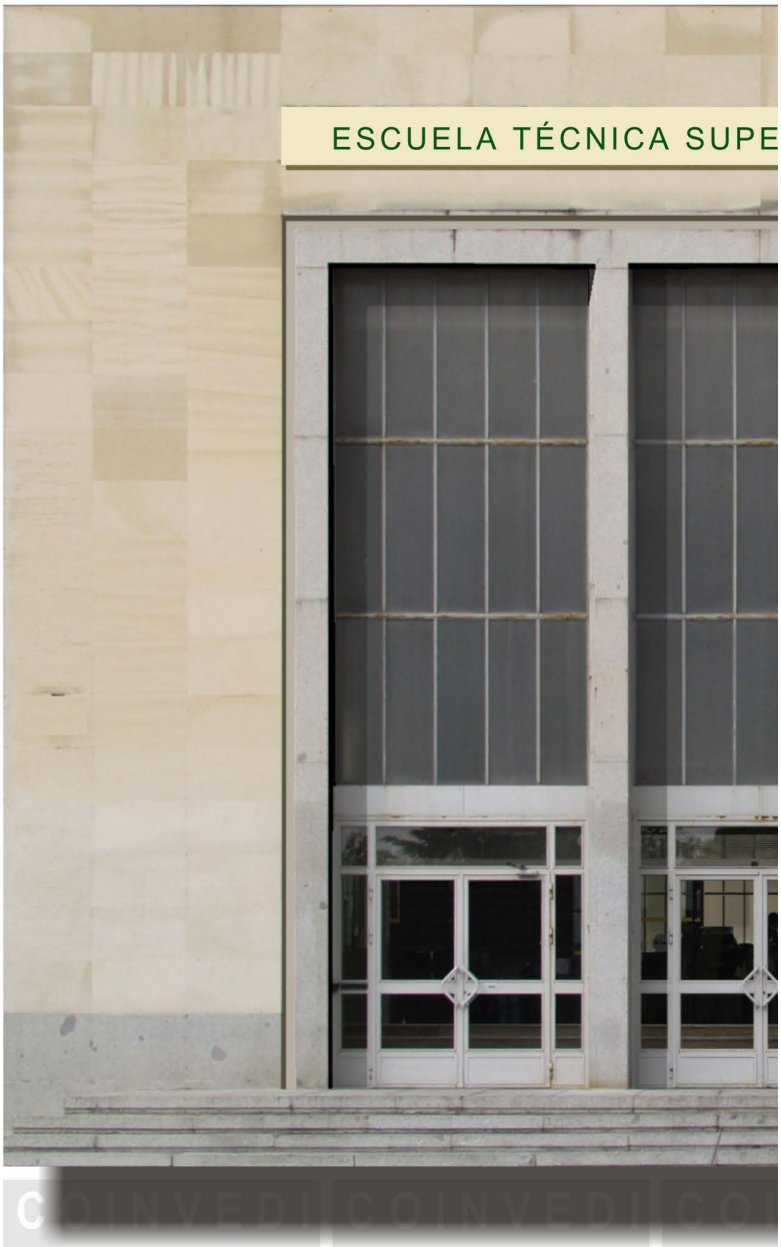
COINVEDI 2015

III INTERNATIONAL CONGRESS ON CONSTRUCTION AND BUILDING RESEARCH (COINVEDI)

Madrid, 14th, 15th and 16th of December 2015

Escuela Técnica Superior de Edificación — Universidad Politécnica de Madrid

BOOK OF EXTENDED ABSTRACTS



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Edited by: Escuela Técnica Superior de Edificación
Av/ Juan de Herrera 6 - 28040 Madrid
tel: 91 336 75 95 fax: 91 336 76 44
Universidad Politécnica de Madrid

ISBN: 978-84-933567-6-7

tecnología edificatoria y medio ambiente TEMA

Materiales de Construcción

PROIESCON rehabilitación integral · revocos y estucos tradicionales

cátedra arpada

informes de la construcción

Fundación EduardoTorroja

CSIC Consejo Superior de Investigaciones Científicas

INSTITUTO EDUARDO TORROJA

etsamadrid

APAREJADORES MADRID

GYPSUM TO GYPSUM

arquitectura Escuela Técnica Superior Universidad de Sevilla

ANALES de Edificación

GOBIERNO DE ESPAÑA MINISTERIO DE ECONOMÍA Y COMPETITIVIDAD

sci Sostenibilidad en la Construcción e Industria

PRESENTATION

Given the success of the 2nd International Congress on Construction and Building Research held in Valencia (Spain), the Director's Conference of Building Engineering (CODATIE) has encouraged the organization of the third edition to the School of Building Construction of Madrid (ETSEM) and in particular to the Building Technology and Sustainability Research Group (TEMA Rg).

Participants from other countries have been invited in order to advance and improve research in the building sector, so as to achieve more sustainable world through research and innovation. The Congress main goal is to present the latest research advances and innovative applications in the Building sector by getting together research groups, administration and companies which have an interest in the building research, development and innovation. In addition, the Congress will provide the opportunity to serve as a meeting point between the University and the business world creating a frame that will facilitate technology transfer.

More than 130 papers will be presented at the III COINVEDI, of which 34% were accepted for poster presentation and 65% for oral presentation. We hope these presentations offer the possibility to interchange experiences among researchers and fruitful interactions from the different perspectives and approaches.

We kindly invite all members of the scientific community and professionals related to Building Construction to participate in the debates so as to attain conclusions to organize and coordinate activities together in the near future, within the Building Construction area.

Finally, we would like to thank everyone for their participation in the Congress and wish all a pleasant stay in Madrid hoping to see you back in the forthcoming editions of the Congress.

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Avda. de Juan de Herrera 6, 28040 Madrid, Spain

14th - 16th of December 2015

BUILDING RETROFIT THROUGH PREFABRICATED PANELS: AN OVERVIEW ON THE STATE OF THE ART

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Keywords: *energy retrofit, prefabrication, panel, state of the art*

1. Introduction – The main aim of this paper is to provide an overview of the use of prefabricated panels in external building retrofitting. Building retrofit represents a pivotal point in terms of energy efficiency, connected to the great amount of existing buildings, both public and private, all around Europe. The need of intervention is underlined by the European Directives: EPBD 2002/91/EC, EED 2012/27/EU, Renewable Energy Directive 2009/28/EC and 2010/31/EU that set requirements linked to retrofit and building renovation.

Prefabrication is a primary retrofit strategy, involving both facades and roofs renovation. Currently most building renovations address isolated building components, such as roofs, windows, façades elements or services [1]. This strategy shows its limits, as it does not involve any long-term energy reduction and often results in expensive solutions. Single renovation measures does not allow optimal results as new problems can arise, including local condensation or overheating.

There have been alternative concepts, developed through several research projects across Europe, involving innovative whole building renovations with prefabricated panels [2]. Each project has its own features, linked to the different contexts and conditions in which they took place. The aim of this paper is a critical classification of these projects, stressing differences and similarities between them, as well as identifying the main issues related to the theme.

2. Methods – Horizon 2020 roadmap stresses the relevance of prefabrication in the wider frame of retrofit [3]. It can help indeed overcoming the issues connected to traditional retrofit, in terms of time, discomfort, construction, aesthetics and cost. In this context, external retrofit provides several advantages, as it requires no internal living space loss, minimum disruption, and condensation risk minimization. Prefabrication plays a primary role in retrofit, as it consents standardization in construction, a certain flexibility in architecture (mainly in terms of finishing) and allows the combination with other conventional retrofit options.

As prefabricated retrofit is a current issue, European projects, research works and architects have developed several projects, mainly focusing on residential context. The review of the state of the art shows several approaches in terms of prefabricated panels.

- Large modules: development of a complete prefabrication solution based on façade modules made of wood, mounted on-site on a timber substructure, in an additive retrofit strategy. Other concepts are based on the addition of large modules on aluminium profiles deriving from standard solutions commonly used for glazed façade [4] [5] [6]
- Small modules: development of small modules, completely prefabricated, with a steel substructure, cork, XPS insulation and aluminium finishing, still as part of an additive retrofit [7].
- Highly standardized small modules: a different approach was carried out developing smaller panels with a high level of standardisation, to be set on the existing façade in combination with other prefabricated panels [6].
- Self-standing steel modules: development of self-standing steel substructures, with steel frame modules covering two stories and providing addition of floor area to an existing building through the closing of balconies and loggias [6].

- The EASEE project provides a further development and application of a prefabricated system on existing residential buildings. It focuses on the envelope retrofitting of existing multi-storey and multi-owner buildings, through a TRM and EPS panels, installed with punctual anchors.

3. Results and Discussion – The majority of the projects analysed regards residential buildings, dating back to the period 1950s-1980s. Tertiary buildings retrofit is a well-documented theme, especially in case of curtain-walls renovation. Disparate solutions are available, mainly developed by façade-systems companies.

The main challenges are linked to design, fabrication, transport and installation: the classification of the projects has been shaped through those parameters, with a focus on residential retrofit. The majority of the projects involves addition retrofit, meaning the positioning of panels on the existing façade, but there are some cases regarding also partial or total replacement of the façade. The main issues are related to the presence of balconies, loggias or windows: in many cases, loggias are closed and transformed in living space, both for energy efficiency and for economical reasons. Some panels includes building services integration, mainly as ventilation ducts and solar systems (solar collectors or photovoltaics) [8].

Most of the projects presented does not include any follow-up, meaning that it is difficult to evaluate the effectiveness of the intervention in time. Several studies were carried out using numerical simulations: actual energy savings may be different from those estimated. Practical case studies are needed to help increase the level of confidence in potential retrofit benefits.

4. Conclusions - Building envelope represents a critical element to reach the 2050 decarbonisation goals, as it consists in the main part of the building thermal loads. The main targets connected to building envelopes regard the improvement of the energy performance, as well as its aesthetics, acoustic and lighting comfort, together with the quality of indoor environment [9]. Prefabrication in building retrofit is on its way to become a major tool to reach these goals. Several projects have been developed, and other are underway, both in terms of research projects and private initiatives. The classification of those projects is helping in identifying the main innovation fields to be further investigated. Some possible future developments are the thickness of the panel (linked to the use of innovative insulation materials), and the adaptation, in terms of finishing, dimensions and adjustments of the panel.

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BIA2015-62950-CIN