Accommodating cabins as a new way of building houses

Introduction

The current economic crisis in Europe has implied, in the specific case of Spain, the almost complete cessation of new buildings construction.
In a few years the house has moved forward from being contemplated exclusively as a primary good to be also considered a capital asset. We analyse the influence that this transformation has had on architecture (housing typology, building methods, the architectural profession and the architect training) and offers architectural alternatives –trough the university– to the present crisis.

Housing: from primary good to capital asset

While in the middle of the 20th century the percentage of home ownership in Madrid and Barcelona was of 6 and 5% respectively[1], nowadays it amounts to 83.2%, what makes Spain be one of the European Community countries with the highest percentage of home ownership[2].
From the beginning of the first housing bubble (1986-1992) -of a speculative rather than constructive nature[3]-, housing prices, which had been growing at rates comparable to consumer prices until then, began to grow in parallel with stock prices and property starts being seen from two perspectives: Firstly, as a necessary good, recognized as a legal right by Article 47 of the Spanish Constitution. Secondly, as a capital asset in its different aspects what caused an increase in housing demand:
1) a generator of wealth thanks to an ever-increasing real estate capital gains, until 2007;
2) a store of value in the medium and long term; or
3) a short-term speculative product (purchase and sale on periods shorter than two years[4]);.
During the second housing bubble from 1997 to 2007, of a constructive nature this time[5], the concept of home as an investment was maintained and reinforced. The fact that housing has become an alternative of investment for many Spaniards has resulted in implications not only on his price (and its outsized rise and revaluation[6]), but also, in regards to the new housing building, on its typology, on its building technologies and on the architects and their professional formation.

a) Impacts on housing typology.
Typologically speaking, there is only one type of housing (hall, living room and kitchen, hallway that leads to 1, 2 or 3 bedrooms and 1 or 2 bathrooms)

and the only variations are therefore quantitative, both in number of bathrooms and bedrooms and in square meters.
It seems unreasonable to ignore the evolution experienced by the family in recent years (one-parent and blended families, single people, etc.) or the population aging.
From our point of view, the fact that the housing supply in Spain remains monolithic is directly related to the widespread consideration of housing as a capital rather than a primary good: the more homogeneous the homes, the greater the probability of being exchanged in the market.

b) Impacts on building methods.
In Spain the same building model from the 60s remains. The construction is on site and follows always the same sequence of procedures: first, foundation and linear structure (beams and columns, usually made of concrete); then, roofing, building enclosure, interior walls and service systems. It is a construction model that uses brick, concrete, cement and plaster as main materials, and requires long work deadlines. It is based on the successive entrance of various trades on site what implies that its success depend on the ability and training of the various professionals.

c) Impacts on the architectural profession.
Most of the modern architecture historiography[7] has presented a heroic image of the architect: an independent professional with clear social conscience, who serves their fellow citizens and is able to transform the society in which he lives.
In Spain, the architects have been unable to counter the voracity of the building developers, to promote new typologies of housing or even to suggest alternative methods to the traditional craft-based construction.

d) Impacts on architect training.
The training of architects in Spain has not substantially changed in the last 100 years. Unlike what happens in other European countries, the Spanish architectural education has an integral character including both aesthetic and technical training (structures and service systems calculating). However, in the present construction model the aesthetics aspect is a priority since the building is designed almost exclusively from the formal viewpoint and technical and structural problems are solved afterward.
Industrial architecture and prefabrication has been absolutely neglected in the Spanish universities. It has been transferred by the architects to the civil engineers on a voluntary basis, what partly explains the lack of development and research on alternative constructive methods on architecture.

The crisis: time to change our real estate model.

The Spanish real state crisis affects principally those whom bought their homes as a personal good, without speculative intentions (motivated, in many cases, by the high prices of rent, which are equal or even bigger than the monthly

mortgage fees), but paid a price inflated by the speculative bubble. Together with this fact, the dramatic rise of unemployment is causing that a growing number of Spaniards are being evicted[8] and, therefore, put at risk of social exclusion.
Therefore, it is time for Universities to offer solutions for the current housing problem, to the extent of our possibilities.

Proposed solutions: ends and means.

The "Modular architecture" Research Line's general aim is to propose industrialized or highly prefabricated housing alternatives, which will simplify the citizens' access to adequate housing, from architectural and also constructive standpoints – considering space, typology, aesthetic, among other criteria, but also constructive quality, energetic efficiency, durability, etc.
Prefabrication seems to be an alternative[9] that, from a logical point of view, should have been developed in house building, as in other countries[10] (Davies, 2005; Kieran & Timberlake, 2004; Ryan, 2010). The alternatives or solutions proposed from our research group share the following points:
a) The development of research on architectural typologies;
b) The abandonment of conventional craft-based building system and the gradually replacement by industrialized construction methods and/or highly prefabricated systems and subsystems assemblies, together with the enhancement of the reuse of existing buildings.
c) The rethinking of the way projects are conceived and the replacing of the hierarchical and pyramidal system –in which architects occupy a top position and aims the formalism– by a matrix arrangement, in which they are part of a team of technicians and engineers.
d) The provision of solutions from a social viewpoint.
e) The incorporation of research to professional practice. With the traditional construction system, every project starts from zero. Industrialized architecture allows to research with each project and to improve the prefabrication systems, as well as sharing and spreading knowledge.
f) The rethinking of the way of future architects training.

Project Description

The "Accommodating cabins as a new way of building houses" is a temporary and somehow emergency project[11]. It does not intend to be a general solution to the housing problems of our country, but aims to be part of a series of alternatives to respond to the presented problems, by the means described in the previous section.
The project's goal is to make available to anyone –and free of charge– the plans, resources and information required for building their own family housing.
The proposed houses are based on the reuse of accommodation cabins (factory-made modules usually used as temporary buildings, offices and restrooms, on the conventional building sites).

The residences must be inexpensive, flexible from the typological point of view (customizable according to the future user's needs), built from the combination of industrially made modules (accommodation cabins), prefabricated subsystems and other catalogue components available on the market, all they set together by dry joints.

What is an accommodation cabin?

Accommodation cabins are light prefabricated structures –manipulated by truck crane–, with small dimensions (length: 3, 4, 6, 8m, width: 2.44m, height: 2.59m), which can be transported by truck without special movement permits.
They consist of a solid frame-typed metal structure. The joints between the columns and the beams are rigid.
a) Advantages of using accommodation cabins as construction basis:
- Ease of obtaining different layouts and typologies from modular elements (see figure 1). The houses are gotten from a variable amount of cabins, depending on the size of the project. It is strongly recommended to use the same type of container in each project. The way the cabins are set together may vary on the ground plane, but not on height (they are attached by bolted joints at the level of the horizontal beams, at the top and the bottom of the structure).
- Construction quality. The houses are industrially built, with a high level of finishes quality. As mentioned, the structure is frame-typed, which means it is structurally resistant to any alteration made on its façades, as, for example, opening holes on them (see figure 2.1).
Furthermore, unlike what happens with shipping containers, the accommodation cabins are usually insulated (walls, floor and roof). Although insufficient, the prior isolation is a good base for further improvement (see figure 2.5).
- Economy. The stagnation of the building sector has strongly dropped the accommodation cabins prices: for example, a 6 meter container costs between 300 and 800 Euros, depending on possible offers and on its state of conservation. The price of shipping containers remains stable on due the residual value of the steel.
b) Inconveniences of using an accommodation cabin as construction base:
- Aesthetic. The containers' aspect is inevitably associated with its temporary purpose.
- Space. The interior space of each module is small, always limited by the width (2.35m on the interior side).
- Thermal and condensation problems. Despite insulated, the frame is a continuous thermal bridge.

Subsystems incorporated to the accommodation cabin.

To avoid the described problems several construction subsystems are incorporated in the house. The essential ones, both from constructive and

aesthetic (external appearance modification) perspectives are two: the addition of a new facade and a new roofing.
The new enclosure – both facades and roof – has to meet several conditions: it has be as cheap as possible, light (so it can be easily assembled by two people) and ventilated (to prevent condensation). It also has to be attached to the frame by removable joints (bolted) and must eliminate thermal bridges –and for this we must ensure that the thermal insulation covers the entire frame, with a minimum thickness of 3 cm.
a) New outer horizontal enclosure: incorporating a ventilated facade.
The new facade is made using cement wood boards bolted on an auxiliary support structure made of treated pine wood battens. The battens enable the separation to provide space for a ventilated chamber and the reinforcing insulation.
b) New "vertical" enclosure: addition of a new roof.
The roof, which goes from a flat to a pitched roof, has dual mission. First, it changes the way the roof works: from a hot, no ventilated cover to a cool and ventilated one. Secondly, it modifies the parallelepiped geometry of the houses.
Although most of the applied subsystems affect the enclosure, the entire interior of the home, from interior partitions to the service systems, is composed of catalogue components or prefabricated building systems and subsystems available on the market.

Building with accommodation cabins: an open project.

As already mentioned, a website that will provide to anyone[12] the required documentation for building their own family housing is under construction.
The website intends to spread information about:
- Different typologies and models of houses.
- The required documentation for the understanding and execution of the building system.
- Different manners of building houses, among which are:
    a) The self-building method: possibility to build/assemble the house by only two people (usually on site).
    b) Pseudo-industrialized construction: possibility of off-site manufacturing, making each module almost prepared to be assembled on site.
- The calculations of insulation, service systems, etc.
- Recommended subsystems and components, indicating where to purchase them (usually on line) and their costs.

The project, although initially restricted, aims to be open and fed back through the experiences of those who take part in it – the ones who build using the documentation spread through the web.

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Figure 1. Different accommodation cabin typologies

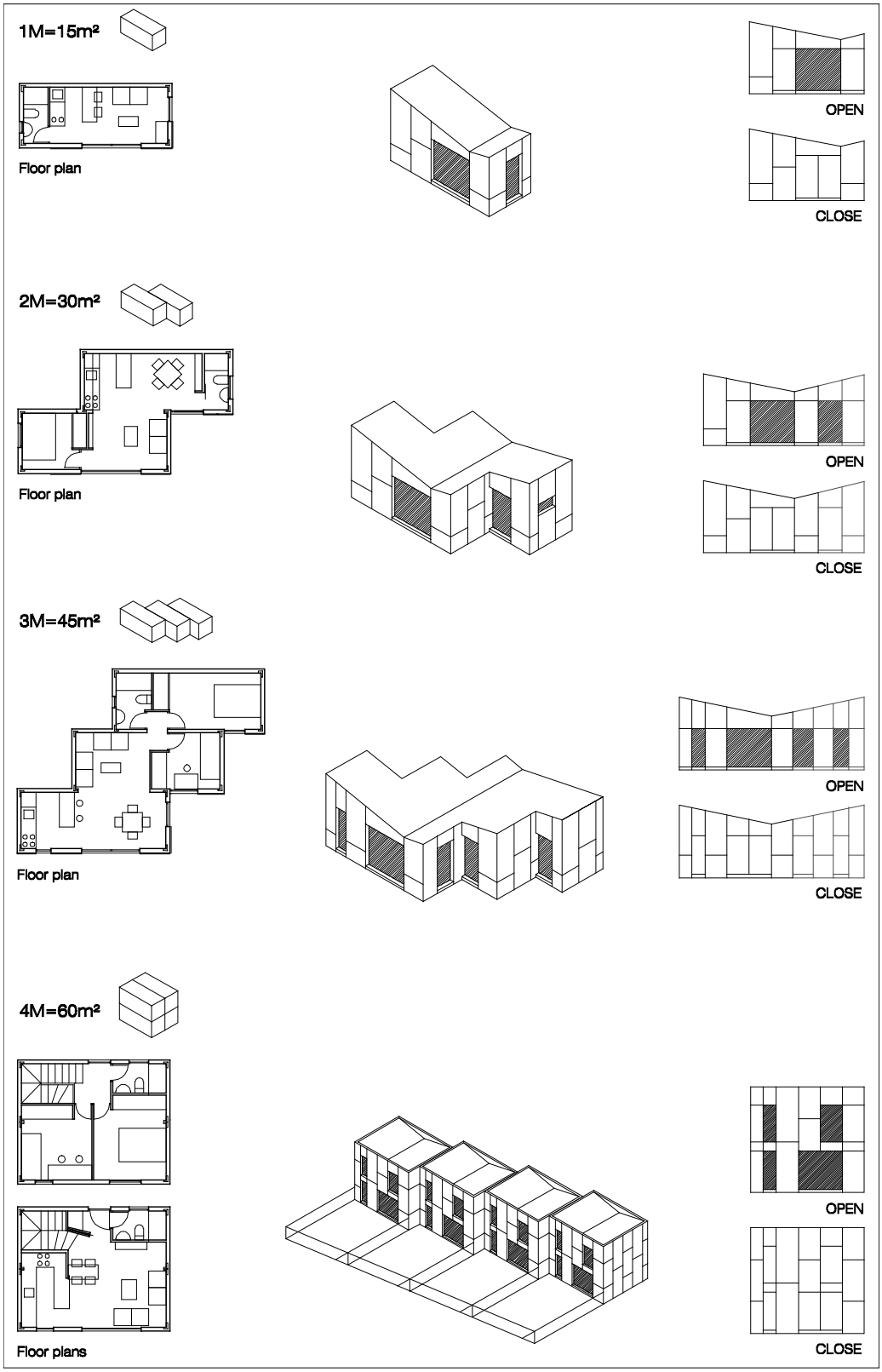
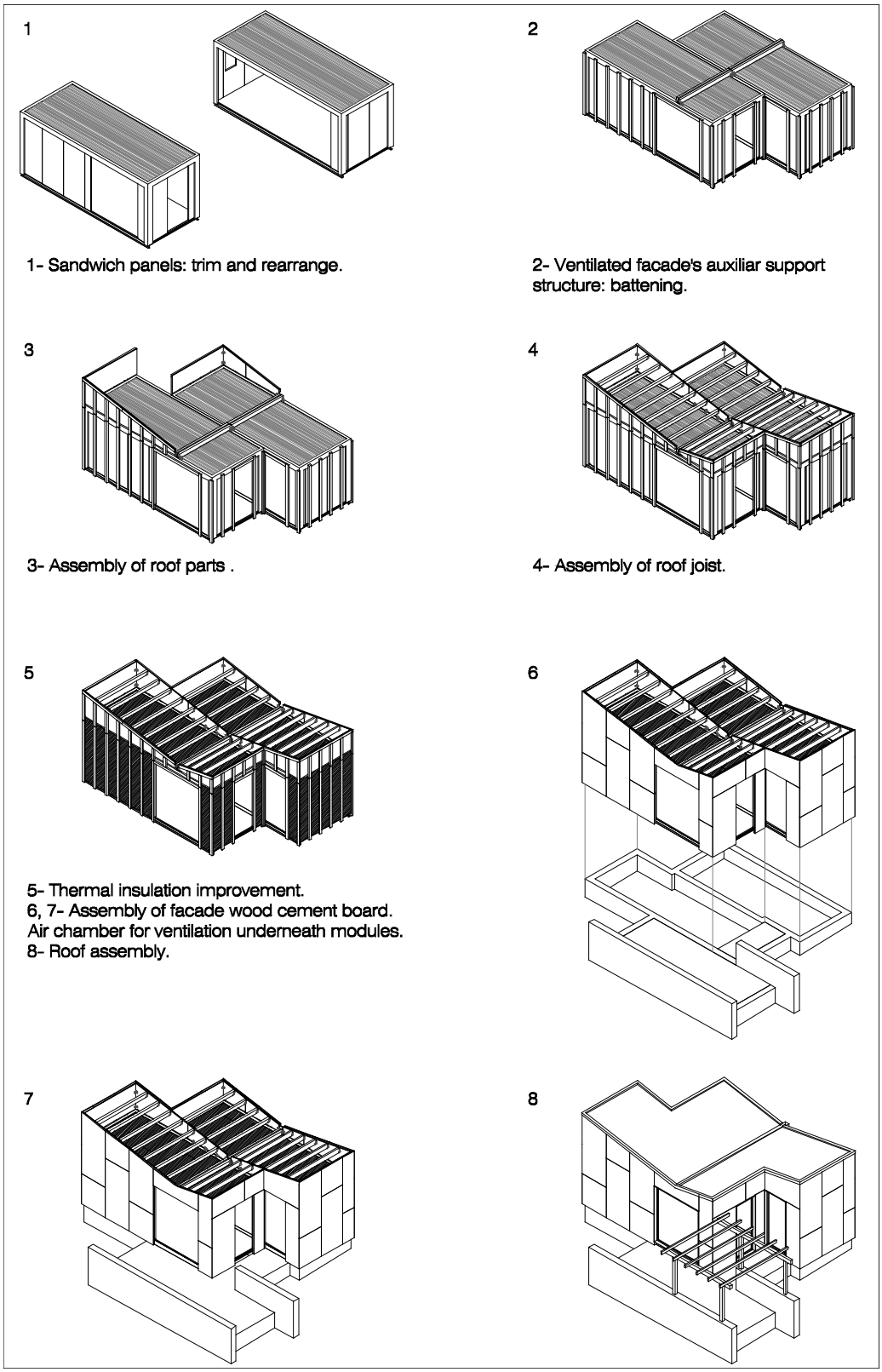


Figure 2. Assembly of two-module housing



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[2] UN. *Special Rapporteur on adequate housing as a component of the right to an adequate standard of living, and on the right to non-discrimination in this context.* A/67/286, 10 August 2012.

[3] In this period, the housing prices soared (IMF, *World Economic Outlook*, September, Washington 2004 and the Spanish Bank, 2005), but the number of housing built was relatively modest (J. F. Bellod. "Crecimiento y especulación inmobiliaria en la economía española" in *Revista Principios: estudios de economía política*, Nº 8, 2007, 59-84.) estimates 236.761 on annual average.

[4] According to data from the Real Estate Registers College, in 2007 one in five homes changed hands before 24 months.

[5] From 1999 to 2007, 612.800 houses on annual average were built (J. F. Bellod, J.F. (2011). *Detección de burbujas inmobiliarias: el caso español*, Contribuciones a la Economía, mayo 2011. Accessible in: http://www.eumed.net/ce/2011a/

[6] Between 1997 and 2004, the overall housing price raises 149% in Spain (UN, *Special Rapporteur on adequate housing as a component of the right to an adequate standard of living, and on the right to non-discrimination in this context.* A/67/286, 10 August 2012).

[7] Panayotis, T. *La historiografía de la arquitectura moderna*, (Ed. Mairea/Celeste, Madrid, 2001).

[8] Since the start of the crisis there have been more than 350.000 eviction (Colau,A. & Alemany, A. *Vidas Hipotecadas. (*Barcelona:Angle Editorial-Cuadrilátero Libros), 2012, 21-22.).

[9] In Spain, even when there is some rejection of the houses built in an industrialized manner (possibly originated from bad experiences occurred with the heavy industrialization of the 70s), prefabrication has succeed, in the same period, in other areas of the construction industry, for example, in the industrial plant building, in the construction of overhead power lines, or in road construction.

[10] Davies, C. *The Prefabricated Home*. (Reaktion Books, London, 2005) & Kieran, S. & Timberlake, J. Pr*efabricating architecture: How manufacturing methodologies are poised to transform building construction*. (McGraw-Hill, New York, 2004).

[11] It would be worth being involve in National Cooperation Programmes and not only in the International ones.

[12] From all around the world, the page will be, at least, in two languages: Spanish and English.

Abstract:

The current economic crisis has meant, particularly in Spain, the almost cessation of new buildings construction. This deep crisis will mean in future an irreversible change in the Spanish construction model, based to date almost exclusively on the brick.
The project “Accommodating cabins as a new way of building houses” is part of a larger research within the line “Modular Architecture” developed by the Research Group “Design and Industrial Production”, belonging to the Technical University of Madrid, which aims to respond to the need for decent housing at an affordable price, by offering through Internet the plans, resources and other technical details required to build a house oneself.
The proposed houses are built from the combination of industrially made modules (accommodation cabins, which are prefabricated modules usually used as provisional constructions in conventional building works), prefabricated subsystems and other catalogue components available on the market, all they set together by dry joints.

Keywords: Recycling, affordable housing prefabricated, self-construction, crisis.