



Potentiality of the industrialization of the balcony serving to environmental strategies

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Abstract: *Despite being an essential part of the Mediterranean facade, the balcony has been relegated to a background in the recent technological evolution of the envelope of buildings built in Spain since the end of the 20th century. In the same way that the facade is taken as an ally in the search for sustainable solutions and is treated as a dynamic skin capable of adapting to climatic changes, balconies, as being architectural spaces in direct relation with the outside are disclosed as elements potentially suitable to meet this objective.*

The current trend toward the industrialization of construction shall address soon the functional and constructive redesign of the balcony to optimize and integrate the entire process of demand, design, manufacturing and execution. This opportunity should be used to incorporate environmental vectors in its design, production and use. We must also respond to refurbishment of balconies in the framework of the renovation of the facade.

Balconies, Industrialization, Environmental strategies, Refurbishment

Introduction

The balcony has been, and still is, an essential architectural element in the configuration of residential buildings in the Mediterranean tradition, with a strong representativeness for users and architects. However, it is not apparently perceived an innovative concern of the same intensity that has characterized the recent technological research of the facade. Over the last years in Spain, the constructive development of the architectural envelope has focused mainly on the evolution of the typology of the lightweight ventilated facade, which seems incompatible with the current relationship with balconies, breaking this new protective and filtering skin.

However, the balcony cannot be left behind, because in addition to the inherent contributions of the element itself and its compositional load, it incorporates a remarkable potential that should be specially considered in the upcoming years for a more sustainable architecture: it allows life on the outside of the building, produces shadows on itself, minimizes the action of rain and wind, it is a good vegetal container, etc. Thus, it seems that its use is being reassumed and will be necessary, therefore, to merge its incorporation with the technological advances of the facade.

Moreover, there is a large fleet of buildings with balconies that, due to his condition of item continuously exposed to the weather (changes of temperature, presence of water, etc.), have

experienced over time obvious damages, undermining its durability (corrosion, leakage of water, landslides, stains, degradation of the coating, etc.) that need to be refurbished.

Everything indicates that the current trend of the construction sector, with most of the agents involved in this process, leads to industrialization. In the same way technical solutions for roofing, walls and voids have been intensively developed, the balcony seems destined to an industrialization of its construction.

Current situation

A first glance shows the strong rooting in Spain of cantilever reinforced concrete construction. However, this solution so apparently consolidated has no more than 100 years, since the structural beginning of the balcony was based on metal parts embedded in the façade wall. It is not until the mid-20th century that the structural capacity of the steel and concrete lead the projection cantilever from the interior beams in continuity with the outside. This method ensured a high-rigid embedment of the balcony with the main structure, as it is the outward extension of the inner slab, but, on the other hand, this practice involved problems such as thermal bridges, leaks, deficiencies in the sealing, etc. In addition, from a functional constructive point of view, it makes no sense when one considers that the requirements and demands for the exterior slab, subjected throughout his lifetime to a rigorous outdoor, and the inner slab between floors, are completely different.

We recently began to detect emerging solutions and architects' concerns to approaches of balconies executed independently of the general building's structure and connected to it via different mechanisms, seeking new formal wills linked to technical and conceptual innovations. In addition, the growing concern in recent years by issues related to sustainability and the environment has made clear the need to resolve, through its own architecture mechanisms, efficient energy exchanges and climate control strategies.

To concerns at formal, constructive and technological level of the designers we must add a manifest functional evolution by the user. The fieldwork, carried out at street, has also unveiled spontaneous samples of dissatisfaction by the user in relation to the new emerging requirements.



Image 1: The customization interventions make appear concerns and requirements not covered by the user. The phenomenon of customization that generally detracts from the initial planning of the project and clutters the façade.

The gradual abandonment of these traditional functions has led to the increase of other functions such as storage of disused objects, accommodation of new technical devices (e.g. air conditioning) or as communicative support.

In the graph shown below are ordered according to the different agents the requirements who has to face the balcony, as any other constructive element. The formal requirements are found in the centre of the frame, since they are common, necessarily, to all stakeholders. The aspects related to hygrothermal comfort, leakage and evacuation, and also the ones related with structural safety, fire safety and safety of use are particularly relevant in the case of the balcony.

On the other hand, the informal requirements that can be shared, different or even contradictory from the point of view of each of the agents involved. What we might call “smart balcony” should satisfy the needs of users, accepting and integrating a controlled customization that adapts to changing needs over time and to the variability of each user; as of the architect, with finishes and requirements depending on the project; and at the same time, the constructor and promoter, with the reduction of costs and the possibility of reusability.

It will also have a common profit: environmental improvement. The very nature of industrial systems is directly linked to the environmental advantages such as minimizing energy consumption, recycling, maintenance throughout the lifetime of the building, the perfectibility and deconstruction.

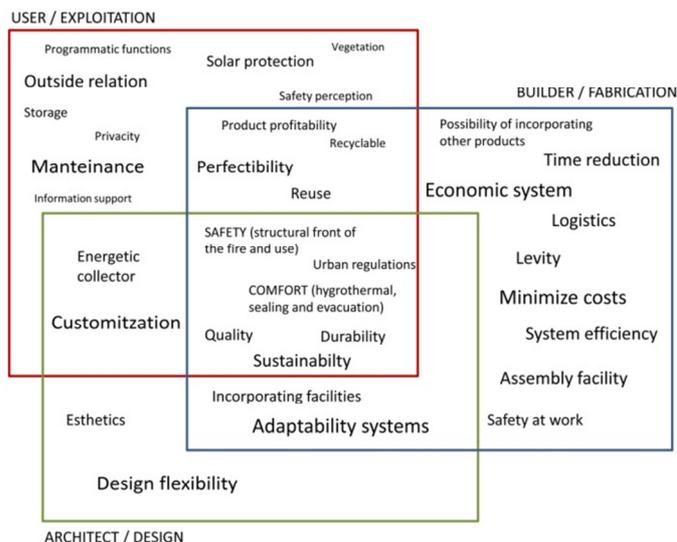


Image 2: Summary table of the main requirements grouped by formal and informal. Most of the specific requirements of each of the different agents involved in the construction process are more peripheral and of each particular environment.

Opportunities detected

For establishing mechanisms for a further industrial development is adequate to make an analysis of the industrialization of the balconies using the SWOT method, detecting strengths

that must be boosted and weaknesses to be transformed in strengths. For example, the industrialization of the balconies would lead to an optimization of resources and reduction of waste generation, resolve outstanding requirements such as the thermal bridge, it can be improved and/or replaceable, optimization of time on site, removable and reusable, greater guarantee of quality, greater safety at work, etc.

Also, threats could be transformed into allies and create synergies between industrialists. And, of course, to seize the opportunities that arise to evolve and adapt to new requirements.

BALCONIES INDUSTRIALIZATION	<p>Strengths:</p> <ul style="list-style-type: none"> • Direct relation with exterior: views, ability of captation, etc • Solar and wind protection • Prevents fire propagation • Tipological diversity • Increase uses in housing • High social skills • Flexible composition • Supports different building systems, materials... 	<p>Weaknesses:</p> <ul style="list-style-type: none"> • Thermal bridge • Cantilevered structural stress (weight and anchor) • Normative restrictions • External elements exposed to degradation • Drilling envelope • Source of pathologies • Low architectural and urban adaptability
	<p>Opportunities:</p> <ul style="list-style-type: none"> • Chance of create a new industry frame not existing • Incorporate values related to sustainability, ecology and sense of business in limited resources • Update social and regulatory requirements • Add new components that improve the environmental performance of balconies • Increase manufacturing facilities • Speed manufacturing to improve the quality • Increase the thermal performance of housing 	<p>Threats:</p> <ul style="list-style-type: none"> • Rigidity of the construction sector • Other industrialists, as concrete companies (lose scope) • Manufacturers of railing on a small scale • Manual labor market • External labor market agents • Lack of maintenance • Excessive construction

Image 3: Analysis through SWOT method about the balcony.

The construction sector is showing a growing concern about finding solutions based on prefabricated elements that fit costs, contingencies, works on site, and improve the final quality of the finishes and, ultimately, efficiency. However, there has not been implemented an industrialized system for balconies, at least not as a whole. Surely the main handicap to the balcony in addressing their immediate technological evolution is that don't seem to be companies specializing in this field, i.e., expressed in language of work, the figure of the "balconist" is not recognized. The constructive element balcony, to be at a point of technical border inside the building, seems that it is also in "no man's land" within the market. A double opportunity is presented to us.

On the one hand, the balcony is in a privileged position of liaison between the interior of the house and the outside, so it offers many possibilities that we are not currently taking advantage of: can work as an energy exchanger, solar energy collector, water collector, even might consider its function as facilities coalesce. In addition, a new constructive language of the balcony, more in keeping with the growing trend toward the industrialization of construction, would allow with mecano type mechanisms to introduce sustainability criteria such as recycling, reuse, perfectibility along the time, etc.

On the other hand, in the absence of a definite industrial profile, we must consider several options: to create a new industrial profile, or an existing sector incorporates it in its

production, or a consortium of companies to develop the balcony as element to industrialize is generated. The strategy of creating synergies between different industrials, so that each contributes its infrastructure and its knowhow, would generate new solutions more evolved technically that respond to outstanding requirements. Alliances could occur, for example, between the prefabrication industries, whether in concrete, wood or metal; joining systems; sustainable systems as green roof, solar protection, captation systems, urban garden; installation as electrical, telecommunications, etc.

In this sense, have been conducted real experiences we can see in the document "Photovoltaics in architectures - lessons learned in PV Nord". One of these experiments was made in a building of collective housing in Copenhagen where acted on the façade to solve acoustic problem transforming the balconies in acoustic screens that simultaneously incorporated photovoltaic cells. Inside of these there was a sliding coloured glass panel. So, the sliding glass panel had a dual function - it reduced heat when opened, and provided warmth in the wintertime.

One of the most important conclusions drawn is that, in a collaboration between industrials, one of the main difficulties is to determine the plots of responsibility of each and that cooperation should be done from the beginning.

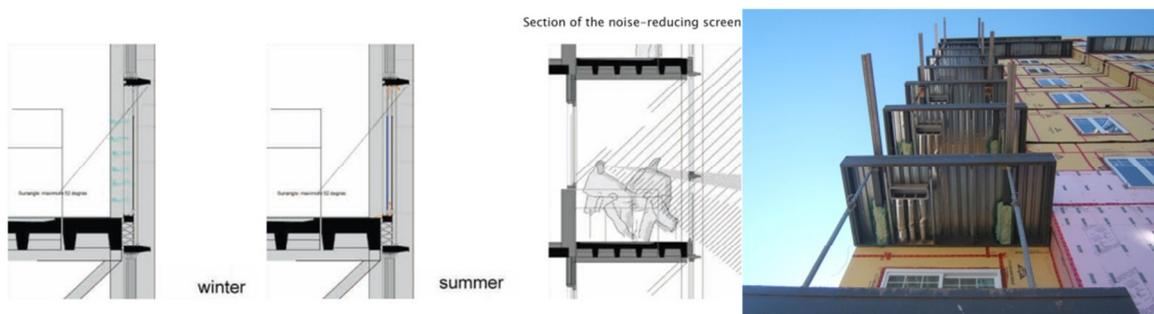


Image 4: Case of alliance between industrial . . . Image 5: Although few, there are some examples of technology available on the market: TMSYSTEME (France).

Another plot of opportunity lies in the field of refurbishment. Up to the present moment we have analysed these issues above all in order to prevent future diseases and new products and systems have been introduced to solve specific problems, but a comprehensive solution of the balcony which satisfies all outstanding requirements has not been addressed.

Thus, there is an unexplored potential in its full renovation. On the one hand, the possibility of correction of this element later to his execution would suit the real needs that are detected during the phase of use of the building, already out for obsolescence (aesthetic, functional, economic, regulations, etc) of the element or adaptability to the user. And on the other hand, the revaluation associated with the incorporation of balconies to existing construction.

The future rehabilitation has to be understood broadly including the improvement of the conditions of the element, restitution of their parties, adaptation to new requirements, adding this element to an existing building with lack of balconies and its maintenance over time. The

use of reusable, removable and perfectible systems also involve aspects linked to sustainability and to a more comprehensive vision of the life cycle of the building component.

Innovative proposals

The development of these ideas has been conducted in a university environment within the Lita (laboratory of innovation and technology of architecture) group and the TOSCA workshop.

The Lita UPC group is a team of emerging research that brings together experts from various ages, training and experience, held together by an interest in technology applied to architecture.

On the basis of the premises established so far, have been generated different profiles of industrialized balconies that can be taken as a starting point to reflect on how the future of industrialized balconies could be. Some of them are as follows.

One of them, we might call balcony XS, would correspond to the urban balcony, with a small size, suitable for an urban context of narrow streets and high density. The solution is presented as an object, an integral component designed "made-to-measure". The anchoring of the subframe element would be using reversible joints in order to be able to recycle and reuse and the inside of the frame could accommodate facilities.

Another type of profile to develop would correspond to a balcony of higher dimensions which would constructively be an open system, customizable from semi-components that allows an optimized transport and an assembly at the worksite. It includes aspects of perfectibility, as it would be feasible to incorporate functions over the useful life of the balcony, expand it, exchange elements, etc. This model could incorporate features programme as a clothesline, a small store, a small reservoir of water, a "technical" railing, etc. as well as installations, both which supplied to the main building (devices of air conditioning, step, etc).

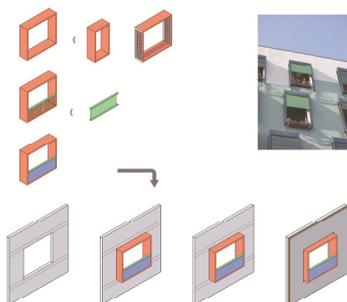


Image 6: Profile 1. Component balcony

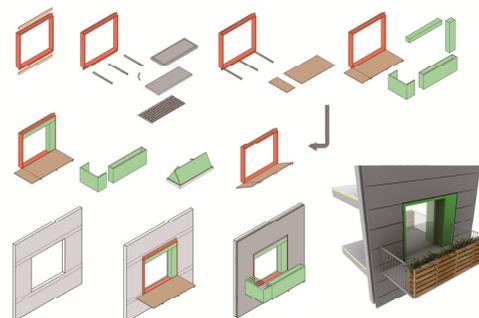


Image 7: Profile 2. Partial component balcony

In the same way as Lita group but in an academic level, the intensive workshop of TOSCA aims to initiate the architect during their training in an underexplored area as a designer of innovative construction. It means rethinking from the standpoint of product innovation, the role of new building materials, construction systems that answer questions that are unsolved nowadays. During the 2013 the TOSCA workshop arose the industrialization of balconies as



subject to develop. Below are some of the emerging proposals and that gather ideas to develop in the future.

Proposal 1: illustrates the idea of how the industrial partnerships can lead to solutions that integrate caption and reuse. In this case, starting from of a reinforced concrete base on which are incorporated bioclimatic systems such as solar panels, solar protection, urban garden and water collector which, moreover, are interrelated between them.

Proposal 2: mobile mechanisms that allow the space to be adapted to the user's needs, has the possibility of adding accessories, easy maintenance with interchangeable parts if any of them become obsolete. This proposal addresses the issue of maintenance over time, the recycling and reuse an item exposed to the weather. A balcony with moving mechanisms to suit different uses a balcony might have (space to be, to store, to grow, etc..).

Proposal 3: this paper works on the stage of refurbishment. An intervention is proposed from the interior of the building thus avoiding the need for cranes and occupation of public space. The system is intended as an assemble-able and disassemble-able kit by appropriate human scale light pieces to be easily manageable and optimize transport. Is achieved in this way, a customizable system, adaptable, light, fast and cheap work, with few materials, cheap and sustainable.

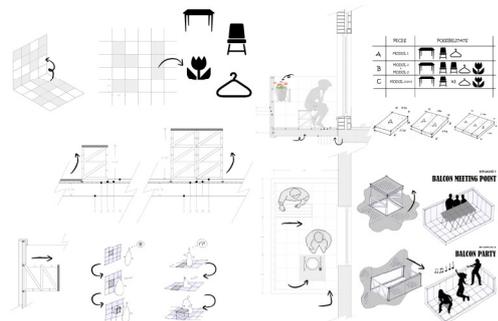
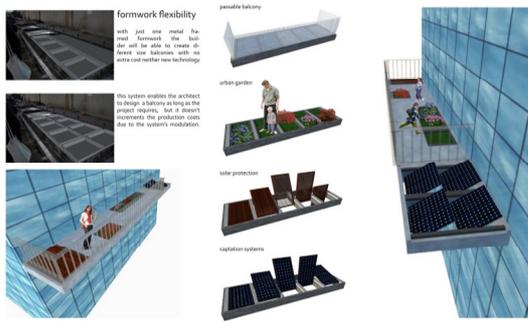


Image 8. Proposal of integration of different industries . Team: De nova, C.; Leal, S.; Llorens, R.; Rovira, E.
 Image 9. Proposal of mobile mechanisms. Team: Gabarró, S.; González, J.; Sabatés, N.; Osete, G; Serra, O.

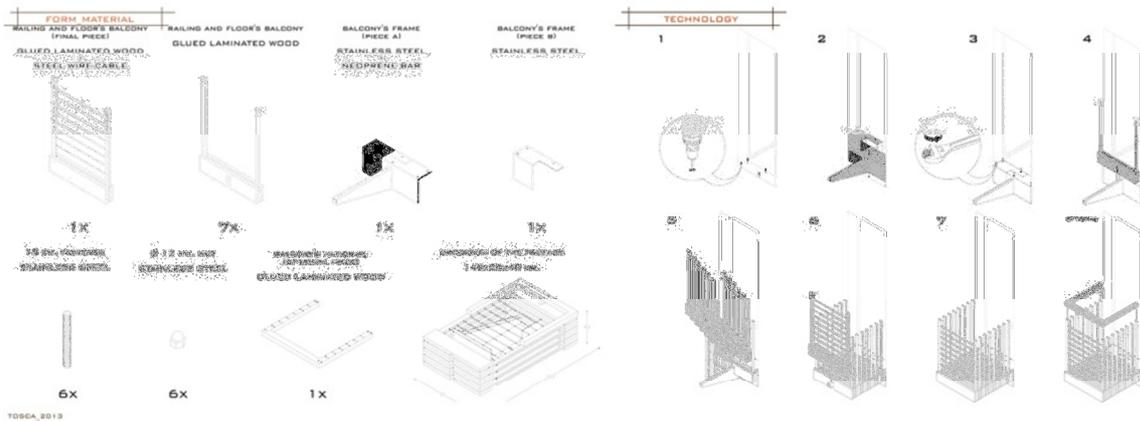


Image 10. Proposal of a balcony kit. Team: Marco, G; Marrasé; A. Perales, J; Valdés, A.

Conclusions

Soon the balcony, as has happened with other building elements shall meet the technical adequacy consistent with the evolution that has suffered the facade. It is appropriate, therefore, to outline the basis for the technological evolutions of this element with the double aim of optimize its production and upgrade its adjustment to recent expectations and needs. So reducing environmental impact: understanding the balcony as a caption and protective element, ease of maintenance, reuse and recycle, etc.

Industrialization is presented as the most appropriate tool to optimize resources, both economic and environmental.