Bioclimatic design at the new social housing building and retrofitting of the old block houses in Vitoria-Gasteiz/ES/Basque Country

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Bioclimatic design and sustainable development

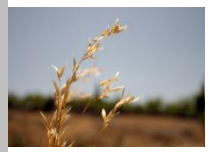
Bioclimatic design **conserves resources** and **maximizes comfort** through design adaptations to site-specific and regional climate conditions.

Describe how the building responds to local climate, sun path, prevailing breezes, and seasonal and daily cycles through **passive design strategies.**

Climate analysis

Sun and solar radiation

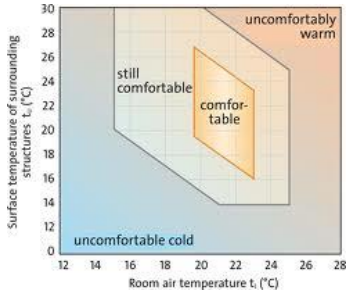
Temperature



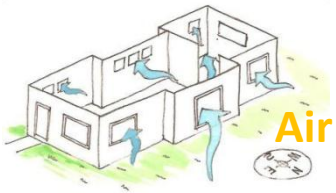
Wind

Precipitation and relative humidity

Comfort: health and quality of life



Thermal comfort



Air quality

Conventional and innovative bioclimatic solutions for refurbishment and new buildings

General design considerations

- orientation
- layout, zone planning
- compactness
- glazing, fenetration
- thermal mass

Principles against heat loss in winter

- Heat protection of the building envelope
  - thermal insulation of the building envelope (external wall; roof, flat; roof, pitched; roof, loft; ground floor)
  - window, glazing
  - double skin facade
  - air-tightness
  - avoid / insulate the thermal bridges
- Passive solar heating systems
  - direct system (sunshine through the window)
  - indirect systems (transparent thermal insulation; thermal storage walls (mass wall, trombe wall); roof pond)
  - isolated systems: (sunspace; thermosypho)

Principles to avoid the summer overheating:

- Passive cooling systems
  - Evaporative cooling
  - Radiant cooling
  - Earth cooling
- Natural ventilation
- Shading against overheating
  - Exterior shading devices (solar screens; roll-down blinds; shutters; vertical louvers/fins; horizontal louvers/fins; canvas awnings (fixed or moveable))
  - Interior shading devices (between glazing, with ventilation; between glazing, without ventilation; behind glazing, with ventilation; behind glazing, without ventilation; slanted glazing on the facade).
- Vegetation, water surfaces
  - vegetation around the building
  - green facade
  - green roof
  - water surfaces (around the building; on the façade)

VITORIA-GASTEIZ COMMUNITY CASE STUDY

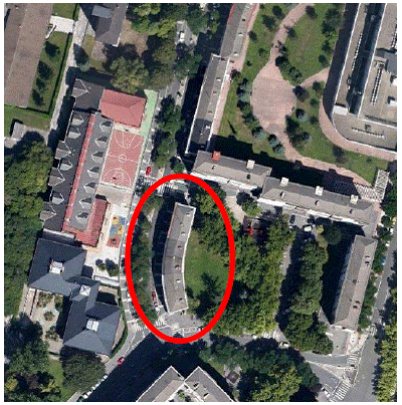
Location

Vitoria-Gasteiz is a 240580 population city located in the Basque Country in the Northeast of Spain. 42.84N,-2.65W. Altitude is about 520m.

- A32: Five dwellings in floor 1 of portal 1 will be joined and use as acare establishment. It will be accessible from one of the locals of the same portal.

- Retrofitting in Zaramaga: residential building with 30 dwellings: **Ground floor + 4 floors + box rooms in the floor under the roof.**

Buildings	Action	Buildings	Dwellings	Gross floor area
A-32	New building	1	171 and 1 care establishment	15.079 m²
Cuadrilla Laguardia	Retrofitting	1	30	1.678m²
TOTAL		**2**	201 + 1 C.E.	16.757 m²



VITORIA-GASTEIZ: CLIMATE DESCRIPTION

CLIMATE ZONE D1 (Vitoria)

Victoria is considered as part of the D1 climatic zone according to this regulation.

Temperature

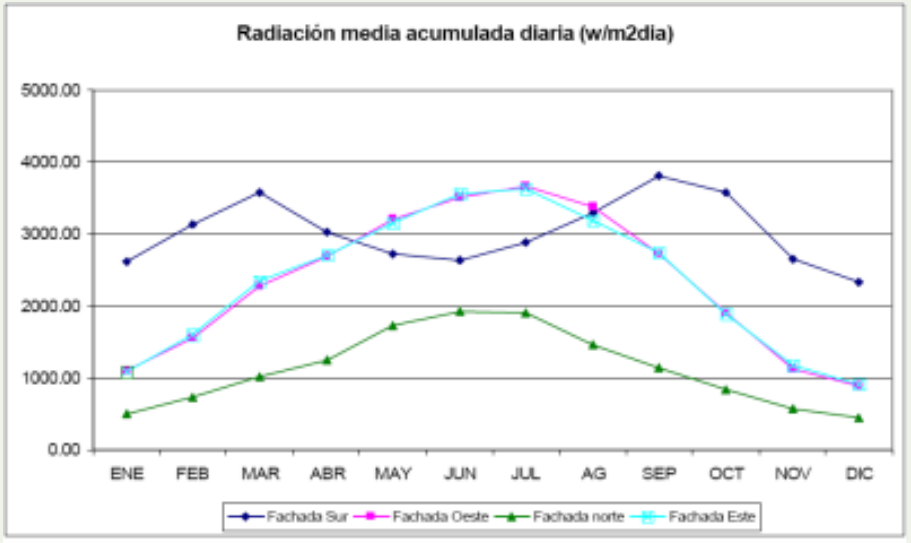
Mean temperatures in Vitoria are those of cold winters (2ºC) and moderate summer (24ºC). Daily temperature fluctuation is not high, around 10-12ºC all year about.

Rain (Precipitations)

. Sunny days in Vitoria are few all year around, from two days during the winter to 4 during the summer months. Rain is abundant, with about 10 rainy days per month during winter, spring and autumn, and shows a reduction during the summer with only 5 or 6 days per month. Summer has the highest number of stormy weather days per month.

Sunshine

Next figure shows solar radiation on the different façades. East and west façade receive much more radiation during the summer period. This is not strongly detriment on a moderate climate as the one in Vitoria. Solar radiation on the south façade shows a significant reduction from March to September, receiving less radiation during the summer period.



Relative humidity

Humidity is almost constant during the different seasons varying from 50 to 60% from winter to summer period.

Wind

Summer period is windier with a northeast direction. This direction is predominant also during spring and September; in those cases the Southwest direction is also important. During the winter and the end of autumn southwest is predominant.

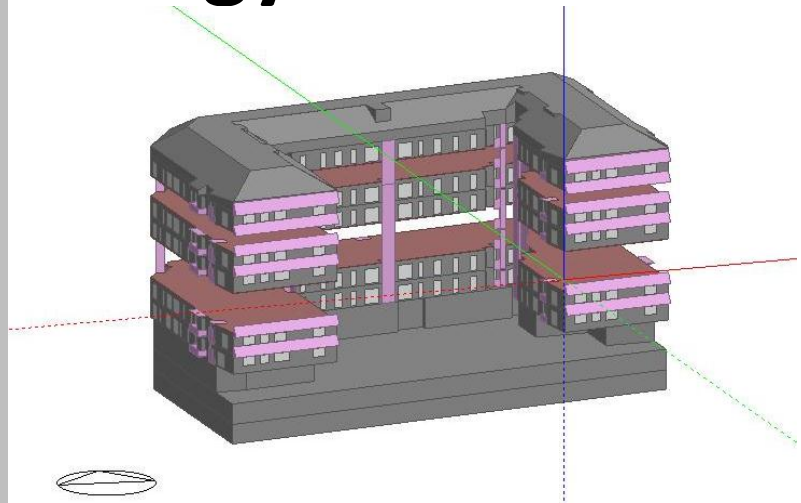
A-32 Project in Salburúa (Vitoria-Gasteiz) is a promotion of subsidized dwellings whose design have taken into account criteria of **energy efficiency**, **harnessing of renewable energy** and **sustainability and continuity over time**.

MAIN GOALS FOR ENERGY EFFICIENCY AND ENERGY MANAGEMENT

CONSTRUCTIVE IMPROVEMENTS TO GAIN A HIGHER ENERGETIC EFFICIENCY	○ 30% Reduction of the total energy consumption estimated by CTE (considering mechanical ventilation of 1.00 renov/hour) ○ Façade thermal transmission < 0´35 W/m²K ○ Roof thermal transmission < 0´24 W/m²K ○ Floor on slab over the ground thermal transmission < 0´30 W/m²K ○ Window frame and glazing thermal transmission < 2´00 W/m²K ○ Shading elements covering >90% of the openings surface
ELECTRIC ENERGY PRODUCTION (FOR HEATING AND HOT WATER)	○ Using cost effective RES technologies using a microgrid. Photovoltaic installations will be used.
OTHER PARTICULAR IMPROVEMENTS…	○ Low temperature heating ○ Low emissive glazing ○ Systems to reduce lighting consumptions.
ENERGETIC MANAGEMENT	○ By the ESCO set up by EVE and VISESA will control the energy distribution and the internal consumption or the energy sold out to the grid.
MONITORING	○ Improvements will be verified by the monitoring of the buildings during their first year in use.

DESIGN PRINCIPLES	
BIOCLIMATIC STRATEGIES (SYNTHESIS)	○ Compact volumes ○ Optimum orientation: South faced ○ Overhanging elements in South façade to shade openings during summer season ○ Natural cross ventilation ○ Lumber rooms under roofing ○ Low transmittance enclosure. High insulation thickness ○ Low emissivity glazing ○ Air tight, thermal break window frames
Shape factor	Relation between the outer surface and the volume contained inside it. It has influence on the energy exchange between the building and the exterior.
Volumetric	Stepped volumes to shade façades in order to avoid direct radiation during summer time and allowing it during winter.
Orientation	To harvest the maximum radiation during winter and the less during summer. Considering dominant winds.
Solar exposure and protection	○ Analysis of the stereographic solar chart to make a correct façade design for each orientation. ○ Projecting elements designed considering solar height both in summer and winter to have and effective use of solar radiation. - Summer: Avoid solar radiation. - Winter: Harvest solar radiation.
Space distribution	It is advisable to fix less occupied rooms in most exposed zones in order to perform as “thermal buffer spaces”.
Surroundings	Influence of buildings, green zones and asphalted zones is also studied: - Consideration of the influence of other buildings, parks, trees, asphalted zones… of the surroundings. - Geographical determining factors and microclimates are also considered under this study.

Energy Performance Simulation

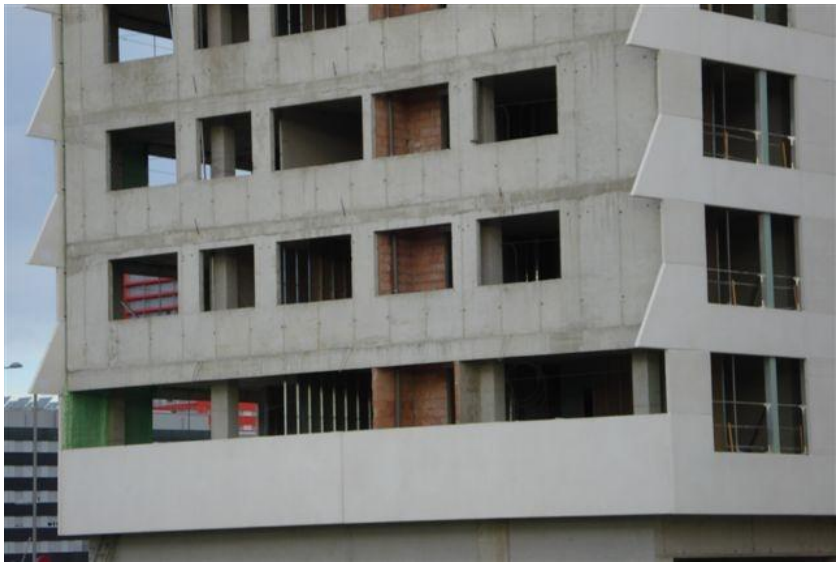


	A-32 (176 flats)
Total conditioned area	12,417 m²
Total CTE heating demand	780,484 kWh/year
Total PIME's heating demand	486,134 kWh/year
Heating demand reduction	38.7 %
CTE demand per square meter	63 kWh/(m² year)
PIME´s demand per square meter	39 kWh/(m² year)

The buildings' projects have achieved the best pre-certification label: A (calculations have been made with the CALENER software, which is the Spanish official tool for certification).

ENERGY CERTIFICATION	A-32 (176 Flats)
Annual energy consumption	
kWh/year	1.402.696,3
kWh/m^2	68,1
Annual CO2 emissions	
$kgCO_2$/year	76.182,4
$kgCO_2$/ m^2	5,0
Energy certification	A

Construction Stage



JANUARY/ DECEMBER 2012

A32 (176 flats)







INITIAL DESIGN´S MODIFICATIONS DURING CONSTRUCTION PHASE, AFFECTING ENERGY EFFICIENCY ISSUES

- **Heat recovery systems** have been added to the mechanical ventilation system in some dwellings (entrances nº 3 and 4).

- In the entrance 3, only half part of the dwellings have this system. Motorization will be done to compare and valuate the solution

Transmittance (U)(W/m².K)	Spanish Regulation	CONCERTO (Best sheets)	PROJECT	Real (Laboratory)
Façade	0,66	0,35	0,30	**0,30**
Roof	0,38	0,24	0,24	**0,18**
Ground floor	0,49	0,30	0,28	**0,22**
Window	3,10	2,00	2,00	**1,88**
Glazing	2,80	2,00	1,90	**1,16**

Energy savings (HEATING)	
Spanish regulation – Project	29%
Spanish regulation – Real	34,5%

PIME´S RETROFITTING IN VITORIA-GASTEIZ CONCERTO COMMUNITY: Cuadrilla Laguardia

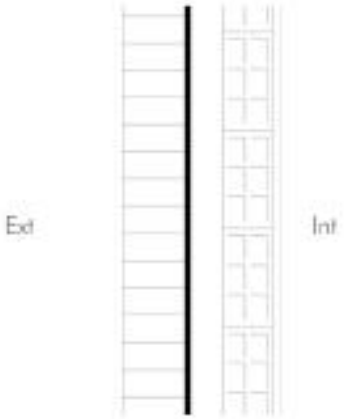
- 30 dwellings (1.678 m^2)
- Building refurbishment works: Nov 2013 – Jan 215
- Monitoring: 2015

- Awareness campaigns to owners: surveys and visit to best practice retrofitting cases (Zaragoza City)

- Bioclimatic Architecture Assessment to the Design team

CUADRILLA LAGUARDIA (30 flats)

Current state:



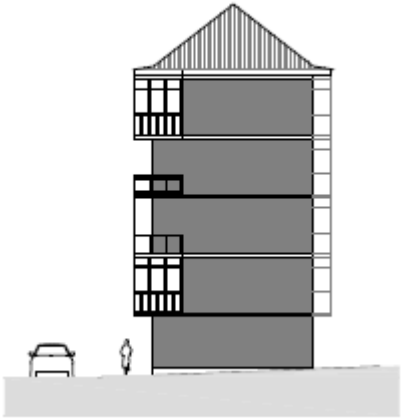
Material	Thickness [cm]
Gypsum	1,5
Brick	9
Air gap	6
Screed	1
Brick	11,5

R_{total}	1,118 [m²k/W]
U	0,894 [W/m²k]

- No thermal insulation in façades.
- Condensations.
- Air leakages.
- No elevator. Accessibility barriers.
- Not efficient installations.
- Water filtrations through the roof.
- Users have realized different enclosures in their dwellings → Lack of uniformity in the façade.
- Irons from reinforced concrete can be seen in the front of the slabs as part of the concrete has fallen.
- Problems with rodents under the floor slab.

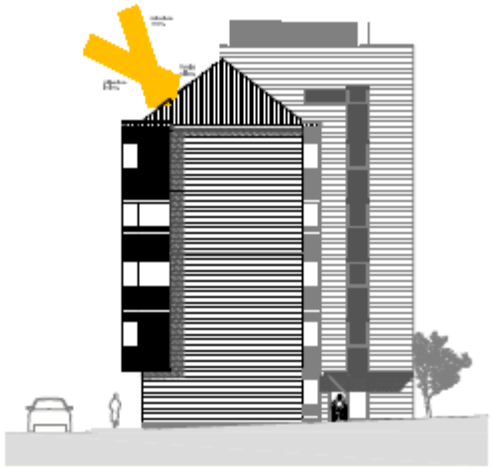
BASIC CHARACTERISTICS

- **Thermal insulation of the building. (ETICS)**
- **Façade uniformization with sun-shaders**
- **Double flow mechanical ventilation with a heat recovery system**
- **Substitute the existing individual boilers by a new highly efficient centralized system for each portal with high performance boilers.**
- **PV installation providing 1260 kWh/year each portal and with a peak power by portal of 1225 Wp**
- **36 m2 of thermal panels providing 34% of total DHW demand. Primary circuits will be interconnected in order to provide water to any portal.**
- **High performance elevators**
- **Monitorization**



ALZADO SUR.

ALZADO ESTE. PLAZA ZARAMAGA.



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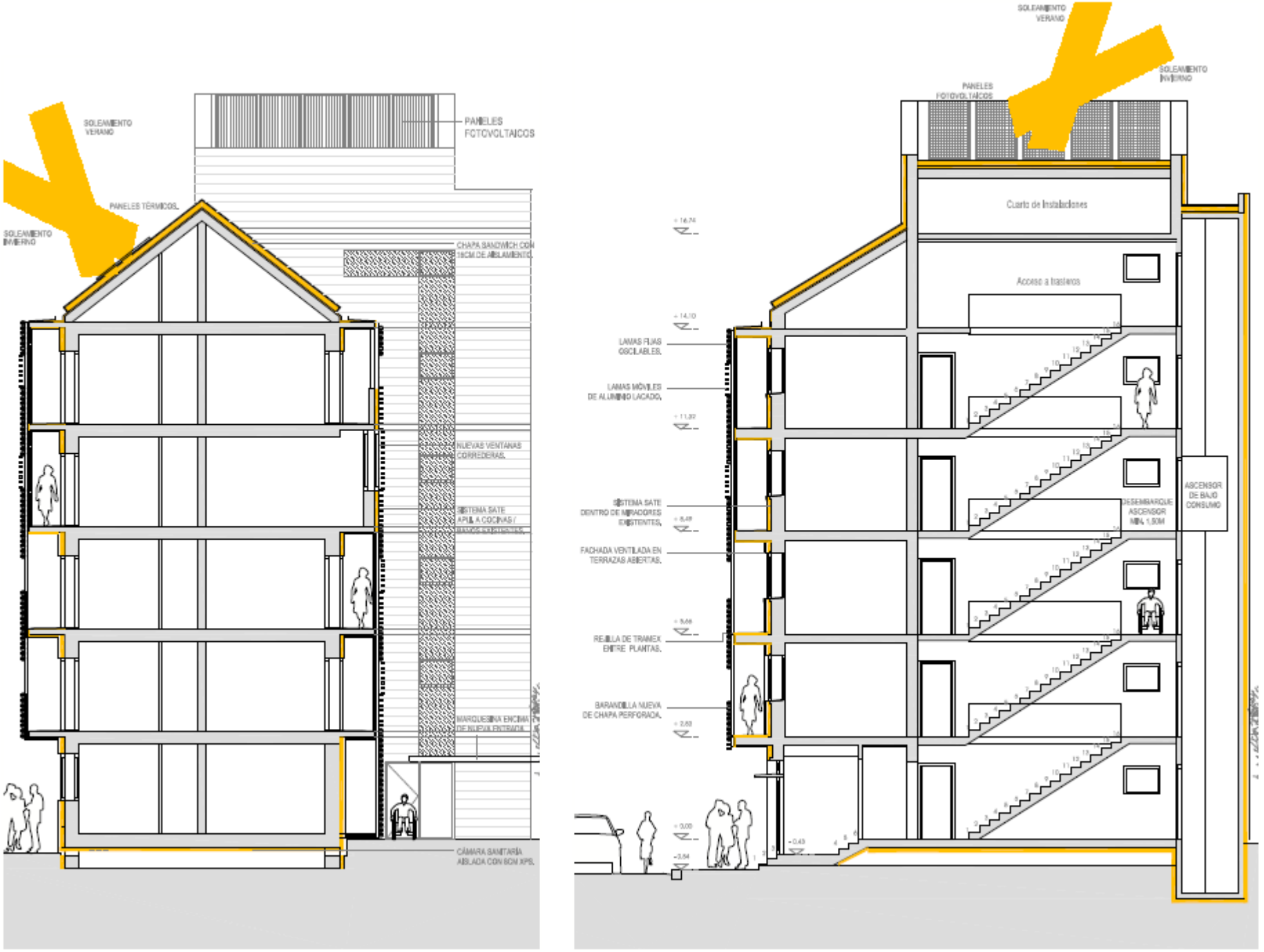
SOLEAMIENTO VERANO
SOLEAMIENTO INVIERNO
PANELES FOTOVOLTAICOS
PANELES TÉRMICOS
CHAPA SANDWICH CON 10CM DE AISLAMIENTO
NUEVAS VENTANAS CORREDERAS
SISTEMA SATE APTO A COCINAS / BAÑOS EXISTENTES
MARQUESINA ENCIMA DE NUEVA ENTRADA
CÁMARA SANITARIA AISLADA CON 8CM XPS
SOLEAMIENTO VERANO
SOLEAMIENTO INVIERNO
PANELES FOTOVOLTAICOS
Cuarto de Instalaciones
Acceso a trasteros
LAMAS FIJAS OSCILABLES.
LAMAS MÓVILES DE ALUMINIO LACADO.
SISTEMA SATE DENTRO DE MIRADORES EXISTENTES.
FACHADA VENTILADA EN TERRAZAS ABIERTAS.
REJILLA DE TRAMEX ENTRE PLANTAS.
BARANDILLA NUEVA DE CHAPA PERFORADA.
ASCENSOR DE BAJO CONSUMO
DESEMBARQUE ASCENSOR MIN. 1,50M