Interreg Sudoe

EUROPEAN UNION

IMIP_
Innovative Eco-Construction System Based on Interlocking Modular Insulation Wood & Cork-Based Panels

European Regional Development Fund

WP5 Activity 5.1.1 Report on use of interlocking panels in public buildings.

IMIP-SOE3/P3/E0963
Project funded by the Interreg Sudoe programme through the European Regional Development Funds (ERDF)

IMIP_
Interlocking Modular Insulation Panels

Interreg Sudoe

PROJECT CONTEXT

Project acronym	IMIP
Project title	Innovative Eco-Construction System Based on Interlocking Modular Insulation Wood & Cork-Based Panels
Project code	SOE3/P3/E0963
Coordinator	Universitat Politècnica de València (UPV), Instituto ITACA
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Technical Report	GT.5 D 5.1.1.
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WP Leader	ISA
Activity coordinator	ISA
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PARTNERS

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IMIP_
Interlocking Modular Insulation Panels

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Instituto Universitario de las Tecnologías de la Información y Comunicaciones
Information and Communications Technologies versus Climate Change

Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria, O.A., M.P - Centro de Investigación FORestal - Departamento de Dinámica y Gestión Forestal (INIA-CIFOR)

Institut Technologique Forêt Cellulose Bois-construction Ameublement (FCBA)

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Asociación de Investigación Técnica de las Industrias de la Madera (AITIM)

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Instituto Valenciano de la Edificación Fundación de la Comunitat Valenciana (IVE)

Instituto Superior de Agronomia (ISA)

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Pôle de Compétitivité XYLOFUTUR XYLOFUTUR PROD MAT FORETS CULTIVEES (Xylofutur)

ASSOCIATED PARTNERS

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Observatòri de la Sostenibilitat d'Andorra (OSA)

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INTRODUCTION

The work is contemplated in the IMIP project of the INTERREG SUDOE Program, within Working Group 5: GT5 (pilot actions)

These works focus on the construction of the Pilot Action Construction as a demonstration of the IMIP systems to be used in rehabilitation and new construction.

This report studies the IMIP systems and the materials that use natural cork and wood as raw materials.
The purpose of this report is to analyze the uses of interlocking panels in public buildings, specifically in the description of the results derived from simulations made within Pilot Actions.

The study is carried out within the scope of the Interreg Sudoe territories and we will focus more specifically on Portugal, France and Spain.

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Table 1: Programme and Project objectives and results.

Programme specific objective	To improve energy efficiency policies in public buildings and homes through the implementation of networks and joint experimentation.
Project main objective	To support the change towards a low carbon economy using bioproducts (wood and cork) for smart, sustainable, and inclusive growth with a special focus on the public construction sector.
Project specific objectives	To design, validate and implement a new ecological construction system to improve energy efficiency in public buildings. Related activities are: - To design an ecological construction system based on innovative wood and cork products supporting a low carbon economy, - To test prototypes, - To develop an Information and Communication Technology for design, modelling, and evaluation of potential construction solutions, - To compare the modular and interconnected insulating panels designed with currently used insulating panels, - To disseminate results and to train prescribers.
Programme result indicator	Percentage of actors in the energy efficiency sector participating in transnational cooperation projects.
Project results	An interconnected modular system of insulating panels made of wood and cork to improve energy efficiency of buildings, including their entire life cycle. A BIM plug-in to analyse the environmental benefits of bioproducts used in construction (carbon storage and substitute effect).

OBJECTIVES

This report consists in:
Describes and analyses the results derived from the simulations of the IMIP systems carried out within Pilot Actions applied in both public and private buildings.

PRINCIPLES

One of the principal intentions of the IMIP project was, a part from designing an innovative eco-construction system based on interlocking modular insulation wood & cork-based panels, is to build the pilot actions and verify the feasibility of the proposals both in interventions on public and private buildings and in new construction works such as rehabilitation or expansion of buildings.

PARTNERS

ASSOCIATED PARTNERS

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Study Cases

A. IMIP implementation as a new buildings

IMIP PILOT ACTION

1 -Valencia Test Site Pilot Action.

2 -Portugal Pilot Action.

OUT IMIP

3 -Salinas Sport Pavilion project.

B. IMIP implementation in renovation buildings

IMIP PILOT ACTION

4 -Espadilla Pilot Action.

OUT IMIP

5 - Benafer (Castellón) Ruin Restoration.

6 - Vilamarxant (Valencia) Town Hall Renovation.

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A. IMIP implementation as a new building

1 – Valencia Test Site. Pilot Action.

The "Valencia" Test site is the building assembled by applying the IMIP construction systems that can be resembled a standard new construction building, dedicated to multiple uses: such as housing, public building, education, services...
This building is the example that can show a new regular construction but with a great improvement in energy efficiency and with a low environmental impact

The systems and details used in this Pilot action have been:

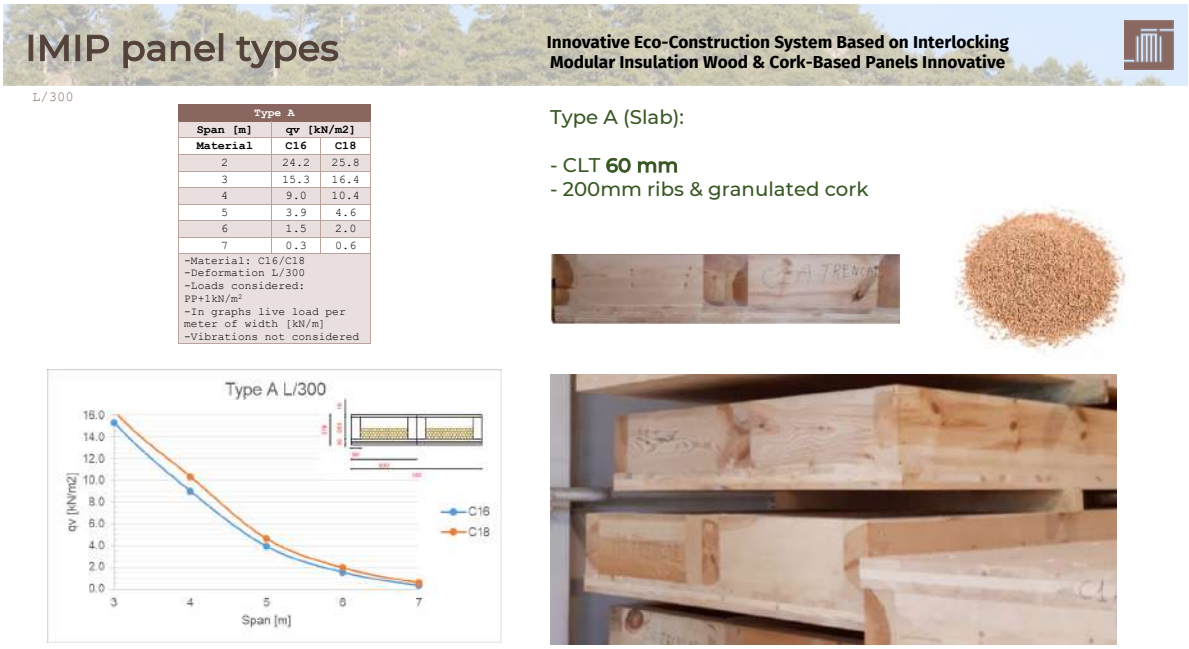

Fig. 1 Type A Deck

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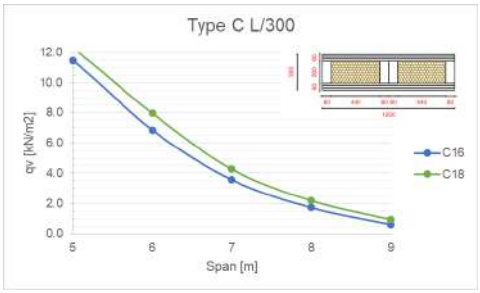
IMIP panel types

Innovative Eco-Construction System Based on Interlocking Modular Insulation Wood & Cork-Based Panels Innovative

L/300

Type C		
Span [m]	qv [kN/m2]	
Material	C16	C18
5	11.5	12.3
6	6.9	8.0
7	3.6	4.3
8	1.7	2.2
9	0.6	0.9

-Material: C16/C18
-Deformation L/300
-Loads considered: PP+1kN/m²
-In graphs live load per meter of width [kN/m]
-Vibrations not considered



Type C (Slab):

- CLT **60 mm**
- 200mm ribs & granulated cork
- CLT **60 mm**

Fig. 2 Type C Slabs

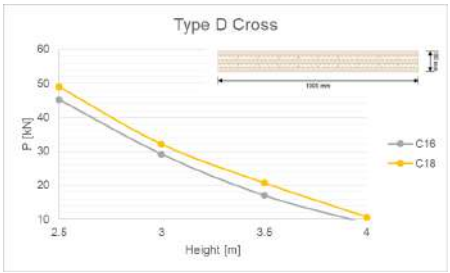
IMIP panel types

Innovative Eco-Construction System Based on Interlocking Modular Insulation Wood & Cork-Based Panels Innovative

Cross (perpendicular)

Type D		
Height [m]	P [kN]	
Material	C16	C18
2.5	45.3	49.0
3.0	29.2	32.1
3.5	17.1	20.8
4.0	8.8	10.7

-Material: C16/C18
-Panel orientation in the perpendicular direction of the load
-Loads considered: Wind 1kN/m² and eccentricity of 2cm
-In graphs live load per meter of width [kN/m]
-Vibrations not considered



Type D (Wall):

- CLT **100 mm**
- 100 mm Black cork board

Fig. 3 Type D Walls

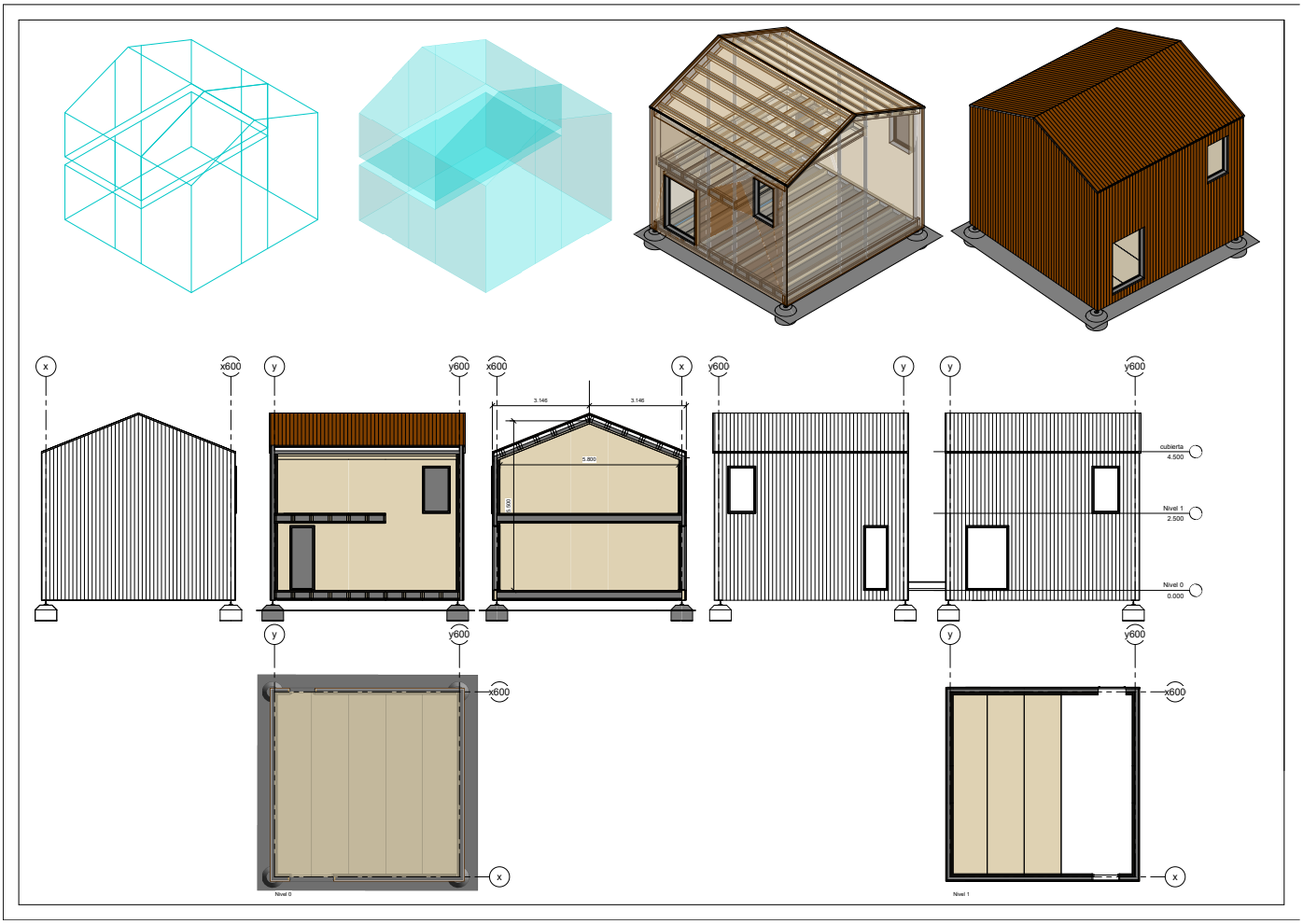


Fig. 4 Construction details of the pilot action in Valencia, combining the IMIP systems solving the different needs to complete the construction of a new building.

In the following images we can see the assemble of the interlocking panels and systems in the building, located at the Polytechnic University of Valencia. Fig .5.

Fig. 5 Valencia pilot action.

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2 – Portugal Pilot Action.

The "Portugal" Pilot Action is an example of a building assembled from the IMIP construction systems and which are assembled in a very simple way, which can be quickly dismantled, palletized and sent to another place to be able to reassemble it.

This type of construction can be dedicated to multiple uses:

such as, emergency housing building, temporary school, field hospital...

This building is the example that can show a new regular construction but with a great improvement in energy efficiency and with a low environmental impact

The systems and details used in this Pilot action have been:

Type C Slabs (The same as Valencia Test Site)

Type D Walls (The same as Valencia Test Site)

Type B Deck and SIP (Fig. 6)

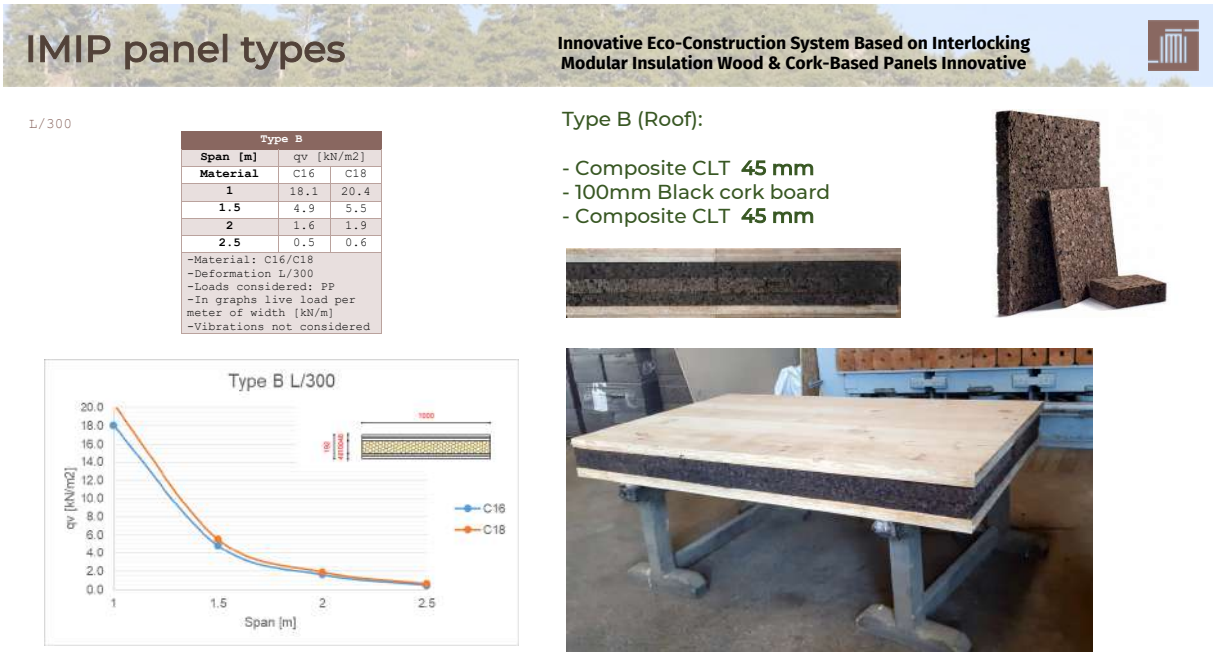

Fig. 6

Fig. 7 1st structural system.

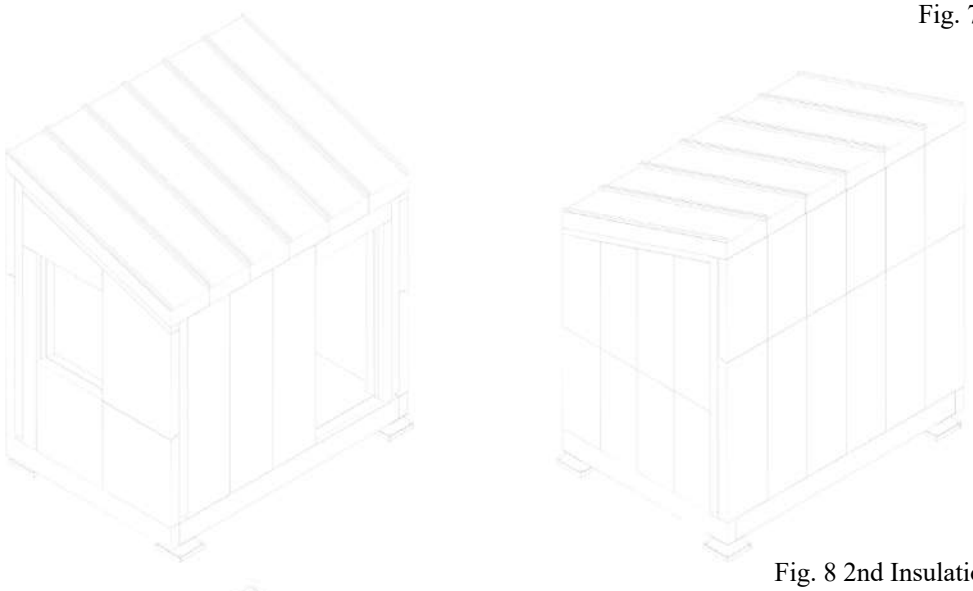

Fig. 8 2nd Insulation and waterproofing.

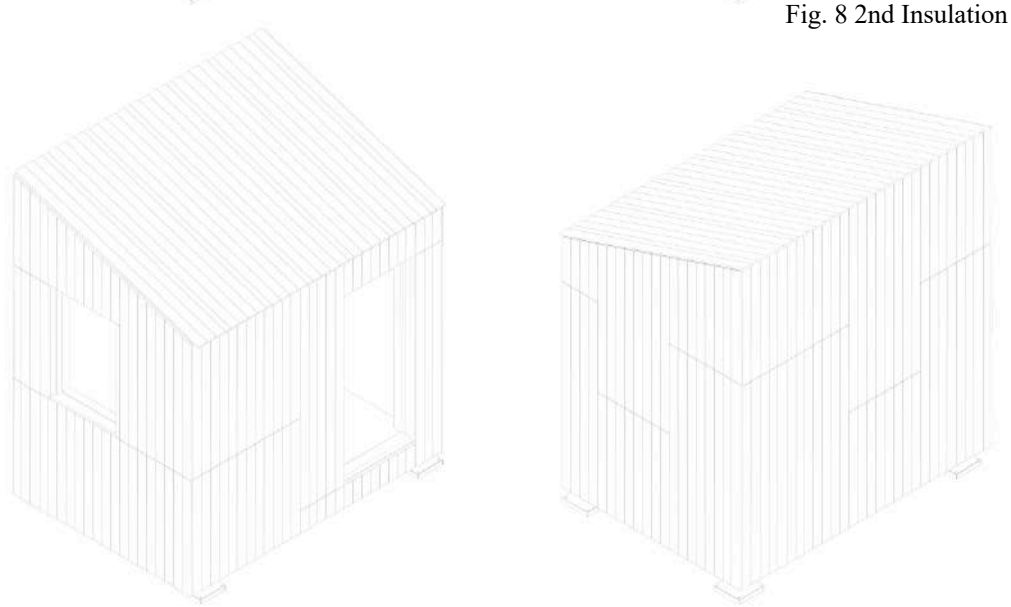

Fig. 9 3rd Finishes and façade systems.

Phased assembly system:

1st structural system
2nd Insulation and waterproofing
3rd Finishes and façade systems

Fig. 10 1st structural system.

Fig. 11 2nd Insulation and waterproofing.

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Fig. 12 3rd Finishes and façade systems.

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3 – Salinas Sport Pavilion project. OUT OF IMIP

The Salinas Sport Pavilion project is an example of a public building out of IMIP project, but assembled from the IMIP construction systems that can be combined with other different systems as the brick walls, steel structure or reinforce concrete.
This type of system located in this construction can be an example of combination with a Brick walls systems.

This building is the example that can show a new regular construction but with a great improvement in energy efficiency and with a low environmental impact

The systems and details used in this project have been:

Type D Walls and Slabs (The same as Valencia Test Site and also in horizontal way)

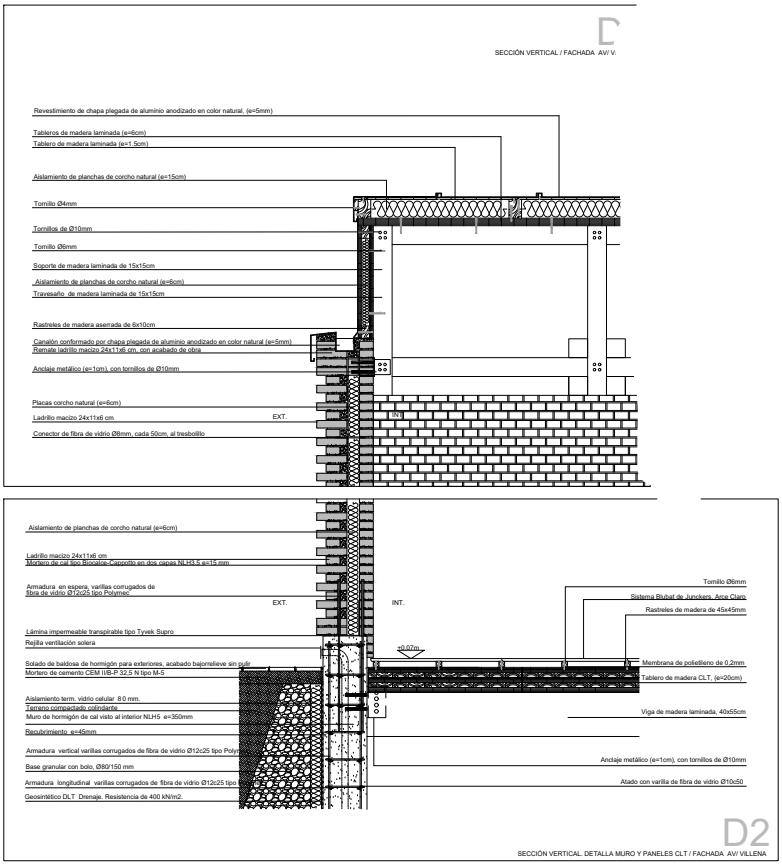

Fig. 14 Salinas details.

Fig. 15 Salinas Sport Pavilion Exterior view.

Fig. 16 Salinas Sport Pavilion Interior View.

B. IMIP implementation in renovation buildings

4 – Espadilla Pilot Action.

The Espadilla Pilot Action in Castellón (Valencia, Spain) is an example of a public building renovation that combines the IMIP systems with other pre-existing systems as the brick walls, steel structure and reinforce concrete.
The building is an old brick wall building that has been renovated by the town hall with the new use as a housing for people with low economic resources and with reintegration problems.

This building is the example that can show a new regular construction but with a great improvement in energy efficiency and with a low environmental impact

The systems and details used in this project have been:

Type D for Deck (The same as Valencia Test Site in horizontal way) Fig.17,18

Fig. 17, 18 Espadilla pilot action panels.

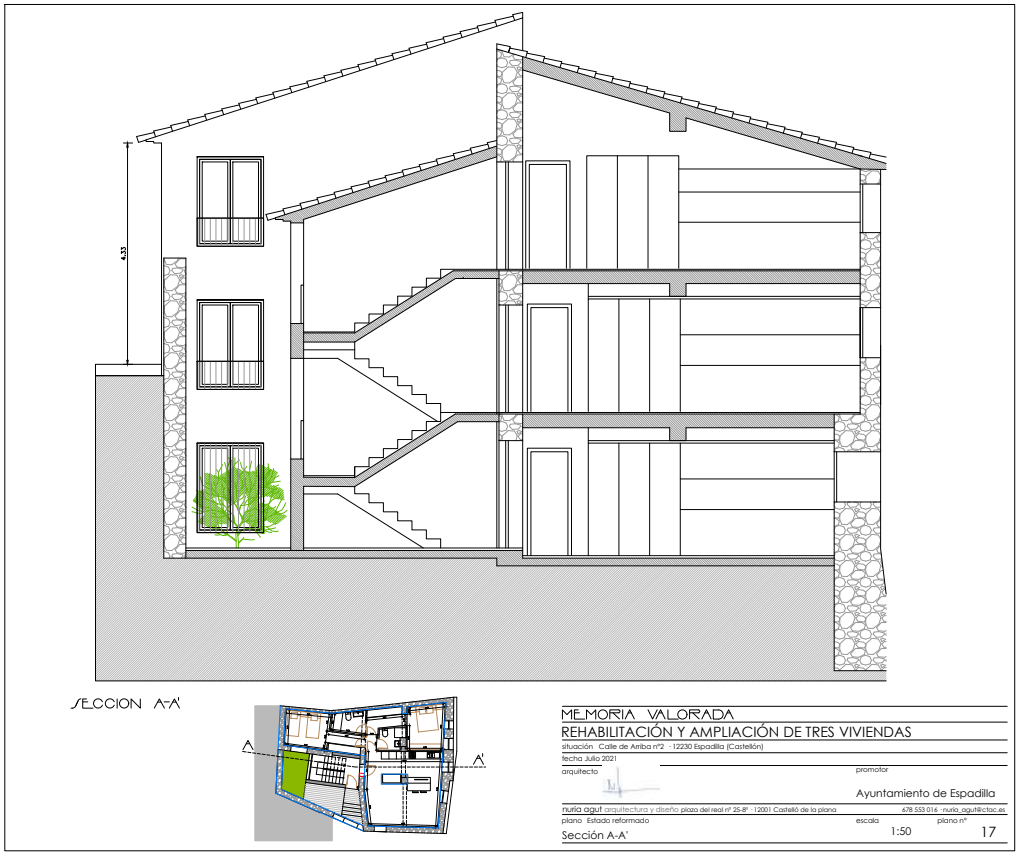

Fig. 17, 18 Espadilla pilot action.

Fig. 19, 20, 21 Espadilla pilot action cover.

5 – Benafer (Castellón) Ruin Restorat. OUT OF IMIP

The proposal for the use of IMIP systems in the rehabilitation of an old ruin, located in the rural world, focuses on prefabricating in the middle of the pre-existence. All the systems are configured to enable the ruin in an agile and habitable way with a considerable reduction of time in relation to the more traditional construction systems. The fundamental idea in this project proposal is to produce proposals that help the recovery of the rural world. To do this, it uses the latest technologies, IMIP sustainable systems, as well as prefabricated production systems.

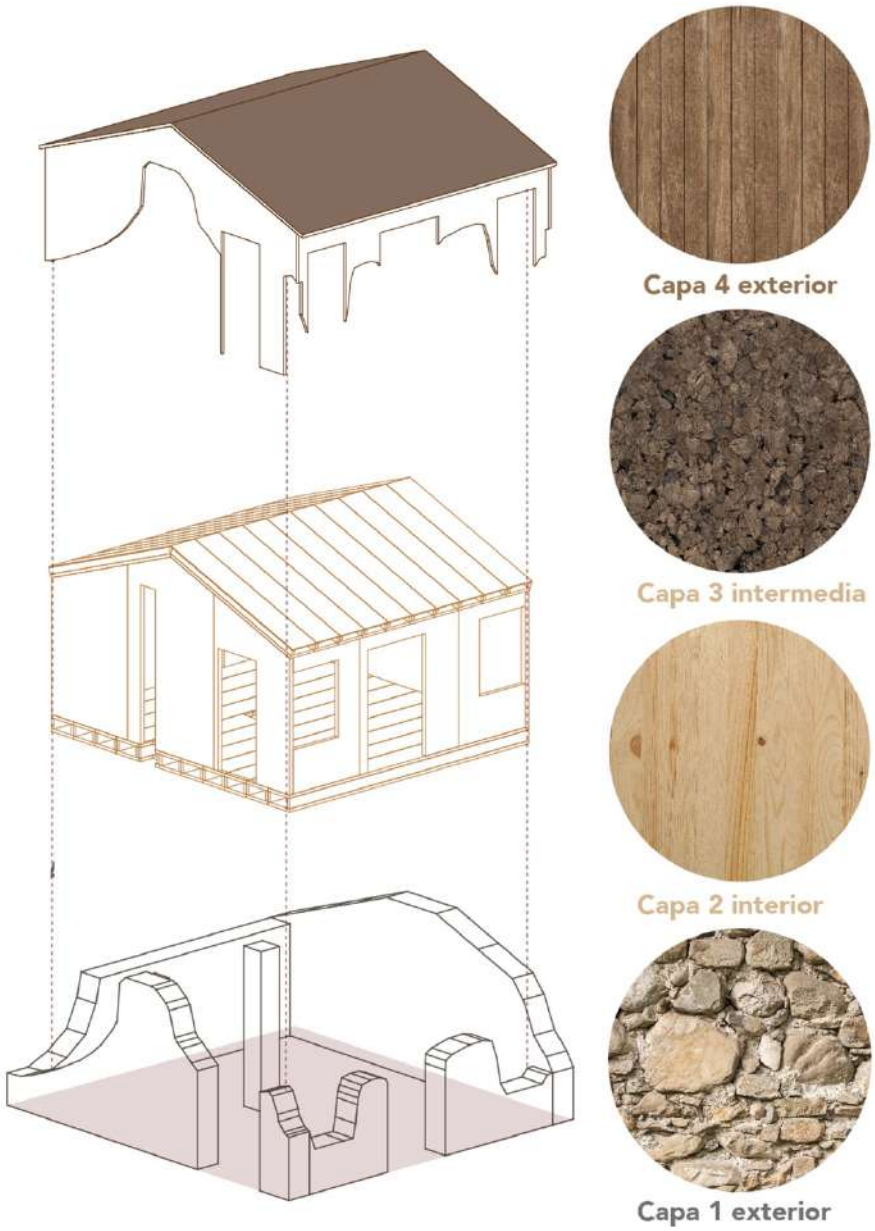

Fig. 22 Benafer construction assembly system.

Thanks to the modeling and production methods, a perfect symbiosis is achieved between the proposed IMIP construction system and the existing one. This customized survey, preview and modeling system facilitates the prefabrication of the panels, considerably reducing the possibility of errors. The integration of BIM with the IMIP web app allows the digitization of all project information, including the data necessary for thermal calculation. By exporting this information to the corresponding software, more reliable energy efficiency results can be obtained.

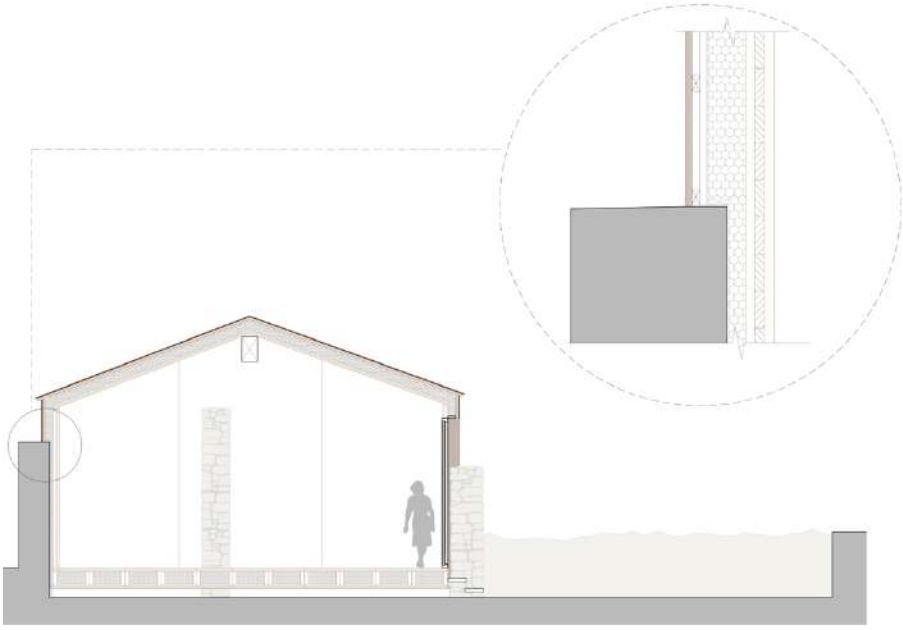

Fig. 23 Details Type D, A, C .

Fig. 24 Benafer project exterior view.

6 – Vilamarxant (Valencia) Town Hall Renovation. OUT OF IMIP

The intervention project on the Vilamarxant town hall building consists of increasing one floor in height on an existing 3-storey building to reach the 4th floor.

For this proposal, it has been projected from the IMIP systems. As a vertical load-bearing structure, a load-bearing wall system is proposed with type D details combined with . for covering type detail B.

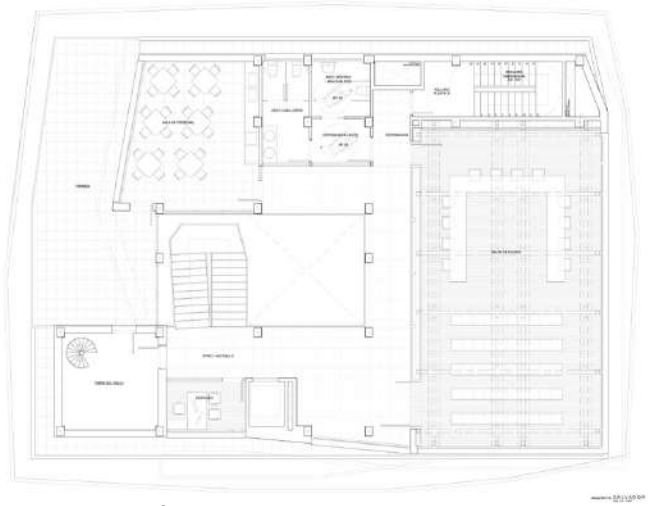

Fig. 24 Benafer project exterior view.

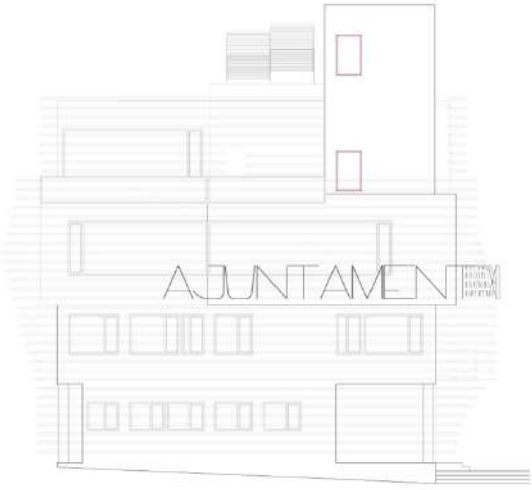

Fig. 25 Benafer plan and elevation.

FINAL CONCLUSION

The IMIP Pilot actions were proposed to be able to cover a range of options both for rehabilitation and for carrying out new construction works, so that any type of project can be undertaken. In this sense, we can affirm that the IMIP Project has been a complete success since the construction systems developed are sufficient to undertake both new construction and rehabilitation using the main systems such as roofs, floors, enclosures and interior partitions with the IMIP SIP.

Another fundamental part was, that the IMIP systems had to be compatible with other existing systems, since rehabilitation is an important item in the sustainable building sector. Once again, with the pilot actions carried out, we have shown that the systems developed are compatible with most of the pre-existing construction systems used both in recent years and those used throughout a large part of the history of construction.

Likewise, we can confirm that through the construction of these pilot actions, both energy efficiency and the reduction of the environmental impacts of the buildings in which they are implemented can be significantly improved.

Finally, to conclude that IMIP does not end in the IMIP project, but that currently outside of what is the IMIP Interreg Sudoe program, projects are being developed that use the results obtained in this program to develop the architectural proposal both in new construction, in extension and rehabilitation.