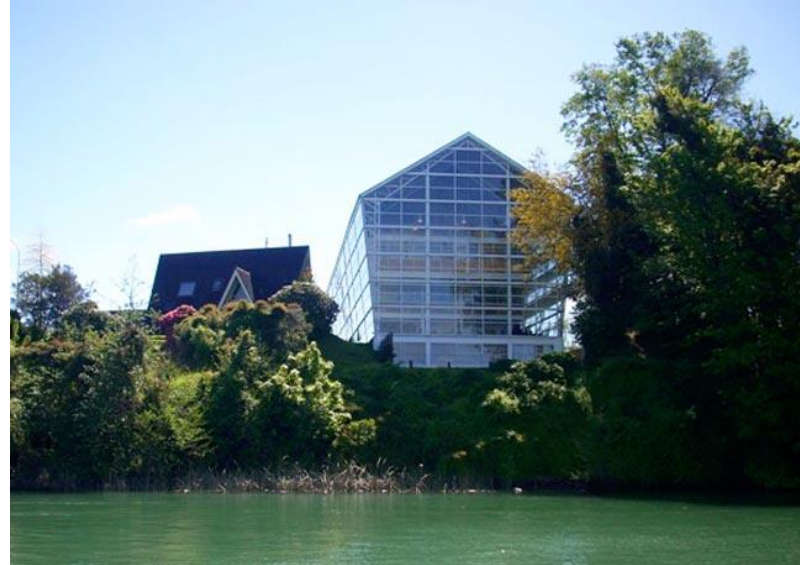


# Faculty of Architecture and Arts\_ Universidad Austral Valdivia

Leonardo Agurto Venegas, U. Austral de Chile, leonardo.agurto@uach.cl

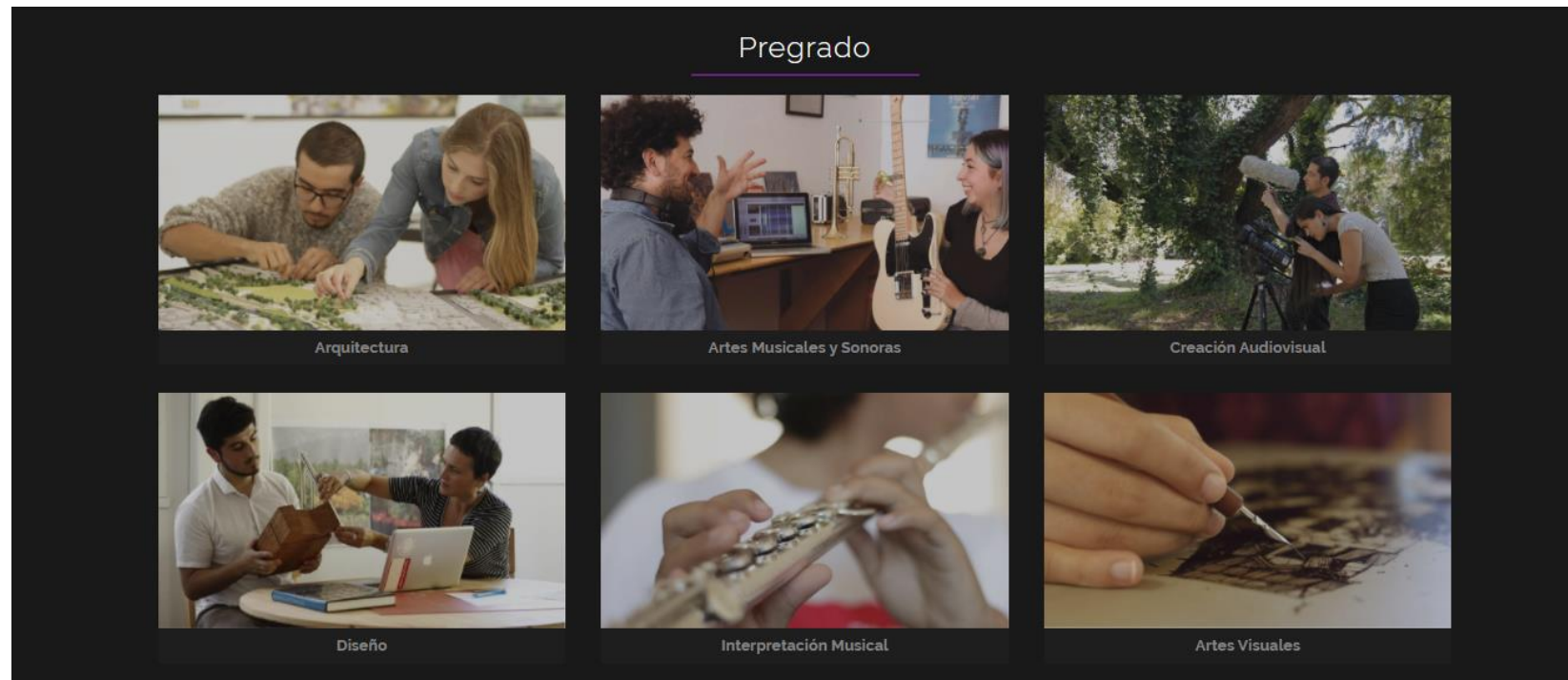


**A FACULTY OF ARCHITECTURE AND ARTS FOR THE AUSTRAL TERRITORIES**

<https://arquitectura-artes.uach.cl/>

# Faculty of Architecture and Arts\_ Universidad Austral Valdivia

Leonardo Agurto Venegas, U. Austral de Chile, [leonardo.agurto@uach.cl](mailto:leonardo.agurto@uach.cl)



**TRANSDISCIPLINARY APPROACH IN TEACHING AND RESEARCH**

**Arts + Architecture + Industrial Design + Audiovisual creation + Sound**

# Prosthesis Project\_From mapping local adaptations to an incremental system for refurbishment and adaptive urban spaces, neighborhoods and buildings

Leonardo Agurto Venegas, U. Austral de Chile, [leonardo.agurto@uach.cl](mailto:leonardo.agurto@uach.cl)

## I. Short Project description:

The PROSTHESIS project is an opportunity to learn lessons, conduct innovative research, and deeply understand current, past, and futures perspectives of development and innovations on cities through design of adaptive solutions under the concept of Circular economy and urban ecosystems.

Industry 4.0, refers to “the means of automation and data exchange in manufacturing technologies including Cyber-Physical Systems (CPS), Internet of Things, big data analytics, augmented reality, additive manufacturing, simulation, horizontal and vertical system integration, autonomous robots as well as cloud computing” (Shahrubudin, N. et al. 2019). One of the main proposals behind this concept is finding mechanisms to progressively integrate and combine all these technologies, intelligent machines, human actors, physical objects, manufacturing lines and processes across organizational stages to build new types of systematic and high agility value chains.

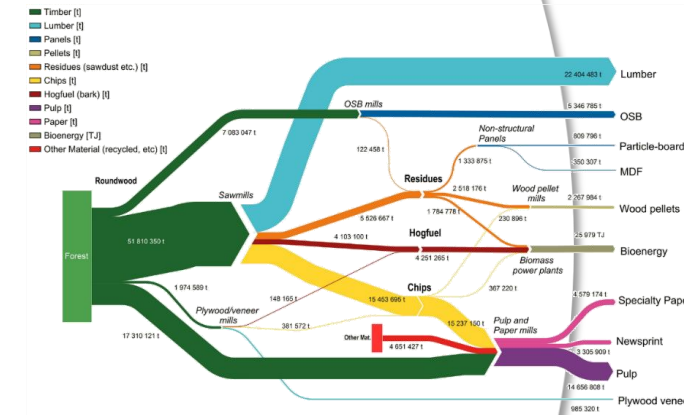
Understanding patterns of design in cities, neighbourhood and buildings, and specially housing, elaborating accurate responses to upgrading spaces, functions and innovation ecosystems is the main objective. Mapping energies, raw, elaborated and waste materials, technological trajectories could make possible to discover new possibilities that emerged based on qualitative and quantitative research, data analysis is challenging and needs some specific approaches in our Latin american contexts.

# Prosthesis Project\_From mapping local adaptations to an incremental system for refurbishment and adaptive urban spaces, neighborhoods and buildings

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Research focus/core competencies related to project, Unfolding Circular Innovation Ecosystems complexities.

- 1. Constructing an hybrid framework:** It is clear that quantitative research and its "instrumental rationality"(Adorno, 1978), is not enough to deal with all the problematics, conflicts and rhythms, so key concepts, standards, and indexes need to be understood, calibrated and redefined. Several disciplines need to be connected, from technology studies to philosophy.
- 2. Unfolding Innovation Ecosystems complexities. The construction of an interactive Atlas.** Mapping Innovation Trajectories. Taxonomies of technologies will be build based on actions, facts, results, representative objects, energy consumption patterns, and socio-environmental impacts. Also, technology classification will be useful to clarify evolution and transition as a gradual transformation in several fields of industry and markets.
- 3. Projecting Innovation (Innovative) complexities. The construction of a new imaginary:** The research aims to settle a ground for the development of a series of prospective discussions , using Research by Design methodology, about several scenarios, showing new necessities and programs, design and business opportunities, adaptive components, potential risks, bsd on local scenarios and daily life.



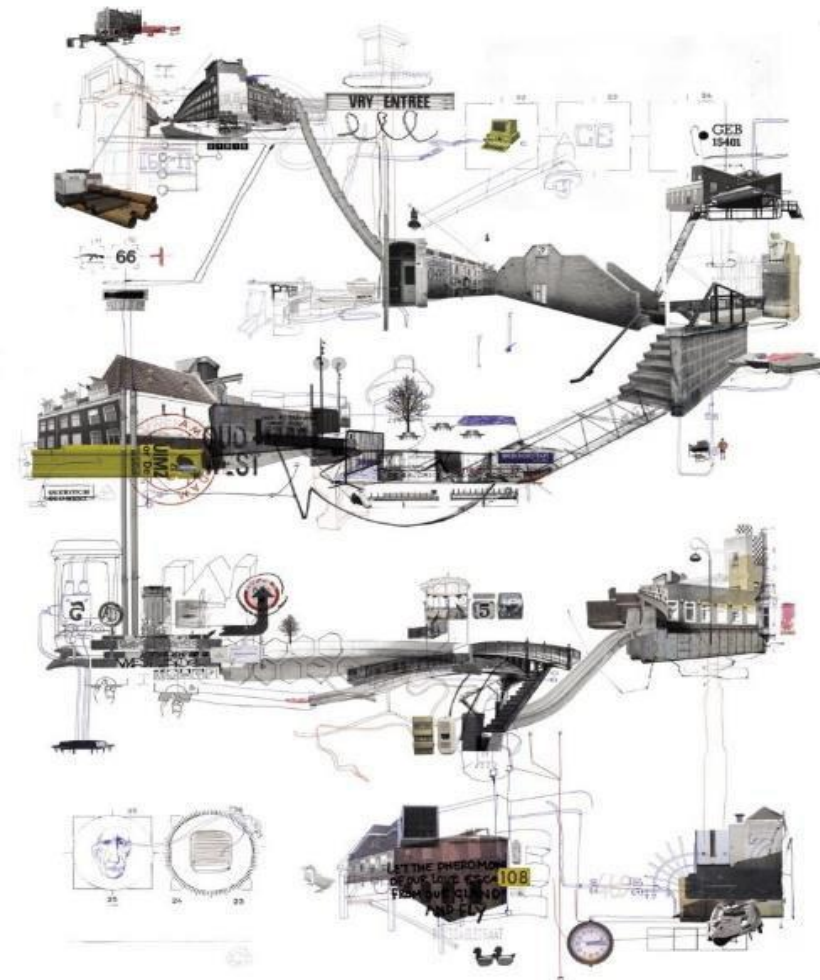
# Prosthesis Project\_From mapping local adaptations to an incremental system for refurbishment and adaptive urban spaces, neighborhoods and buildings

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**Research by Design methodology, about several scenarios . Unfolding Circular Innovation Ecosystems complexities in the city:**

Creating a methodology, addaptied to several scenarios, showing new necessities and programs, design and business opportunities, adaptive components, potential risks, based on local scenarios and daily life. discussing and also proposing design exercises, mapping and designing projective realities and ecologies in many areas and contexts such as:

- City development and urban spaces impact.
- Decarbonizing cities
- Renewable Energy integration
- Consumption patterns and human life perspectives.
- Rural spaces and landscape impacts.
- Technology production and applications. Regenerative Technologies for cities.
- The new organization: In work, social organization.
- Business, public finance,



**1. INTEGRATED MAPPING AND DESIGN PROCESS**

1.1. Stocktaking of solutions



1.2. Local analysis process / Mapping



1.3. Research by design



1.4. Optimization process

**2. EXPERIMENTAL RESEARCH**

2.1. Components construction



2.2. Field-based experiment



2.3. Monitoring system



2.4. Correction process

**3. RESULTS**

DESIGN OF PROTOTYPES  
Projects and constructability  
Theoretical performances  
LCA

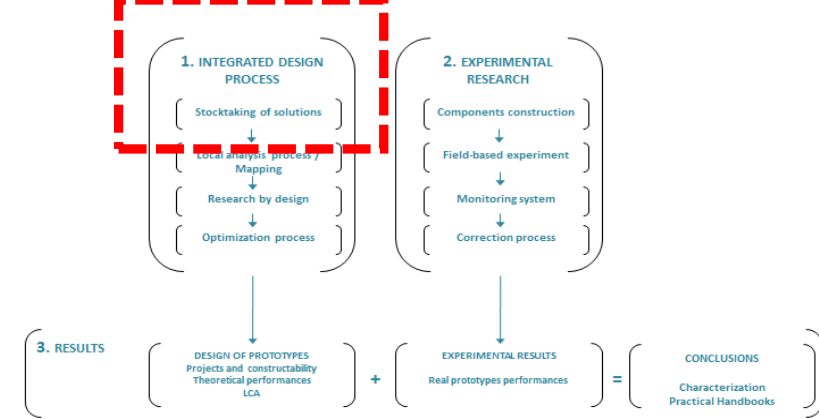
+

EXPERIMENTAL RESULTS  
Real prototypes performances

=

CONCLUSIONS  
Characterization  
Practical Handbooks

# 1.1. Stocktaking of solutions

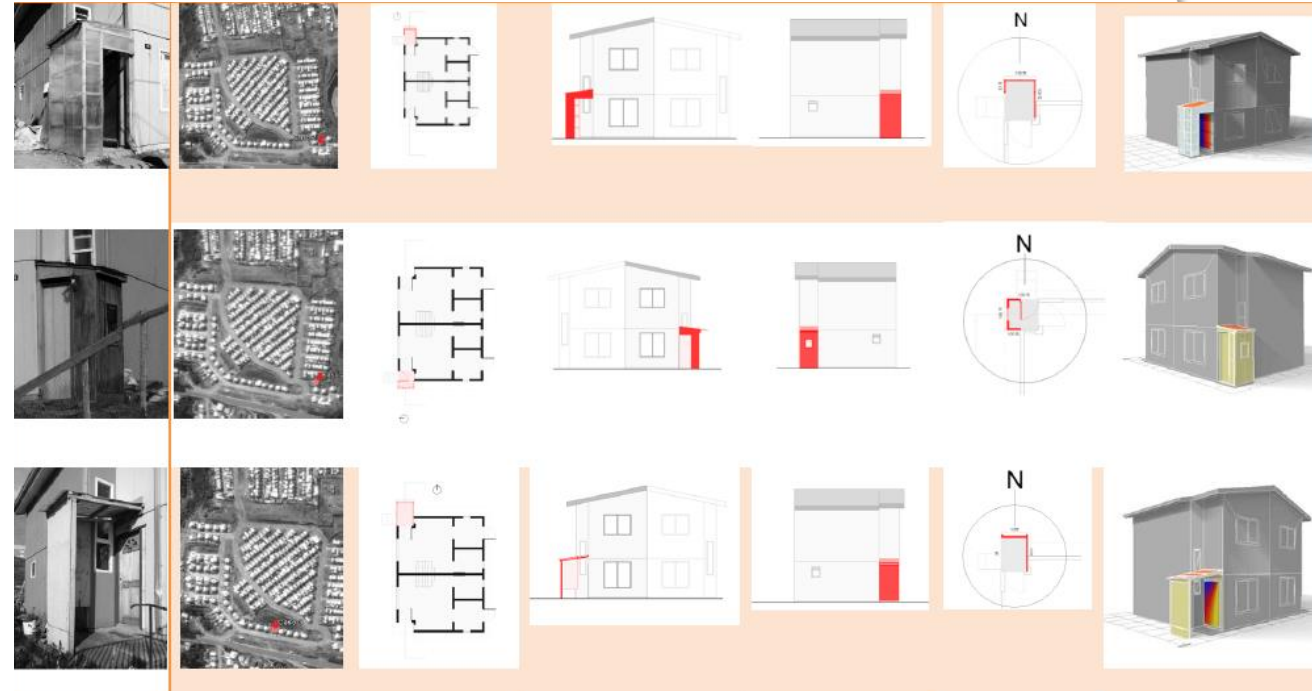
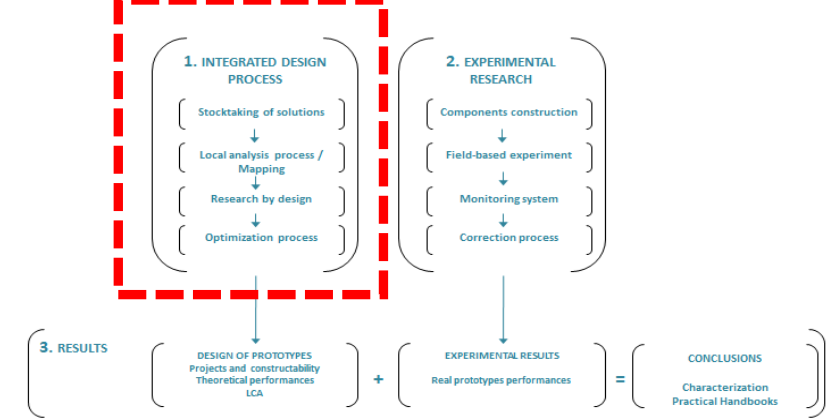


WINTER			SUMMER		
BIOCLIMATIC SOLUTION			BIOCLIMATIC SOLUTION		
<b>AVOID LOSS</b>	<b>CONDUCTION</b>	<b>Minimize conductive heat flow</b>	<b>AVOID GAIN</b>	<b>CONDUCTION</b>	<b>Minimize conductive heat flow</b>
		Insulation Spacing between elements / Conduction breakage Indoor wall surface treatment Gap facades intervention			Insulation Spacing between elements / Conduction breakage Indoor wall surface treatment Gap facades intervention
	<b>CONVECTION</b>	<b>Minimize external air flow</b>		<b>PROMOTE LOSS</b>	<b>Promote earth cooling</b>
		Transitional spaces			Potential of earth as a heat exchanger
		<b>Minimize infiltration</b>	<b>Minimize infiltration</b>		<b>Promote ventilation</b>
		Thightness / Gaskets and Seals	Double-leaf enclosures with air chambers Glazed solar chimney		Solar chimney Openings Wind tower Night cooling
<b>PROMOTE GAIN</b>	<b>RADIATION</b>	<b>Promote solar gain</b>	<b>PROMOTE GAIN</b>	<b>RADIATION</b>	<b>Promote radiant cooling</b>
		Direct gain Semi-direct gain Indirect gain with heat storage			Night re irradiation sky Radiant cooling
<b>EVAPORATION / CONDENSATION</b>					<b>Promote evaporative cooling</b>
					Evaporative cooling

COMFORT CONTROL STRATEGIES - WINTER				
	BIOCLIMATIC SOLUTION	GENERIC PROSTHESES	SPECIFIC PROSTHESES	ANOTHER FEATURES
CONDUCTION	Minimize conductive heat flow	Fixed insulation		
		Movable insulation Air chambers		
	Spacing between elements / Conduction breakage	Ventilated facade	Ventilated facade with open joints Ventilated facade with closed joints	Windows with different outside materials
	Indoor wall surface treatment	Technical floor	Windows and carpentry with thermal bridge breakage Cantilever with thermal bridge breakage	Balcony with thermal bridge breakage
CONVECTION	Minimize external air flow	Refractory lining	Metal plate on the wall	
		Gap facades intervention	Double-leaf window	
CONVECTION	Minimize infiltration	Buffer spaces	Added in facades integrated	
		Transitional spaces	Link with public space Permeable spaces Functional Annex	
RADIATION	Promote solar gain	Thightness / Gaskets and Seals	Double-leaf door	
RADIATION	Promote solar gain	Solar collectors	Collector windows	Shape Surface Sloped of the surface Materiality changes Transparent Surface skylights Tubular skylights
		Solar equipment integration	Heliodomestic Solar dryer Solar distiller	Shape Accumulator kitchen and solar Parabolic kitchen Clothes dryer Dish dryer
	Semi-direct gain	Sunrooms		Water bottles in the roof
	Indirect gain with heat storage	Green-house	With different kind of accumulator wall	ventilated not ventilated separated
		Trombe wall	Classic Trombe wall	Water w all (1) Single glazed_matt
		Bank roof		
		Thermal mass	Aggregates indoor wall	
			Water wall	

COMFORT CONTROL STRATEGIES - SUMMER 1/2					
	BIOCLIMATIC SOLUTION	GENERIC PROSTHESES	SPECIFIC PROSTHESES	ANOTHER FEATURES	
CONDUCTION	Minimize conductive heat flow	Fixed insulation			
		Movable insulation			
	Spacing between elements / Conduction breakage	Ventilated facade	Ventilated facade with open joints Ventilated facade with closed joints	Windows with different outside materials	
	Indoor wall surface treatment	Technical floor	Windows and carpentry with thermal bridge breakage Cantilever with thermal bridge breakage	Balcony with thermal bridge breakage	
CONVECTION	Minimize infiltration	Refractory lining	Metal plate on the wall		
		Gap facades intervention	Double-leaf window		
CONVECTION	Minimize infiltration	Double-leaf enclosures with air chambers	Added in facades integrated		
		Glazed solar chimney	Link with public space Permeable spaces Functional Annex		
RADIATION	Minimize solar gain	Shading devices	Double-leaf door		
	Promote solar gain	Solar collectors	Collector windows	Shape Surface Sloped of the surface Materiality changes Transparent Surface skylights Tubular skylights	With out the possibility to stay under the eaves / shelter With out the possibility to stay under the eaves Livable Reconfigurable corridor Cantilever flat Other functions Clotheslines Canopies Planter Podium / box Pergola Pentail Corridor Horizontal Vertical Oblique All orientations
		Solar equipment integration	Heliodomestic Solar dryer Solar distiller	Shape Accumulator kitchen and solar Parabolic kitchen Clothes dryer Dish dryer	Horizontal Vertical Oblique
Semi-direct gain	Sunrooms		Water bottles in the roof	Horizontal Vertical Oblique	
Indirect gain with heat storage	Green-house	With different kind of accumulator wall	ventilated not ventilated separated		
		Trombe wall	Classic Trombe wall	Water w all (1) Single glazed_matt	
		Bank roof			
		Thermal mass	Aggregates indoor wall		
			Water wall		

# 1.2. Local analysis process / Mapping





# 1.3. Research by design process

1.2. ACCUMULATION.  
Tubes with mass materials,  
water, sand, clay or gravel.  
Different configurations of  
thermal mass to integrate  
housing in wood

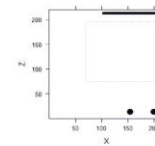
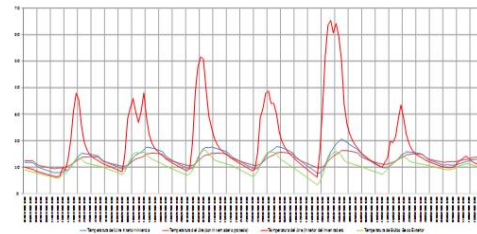
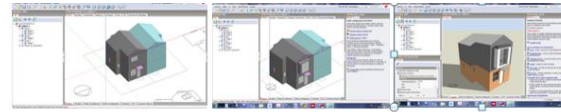
FIXED FRAME SIDE. To  
complete opening of the  
slide of the greenhouse

PANE OF GLASS FOR  
HARVESTING SOLAR.  
Greenhouse by single crystal  
blade movable sideways to  
avoid overheating in summer

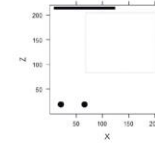
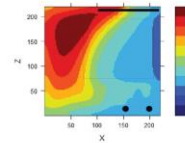
Adaptable frame and adjustable  
to any type of structure.  
Different fastening systems.

Pine wood frame with angular  
projection chance to promote  
the uptake

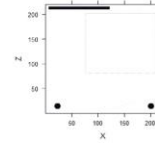
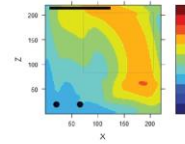
SHADING Removable horizontal slats in winter  
to prevent excessive solar gain.



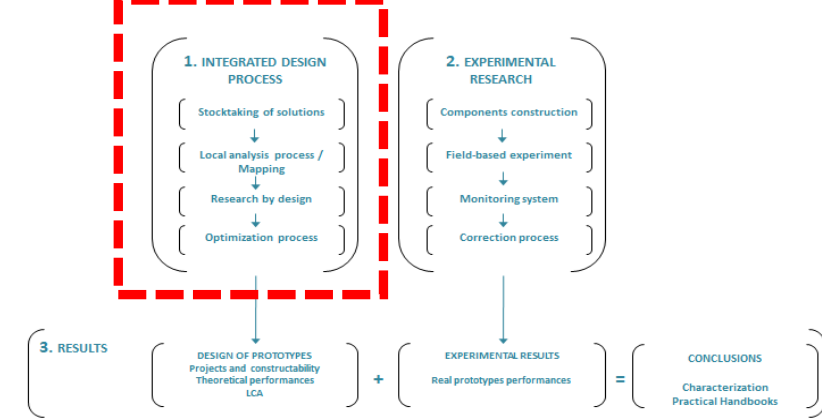
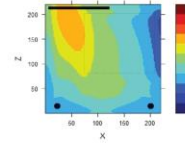
a)



b)



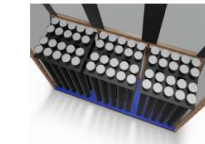
c)



3.

2 de Febrero del 2016

Búsqueda de una estructura que permita una superficie vidriada mayor. Carpintería en madera y recubrimiento en vidrio 6mm. Menor espacio, no habitable, con piso propio y utilizando la totalidad de la planta con tres baterías removibles de tubos de PVC 120mm. Rellenos con agua para cumplir la función de masa térmica. Chapas metálicas pintadas negras unidas a las costillas modulares para aumentar la capacidad de concentración del calor. Incorporación del color azul representativo del proyecto Prótesis.

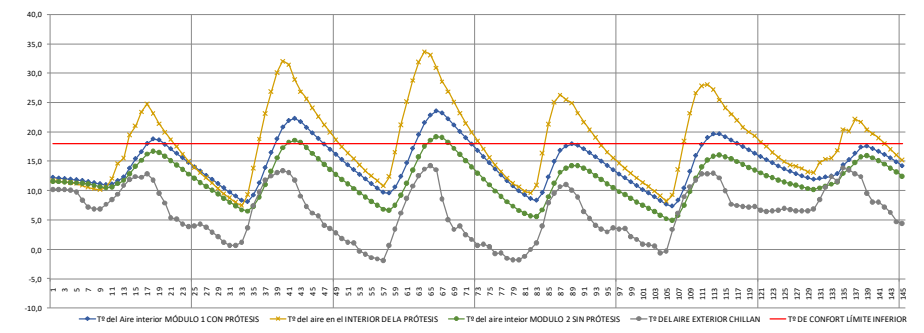
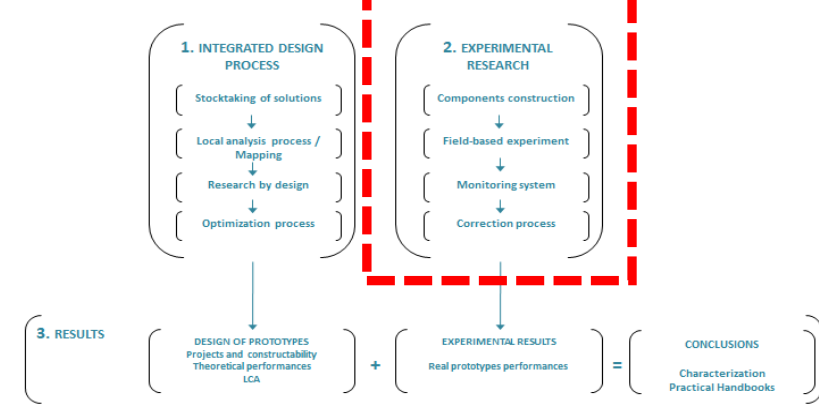
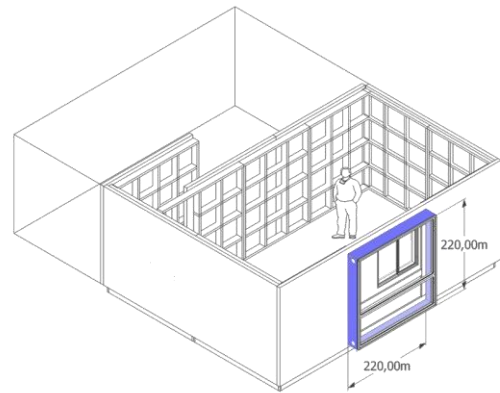


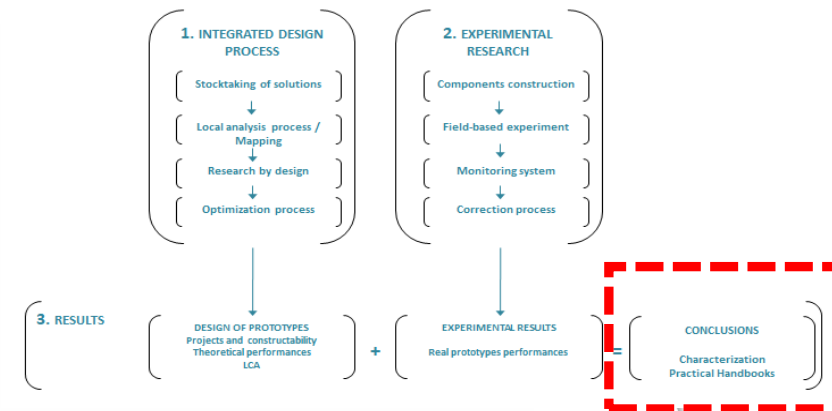
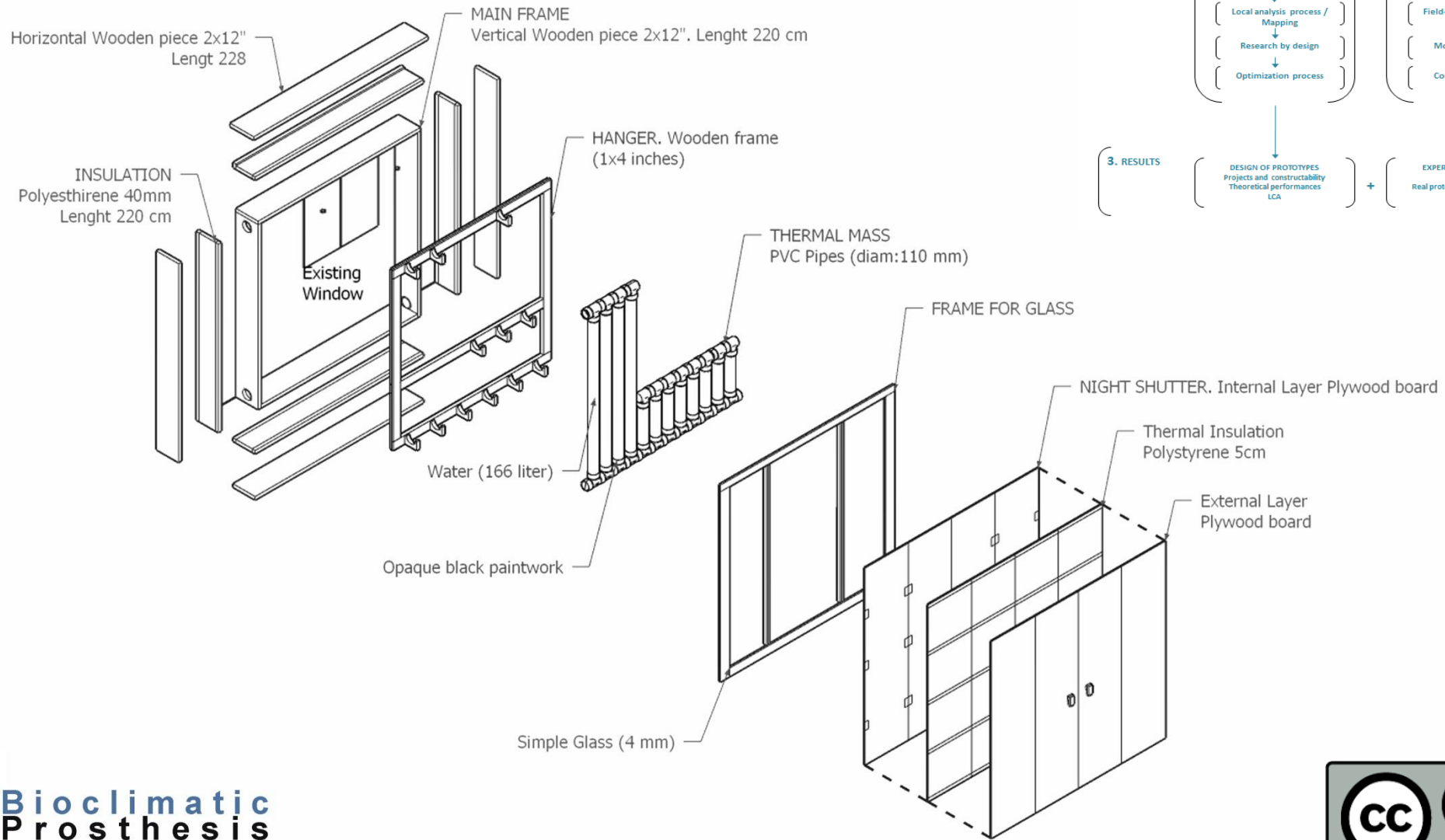
4.

20 de Febrero del 2016

Eliminación del ángulo óptimo en el cristal y tuberías  
Incorporación de postigos para la conservación de  
energía durante la noche.





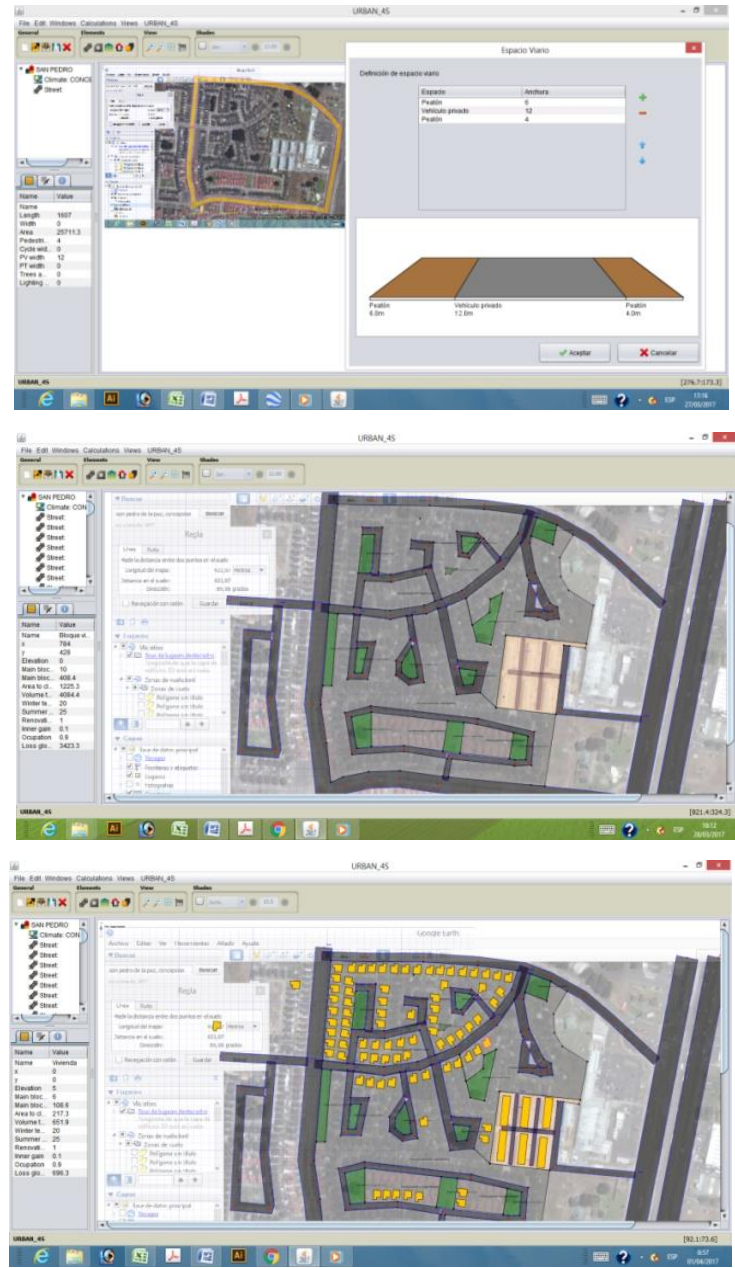




# URBAN\_4S

## Sustainable\_Socio\_Spatial Software

Desarrollo de una herramienta computacional para el diseño y evaluación de conjuntos urbanos resilienciales en base a criterios urbanos, sociales, de eficiencia energética, de calidad y sostenibilidad. Id. Proyecto: 14.01.2018\_2014/2017\_FONDECYT Programa IDE4 en dos etapas. Concepción-Zaragoza 4F: 2017





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## Links

<https://challenge.whatdesigncando.com/projects/bioclimatic-prosthesis/>

<https://www.sciencedirect.com/science/article/pii/S2352340920304418>

<https://www.researchgate.net/profile/Leonardo-Agurto>

<https://architectuur.kuleuven.be/departementarchitectuur/english/research/phd-postdoc/postdoc/LeonardoAgurtoVenegas>

<https://vimeo.com/235235979>

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Shahrubudin, N., Chuan, L. Te, & Ramlan, R. (2019). AN OVERVIEW OF CRITICAL SUCCESS FACTORS FOR IMPLEMENTING 3D PRINTING TECHNOLOGY (September). DOI:10.5937/jaes17-21526

Tay, S. I., Tun, U., Onn, H., Chuan, L. Te, Tun, U., Onn, H., Onn, H. (2018). AN OVERVIEW OF INDUSTRY 4. 0: DEFINITION, COMPONENTS, AND GOVERNMENT INITIATIVES (April 2019).