVICE BY ADOPTING THE TOTAL ENERGY CONSUMPTION APPROACH: A CASE STUDY IN TEHRAN

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ABSTRACT

Greenhouse gases are responsible for climate change, and the building sector is one of the main areas to reduce carbon dioxide emissions. In terms of air pollution, Tehran is one of the top cities in the ranking (Heger and Sarraf 2018). Therefore, paying more attention to this issue is absolutely essential. GB (green building) is one of the parameters to achieve a sustainable city. This paper analyses GR (green roof) and SD (shading device), which are two crucial parts of a GB from the EC (energy consumption) approach in a residential building in Tehran city.

The heating and cooling system in the building is based on natural gas and electricity. This paper compares energy consumption, including ELC (electricity consumption) and GC (gas consumption) before and after GR and SD to find out whether or not they are suitable for this building and the current case study.

Keywords: Green building, Green roof, Shading devices, Electricity consumption, Gas consumption.

INTRODUCTION

With the remarkable rise in EC and greenhouse gases due to increasing population and improvement of living standards, energy conservation has become a crucial subject in sustainable development (Li *et al*. 2021). The building sector consumes 40% of global energy and produces 30% of carbon dioxide emissions (Wu *et al*. 2019). Greenhouse gases are responsible for climate change (Mustaffa, Mat Isa, and Che Ibrahim 2021).

According to predictions carbon emissions of buildings will go up to 42.4 billion tons in 2035, 43% increase compared to 2007 (Kearney 2010). saving energy and following carbon emission reduction is a significant issue now and in the future. The concept of green building has been known as an innovative approach to carrying out and reaching sustainability (Abdelaal and Guo 2021). A GB is usually introduced as an environmentally friendly building with efficient energy, low environmental impact and high-recycled materials compared to a non-green building (Ali and Al Nsairat 2009). GB does not only reduce the negative impact on the environment but also decreases operating energy costs. Using fossil fuels for generating electricity indicates an unsustainable urban area (Martinopoulos 2020). Roofs generally cover 20-25% of the total urban area (Izquierdo, Rodrigues, and Fueyo 2008). A GR is a good step to reach a green building and following it, sustainability. In recent years GR approach has illustrated sustainability and has been spreading fast in many countries (Shafique, Kim, and Rafiq 2018). GR prevents short wave radiation absorption and works like thermal insulation in the roof, which means it prevents heat entering in summer and heat escaping in the winter (Gunawardena, Wells, and Kershaw 2017).

Furthermore, it can mitigate the urban heat island effect(Takebayashi and Moriyama 2007)(Ouldboukhitine, Belarbi, and Sailor 2014), Reduce water runoff(Speak *et al*. 2013). Only 13% of the solar radiation can pass through the GR while 27% is reflected and 60% is absorbed by soil and plants (Ekaterini and Dimitris 1998). Another part of GB is the green façade and window shading is a segment of the green façade(Zheng, Dai, and Tang 2020). Shading devices(SD) are widely used in building to improve energy performance by controlling solar radiation and sunlight(Yao 2020). For instance, if the window is completely shaded by the shading device, it can block solar heat gain by approximately 80% (Chi *et al*. 2020). Using SD for the windows in the height of summer reduces the temperature by 4-6 degrees. (Ip *et al*., 2004).

CONCLUSION

The result of the analysis shows that in terms of both GR and SD, inference about the efficiency of any of them depends on many parameters, like HVAC system, type of climate zone, etc. For instance, in this building, if the heating system was based on electricity, the EC could be different. According to the result, there was not a remarkable difference in EC in the building with and without GR due to increasing in GC. The creation of a GR is more effective and affordable if we use it in a climate zone with prolonged sunshine duration per day and moderate winters.

As seen in the results, GR has well performance in the summertime and reduces ELC for cooling, but in the winter it will increase GC for heating. In addition, the function of GR in reducing cooling load is proportional to substrate's insulation performance and reflection and absorption of solar radiation by vegetation layer (Feyisa, Dons, and Meilby 2014) (Abuseif, Dupre, and Michael 2021).

In the case of SD, there was a considerable decrement in ELC in the winter due to sunlight blockage and a twofold increase in GC for the same reason. The main reason for this problem is using fixed SD in the building, utilization of a moveable SD on daily, monthly or seasonal terms allows it to be more efficient compared to a fixed one (Akbari Paydar 2020).

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COMPORTAMIENTO TRIBOLÓGICO EN LAS UNIONES SOLDADAS, ANÁLISIS DEL MÉTODO DE DESGASTE COMO MEDIDA DE MEJORA A LA SEGURIDAD ESTRUCTURAL.

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ABSTRACT

The study describes the process of analyzing the tribological behavior of welded joints, present in metallic structures and other structural elements affected by friction and wear, used in construction processes. Its control is of vital importance in ways to comply with the regulations regarding the structural code and on actions in the building that comply with the bearing capacity of the buildings. In the first part of the document, the concepts related to the science of tribology are briefly exposed. The elements that make up a tribological testing machine based on the “pin on disk” principle are described below.

Finally, a practical case is presented as an example and experimental validation of the friction and wear analysis on the welded joint of cast metal sheets welded with a 60% Ni-Fe contribution electrode, finally the conclusions and the derived advantages are exposed from the application of the method to the control and execution of welded joints on site.

Keywords: Tribometer, welded joint, friction, wear, structural control, building construction.

INTRODUCTION

El estudio del comportamiento tribológico de las uniones soldadas presentes en las estructuras metálicas y demás elementos afectados por el rozamiento y desgaste usados en los procesos constructivos, puede contribuir en gran medida a la mejora del control preventivo frente a las acciones en la edificación, ya sean permanentes, variables o accidentales y que afectan a la estructura una vez construida. De igual modo, puede ser un parámetro indicador del cumplimiento de la normativa referida

al código estructural y sobre acciones en la edificación, que garantizan la capacidad portante de las estructuras que forman parte de los edificios.

La confiabilidad de las estructuras metálicas usadas en el ámbito de la edificación está regulada normativamente a través del "Código Técnico de la Edificación", en concreto en su documento básico "DB SEA-Seguridad Estructural" publicado en el Real Decreto 314/2006, de 17 de marzo. (BOE 28/3/2006). Referidos al apartado de seguridad control y ensayos, se encuentran los epígrafes dedicados al control de calidad, control de calidad de los materiales y control de calidad de la fabricación (Ministerio de Fomento, 2019,).(EAE, 2011)

El "Código Estructural", recientemente aprobado, (BOE 2019, 2021) tiene por finalidad mejorar la seguridad estructural y la seguridad en caso de incendio, así como la protección medioambiental y la utilización eficiente de los recursos naturales. Proporciona herramientas para la evaluación de la sostenibilidad de las estructuras considerando las características prestacionales, ambientales, sociales y económicas que aportan los agentes que participan en su proyecto y ejecución.

En el Código Estructural también se regulan las cuestiones relativas a bases de proyecto y análisis estructural, así como a los requisitos técnicos exigibles a los materiales o componentes, a la durabilidad y vida ÚTIL de las estructuras.

Dentro de los requisitos técnicos, parámetros como la durabilidad o vida ÚTIL pueden ser determinados a través de estudios de desgaste como el que aquí se presenta.

CONCLUSION

Para el caso de uniones soldadas en estructuras metálicas, el método propuesto permite realizar un análisis tribométrico mediante máquina de ensayos "pin on disk" que nos proporciona los datos de rugosidad y permite obtener datos como el coeficiente de fricción por tiempo y desgaste. El método resulta ÚTIL para extrapolar y comparar el desgaste efectuado y comparado con diferentes materiales que interaccionen entre ellos.

En conclusión este método complementa los datos de partida de los materiales proporcionando una lectura superior relacionada con los requisitos técnicos exigibles a los materiales o componentes y a la durabilidad y vida ÚTIL de las estructuras.

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DIAGNÓSTICO DEL FALLO EN LAS INSTALACIONES DE BOMBEO EN PISCINAS OLÍMPICAS

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ABSTRACT

The study focuses on the diagnosis of the failure in the suction installations of the pressure groups in an Olympic swimming pool. Likewise, it is intended to make a work guide to be able to determine the faults in this type of installations. Finally, a practical case is presented as an example and experimental validation of the friction and wear analysis on the welded joint of cast metal sheets welded with a 60% Ni-Fe contribution electrode, finally the conclusions and the derived advantages are exposed from the application of the method to the control and execution of welded joints on site.

Keywords: Fault diagnosis, suction lines, pressure groups, fracture, polymers.

INTRODUCTION

Los fallos de funcionamiento que se suelen detectar en las piscinas olímpicas son MÚLTIPLES, siendo atribuible en la mayoría de los casos a los siguientes factores actuando de forma individual o combinada: mala calidad de aire y del agua, elección incorrecta de los materiales desde el punto de vista de compatibilidad con el agua (Romero *et al*, 2010), así como, de resistencia mecánica, grupos de presión ineficientes y en ocasiones sin NINGÚN tipo de regulación electrónica, sistemas de purificación de aire deficientes, producción escasa de agua caliente sanitaria, filtros inadecuados, carencia o inexistencia de sistemas de control analógico/digital (PLCs, HMI, Scada, etc.), carencia de aislamiento térmico tanto en el vaso como en la edificación, mantenimiento deficiente y en ocasiones inexistente, etc.

Estos fallos son muy comunes en este tipo de instalaciones debido a un mal diseño por parte de los proyectistas, con desconocimiento en las disciplinas de la ingeniería hidráulica, mecánica, materiales, electrónica y química. Esto provoca instalaciones con un elevado coste energético, enfermedades en la piel, ojos, oídos, vías respiratorias etc., y en el peor de los casos a fallos irreversibles del sistema.

El trabajo que se desarrolla hace referencia a un caso real en unas instalaciones de una piscina olímpica ubicadas en la Comunidad Valenciana, sin indicar datos específicos por razones de protección de datos. En esta ocasión, el fallo fue atribuible al sistema hidráulico con rotura de las tuberías en la línea de aspiración en los grupos de bombeo.

La sala de máquinas estaba formada por los siguientes elementos:

- Instalación hidráulica de siete bombas conectadas en paralelo. Seis de las bombas son iguales de 5.59 kW/cada una y una más de 4.05 kW. Las seis bombas están montadas en grupos de dos, formando lo que en adelante se denominará línea de bombeo 1, 2 y 3. El uso de las 7 bombas se destina a la barredera, el dosificador del floculante y pH, los cloradores salinos, la recirculación del agua en la piscina previo lavado, filtrado y juegos.
- Sistema de filtrado, formado por 3 depósitos de 1800 litros cada uno.
- Cloradores salinos, compuesto por 1 clorador maestro y 3 cloradores esclavos.
- Dosificadores de cloro.
- Cuadros eléctricos y electrónicos.
- Las tuberías del sistema hidráulico formadas por materiales poliméricos de PVC-U SEGÚN la norma UNE 53-11288 con calibres DN-200, 140, 125 y 90, de PN-10. Las válvulas utilizadas en toda la instalación son de material polimérico del tipo de mariposa de cierre un cuarto con palanca metálica y gatillo de posición.

Durante la inspección la instalación hidráulica en el sistema de aspiración presentaba las siguientes patologías: rotura de las tuberías de aspiración principales formadas por material polimérico PCV-U de diámetro nominal DN-200 y 90, figura 1; y rotura de los 6 filtros (uno/bomba) de cada una de las bombas, figura 2.

Las causas que han provocado este fallo se analizan en los siguientes apartados.

Figure 1. Detalle de la rotura de las tuberías de aspiración.
Figure 2. Detalle de la rotura de los 6 filtros individuales.

CONCLUSION

Del diagnóstico del fallo se desprende que la hipótesis más afín a la rotura de los materiales es debido a causas de presiones negativas en el interior de las tuberías en la línea de aspiración.

Del estudio de las patologías se demuestra que la rotura de los materiales ha sido de forma generalizada siendo del tipo frágil, así mismo, presenta signos de clivaje, lo cual proporciona indicios de que la rotura ha sido progresiva debido a ciclos de fatiga hasta alcanzar un espesor mínimo de 4 milímetros, y es entonces cuando la rotura ha sido SÚBITA. Como conclusión del cálculo hidráulico, para que se produzca la rotura de las tuberías de aspiración se han tenido que manipular las válvulas de mariposa principales, es decir, se ha disminuido la sección de la vena líquida.

Como resumen de las conclusiones, las instalaciones hidráulicas del grupo de bombeo o recirculación de la piscina ha sido provocado, por ciclos de fatiga por variación de las presiones negativas internas en el interior de las tuberías de aspiración, provocadas por el cierre parcial de la válvula/as de mariposa DN-200 y DN-90.

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HORMIGONES DE BAJO IMPACTO AMBIENTAL: LOS GEOPOLÍMEROS. EVOLUCIÓN DE LA RESISTENCIA

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ABSTRACT

El hormigón armado es el material de construcción más utilizado en el mundo actualmente debido a su versatilidad y sus propiedades mecánicas. Sin embargo, una de sus principales desventajas es la emisión de CO2 que se genera durante la fabricación de sus componentes, concretamente del cemento. Debido a esto, son muchos los autores que han tratado de buscar alternativas lo suficientemente fiables y que consigan reducir el impacto medioambiental generado durante su fabricación. En este estudio se analizará en detalle una de estas variantes, los geopolímeros. Durante la fabricación de los geopolímeros se sustituye en el amasado el cemento (OPC, Ordinary Portland Cement) por aluminosilicatos, los cuales son activados con una solución alcalina que sustituye el agua de amasado. Los aluminosilicatos son compuestos que proceden del desecho de otros procesos industrials, como la ceniza volante o la escoria de altos hornos. De esta forma, se sustituye el compuesto más contaminante de los OPC por un material reciclado, lo que incrementa el grado de sostenibilidad de estos materiales y reduce el impacto medioambiental.

En este trabajo se analizará la influencia de las condiciones de curado (temperatura y humedad) en la resistencia a compresión de diferentes tipos de geopolímeros, y se compararán con vairos hormigones. Para la fabricación de los geopolímeros descritos en este estudio se utilizará ceniza volante como aluminosilicato e hidróxido de sodio como disolución alcalina para activarlo.

Keywords: Geopolímeros, hormigón, sostenibilidad, condiciones de curado, resistencia a compresión.

INTRODUCTION

El hormigón es el material de construcción más utilizado del mundo, con un consumo mundial de cerca de 3600 millones de toneladas anuales. La previsión en el futuro es de este dato siga incrementando hasta los 5 billones de toneladas en 15 años. Su fiabilidad y durabilidad junto con la versatilidad que ofrece y su bajo coste son las claves de su éxtito (Mohammed, 2012). Sin embargo, uno de los principales inconvenientes que este material presenta es la contribución del sector que lo fabrica a la emisión de gases de efecto invernadero.

A pesar de los diferentes estudios en busca de alternativas fiables para la producción de hormigón, el proceso de obtención del Cemento Portland Ordinario (OPC de sus siglas en inglés "Ordinary Portland Cement") sigue siendo uno de los procesos más contaminantes. De este proceso industrial, se estima que se generan entre un 5 y 7 % del total de emisiones de CO2 que se emiten a la atmósfera anualmente. Esto se genera durante la calcinación de la piedra caliza para la obtención del Clinker, el cual es un proceso altamente contaminante, además de que requiere un alto consumo de energía y recursos naturales (Albornoz, 2015; Louise, 2013).

Este gran inconveniente ha generado que la industria de la construcción y la investigación haya tratado de buscar alternativas eficaces y de similares características, pero que reduzcan considerablemente la contaminación en el proceso de producción de los diferentes materiales de construcción. Una de las alternativas que aparece en este abanico de posibilidades y que más éxito ha cosechado en los últimos años son los geopolímeros, un sustituto del hormigón, mucho más sostenible y que aprovecha residuos de otros procesos industrials, lo que aumenta su eficiencia (Louise, 2013).

El cemento geopolimérico es un conglomerante sintético inorgánico, el cual se obtiene de aluminosilicatos, los cuales, activados mediante una solución alcalina, generan el proceso denominado geopolimerización (Tejedor,2018).

Como fuente de aluminosilicatos se emplean residuos obtenidos de otros procesos industriales, como la escoria de alto horno y la ceniza volante. Otras adiciones, como la puzolana natural o el metacaolín también han sido estudiadas, pero con menos éxito. Se trata de materiales de deshecho que no tienen ningún uso y con los geopolímeros se plantea su reutilización (Davidovits,2015; Živica,2014; González, 2012).

A pesar de que los geopolímeros han sido extensamente estudiados en numerosas ocasiones, existen muchas variables que no han sido analizadas con el suficiente detenimiento. En este trabajo se recoge un estudio comparativo de la evolución de la resistencia a compresión de diferentes tipos de geopolímeros sometidos a diferentes condiciones de curado. Los resultados obtenidos se comparan con dos hormigones convencionales.

CONCLUSION

Con los resultados obtenidos, se puede afirmar que la temperatura de curado influye significativamente en la resistencia de los hormigones geopolímeros. Una temperatura de curado alta junto con una humedad del 100% permite alcanzar resistencias muy altas para este tipo de hormigones, llegando a triplicar las resistencias de los hormigones convencionales. Por tanto, aunque los geopolímeros no han sustituido al hormigón armado en la actualidad, suponen una alternativa real. Además, este tipo de hormigón es mucho más sostenible, eficiente, limpio y permite reducir significativamente las emisiones de CO2 a la atmósfera, mayoritariamente debido a la producción del cemento, sustituido en el amasado de este tipo de materiales por residuos obtenidos de otros procesos industriales. Por tanto, este proceso también permite favorecer el reciclaje de materias de deshecho y reducir los residuos generados.

Como conclusión, y para una posible línea de investigación futura, el estudio de la evolución de la resistencia de estos materiales a muy temprana edad, durante los 7 primeros días, podría ayudar a encontrar posibles usos a estos materiales enfocados al sector del prefabricado.

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ENHANCEMENT OF THE REINFORCEMENT CONCRETE STRUCTURES BY MEANS OF SMART MONITORING SYSTEMS

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ABSTRACT

The increasement of the structure's services-life plays a significant role in saving resources, carbon-footprint decreasement and reduction of building and demolition wastes. Facts that have huge impact in the sustainable society development. Considering this, the monitoring systems are ones of the most effective measures to achieve the extension of the structures service-life in order to increase the sustainability in this sector. In the case of the Reinforcement Concrete Structures (RCS) the implementation of embedded voltametric sensors like monitoring system would be the most suitable. These sensors allow creating smart sensors networks, recollecting the most quantity and accurate information as is possible of the RCS, this produces the optimisation of the maintenance and refurbishment actions, reducing the resources employed in these tasks.

In this study is presented a proposal of very effective smart monitoring system to control the durability of the RCS. This system is capable to estimate parameters very correlated with the corrosion phenomena such as: oxygen permeability, humidity availability variations, pH and concentration of chlorides in the concrete pore solution. Being the corrosion, ones of the main phenomenon of lost durability in RCS.

Keywords: Sensors, monitoring, smart grids, durability.

INTRODUCTION

Considering the current socio-economic context, the sustainable development of the cities is very important (Naik,2008). In order to get this, the increasement of the structure's services-life plays a significant role in the saving of resources, carbon-footprint decreasement and reduction of building and demolition wastes (Naik,2008).

Indirectly the rise of the structures service-life reduces the energy consume and the heat emissions, these are one of the mainly objectives in the Horizon 2020, due to the construction is energy-intensive industry (Global Energy Review ,2020).

In order to achieve the extension of structures service-life to improve the sustainability in this sector (Naik,2008), the monitoring systems are ones of the most effective measures. In the case of the Reinforcement Concrete Structures (RCS) the implementation of embedded sensors as monitoring system would be the most suitable (Duffó *et al*,2009; Gandía-Romero *et al*,2016). The sensor system configured by voltametric sensors have a great potential (Alcañiz *et al*,2011; Gandía ,2014). In these sensors are applied a potential sweep, favoring the reaction of the different substances contained in the concrete pore solution with the sensor surface. Through the response signal it is possible to identify and quantify the presences of aggressive agents in the concrete pore solution, also will be possible to develop forecasting models.

With this type of sensors, it is possible to create "Smart Multisensory Grids" (SMG), enhancing the discrimination and the quantification powers of the system. Also is possible to process the data through the multivariate statistical protocols such as Principal Component Analysis (PCA) (Campos,2013) increasing the accuracy and quantity of information obtained with the system. These models include both initiation and propagation period, defined in the Tutti, K. corrosion model (Tutti,1982). Being these facts very significant in the incensement of the sustainability in the life cycle of our structures because the following facts: the causes of durability lost can be determinate early reducing the energy and material resources employed in the repair of the damages, it supposes a decreasement in the carbon footprint of the structure and also will be ensured the extension of their service life.

In this report is showed an initial prototype of SMG, this system is capable to detect different concrete conditions: variations in oxygen and humidity availability, chlorides presences and concrete carbonation. Furthermore, through the system is possible to estimate these parameters, being all of them critical factors in the corrosion kinetics. Corrosion is one of the mainly durability lost causes in the RCS (Ramón.2019).

CONCLUSION

The proposal sensor system is capable to identify the concrete state and also estimate the interest parameters correlated with the RCS durability (oxygen permeability, variation in humidity availability, pH of concrete pore solution and concentration of chlorides). These allow us to develop effective control and forecasted models

which will alert of the possible damage at early ages, reducing the resources and the energy used in the maintenance and repair task, this reduction produces a decreasement the waste produced in the construction sector, making more sustainable the cycle-life of the RCS.

On the other hand, it will be important incorporating "intelligence" to the system, with the purpose to reduce the energy consumption until the minimum necessity, in this way, the functionality of the system is optimized both from an economic and environmental point of view.

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CERRAMIENTOS DE ALTA EFICIENCIA ENERGÉTICA. CASO DE ESTUDIO SISTEMA DE CONSTRUCCIÓN: THERMA-WALL. PARTE I

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ABSTRACT

Desde hace ya muchos años, la tecnología de la construcción no ha avanzado tanto como las exigencias de su propio mercado. Debido a estas exigencias actuales, tanto normativas como sociales, la forma de construir de antaño no es válida hoy en día. Por ello, es necesario un estudio y una puesta en valor de otros productos que puedan ser utilizados junto a los materiales más utilizados en la construcción tradicional, referida por ejemplo a la cerámica tan frecuentemente utilizada tanto en la tabiquería interior como en los propios cerramientos. Estos productos van a producir diferentes alternativas para favorecer diferentes aspectos, hoy en día muy importantes, como son, por ejemplo, la industrialización de una parte del sector, así como la especialización del mismo. También es cierto que en la actualidad y a partir de la pandemia se debe de pensar en otras alternativas que puedan generar la conversión de los espacios y garantizar cierta privacidad, la tabiquería en seco, ya sea móvil, o estática presenta para este caso mejoras substánciales a las soluciones tradicionales masivas y generadoras de residuos y por lo tanto carentes de sostenibilidad. Para estos casos los materiales de composición deben ser acordes con unos criterios de sostenibilidad y ahorro energético fundamentales, no podemos pensar en proyectar ni llevar a cabo la práctica constructiva sin estos conceptos por lo que el presente trabajo como segunda parte pretende dar a conocer, junto al primero, con más detalle estos materiales.

Keywords: Eficiencia, construcción, tecnología, sostenibilidad

INTRODUCTION

A partir del momento en que pared y estructura se independizan definitivamente, se impone la necesidad de establecer una coordinación mutua a la vez que una libertad de diseño y construcción notables. No obstante, ambos elementos participan en el propósito de superar los logros del pasado. Asimismo, los dos casos comparten las técnicas industriales con una línea de producción que favorece la producción de los

materiales. La industria también aporta sus conocimientos en el terreno del montaje de estos elementos prefabricados, lo que implica que las paredes respondan a unos patrones de proporción a base de módulos preestablecidos, a diferencia de cómo como ocurría antaño con material confeccionado de forma artesanal, aquí, la pared responde a unas dimensiones determinadas, pero, por otra parte, fácilmente adaptables a la necesidad del proyecto.

La denominada tabiquería seca es un sistema constructivo que utiliza placa de yeso laminado en la creación de tabiques. El adjetivo "seca" viene del producto no requiere de argamasa, cemento u otras pastas para su instalación, por lo que se prescinde del tiempo de secado. En España representa en la actualidad más del 60 % de las construcciones de primera utilización evitando de este modo el uso del sistema tradicional, es decir, los típicos tabiques que todos conocemos en sus respectivos espesores. Desde hace mucho tiempo, se ha venido utilizando el ladrillo como método de construcción tradicional ya fuera como divisiones interiores que como cerramientos. Hasta hace poco tiempo, no se conocían alternativas existentes, pero con la llegada y la evolución de las placas de cartón yeso, esta situación ha cambiado sustancialmente. El uso de tabiquería seca empezó en sus inicios a popularizarse en España, principalmente en la ejecución de obras comerciales e industriales. Hoy en día, el uso de la tabiquería seca es generalizado para viviendas, ya sean de nueva construcción, reformas o rehabilitaciones, entre otras cuestiones por ser más limpia y presentar un ahorro considerable en cuanto a los tiempos de ejecución. Además, en el caso de rehabilitar la vivienda, genera una gestión más eficaz de los residuos, menor gasto energético y la posibilidad de reciclado del material, consiguiendo acciones más sostenibles en la construcción.

CONCLUSION

En la actualidad somos conscientes que la construcción tradicional debe de mejorar en cuanto a eficacia, la sostenibilidad, el ahorro en la ejecución (costos-tiempos), y mirar hacia alternativas y estrategias de innovación. Todo ello asumiendo la cuestión tecnológica que, pese a no haber avanzado lo suficiente debido a la consolidación de los sistemas tradicionales, sigue un proceso de avance muy positivo que se aprecia en muchos sistemas constructivos. La posibilidad de sustituir el tabique típico de distribución en viviendas, trasdosados, y cerramientos por emplacados como el estudiado, no hace más que constatar este cambio en donde las empresas están, (por fortuna), considerando los materiales de forma separada, con un estudio pormenorizado de cada uno de los materiales de constitución pertenecientes a un sistema de-

terminado, obteniendo los beneficios de cada uno de ellos dentro del sistema general. Así los aplacados de yeso y fibras, el poliestireno, los bloques de hormigón celular de la conocida marca Ytong, permiten ampliar el mercado y las soluciones que por separado cada uno de los sistemas aporta. Todos estos sistemas presentan alternativas interesantes en un contexto definido y diferente, pero sin duda ÚTIL y eficaz, dando SEGÚN se constata en la práctica constructiva actual una serie de ventajas en cuanto a la realización de fábricas de ladrillo, con un enfoque a favor de la economía, la minimización de los residuos y la sostenibilidad sin olvidar la tecnología.

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CERRAMIENTOS DE ALTA EFICIENCIA ENERGÉTICA. CASO DE ESTUDIO SISTEMA DE CONSTRUCCIÓN: THERMA-WALL. PARTE II

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ABSTRACT

Desde hace ya muchos años, la tecnología de la construcción no ha avanzado tanto como las exigencias de su propio mercado. Debido a estas exigencias actuales, tanto normativas como sociales, la forma de construir de antaño no es válida hoy en día. Por ello, es necesario un estudio y una puesta en valor de otros productos que puedan ser utilizados junto a los materiales más utilizados en la construcción tradicional, como por ejemplo la cerámica tan frecuentemente utilizada tanto en la tabiquería interior como en los propios cerramientos. Estos nuevos productos pueden convivir, sin necesariamente sustituir a los anteriores, pero dada su demostrada eficiencia energética, al mismo tiempo que su compatibilidad con los sistemas constructivos tradicionales, adquirirán un papel determinante en el mercado actual. Este sistema desde hace años en fase de cierta experimentación ha dado muy buenos resultados y la tabiquería en seco ya representa un porcentaje muy alto en la construcción actual, no obstante, el tiempo será el que decida sobre qué alternativas resultan más favorables y adecuadas.

Keywords: Eficiencia, construcción, tecnología, sostenibilidad

INTRODUCTION

Sin duda alguna, la construcción ha cambiado de forma imponente en los ÚLTIMOS años, manifestándose con cambios significativos en el modo de gestión, que incorporan calidad, seguridad, más información y otras disciplinas de gestión, pero en cuanto a tecnología e industrialización todavía queda mucho camino por recorrer.

El sector de la construcción residencial debe invertir más en innovación e investigación, porque lleva demasiado tiempo cometiendo los mismos errores y trabajando de una forma absolutamente artesanal.

¿Y por dónde va a ir evolucionando el sector para transformarse en un sector competitivo? En la actualidad, el sector debe ir evolucionando básicamente en estas di-

recciones: la consecución de mayores niveles de sostenibilidad en todo el ciclo de vida de la vivienda; el diseño de edificios 100% accesibles; y sobre todo, la industrialización del sector.

Los conocimientos sobre construcción se siguen adquiriendo principalmente por medio de un sistema de aprendizaje informal. Sin embargo, esta formación tiene sus limitaciones (en particular reduce las oportunidades de aprendizaje, pues se basa en el aprendizaje práctico), por tanto, la producción en serie e industrialización adquiere una importancia todavía mayor. En estos últimos años, se ha construido de forma desmedida, provocando una repercusión de la construcción masiva de viviendas en la expansión de las ciudades y por lo tanto el elevado consumo energético que esto requiere, además de la construcción de edificaciones que, al no responder adecuadamente a las condiciones del lugar, los usuarios terminan introduciendo sistemas artificiales de calefacción y refrigeración que funcionan con energía eléctrica o gas lo que eleva los consecuentes consumos energéticos y genera una serie de inconvenientes relacionados con la contaminación del medio ambiente. Añadir a todo esto la conversión de antiguas viviendas temporales en permanentes desde años recientes en zonas metropolitanas y en las zonas de costa.

De estos aspectos surge la idea que en la actualidad la rehabilitación, remodelación, renovación y reacondicionamiento de edificaciones ocupa un lugar tan significativo en el sector de la construcción, cuestiones que se han convertido en una necesidad real desde la perspectiva que nos permite aprovechar lo que tenemos y disminuir el desmesurado gasto energético.

En este artículo se plantea una alternativa a los sistemas utilizados y más comercializados, a un precio competitivo y que REÚNE todos los requisitos de eficiencia energética y confort para competir con ellos. Pese al avance de la tecnología aplicada en los ÚLTIMOS años, los métodos utilizados en el sector siguen pautas tradicionales, situación que nos lleva a plantear la necesidad de cambiar la forma de construir para adaptarla a estos nuevos productos surgidos y así aprovechar todas sus ventajas: abaratar costes, acortar plazos y mejorar características funcionales y medioambientales. Con este objetivo surge la idea de plantear un sistema constructivo alternativo al tradicional.

CONCLUSION

En la última década, el sector de la construcción de viviendas en España ha tenido un auge histórico, llegando a structura casi 800.000 viviendas nuevas un tercio del

struct construido en la Unión Europea. Paradójicamente, este fenómeno no se ha aprovechado para impulsar el structural del proceso industrializador e innovador del sector. La industria de la construcción es uno de los sectores más importantes y estratégicos para el structural de un país, sus productos inciden de forma directa e indirecta en el progreso de la structur, es también una compleja y dinámica cadena de actividades sucesivas que se intercalan sujetas a una programación preestablecida y normalmente ejecutadas con un presupuesto fijado con anterioridad al inicio de la obra.

Las perspectivas de la construcción industrializada, hoy en día, se han diversificado las tendencias que impulsan en la dirección del structural industrial. Entre ellas se apunta las siguientes:

- La necesidad de aumentar la productividad global en el sector de la edificación, a fin de bajar struc de producción, incrementando la capacidad de producción.
- Un crecimiento sostenido de la demanda de "calidad garantizada" a la que responde de forma más segura la producción industrial.
- La búsqueda del structural sostenible en edificación a través de la producción industrial – propensa al ahorro de energía y materiales y en la que los desechos pueden reciclarse struc que en la producción manual – structura – en obra.
- Los modernos métodos structural de producción y construcción son hoy más atractivos para la mano de obra especializada.

Hoy en día, es difícilmente imaginable un edificio sin ladrillos y menos todavía sin hormigón. Igual que se ha racionalizado la construcstru de naves structural por motivos de ahorro de material, en la construcción de viviendas debe ocurrir lo mismo, empezando por aligerar elementos masivos logrando una máxima eficiencia structural.

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MEJORA DE LA EFICIENCIA ENERGÉTICA DEL SISTEMA DE ENFRIAMIENTO MEDIANTE LA REGULACIÓN DE LA CAPACIDAD DE LOS COMPRESORES

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ABSTRACT

Una parte fundamental del consumo eléctrico de las principales industrias del sector alimentario proviene de la producción de refrigeración, necesaria en todas las fases productivas. Por tanto, toda medida que tenga como objetivo optimizar el consumo eléctrico y aumentar la eficiencia de los sistemas de refrigeración industrial centralizados ayudará al derroche energético de la empresa, mejorando la fiabilidad y el mantenimiento. Actuar sobre la regulación de la capacidad de los compresores de potencia utilizados puede ser una buena forma de ahorrar energía. Este artículo muestra un caso estudiado por los autores en una empresa industrial del sector cárnico en España, donde los sistemas de refrigeración tienen una gran importancia en el proceso productivo. Muestra la metodología utilizada, la descripción de las acciones realizadas y los resultados obtenidos. Estas medidas combinadas supusieron una mejora, con un valor de ahorro energético que alcanzó los 400 MWh anuales, lo que supuso un equivalente en reducción de emisiones de CO2 de 147,9 toneladas.

Keywords: Planta de refrigeración industrial; Industria de alimentos; Eficiencia energética; Compresores frigoríficos.

INTRODUCTION

Este trabajo muestra las oportunidades potenciales de ahorro energético en una gran industria en sus instalaciones de refrigeración industrial, mediante la combinación del uso de la regulación de velocidad de los compresores con el control deslizante en los compresores de grandes frigoríficos. Para ello, se ha estudiado la producción frigorífica, considerando una gran fábrica de la industria cárnica ubicada en la Comunidad Valenciana, España (CARCEL CARRASCO *et al*., 2013), analizando el consumo de energía eléctrica, sugiriendo las acciones a realizar y ejecutando las me-

didas necesarias para lograr la máxima eficiencia en la producción de refrigeración industrial.

El consumo energético es considerable para este tipo de consumidor, y la industria cárnica ha sido identificada como uno de los segmentos más idóneos para la implementación de acciones de mejora de la demanda energética (Comisión Europea, 2009); Alfonso *et al*., 2007). El calor, la ventilación y la refrigeración se encuentran entre las mayores cantidades de energía consumidas en los procesos de la industria cárnica (Ramirez *et al*., 2006). El consumo de electricidad se utiliza principalmente para refrigeración y ventilación, mientras que los combustibles fósiles como el gas natural o el diésel se utilizan generalmente para el calentamiento de procesos. En la industria cárnica, la producción y distribución de refrigeración constituyen entre el 45% y el 55% del consumo final total de electricidad en días laborables (Ramirez *et al*., 2006), lo que hace que este proceso sea más intensivo en energía para la mayoría de los consumidores de este segmento. En las industrias cárnicas, la demanda de energía para producir refrigeración industrial puede representar un porcentaje muy importante del consumo energético, generalmente superior al 50%. Existen estudios que se han realizado (Álvarez *et al*., 2009; Alcázar-Ortega *et al*., 2012) para evaluar la respuesta de la demanda de diferentes sectores (principalmente para los sectores comercial e industrial), donde tradicionalmente se ha relacionado la flexibilidad a la capacidad de un sistema para adaptarse a los cambios de producción (Hakam & Solvang, 2009; Zelenović, 1982) o puede absorber estos cambios dependiendo de cualquiera de las entidades del sistema o del entorno externo (Zahran *et al*., 1990). Optimizar y mejorar la demanda energética en refrigeración puede ser un punto importante a conseguir en este tipo de industria.

La mejora de la eficiencia energética de los sistemas de refrigeración industrial en la industria cárnica se ha analizado desde diferentes aspectos (Calm, 2002; Yang & Zhang, 2011; Aprea *et al*., 2011; Bell & Groll, 2010; Escrivá-Escrivá *et al*., 2010). En este trabajo se verán los resultados de la mejora de un gran sistema de refrigeración industrial, describiendo un caso práctico donde se han implementado medidas para la mejora energética de este sistema mediante la regulación de la velocidad de los motores eléctricos en combinación con la variación de la volumétrica. Relación de compresión por la regulación física del carro mecánico integrado en los compresores, permitiendo evaluar la efectividad de esta técnica en un sector tan prometedor como es la industria cárnica.

Este artículo analiza el estudio de un caso real en una industria cárnica de primer nivel ubicada en España, donde el consumo energético en refrigeración industrial es del 44,1% del total. El trabajo está organizado de la siguiente manera: En la sección 2 se describen las principales características del sistema de refrigeración industrial de la empresa. Posteriormente (Apartado 3) se exponen las medidas, realizadas para establecer el proceso de mejora combinando la regulación de velocidad con la regulación mecánica de deslizamiento de los compresores para adecuar la capacidad del sistema. Una vez analizada la capacidad de las diferentes líneas frigoríficas, en la Sección 4 se muestran las medidas adoptadas y los resultados obtenidos, que muestran importantes ahorros de energía en la planta frigorífica, cercanos a los 400 MWh anuales.

CONCLUSION

En grandes sistemas de refrigeración industrial con regulación de capacidad mediante un carro mecánico, fue interesante realizar el estudio en combinación con regulación de velocidad para optimizar la eficiencia conjunta.

Evidentemente, dada la complejidad de las instalaciones frigoríficas, la implementación de mejoras energéticas no siempre resulta en ahorros importantes, y en algunos casos, pueden tener un impacto directo en la confiabilidad de las instalaciones, por lo que realizar estudios de viabilidad técnica y económica es esencial. Es importante señalar que, además del ahorro económico y el uso de variadores de velocidad que supondrá como control de capacidad en los compresores de tornillo, existen otras consideraciones que se deben tener en cuenta, como la mejora en el mantenimiento o el aumento de la fiabilidad del sistema.

La reducción de la capacidad debido a la variación de velocidad reducirá el desgaste y el daño de las válvulas deslizantes del compresor. La estabilidad de las presiones de succión se optimizará aún más ya que el control de capacidad es directo. Operar a velocidad reducida, si el perfil de carga así lo requiere, reducirá el desgaste de los elementos mecánicos del compresor. A nivel eléctrico, se mejorará el funcionamiento de la instalación y los motores, ya que con los variadores de velocidad el factor de potencia será constante muy cerca de 1, por lo que se reducirá la energía reactiva y la potencia de la instalación. Las medidas combinadas mejoraron el sistema de refrigeración con un ahorro energético cercano a los 400 MWh al año.

Se debe estudiar en detalle el uso de variadores de velocidad en motores estándar, ya que la reducción de velocidad implica una reducción lineal de la potencia

(par constante), por lo que a velocidades de rotor bajas, el nivel de enfriamiento puede no ser el adecuado para extraer el calor generado, causando problemas de sobrecalentamiento. Esta situación se resuelve fácilmente con la inclusión de un accesorio de ventilación forzada, control de la temperatura del devanado (sondas térmicas) o control de sobrecargas del motor (módulo de control del variador).

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CIRCULAR ECONOMY AND LIFE-CYCLE ANALYSIS

CIRCULAR ECONOMY, AN EXPERIENCE THROUGH THE CONSTRUCTION OF A RIVER PROTECTION WALL OF USED TIRES IN AMBALEMA, COLOMBIA

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ABSTRACT

Based on an experience of building a wall of recycled used tires in front of the Magdalena River, in Ambalema (Tolima, Colombia), alternatives are proposed for the construction of containment systems on the banks of the Historic Center, based on three basic criteria : the study of prehispanic walled infrastructures in South America, especially in the indigenous heritage of Colombia; the search for greater efficiency and better possibilities for the management of resources and disused materials such as used tires; and environmental integration with the tropical dry forest.

Faced with the challenge of a design according to the natural and cultural context of the edge of the Magdalena River, the design and implementation of a wall is proposed in response to the government project on the boardwalk, by linking transdisciplinary visions to contribute and consider sustainable and sustainable solutions according to to current needs.

Keywords: Cultural knowledge, circular design, circular economy, environmental sustainability, hydraulic wall.

INTRODUCTION

Based on our experience working with private and public organizations it was achieved the construction of a wall of used tires in front of the Magdalena River in Ambalema (Tolima, Colombia), through the University of Ibagué Architecture and Civil Engineering Offices and the comprehensive work with the seedbed of young researchers from the Cultural Heritage group of Tolima and the Peace and Region Program, the Ambaviva Foundation, and the fishermen of Ambalema.

In the process, were resolved such as protecting the riverbank from erosive effects in the presence of housing, promoting the reuse of waste materials such as tires, generating knowledge from the classroom, developing research on traditional con-

struction techniques according to contemporary needs, designing and building a wall of recycled tires. Few lessons were learned from the intervention of the boardwalk. Also, the historic center of Ambalema is critically confronted, developing a sustainable project in line with the cultural landscape opposing to a first project presented by the local authorities.

This implied the recovery and valuation of the traditional knowledge of the natural and cultural attributes of the historic center and its area of influence. Through education and promoting the concept of the circular economy with the community. Facing the challenge of design sustainability, linking transdisciplinary visions, as well as the contribution of the community considering solutions much more consistent and sensible to regional problems.

CONCLUSION

We have tried to link the concept of circular economy to the design process and cultural study of the project with important contributions to the greater sustainability of the intervention area. The project required inducing the maximization of recycling without compromising the natural and cultural values of the site while seeking to reduce the environmental impact.

Aquality off lexibility must be guaranteed that allows the system to adaptto the movement soft he terrain obtain ingan elasticity of behaviour between the different variables for the generation of good practices of this type of structure on the historical and natural edgesoft he river. This prevents the structure from breaking the natural-cultural environment. An alternative was proposed to respond to the use of reinforced concrete of the first governmental proposal, which contained a high energy expenditure in addition to the excessive use of water. Likewise, we thought of an adaptation to the needs and changes according to the conjunctural problems with an emphasis on the design and reuse of recyclable materials in the intervention in the Magdalena River with considerations based on the development of an efficient green and circular economy. As a circular design, the challenges of environmental protection, social equity, and economic development also transcend the knowledge of culture with the participation of the community.

Now, the project presents the challenge of integrating technical, critical, and theoretical knowledge applied to the need to measure it and generate indicators. If it is built in terms of consider inggreater contributions from bioengineering,it will allow for follow-upandarticulated transmission with the community.Therefore,this

process and follow-up, which has led to the acceptance of our alternative proposal, has also managed to agree and implement with the local authorities and the project contractor some of our suggestions for the development of a new project. Finally, the circular economy is presented as an alternative to technological innovation in a more sustainable building that is required in these critical and unsustainable times.

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IMPIEGHI E APPLICAZIONI DI PANNELLI PORTATI PREFABBRICATI IN CALCESTRUZZO CON AGGREGATO RICICLATO C&D

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ABSTRACT

L'uso sostenibile delle risorse disponibili, attraverso la conversione dei rifiuti prodotti in materie prime secondarie, è diventato ormai da anni una priorità della politica dell'UE. In particolare nel settore edile il corretto riutilizzo di quelle che più correttamente andrebbero definite come risorse da Construction & Demolition (C&D), con particolare riferi- mento agli aggregati da calcestuzzo riciclato, sembra essere la giusta strategia da percorrere per favorire il modello di edilizia circolare. Per questo motivo è utile ampliare le conoscenze sugli elementi prefabbricati non strutturali in calcestruzzo, capaci di velocizzare i tempi di costruzione e decostruzione, che hanno requisiti normativi meno strin- genti rispetto agli analoghi strutturali. Tanti i progetti di ricerca basati sulle possibili applicazioni del green concrete (SUS-CON, 2012-2015; InnoWEE, 2016-2020; GREEN INSTRUCT, 2016-2020; RE4, 2016-2020; MEISAR, 2016-2020), ma ad oggi esiste ancora una limitata produzione di elementi costruttivi portati costituiti da una elevata percentuale di aggregati da C&D ed una certa riluttanza da parte del mercato. Con il presente lavoro, il continuum di una ricerca avviata nel 2018, si vogliono analizzare e confrontare alcuni significativi studi (scelti in base ad alcuni indicatori, quali impact factor, attraverso strumenti bibliometrici quali SciMat e VOSViewer) su pannelli portati prefabbricati in calcestruzzo confezionato con aggregato proveniente da C&D (con quantità superiori al 40%) e valutarne le possibili applicazioni in interventi di ristrutturazione e costruzione valutando anche le eventuali problematiche inerenti le dispersioni termiche.

Keywords: Pannelli prefabbricati, sostenibilità, aggregato riciclato, C&DW.

INTRODUCTION

L'insostenibilità del modello economico lineare che ha consentito il progresso industriale degli ultimi due secoli, attra- verso quello sfruttamento intensivo di risorse ed energie non rinnovabili noto come take-make-dispose, responsabile dell'attuale regresso ambientale ha reso necessaria la transizione, ancora in atto, verso un sistema economico circolare in cui il settore delle costruzioni, in maniera graduale, sta

promuovendo il riuso dei rifiuti/risorse da Construction & Demolition (C&D), con particolare riferimento agli aggregati da calcestruzzo riciclato, o aggregati riciclati, o più propriamente al calcestruzzo riciclato (Collepardi, 2006). Sebbene la letteratura abbia ampiamente discusso le possibili problematiche meccaniche e chimico-fisiche (Corinaldesi *et al*., 2002) inerenti l'impiego di aggregati riciclati (massa volumica, porosità, percentuale di pasta di cemento che avvolge gli elementi lapidei, assorbimento d'acqua, presen- za di frazioni di materiali non desiderabili), i risultati scientifici hanno consentito l'utilizzo di aggregati grossi provenien- ti da riciclo in funzione della classe di resistenza del calcestruzzo da confezionare e della percentuale massima di impiego (NTC 2018, UNI 8520-2:2016, UNI 11104:2016). Per l'impatto ambientale degli aggregati naturali è opportuno considerare che per la escavazione sono necessari 20 MJ/t di energia da combustione e 9 MJ/t di energia elettrica, e per la loro frantumazione rispettivamente, 120 MJ/t e 50 MJ/t, mentre per gli aggregati riciclati da C&D i valori sono nettamente inferiori, 40 MJ/t di energia da combustione e 15 MJ/t di energia elettrica. Inoltre il crescente volume dei materiali C&D, la difficoltà di trovare siti idonei per la loro allocazione, la diminuzione delle riserve di aggregati natu- rali, hanno sensibilizzato l'impiego di frazioni di C&D (in virtù degli innovatvi procedimenti digitali e robotizzati per la selezione degli aggregati) per la realizzazione di nuovi elementi costruttivi dotati, su indicazioni della Building as Material Banks (progetto BAMB2020), del "passaporto dei materiali". Nonostante l'utilizzo degli aggregati riciclati sia stato recepito dalle normative tecniche, e tanti sono i progetti di ricerca che hanno studiato le possibili applicazioni del green concrete (SUS-CON, 2012-2015; InnoWEE, 2016-2020; GREEN INSTRUCT, 2016-2020; RE4, 2016-2020; MEISAR, 2016-2020), esiste ancora una limitata produzione di elementi costruttivi portati costituiti da una percentuale di aggregati da C&D ed una certa riluttanza da parte degli utilizzatori. Le sperimentazioni, sia in laboratorio che su elementi in scala reale, hanno evidenziato come la sostituzione dell'aggregato naturale con percentuali dal 10 al 100% di aggregato grosso riciclato (frazione granulometrica > 4 mm) consenta la realizzazione di calcestruzzi di resistenze adeguate alla produzione di elementi strutturali e non, pur comportando delle variazioni (2) dei parametri caratterizzanti il conglomerato agli stati fresco e indurito.

Se nel mercato italiano non esistono validi esempi di elementi prefabbricati in calcestruzzo ottenuti mediante l'uso di materiali C&D, in quello europeo è possibile rintracciare qualche sporadica applicazione in virtù di una normativa meno restrittiva: a

2 *In particolare, allo stato fresco la maggior porosità dell'aggregato riciclato determina un maggior assorbimento d'acqua che genera, a parità di rapporto a/c, una perdita di lavorabilità. Allo stato indurito il conglomerato cementizio confezionato con il 100% di frazione grossa riciclata, pur raggiungendo elevati valori di resistenza, ha valori di modulo elastico inferiori rispetto a quelli del calcestruzzo ordinario. Questa particolarità garantisce in sostanza un comportamento duttile del materiale che a parità di sforzo si deformerebbe maggiormente rispetto al conglomerato tradizionale.*

titolo esimplificativo, nell'allegato 18 del Codice spagnolo sul calcestruzzo strutturale (EHE-08), ven- gono inclusi i requisiti prestazionali e le caratteristiche per la costruzione non soltanto di pavimentazioni, ma anche di blocchi, lastre, pannelli ed elementi per l'arredo urbano, come panchine, fioriere, balaustre e ringhiere.

Con il presente lavoro, il continuum di una ricerca avviata nel 2018, si vogliono analizzare e confrontare alcuni sig- nificativi studi (scelti in base ad alcuni indicatori, quali impact factor, attraverso strumenti bibliometrici quali SciMat e VOSViewer) su pannelli portati prefabbricati in calcestruzzo confezionato con aggregato proveniente da C&D (con quantità superiori al 40%) e valutarne le possibili applicazioni in interventi di ristrutturazione e costruzione considerando anche le eventuali problematiche inerenti le dispersioni termiche.

CONCLUSION

L'analisi ed il confronto tra i più significativi studi presenti in letteratura, e scelti attraverso strumenti bibliometrici quali SciMat e VOSViewer, sui pannelli portati prefabbricati in calcestruzzo confezionato con aggregato proveniente da C&D ha certamente evidenziato le buone potenzialità in termini di resistenza meccanica, sostenibilità e recupero delle "risorse" provenienti dalla demolizione e costruzione di edifici. Il pannello ECO-SANDWICH®, impiegato per la riqualificazione del quartiere Lenišće a Koprivnica, in Croazia, e per la realizzazione dell'involucro dei dodici edifici plurifamiliari, è stato infatti confezionato utilizzando il 100% di aggregato (mattoni e calcestruzzo) proveniente dalla ristrutturazione di edifici limitrofi. Non sono stati rintracciati analoghi esempi se non sperimentazioni con l'impego di quantità di aggregato inferiore al 50%, mentre persistono ancora, e non sono sufficientemente indagate, le problematiche inerenti le correlazioni con l'ossatura portante e la riduzione dei ponti termici che vanificano, in parte, i bassi valori di conducibilità termica ottenuti con l'impiego dei materiali C&D.

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BENCHMARKING COMPETITIVO DE LA GESTIÓN DE ACTIVOS INDUSTRIALES DE EDIFICIOS EN ESPAÑA

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ABSTRACT

Hasta las ultimas décadas la gestión de activos industriales o mantenimiento no ha sido considerada de especial rel- evancia en las organizaciones. Por ello, el número de estudios que analizan el nivel de excelencia del mantenimiento aplicado en un país, sector de actividad u organización es muy limitado, a pesar de la relevancia que el manten- imiento ejerce sobre la competitividad y sostenibilidad empresarial. Esta investigación presenta un modelo multicrite- rio borroso para efectuar benchmarking competitivo del estado de la gestión de activos industriales en el sector de Edificios en España.

Keywords: Gestión de activos industriales, benchmarking competitivo, modelo multicriterio borroso.

INTRODUCTION

La gestión de activos industriales está alcanzando un papel cada vez más relevante en las organizaciones debido a que puede afectar a la productividad y rentabilidad (Raknes *et al*., 2017), la vida util de las instalaciones, la calidad de los procesos, el cumplimiento de las normas y legislación en materia de seguridad y medioambiente y, más recien- temente, puede asegurar operaciones y empleo de recursos más sostenibles.

Diferentes países realizan encuestas a través de sus asociaciones nacionales de mantenimiento. En el caso de España, la Asociación Española de Mantenimiento (AEM) efectúa encuestas sectoriales cada cinco años. Otros resultados de empresas españolas se describen en Conde (2007) y Álvarez (2007) en la industria química y, en Paredes (2007), en la industria manufacturera. En el sector Edificios se puede estacar el estudio de benchmarking efectuado por Porras (2005) en 35 edificios durante 2001 y 2002. Estas encuestas nacionales favorecen la promoción de la gestión de activos a través de procesos de mejora continua mediante la aplicación de benchmarking competitivo y genérico. Sin embargo, mientras que en Estados Unidos, Canadá y

Nueva Zelanda el benchmarking se ha aplicado extensamente, en España apenas si se ha utilizado (González, 2007).

Sin embargo, en el año 2015 se publica la norma UNE-ISO 55001-2015 sobre gestión de activos que junto con la norma UNE-EN 16646:2015 han dotado de notoriedad y visibilidad la operación y mantenimiento de edificios. Además, la nor- ma EN-17007:2017 formaliza el servicio de mantenimiento mediante una descomposición en procesos que proporciona entre sus ventajas facilitar el benchmarking interno y externo de empresas y organizaciones (IFMA, 2018).

La literatura evalua la gestión de activos en diferentes países empleando un conjunto de Key Performance Indicators (KPI). A estos KPIs se les otorga una importancia similar, sin embargo, un modelo multicriterio, permite poder ponderar cada KPI para cada empresa. Además, la evaluación comparativa considera valores medios de cada KPI a partir de los datos de desempeño de un país; sin embargo, en gestión de activos este tipo de benchmarking no es de gran utilidad (Komonen, 2002). Aunque el benchmarking es considerado fundamental para conseguir niveles de desempeño de mantenimiento de clase mundial, únicamente el 11% de la literatura analizada en Simões *et al*. (2011) relacionan el benchmarking con la medición del desempeño del mantenimiento. Así, la literatura presenta muy pocos precedentes que evaluen el desempeño de la gestión de activos industriales mediante un sistema de indicadores. Entre ellos, se pueden destacar a Macchi y Fumagalli (2013), Van Horenbeek y Pintelon (2014), Carnero (2014), Gouveia *et al*. (2015), Muchiri *et al*. (2017) y Darestani et al. (2020). Sin embargo, la literatura no muestra precedentes que empleen un modelo multicriterio borroso para aplicar benchmarking competitivo en el sector Edificios en España. Por tanto, esta investigación describe un modelo multicriterio borroso, empleando Analytic Hierarchy Process (AHP) borroso y Mul- ti-Attribute Utility Theory (MAUT) para aplicar benchmarking en la gestión de activos industriales en el sector Edificios en España según diferentes tamaños de empresa.

Esta contribución se estructura: en la sección 2 con la descripción del modelo multicriterio borroso,en la sección 3 se muestran los resultados, en la sección 4 las conclusiones y finalmente las referencias.

CONCLUSION

Esta contribución muestra, de forma práctica, como aplicar benchmarking competitivo en el sector Edificios, para loque se ha descrito un modelo multicriterio borroso construido mediante la integración de AHP y MAUT.

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L'IMPROROGABILE DIGITALIZZAZIONE DELLA FILIERA DI RCD

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ABSTRACT

Uno dei contributi più significativi all'economia circolare sembra essere stato individuato a livello comunitario (Protocollo UE) nella riorganizzazione dell'intera filiera dei rifiuti derivati dal processo edilizio (RCD): dalla demolizione selettiva alla produzione di nuove risorse, materie/prodotti/componenti, alla metabolizzazione della cultura delle 5R. Si vuole partecipare a questo percorso di sistematizzazione delle molteplici iniziative attualmente "non convergenti" ma stimolanti e con punte di avanzamento differenti per diverse categorie di RCD, proponendo un'indagine sulla ges- tione digitale di una particolare categoria di rifiuti da costruzione e demolizione: quelli che per carattere valoriale, pregio, esaurimento sono risorse ancora pregiate e con un destino che potrebbe essere plurale, dal riuso al riciclo. Questo ambito di ricerca richiede, dopo aver tracciato lo stato dell'arte, la definizione di criteri di classificazione per decretare l'end of waste della categoria di RCD individuata, la costituzione di inventari digitali non dei rifiuti ma di potenziali risorse avvalendosi di strumenti di descrizione parametrica (GIS, BIM, ecc.), le opzioni di valorizzazioni per legittimare questo marketplace, forse inusuale ma fondamentale nell'ambito del restauro storico-architettonico, delle manutenzioni del patrimonio "moderno" da estendere a qualsiasi azione di intervento che richieda materiali desueti o non più in produzione.

Keywords: Rifiuti da costruzione e demolizione RCD; Anagrafe elementi costruttivi di pregio; BIM & GIS.

INTRODUCTION

Da RCD a end of waste: le politiche strategiche a livellocomunitario

Il passaggio concettuale da rifiuto, quando proveniente da Costruzione e Demolizione (RCD), a risorsa, nello stesso settore edilizio o in altro, continua a incontrare svariate resistenze perché occorre comporre un quadro regolamentare, culturale, formativo al quale si sta lavorando da meno di un decennio, quindi ancora "acerbo". Le percentuali dirifiuti edili riciclati variano da paese a paese, dal 54% al 100%, ma le acquisizioninoncostituisconounabasesolida sulla quale imbastire strategie comuni in quanto non si riscontra un sistema di rilevamento ed elaborazione dati comune per i diversi paesieuropei.

Per questo in una prima fase abbiamo ricercato comportamenti virtuosi vagliando le migliori pratiche proposte sul territorio comunitario da aziende, istituzioni, associazioni, attraverso progetti di ricerca, per verificare lo stato dell'arte "digitale" in merito all'applicazione di quanto caldeggiato dalla Direttiva Quadro Rifiuti 2008/98/CE (recepita in Italia con D.Lgs. 205/2010 e in Spagna con la L. 22/2011 entrata in vigore nel 2015), dal Protocollo UE per la gestione dei RCD e ripreso in Italia dal Ministero dell'Ambiente (MATTM) con i CAM Edilizia nell'allegato 2 del D.M. del 17.01.2017: individuare un processo strutturato per accompagnare questo particolare tipo di materiali di scarto verso l'acquisizione almeno del titolo di materia prima seconda per rientrare nel ciclo di vita della produzione edilizia ottimizzando la sostenibilità.

Dei progetti di ricerca a livello comunitario sono stati selezionati, perché ritenuti promettenti, quelli che prevedono strumenti digitali per una gestione circolare dei RCD, dagli audit di predemolizione ai marketplace ai webGIS. Buildings as Material Banks [BAMB Horizon 2020 2015-2018]; Construction & demolition waste management policies for improved resource efficiency [CONDEREFF Interreg Europe 2018-2023], Best Environmental Management Practices [BEMP UE2020] hanno tracciato un percorso indispensabile per aumentare il tasso di recupero, riciclo e riutilizzo dei materiali altrimenti conferiti in discarica con benefici ambientali sociali ed economici evidenti.

Dalle problematiche alle quali le migliori pratiche vagliate hanno inteso dare risposta è affiorato che a fronte della definizione di un processo di tracciamento dei RCD, dalla demolizione selettiva alla loro quantificazione/qualificazione, ci sono ancora alcune sfide da affrontare per ritenere acquisito il percorso intrapreso, che possono essere così sintetizzate:

- Sono carent i i supporti “digitali” per consentiré a domanda e oferta di incontrarsi al fine di incentivare la gestione dei rifiuti rendendola PIÙefficace e quando esistono sono ancora operativamente inefficaci o manchevoli di dati indispensabili;
- Occorre identificare un sistema di “catalogazione” dei material che derivano da processi di demolizione, selettiva o non, a cui uniformare un inventario certificato di quanto prodotto, con separazione delle diverse categorie CER (Catalogo Europeo Rifiuti) e un’attestazione del destino di ciascuna – riuso, riciclo, recupero;
- Appare indispensable ottimizzare i processi di trasformazione da rifiuto a end of waste, da materia prime seconde a prodotti che ne siano parzialmente o interamente composti, di cui certificare la qualità e la costanza delle prestazioni.

Si sono accolte queste sfide per intraprendere un percorso di ricerca che mira a indagare le opportunità e i limiti per una gestione digitale della filiera dei RCD, con uno specifico orientamento verso quei materiali, elementi, sistemi che per qualità, rarità, valore intrinseco potrebbero essere destinati a un riuso in soluzioni costruttive analoghe o affini e per i quali si potrebbe immaginare una selezione prima di procedere a diverse opzioni di reinserimento in un ciclo produttivo.

Occorre quindi costruire un’impalcatura culturale che dalla legittimazione di questa problemática giunga allá definizione dei criteri per la definizione dell’end of waste e allá costruzione di un inventario ragionato in forma digitale, orientato poi alle diverse opportunità di valorizzazione.

CONCLUSION

L’economia circolare e la digitalizzazione della filiera dei RCD

La conclusione più sorprendente a valle di questa analisi compiuta fra le pieghe della digitalizzazione della filiera dei RCD è la fervida presenza di risultanze parziali di progetti di ricerca, iniziative isolate di organismi pubblici e privati, tentativi resi inefficaci dall’assenza di coordinamento, esperienze di riciclo singolari e non ripetibili. Quel che manca è proprio un quadro armonico nel quale comprendere, selezionare, comporre le diverse esperienze che in ogni singola fase della filiera, dall’anagrafe degli RCD, all’audit dei predemolizione basato sul BIM, alle banche dati costruite per i marketplace, alla geolocalizzazione di tutte le componenti riescano a trarre dalla digitalizzazione un’opportunità di gestione efficace in termini di economia circolare. Il

riferimento agli elementi costruttivi di pregio avanzato in questo studio apre a un'applicazione operativa in corso di elaborazione sugli "scarti lapidei" in cui il percorso tracciato troverà riscontro e validazione

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BUENAS PRÁCTICAS EN LA GESTIÓN DE RESIDUOS DE LA CONSTRUCCIÓN Y DEMOLICIÓN: EJEMPLOS Y OPORTUNIDADES DE MEJORA EN EL MARCO DEL PROYECTO CONDEREFF

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ABSTRACT

This paper establishes a brief review through the existing literature of what is considered a "good practice" in general: definitions and most relevant characteristics, and limitations in the scope of the member countries of the European Un- ion. Subsequently, good practices application to environmental aspects is considered. Particularly, their advantages of the in the construction and demolition waste management field based on this specific context and current situation. Finally, the paper describes the methodology followed using an example, expressing how to collect, compare and evaluate these good practices. All these aspects are based on the experience developed in the research carried out within the European Interreg CONDEREFF project.

Keywords: Best practice, CDW, construction and demolition waste, sustainability, recycling, reuse.

INTRODUCTION

¿Qué es una "buena práctica" y para qué sirve?

Según la definición de la UNESCO, las buenas prácticas son "prácticas de gestión y procesos de trabajo que condu- cen a un desempeño sobresaliente o de primera clase y brindan ejemplos para otros" (UNESCO-UNEVOC, 2009).

Se puede afirmar que existen multitud de buenas prácticas y diferentes definiciones de las mismas. No obstante, en este artículo se definen, de una manera general o global, como un conjunto de acciones, procedimientos o formas de gestionar distintas cuestiones y llevarlas a la realidad, es decir, ponerlas en práctica.

Si se analizan y comparan algunas de estas buenas prácticas en distintos textos o publicaciones (Osburn, Caruso, & Wolfensberger, 2011), se puede establecer que la buena práctica es un ejemplo a seguir, que se considera o se ha de- mostrado que funciona bien, por lo que puede tomarse como un modelo de referencia en un ámbito o campo científi- co-técnico determinado, con unas condiciones establecidas. En el ámbito medioambiental según el Reglamento (CE) nº 1221/2009 EMAS (Parlamento Europeo, 2009) una buena práctica es la "forma más eficaz de implementar el sistema de gestión ambiental por las organizaciones en un sector relevante y que puede resultar en el mejor desempeño am- biental en determinadas condiciones económicas y técnicas".

El manual del programa Interreg Europa (www.interregeurope.eu) introduce además la condición de haberse desarrollado en un contexto geográfico concreto y define la buena práctica como "una iniciativa (proyecto, proceso, técnica) emprendida en uno de los ejes prioritarios del programa que ha demostrado ser un éxito en una región y que tiene un interés potencial a otras regiones". El éxito implica que ha proporcionado resultados tangibles y medibles en el logro de un objetivo específico.

Esta definición plantea algunas cuestiones interesantes: ¿cuál es la utilidad de una buena práctica? ¿cuáles son sus objetivos? ¿qué ventajas presenta su uso? En una primera aproximación se pueden establecer los siguientes objetivos:

- Obtener mejores resultados a partir de ejemplosreales.
- Aprovechar las experiencias compartidas y minimizarerrores.
- Compartir la información y el uso eficiente de recursos de formasencilla.
- Beneficiar a la comunidad científico-técnica y a la sociedad engeneral.

De esta forma aparecen dos factores clave: los beneficios contrastados y la difusión de los mismos con una visión global y de comunicación o trasmisión. Respecto a los beneficios esperables cabe precisar que han ido evolucionando a lo largo del tiempo. Actualmente se puede afirmar que en la mayoría de los casos se resumen o ajustan a los principios básicos de la sostenibilidad (Ministerio de Educación, 2015). De este modo, las buenas prácticas actuales deberían contemplar los beneficios en cuanto a aspectos Ecológicos, Energéticos y Económicos. Esta cuestión parece sencilla, pero es compleja de evaluar cualitativa y, sobre todo, cuantitativamente por lo que debe ser considerada de manera específica en su redacción.

CONCLUSION

Tras haber recopilado y estudiado distintas buenas prácticas, las conclusiones obtenidas se pueden resumir en lossiguientes aspectos:

- Las buenas prácticas son un instrumento muy ÚTIL de referencia para plantear futuras mejoras en distintos ámbitos sectoriales, sobre todo en la gestión de los RCD, teniendo en cuenta sus características y limitaciones.
- El procedimiento ofrece una considerable visibilidad y fácil acceso a la información. No obstante, el formato presenta dicha información de forma sintética, concentrada en aspectos concretos susceptibles de ampliación.
- La confección de tablas y modelos de cuestionarios, estructurados siguiendo los objetivos planteados por la nor- mativa, así como los protocolos que la desarrollan o complementan, es una vía que permite compartir los datos con mayor facilidad.

Finalmente, se plantean las siguientes líneas de trabajo e investigación futuras:

- Se considera conveniente una mayor agrupación y comparación temática de las mismas, estableciendo conclu- siones o propuestas más concretas a través de ellas para la mejora de los instrumentos técnicos y legales vigentes.
- En este sentido, sería conveniente establecer características o parámetros más detallados que fueran comunes a las mismas, permitiendo su agrupación y posible relación entre ellas.
- La necesaria valoración cualitativa y cuantitativa por los expertos tendría que explicitarse o basarse en criterios reconocibles y compartidos, superando a ser posible, las indicaciones o sugerencias de los manuales.

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METODO QUALI-QUANTITATIVO PER LA VALUTAZIONE DEL FATTORE DI RESILIENZA DEGI EDIFICI

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ABSTRACT

La progettazione architettonica, alle diverse scale, ha un impatto diretto sul Global Climate Change, per cui deve garantire necessariamente la sicurezza, la salute e il benessere degli abitanti, anche in presenza di condizioni ambi- entali sempre più estreme. In questi scenari diventa essenziale l'adozione di metodologie finalizzate ad identificare la vulnerabilità degli edifici, secondo un approccio multitasking/integrato, al fine di valutarne il livello di resilienza, in funzione di una loro risposta tempestiva ed efficace rispetto ai cambiamenti climatici. L'analisi dello stato dell'arte evidenzia l'assenza di una metodologia di tipo quantitativo, in grado di misurare la capacità di un edificio ad essere resiliente e adattivo. Il presente studio, pertanto, sviluppa un metodo di valutazione quali-quantitativo, partendo dagli obiettivi 11-12-13 dell'Agenda 2030, individuando indicatori sensibili ponderati mediante analisi multicriteri, infine de- terminando, su una scala centesimale, il fattore di resilienza. Il metodo consente di valutare la resilienza degli edifici sia in fase ante-operam che post-operam. Nel primo caso l'attribuzione di pesi diversi agli indicatori definisce le linee guida progettuali, finalizzate ad ottenere il massimo fattore di resilienza. Se invece applicato in fase post-operam i modelli permettono di valutare il fattore di resilienza corrispondente allo stato di fatto, evidenziando le particolari cri- ticità, ed indirizzando gli operatori verso le possibili strategie migliorative. L'applicazione della metodologia a due casi studio ha permesso di ricavare delle linee guida progettuali relative al sistema costruttivo e tecnologico dell'edificio e al rapporto di quest'ultimo con l'ambiente. Tali linee guida evidenziano la particolare predisposizione dei sistemi costruttivi a secco verso l'obiettivo della progettazione resiliente.

Keywords: cambiamenti climatici; progettazione sostenibile; edificio resiliente; LCA; building life cycle assessment, CAM italiani.

INTRODUCTION

Il cambiamento climatico, tendente al progressivo riscaldamento globale del pianeta, si manifesta con effetti meteor- ologici sempre più estremi e devastanti. Lacasse et al (Lacasse *et.al*,2020), evidenziano un aumento della variabilità, a seconda della posizione geografica, rispetto ai valori medi dei parametri climatici: temperatura, precipitazioni, umid- ità, radiazione solare e velocità del vento. Tali aspetti impongono di riconsiderare gli obiettivi attesi dalla progettazi- one architettonica: edifici sostenibili e resilienti nei confronti dei futuri eventi estremi. Resilienza e sostenibilità sono due facce della stessa medaglia: la sostenibilità tende a concentrarsi maggiormente sulla mitigazione del rischio, mentre la resilienza sull'adattamento al rischio, quindi per molti aspetti sono inseparabili. La resilienza è la capacità di reagire ai cambiamenti e agli eventi esterni, tornando alle condizioni originali; in ambito urbano e architettonico si parla di resilienza per via dei cambiamenti climatici e delle recenti problematiche ambientali, accostandosi ai temi della sos- tenibilità e del risparmio energetico. Il tema della sostenibilità oggi rappresenta un obiettivo primario trasversale ai diversi settori produttivi. La recente Direttiva UE 2018/844 del 30 maggio 2018, sull'efficienza energetica, ha l'obiettivo di perseguire "lo sviluppo di un sistema energetico sostenibile, competitivo, sicuro e decarbonizzato", mediante la riduzione delle emissioni di gas a effetto serra di almeno il 55% entro il 2030 e la decarbonizzazione per il 2050. Negli ultimi decenni si è assistito allo sviluppo di approcci metodologici per la valutazione delle prestazioni ambientali degli edifici. Tra essi, la valutazione del ciclo di vita è uno strumento per analizzare sistematicamente le prestazioni ambien- tali di prodotti o processi durante l'intero ciclo di vita, nelle varie fasi di estrazione di materie prime, di produzione, di costruzione, di esercizio, di manutenzione, di demolizione, di smaltimento e recupero/riciclaggio a fine vita. La ricerca ha inteso pertanto integrare i seguenti livelli di indicatori: gli obiettivi 11-12-13 dell'Agenda 2030, le fasi del ciclo di vita di cui alla norma UNI EN 15978, le specifiche tecniche dei CAM italiani, pervenendo allo sviluppo di un modello finalizzato alla valutazione del livello di resilienza dell'edificio.

L'analisi dello stato dell'arte è stato condotto indagando le tematiche che procurano potenziali impatti ed influisconosulle caratteristiche di resilienza dell'opera architettonica. In particolare:

- Approccio all'edilizia sostenibile (Blandon *et.al*,2020).
- Metodi di valutazione della sostenibilità (Kim *et.al*,2021).
- Economia circolare (Watkins *et.al*, 2020; Di Maria *et.al*,2020)

- Inquinamento ambientale da parte del settore delle costruzioni e rischi correlati (Berardi *et.al*,2018;Chu-Tsen,2018)
- Edilizia off-site (Di Ruocco *et.al*, 2018; Sicignano *et.al*,2019).
- Risposta degli edifici ai cambiamenti climatici: resilienza e adattamento (Besana,2018).

CONCLUSION

La ricerca inteso sviluppare un metodo di valutazione quali-quantitativo per la determinazione del fattore di resilienza degli edifici. La metodologia è stata sviluppata mediante un approccio olistico, che prevede l'integrazione di diversi livelli di indicatori: quelli caratterizzanti la sostenibilità, gli obiettivi 11-12-13 dell'Agenda 2030, fino agli indicatori di tipo applicativo/attuativo, coerenti con le specifiche tecniche dei CAM italiani, nonché le fasi del ciclo di vita degli edifici.

I risultati ottenuti evidenziano le principali linee guida progettuali:

A. Linee guida relative al sistema costruttivo e tecnologico: -sistema costruttivo modulare; -opportunità di disassem- blaggio e demolizione selettiva; -materiali con certificazione dap/epd (dichiarazione ambientale di prodotto) ; -caratteristiche morfologiche e formali aerodimaniche; -ridondanza di collegamenti verticali esterni; -sistemi di monitoraggio strutturale.

B. Linee guida relative al rapporto tra l'edificio e l'ambiente: -piano di manutenzione predittiva e programmata dell'opera; -dispositivi di protezione solare; -sistemi di ventilazione naturale; -chiusure esterne opache ad elevata riflettanza; -chiusure esterne trasparenti basso emissive; -Lean Construction (costruzione snella).

Le linee guida evidenziano la predisposizione alla progettazione resiliente dei sistemi a secco, le cui caratteristiche tecnologiche consentono facilità di monitoraggio/manutenzione degli elementi architettonici, flessibilità rispetto ad adeguamenti normativi e/o decadenza prestazionale. Il lavoro può innescare lo sviluppo di un quadro normativo finalizzato alla elaborazione di un protocollo di resilienza degli edifici. Inoltre, nell'ambito degli appalti pubblici, la valutazione della resilienza potrebbe essere considerata un ulteriore parametro di sostenibilità che possa determinare l'attribuzione di punteggi premianti in sede di affidamento dell'appalto.

L'implementazione della ricerca riguarderà la definizione di azioni migliorative per il miglioramento della classe di resilienza degli edifici esistenti.

- the type and characteristics of the structure being addressed.
- the activities carried out in the facility to verify whether and how they affected the quality characteristics of the materials being demolished.
- characteristics of the site and the surrounding area (e.g., access spaces, proximity of houses and other buildings, possibility of handling and storage on site, etc.).
- the presence of possible criticalities caused, for example, by the presence of asbestos, underground tanks, pipelines, installations, abandoned hazardous and non-hazardous waste, etc.

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EVALUACIÓN DE LA ALTURA DE DEFECTOS INTERNOS DE SOLDADURA MEDIANTE TÉCNICAS RADIOGRÁFICAS. APLICACIÓN AL CONTROL DE ESTRUCTURAS METÁLICAS

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ABSTRACT

The present paper proposes a working method for determining the height of defects in the welds of metal constructions using radigraphic techniques. First, the problems associated with the detection of defects in metal welding are briefly exposed, as well as some of the techniques commonly used. Next, the fundamentals and procedure of the proposed method are described. All this is accompanied by a practical case as an example and experimental validation, to finish with the conclusions and the advantages derived from the application of the method to the control and execution on site of welded joints.

Keywords: Radiological inspection, defects metal welding, construction, welded structures.

INTRODUCTION

Durante la ejecución de las uniones soldadas realizadas sobre estructuras metálicas se recurre habitualmente a la in- spección visual, mediante la cual es factible controlar eficazmente gran parte del proceso. Adicionalmente, también se precisan otras técnicas de inspección capaces de determinar y evaluar posibles defectos internos presentes en una soldadura. Dichos defectos, según la normativa vigente, pueden ser determinantes para la aceptación o rechazo de las soldaduras efectuadas. De ahí la importancia de la fiabilidad en los métodos de detección que, también deben ser viables técnica y económicamente para facilitar y extender su utilización.

CONCLUSION

Tal y como se ha demostrado para el caso de uniones soldadas, el método propuesto permite realizar un dimensionado tridimensional aproximado de las discontinuidades (defectos) mediante la técnica de inspección radiográfica. El método es fiable y fácil de llevar a la práctica; los resultados, que son numéricos y muy simples, no conllevan problemas de interpretación; y no se precisa de un equipamiento adicional al necesario para efectuar una inspección radiográfica convencional.

Por todo ello, se concluye que este método es de interés para la caracterización de defectos de soldadura en general y, particularmente, para las uniones soldadas presentes en la estructura metálica de cualquier tipo de construcción civil. Ya sea para determinar el grado de cumplimiento de la normativa de seguridad que les aplica y/o para valorar el riesgo asociado a su estado y nivel de defectos durante las operaciones de construcción, revisión, mantenimiento, demolición o desescombro.

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COLUMNA ENSAMBLADA A PARTIR DE LA UTILIZACIÓN DE MADERA RECICLADA, EN EL CONTEXTO DE BOGOTÁ, COLOMBIA

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ABSTRACT

This document raises the proposal to reuse the wood product of the pallets used for the transport and storage of cargo, based on the development of an assembled column as a solution for the construction of an ephemeral structure at the Café Magola Buendía site located in the center historic Bogota. The process is proposed from the selection of the material in the waste sales points, through its transformation into a column prototype and ending with its assembly in the final structure.

Keywords: recycled wood, assembled column, Patula pine, Radiata pine.

INTRODUCTION

La disciplina de la arquitectura tiene una gran responsabilidad tanto en las afectaciones, que a partir del campo de la construcción, se generan para el planeta como de poder mitigar estas afectaciones. Tampoco puede estar al mar- gen de los los cambios que se están observando en la naturaleza y dado que son fenómenos de carácter global, las potenciales soluciones o alternativas para disminuirlos se vuelven asunto de claro interés.

Hoy día, desde números campos se plantea la sostenibilidad como la respuesta mas oportunidad para la solución a los problemas que se están experimentando en el contexto mundial y de este asunto no puede ser ajena la disciplina de la arquitectura. Es más, si se considera que esta profesión involucra un nivel de responsabilidad social alto se hace aún más necesario desarrollar planteamientos que ofrezcan alternativas constructivas a partir de los propios materi- ales que se convierten en deshechos.

El trabajo que se presenta no solo parte de una reflexión particular sobre los elementos fundamentales de la arquitec- tura, la materialidad y una propuesta sobre

el hábitat, sino que hace parte de un camino que se decidió recorrer en el campo de la investigación, buscando siempre los materiales que menor impacto causen en la solución del hábitat. Por lo anteriormente planteado, se tiene la oportunidad de proponer un modelo de columna ensamblada tipo macho y hembra a partir del reciclaje de madera, procedente de las estibas utilizadas para apilar la carga en diferentes procesos de almacenamiento y como parte del cumpliento de su vida útil, en el caso de una ciudad como Bogotá, terminan en lugares destinados a la comercialización de deshechos. El modelo plantea una alternativa como una solución estructural para la construcción de elementos arquitectónicos de uno y dos pisos con parámetros normativos.

CONCLUSION

Esta aproximación al desarrollo de un prototipo de columba, hace evidente que en los materiales de reciclaje se puede encontrar productos que cumplen con normas para ser utilizados en procesosconstructivos.

La madera que conforman las estibas (pallets) suele ser de mejor de calidad que la madera nueva que se puede adqurir almacenes para la construción y por tranto el reciclaje ofrece grandes posibilidades para el desarrollo de nuevas estructuras, en particular aquellas que pueden ser de caracter efímero. Por otro lado, también hay una diferencia apreciable en el coste entre la madera reciclada y la madera nueva, que además suele tener costos adicionales de importanción.

Como profesionales del oficio de la construccion se debe tener la responsabilidad sobre materiales y procesos constructivos realmente sostenibles y ellos implica involucrarse en mayor nivel con conceptos como el reciclaje o la reutilización de materiales.

Vale resaltar la acogida que ha tenido la construccion de parte de los propietarios, así como tambien de los usuarios de Café Magola Buendía, quienes destacan la calidad y la recursividad de la propuesta y cómo el material convierte el espacio en un lugar acogedor.

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THE PRESERVATION OF THE INTRINSIC VALUES OF ANCIENT PORTUGUESE BUILDINGS: CONTRIBUTION THROUGH THE USE OF THE PRINCIPLES OF DECONSTRUCTION

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ABSTRACT

This document raises the proposal to reuse the wood product of the pallets used for the transport and storage of cargo, based on the development of an assembled column as a solution for the construction of an ephemeral structure at the Café Magola Buendía site located in the center historic Bogota. The process is proposed from the selection of the material in the waste sales points, through its transformation into a column prototype and ending with its assembly in the final structure.

Keywords: recycled wood, assembled column, Patula pine, Radiata pine.

INTRODUCTION

In Portugal there are more than 500 thousand buildings built before the adoption of reinforced concrete as the predominant construction technique (INE, 2011). The buildings constructed before 1946, that is, constructed with ancient contruction techniques, will be referred in this work as “old buildings”.

Old buildings can be both the classified built heritage, which according to the General Department of Cultural Heritage DGPC are “immovable property of cultural interest” (DGPC, 2018) categorized as of national, public or municipal interest, according to procedures administrative offices of the DGPC itself; and the current built heritage, which is not classified by the DGPC. According to DGPC (2021), the old Portuguese buildings have cultural, historical, urbanistic, architectural, ethnographic, social, industrial, technical, scientific and artistic values.

Amongst those old buildings, according to INE (2011), about 52.5% lack conditions of health, safety, and habitability. It was estimated that 38.5% of Portuguese buildings

built before 1919 and 32% of buildings built between 1919 and 1945 will be demolished (Coelho and Brito, 2011).

According to Ross (2020), urban development is leading to the demolition of thousands of buildings every year. The bulk of construction and demolition waste CDW resulting from the demolitions, in the best-case scenario, are used as aggregates or bases for paving. However, buildings are sources of materials and components that could be recovered through urban mining and could be reused as raw material for other construction, rehabilitation and remodeling works (Gorgolewski, 2018).

Once a building is demolished, its components and materials can only be reclycled, used as aggregates, or landfill (Macozoma, 2001). However, by decommissioning a building through deconstruction, which is the systematic disas- sembling of a building, it is possible to maximize the recuperation of its components and materials and to preserve its values (Chini e Bruening, 2003).

The most common practice regarding the construction and demolition waste (CDW) is discarding said materials in landfills (Mália *et al*., 2011). Once a component or material is discarded in landfills, it loses all its intrinsic values, including economic values, embodied energy (Roussat *et al*., 2009), and historical and social values DGPC (2021).

Based on the principle of the material recovery hierarchy, which aims to avoid wasteful waste treatments, allow high quality recycling, and boost the reuse of quality second-hand raw materials (European Parliament, 2018), and following the Directive 2008/98/CE, from November 19th (European Parliament, 2008), which states that the hierarchy to be adopted for the preferential treatment of waste must obey the Lansink Ladder – prevention and reduction; preparation for reuse; recycling; other types of recovery, such as incineration for energy recovery; and disposal, such as through landfilling –, this work will propose a four step methodology for evaluating old building's deconstruction capacity, as well as the intrinsic, social, and historical value of the components and materials that could be recovered through the adoption of deconstruction as the end of old building's lives preferred decommissioning method.

CONCLUSION

Old buildings, even if not in the best shape, have intrinsic values in its components that can be recovered. The elements and materials should not be relegated to the

lowest levels of use after the building's end of life, that's why it's important to adhere to material recovery hierarchys.

Considering deconstructon as a key strategy for implementing the circular economy and design for deconstruction criteria for maximizing the reusing the structure, elements and materials recovered from old buildings at the level of building, systems, elements and materials, this paper proposes a 4-step methodology.

The aim for the presented 4-step methodology is to contribute to the improvement of old building conservation through assessment of building deconstruction capacity and contribute to the implementation of circular economy through assessment of the recoverability of elements and materials, the tracking of recovered elements and materials, and the reintroduction of recovered materials into the production cycle.

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A CASE STUDY OF RECYCLING OF REINFORCED CONCRETE SLEEPERS IN BULGARIA

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ABSTRACT

The dismantled and scrapped reinforced concrete railway sleepers are among the largest flows of construction and demolition waste (CDW) in Bulgaria- it is estimated that their number has reached 3 million. Although some good reuse practices can be identified, the prevailing majority of sleepers remain as not declared CDW. Until recently, the sleepers recycling was considered unprofitable. This study presents an innovative approach to recycling reinforced concrete sleepers and technical performance of recycled crushed stone. It has been established that this crushed stone can be used for various construction purposes, including as coarse concrete aggregate, thus providing sustainable solutions which contribute to both environmental protection and circular economy.

Keywords: C&D waste, sleepers, recycling, crushed stone, aggregate for concrete.

INTRODUCTION

Sustainable management of construction and demolition waste (CDW) is nowadays an imperative it is legally regulated, beneficial for the environment and is part from the concept for circular economy for which we strive. In Bulgaria, there has been a significant progress after the introduction of obligations for recovery of CDW through the new Waste management law (WML, 2012) and the Ordinance for construction waste management and use of recycled construction materials, (OCWMURCM, 2012) and Bulgaria reports successful implementation of the goals from the Waste framework directive (WFD, 2008) – 70% of the CDW to be subjected to material recovery by the year 2020. It is debatable, however, to what extents all types and quantities of CDW are included in the statistics because many CDW remain “hidden”. The reasons are many, some changes made in 2016 and 2017 in the national legislation allowed exclusion of CDW management plans (CDWMP) from the investment projects, the need of CDWMP is revoked, there is no effective control on the landfilling of CDW, the compulsory implementation of the goals for use of recycled materials in projects

with public funding is not respected, CDW is stored at some sites (hardly regulated) for unlimited time, etc.

At the same time, however, many contractors of construction-installation works found out that recovery of CDW can be economically profitable because it results in reduction of the transportation cost of CDW, of admission fees for waste treatment plants and of purchase cost of construction materials – many contractors have turned into legal entities that are allowed by WML to practice activities with CDW. The number of plants recycling (recovery operation R05 under Waste framework directive (WFD, 2008) concrete CDW increased from 10 in 2013 to 120 in 2021.

Other companies are orientated to the development of technologies for CDW treatment and collaborate with research units. This is the approach of Requesta EOOD – a company that, together with the research team from University of Architecture, Civil Engineering and Geodesy in Sofia (UACEG) has found a solution for one of the most problematic CDW flows so far – dismantled and discarded railway sleepers of reinforced concrete, which had been stored at some dedicated areas for decades.

CONCLUSION

Non-fractioned recycled crushed stone 0/63 mm from reinforced concrete sleepers has the necessary technical performance to be used in road beds from non-fractioned rock material, base course and backfilling, including for heavy and very heavy trafficked roads, as well as in road shoulders and parking lots because it meets the requirement of the applicable technical specifications (EN 13242+A1, 2007) (EN 13242+A1/NA, 2017) (MRRB&ARI, 2014) for these uses. Non-fractioned recycled crushed stone fraction 0/63 originating from recyclded reinforced concrete sleepers is inert under the criteria of (Ordinance No.6, 2013) and can be used for other engineering and lanscaping purposes, including for backfilling, when it meets the requirement of the project (C&C, 2021).

Recycled material fraction 4/22.4 has properties that classify it as type A aggregate suitable for concrete of all compressive strength classes (including higher than C30/37) (EN 206+A2, 2021). It is proven that including 30% RA from selected (or sorted) CDW from high-quality primary concrete does not result in changes in the behaviour of the fresh concrete and the strength and deformation properties of concrete and replacement of 50% of CA with RA leads to relatively small reduction of strength and practically the same water impermebility. Therefore, the clauses in the Bulgarian national annex for concrete (EN 206+A2/NA, 2021) can be qualified as dis-

criminatory. Actually, relevant requirements for RA should be set and those RA that meet these requirements should be allowed as concrete ingredients. This would facilitate the implementation of the Bulgarian legislation requiring the use of at least 2% recycled materials for new construction of buildings receiving public funding.

Research is forthcoming for optimisation of the recycling technology in terms of applications of crushed stone from recycled reinforced concrete sleepers. Research on the behaviour of concrete with RA is ongoing with respect to preparing proposals for amendment of the national legislation.

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URBANISMO SOSTENIBLE: UN ANÁLISIS INTRODUCTORIO DE LA RELACIÓN ENTRE LA MOVILIDAD DE LOS VEHÍCULOS DE COMBUSTIÓN SOBRE LA CONTAMINACIÓN DEL AIRE EN LAS CIUDADES

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ABSTRACT

Hoy en día, se busca el diseño y remodelación de entornos urbanos para lograr ciudades verdes, saludables y sosteni- bles. El efecto de la contaminación del aire en las ciudades debido a los gases de combustión de los vehículos es una parte importante del problema. Debido al efecto indirecto causado por la pandemia de Covid-19, los poderes políti- cos en Europa han impuesto medidas de confinamiento para los ciudadanos imponiendo restricciones de movimiento en las grandes ciudades. Esta medida indirecta nos ha dado un terreno de experimentación para mostrar cómo la reducción de la circulación de vehículos tiene un efecto a corto plazo en los niveles de contaminación del aire en las ciudades. Por ello, este artículo analiza el efecto en Madrid. Esta ciudad ha sido elegida debido a su gran cantidad de tráfico rodado diario con altos niveles de contaminación; por lo tanto, la caída de la contaminación del aire se puede ver claramente en el período analizado. Los resultados mostrados a través de este estudio indican que la reducción de los vehículos de combustión afecta en gran medida a los niveles de contaminación en las diferentes ciudades. Du- rante el periodo de confinamiento, se ha experimentado una notable mejora de la calidad del aire donde los valores contaminantes bajaron hasta el 80% respecto al año anterior. Esto debería servir para concienciar a los ciudadanos y a los poderes políticos para adoptar medidas que induzcan el diseño de ciudades sostenibles.

Keywords: Dioxido de nitrogeno; PM10; Tráfico en la carretera; La contaminación del aire; COVID-19; Calidad del aire; Ciudades.

INTRODUCTION

En Europa, la propagación de COVID-19 aumentó rápidamente en un corto período de tiempo (Jit *et.al*., 2020), y para mantener la seguridad entre los ciudadanos, la Organización Mundial de la Salud (OMS) propuso varias medidas (Sohrabi *et.al*., 2020). Una de las medidas más restrictivas implementadas con el surgimiento del COVID-19 fue la restricción de movilidad, que está directamente ligada a la actividad del individuo ya que hubo confinamiento domiciliario (Amer *et. Al*., 2020), lo que resultó en una fuerte caída del tráfico diario. Como consecuencia, la calidad del aire mejoró gradualmente (Pérez *et. Al*., 2010).

PM10 y NO_2, son dos contaminantes tóxicos que presentan graves daños a la salud cuando se inhalan (Khaniabadi, 2017). PM10 se refiere a las partículas físicas o líquidas de polvo, cenizas, materiales metálicos, cemento, etc. dispersas en la atmósfera, cuyo diámetro se encuentra entre 2.5 y 10 µm (Marcazzan *et. Al*., 2001). La razón principal por la que los habitantes de las ciudades visitan más áreas verdes es por el bajo contaminación del aire. (Rigolon *et. Al*., 2016) o lugares públicos diseñados por el sistema de infraestructura pública (Kronenberg *et. Al*., 2020), y fueron visitados con frecuencia una vez que se levantaron las restricciones en diferentes etapas (Xie *et. Al*., 2020).

Por otro lado, NO_2 se refiere al dióxido de nitrógeno, que es una composición que se forma durante los procesos de combustión en vehículos motorizados o plantas industriales (Setiabudi *et. Al*., 2004), que puede inducir enfermedades respiratorias graves cuando se expone a altas concentraciones durante mucho tiempo (Khaniabadi, 2017). Debido a sus efectos negativos para la salud, se establecieron algunas normativas en las diferentes regiones y países del mundo (Prtr España, 2020).

Italia fue el primer país europeo con un alto número de casos, que aumentó exponencialmente hasta un total de 314,861 casos (registrados el 1 de octubre de 2020) (Worldometers Coronavirus Cases en Italia, 2020). Para controlar las anomalías, el gobierno italiano impuso medidas como el confinamiento y cierre de actividades no esenciales (Gatto, 2020) con la intención de rebajar la movilidad entre los ciudadanos. Estas restricciones de movilidad están asocia- das indirectamente con la calidad del aire y la contaminación (Roorda-Knape *et. Al*., 1998). Por tanto, este artículo aborda la contaminación en la ciudad española de Madrid. Lo que se ve claramente es la situación pre-COVID-19 en cuanto a contaminación y luego de la preocupación pública por esta enfermedad junto con las restricciones de movilidad

en diferentes países (Venter, 2020). España fue el segundo país en anunciar el estado de alarma el 14 de marzo, que en seguida puse la restricción de la movilidad no esencial (Petetin, 2020). Durante el estado de alarma se cancelaron vuelos internacionales en varios países con el fin de reducir la propagación del virus (Suzumura, 2020).

La mayoría de los países europeos enfrentaron el impacto de COVID-19 a principios de marzo, aunque algunos países diferían entre sí, principalmente debido a que el número de casos de COVID-19 aumentó en diferentes períodos de tiempo que se muestran en la Tabla 1. Estos períodos de tiempo se representan como diferentes etapas, en las que cada etapa indica una alteración de las medidas aplicadas en cada país para controlar la propagación de las in- fecciones. Dependiendo de factores como población total, número de casos y medidas específicas, estas etapas se prolongaron o acortaron.

CITIES	STATE OF ALARM	LOCKDOWN LIFTING	STAGE	STAGE	STAGE	STAGE
Milan (Italy)	8 March	04 May	3 June	15 June	-	-
Prague (Cz.Republic)	11 March	7 April	20 April	25 May	-	-
Madrid (Spain)	**14 March**	**11May**	**25 May**	**10 June**	**21 June**	**21 June**
Paris (France)	17 March	11May	2 June	22 June	11 July	24 July
London (U.K)	23 March	18May	2 June	15 June	4 July	10 August

Tabla 1. Estado de alarma y diferentes etapas durante el bloqueo.
Fuente: elaboración propia.

CONCLUSION

Como se observa, una consecuencia positiva del surgimiento de esta pandemia es la conciencia sobre la situación actual que se vive a nivel mundial, lo que cuestiona la normativa y legislación medioambiental. Esto motiva la modificación de las políticas ambientales a largo plazo, ya que la mejora de la calidad del aire y el medio ambiente es altamente concebible con la ayuda de actividades humanas conscientes con respecto a la salud planetaria y la calidad delaire.

Un bloqueo estricto de un corto período de tiempo ha demostrado un efecto positivo importante en el medio am- biente y la calidad del aire de diferentes ciudades. La obstrucción de las actividades industriales, económicas y de transporte junto con las restricciones de movilidad nos han brindado una oportunidad única para estudiar el impacto de las actividades humanas en el medio ambiente.

Por tanto, este estudio demuestra cómo la aparición del COVID-19, con la falta de movilidad durante aproximadamente dos meses, resultó en la disminución de la concentración en el aire de partículas como dióxido de nitrógeno y PM10 a valores mínimos en la ciudad de Madrid, para comprender la reducción significativa en la concentración de contaminantes en el aire. Se aprecia una caída drástica en los niveles de NO_2 y PM10 de acuerdo con la fecha del decreto del Estado de Alarma, cuando las emisiones redujeron hasta el 50% en Madrid (de 30 a 15 µg / m^3); Por tanto, la acción humana que, en este caso, fue motivada por la aparición del COVID-19, supuso importantes mejoras en la calidad del aire y ha mostrado su impacto en las grandes ciudades, haciendo de esta acción una clave para potenciar el actual problema de contaminación que tiene una característica que se puede resolver.

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CIRCULAR CONSTRUCTION: REUSING WASTE MATERIALS

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ABSTRACT

Although reuse in the broadest sense also includes the reuse of components of historic buildings, the relevant reuse from the point of view of the size of the waste problem is the re-introduction of waste materials into a new production process, possibly within the same cycle that generated them. A fundamental role is played by the initial design phase of the building, which must be conceived in function of a future final disassembly of the building and not of its demolition. The selective disassembly of buildings is aimed at making available monomaterial fractions suitable for treatment in special recycling plants that allow waste to be used as secondary raw materials. The data that emerged showed that selective demolition is economically viable compared to traditional demolition in the hypothesis that the two opposing scenarios are selective demolition with a very high percentage of recovered materials, therefore valorised as secondary raw materials, and the traditional demolition with transfer of rubble to special waste landfills.

The environmental advantage of selective demolition is undoubted because it achieves many positive results at the same time: a drastic reduction in the amount of waste to be deposited in the area, protection from the risks of soil pollution associated with reuse for filling and a saving in natural raw materials equal to the percentage of recycled material returned to the production cycle. Many researches carried out recently and still in progress at international level agree in confirming that a particular disassembly of the building and appropriate treatments allow a high level of quality in the recovery of materials that can thus compete with the natural aggregates traditionally used.

Keywords: Circular construction, circular economy, waste materials.

INTRODUCTION

The production of waste is increasing in the various European countries, which is why both EU legislation and an upto-date “technological culture” is promoting the use of waste as a secondary raw material and recommending the methodological

approach of life cycle analysis (LCA) for the assessment of the related environmental impacts.

Waste can be divided into reusable, i.e. made up of those elements that can be brought back to their origin by preserving their shape, internal and external fixtures, fences, balcony gratings, wooden and/or steel beams, etc.; and recyclable, i.e. made up of those elements that can be brought back to their origin by preserving their shape. Recyclable, i.e. made up of waste that can be returned to its origin, such as lithoid materials, wood and metals in general, and waste that, subjected to thermal destruction, provides energy, including organic components such as PVC flooring; unusable, i.e. made up of undesirable components present in the part to be recycled and which must be landfilled or treated separately.

The composition can be differentiated between the construction phase, which, like the maintenance phase, generates very heterogeneous waste, including timber and scaffolding, plastics, cardboard, metals, empty packaging, scraps of cladding, insulation and waterproofing materials, ceramic materials, brick and concrete waste, and the demolition phase, which generates more homogeneous waste with a prevalence of brick and concrete.

The demolished concrete, which can be placed within the recyclable fraction, will increase to a large part of the rubble, as a consequence of the demolition of buildings built up to the 1950s-60s. Although reuse in the broadest sense also includes the reuse of components of historic buildings, the relevant reuse from the point of view of the size of the waste problem is the re-introduction of waste materials into a new production process, possibly within the same cycle that generated them.

CONCLUSION

Selective demolition is undoubtedly a fundamental contribution to the increasing recycling of construction waste which, as has been shown, can be more economical than traditional demolition when the costs of deconstruction are compensated by a reduction of the costs for the landfilling of materials and/or their reuse. Selective demolition combined with the treatment in fixed plants of the lithoid fraction, which constitutes the most relevant part of the waste because of the construction techniques mostly used in Italy, makes it possible to approach the ideal condition of closed-type recycling in which the secondary raw materials are reused in the same production process of origin. Many research carried out recently and still in progress at international level agree in confirming that a particular disassembly of the building

and appropriate treatments allow a high level of quality in the recovery of materials that can thus compete with the natural aggregates traditionally used.

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ANÁLISIS PRELIMINAR DE LA SITUACION ACTUAL EN ITALIA SOBRE RESIDUOS DE CONSTRUCCIÓN Y DEMOLICIÓN (C&D): DESAFIOS Y OPORTUNIDADES

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ABSTRACT

El volumen de residuos procedentes de la Construcción y Demolición en Europa aumenta cada año, la Unión Europea ha decidido tomar el control del asunto recojiendouna prácticas y objetivos comunes a alcanzar. Este artículo analiza cómo funciona la gestión de residuos en Italia ajustando su sistema a la Unión Europea, en materia de Construcción y Demolición, teniendo en cuenta la disposición de material procedente de la producción de C&D (Construction and Demolition). En Italia, la disposición puede diferir SEGÚN las regiones en las que se divide, y esto debe tenerse en cuenta a la hora de analizar información que refleje los distintos aspectos logísticos vinculados al territorio. También es necesario considerar cómo el volumen de residuos puede variar SEGÚN el tamaño de la región considerada y el tipo de desarrollo industrial al que pertenece. El análisis de la situación italiana muestra sus logros respecto la canti- dad de residuos C&D reciclados que después del 2010 alcanza un valor igual o superior al mínimo establecido por la Union Europea, aunque todavía existen barreras en el campo de su gestión. A través de la recolección de datos, se ha visto el diferente volumen que se genera en las actividades relacionadas con la construcción en el país, junto con el volumen de residuos recuperados. Así, el objetivo de este trabajo es profundizar en el conocimiento general sobre los residuos producidos por la Construcción y Demolición en Italia y las prácticas de gestión de residuos adoptadas SEGÚN la Unión Europea.

Keywords: Residuos de C&D; construcción; demolición; Unión Europea; reciclaje.

INTRODUCTION

La Unión Europea desea lograr una “sociedad fundada en el reciclaje, que busque evitar la producción de residuos pero que, en cualquier caso, los utilice como recurso” (ADELLA *et al*., 2020). Considerando solo los residuos derivados de la con-

strucción y demolición, este tipo se produce mundialmente en grandes cantidades (Letcher & Vallero, 2011). El nivel de peligrosidad es bastante bajo, y es fácil evitar las normativas vigentes sobre su disposiciòn, desechandolos en lugares no autorizados (Pillari, 2019). En el caso italiano, considerando el año 2018, ÚLTIMO año del que se conocen los datos, la cantidad de residuos especiales generados fue de alrededor de 143 millones de toneladas, de las cuales 59 millones de toneladas fueron producto ÚNICAMENTE de las actividades de C&D (ISPRA, 2020). Esto significa que el nivel de producción de residuos C&D alcanza el 40% de los residuos generados, en línea con los datos europeos, y representa una fuente valiosa si se gestiona correctamente (Hoornweg *et al*., 2013). Los resultados sobre generación y residuos recuperados implican no solo a todo el país sino también a las regiones. Como se muestra en la Figura 1, el país está dividido en regiones, pero se hace una distinción más amplia entre tres categorías: norte, centro y sur.

Figura 1. Regiones de Italia y división entre territorios.
Fuente: elaboración propia.

Las distintas partes en las que se divide el país ofrece una gran variedad de información que muestra cómo la economía y el desarrollo industrial se vincula directamente a los diferentes datos obtenidos (Barbaro, 2018; European Commission, 2018; European Commission, 2020). Debe tenerse en cuenta que las tres zonas tienen una

ligera división que contribuye de distinta al desarollo del pais; en el norte se desarollan más las las industrias y la producción, el centro es la zona administrativa con la capital y en el sur encontramos la mayoria de la producción agrícola. El artículo pretende enfatizar cuáles son las zonas con mayor cantidad de residuos producidos y reciclados y las razones de tal comportamiento. Este país presenta un sistema de recolección de datos detallado y actualizado sobre la gestión de residuos a nivel nacional, sin embargo, uno de los principales problemas es que los datos no están homogeneizados a nivel regional (Comisión Europea, 2015). Las 20 regiones diferentes del país recolectan la información utilizando sus normativas y escalas internas, y cuando es necesario recolectarlos para un estudio más amplio a nivel nacional, generalmente no es posible o solo se queda a nivel estadistico (Paleari & Campioli, 2015). Como consecuencia de las estrategias adoptadas por la Unión Europea, la decisión sobre la aplicación de la normativa sobre el Green Public Procurement requerirá la inclusión de criterios ambientales claros y verificables para los productos y servicios en el proceso de contratación pública (Comisión Europea, 2020).

Italia fue el primer país, entre los Estados miembros de la UE, en imponer la obligación de aplicar CAM (Criterios Ambientales Mínimos) para las estaciones de contratación pública, relanzando la importancia que juegan las compras de tipo verde como herramienta es- tratégica (Ronchi & Nepi, 2013). El uso de estas prácticas aspira a un sistema de datos colectivo unificado con información más clara sobre los resultados nacionales y regionales. Con los buenos resultados en residuos de C&D reciclados que alcanzaron más del 75% en 2017 (último año para el que se reportan los datos), la implicación en el país para alcanzar el estándar europeo se encuentra en buen camino, pero aún así, la política y las barreras sociales, como las prácticas ilegales implementadas en el pasado, mantienen un nivel de desconfianza en el uso de residuos reciclados (European Union, 2008). Por tanto, este trabajo tiene como objetivo evaluar cuestiones que afectan de forma indirecta y directa al proceso de residuos y el papel de la normativa vigente por parte de la Unión Europea. En el caso de Italia se realiza un estudio extenso, donde se analizan las diferentes producciones de residuos junto con las tasas de recuperación.

CONCLUSION

El presente trabajo aborda el estado actual de la situación de la gestión de C&D en Italia, mostrando los buenos resultados en alca- nzar los niveles de reciclaje y reutilización de residuos establecidos por la Unión Europea, alcanzando un nivel del 75,1% de material de desecho de C&D preparado para ser reciclado. Sin embargo, se

deben atender más cambios y mejoras en cuanto a los diversos resultados entre regiones. Como se muestra en la comparativa entre Lombardia, Valle D'Aosta y Molise, los datos todavía están demasi- ado afectados por el territorio y el desarrollo de cada zona, la respuesta a la situación económica ha sido impulsada por el desarrollo industrial de cada región, siendo más afectado si está más desarrollado. Este aspecto es imposible de eliminar, pero se podría lograr un resultado más homogéneo si las regulaciones y las reglas se adaptan de la misma manera en todas partes. Otro aspecto a abordar es la gestión de los residuos que no se reciclan (European Commission, 2018), incluso si el 76% de los residuos de C&D se reciclaron, el 24% esta destinado al vertedero (Comisión Europea, 2015). Estos datos todavía tienen un valor demasiado alto, pero están mejorando en los últimos años. El principal material casi reciclado en su totalidad es el residuo de tipo minerale, del cual sólo el 3% llega a los vertederos. Para otros materiales sigue en vigor la desconfianza del usuario, la mala separación en origen de los residuos y la falta de prácticas de demolición selectiva (Comisión Europea, 2018). Cuando se abarquen tambien estos aspectos, se podria continuar el camino hacia una mejor gestión incluyendo la sostenibilidad y las buenas prácticas.

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