

## Strategic Plant Selection as a Bioclimatic Control Mechanism: Evaluating Thermal Comfort Performance in Mediterranean Patio Housing

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### INTRODUCTION & AIM

Mediterranean cities are increasingly affected by urban heat island effects and extreme heat events associated with climate change. Conventional cooling systems intensify energy consumption and contribute to additional environmental impacts.

Traditional Mediterranean courtyard architecture historically incorporated passive climatic mechanisms capable of improving thermal comfort through shading, ventilation, thermal inertia, and evaporative cooling.

#### Aims

The “Casa Patio Todobarro” project aims 1) to integrate a carefully selected range of vegetation into a building in order to achieve passive regulation of environmental conditions and enhance environmental comfort, and 2) to evaluate the potential of ceramic passive systems to mitigate urban heat stress, generate localized urban microclimates, and reduce dependence on active cooling technologies.

### METHOD

#### Study Area

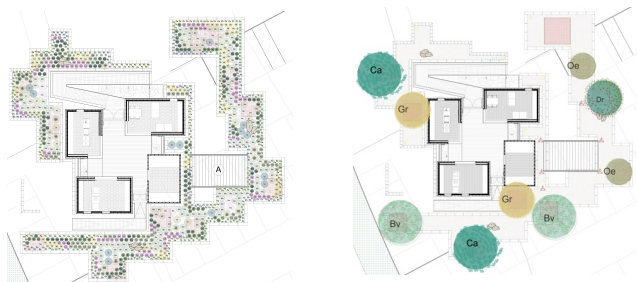
The intervention was developed in an outdoor residual space at the University of Málaga campus (Southern Spain), selected for its high solar exposure and urban heat island conditions.

#### Experimental Prototype

The project adapts the “Casa Patio 2.12” prototype from Solar Decathlon Europe 2012, reinterpreting Mediterranean courtyard architecture through passive environmental design.

#### Strategic Plant Selection

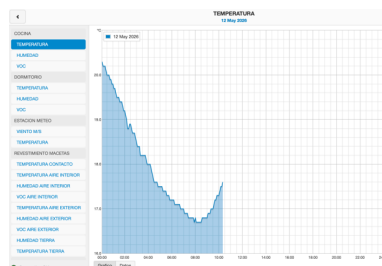
The species selection protocol employed consists of (1) conducting a topoclimatic study of the surrounding environment, (2) analysing future climate trends, (3) identifying species adapted to the present and future conditions of the target environment, and (4) screening the species and making the final selection of the flora to be introduced.



- |   |   |   |
|---|---|---|
| <b>Pn</b> <i>Phyla nodiflora</i> _ 165 ud.              | <b>Mc</b> <i>Myrtus communis</i> _ 132 ud.                              | <b>Bv</b> <i>Bauhinia variegata</i> _ 2 ud. |
| <b>Pa</b> <i>Paronychia argentea</i> _ 165 ud.          | <b>No</b> <i>Nerium oleander</i> _ 13 ud.                               | <b>Ca</b> <i>Celtis australis</i> _ 2 ud.   |
| <b>Tr</b> <i>Trifolium repens</i> _ 165 ud.             | <b>Pi</b> <i>Pistacia lentiscus</i> _ 13 ud.                            | <b>Dr</b> <i>Delonix regia</i> _ 1 ud.      |
| <b>Sr</b> <i>Salvia rosmarinus</i> _ 80 ud.             | <b>Vt</b> <i>Viburnum tinus</i> _ 13 ud.                                | <b>Cr</b> <i>Grevillea robusta</i> _ 2 ud.  |
| <b>Srp</b> <i>Salvia rosmarinus prostratus</i> _ 80 ud. | <b>Ch</b> <i>Chamaerops humilis</i> _ 13 ud.                            | <b>Oe</b> <i>Olea europaea</i> _ 2 ud.      |
| <b>Ls</b> <i>Lavandula stoechas</i> _ 80 ud.            | <b>Par</b> <i>Parthenocissus ficusoidata</i> "Veitchii Robusta" _ 6 ud. |   |
| <b>Nt</b> <i>Nassella tenuissima</i> _ 80 ud.           |   |   |
| <b>Tm</b> <i>Thymus mastichina</i> _ 80 ud.             |   |   |

#### Environmental monitoring

A comprehensive sensor network and on-site meteorological station continuously monitor air temperature, relative humidity, surface temperature, solar radiation, wind variables, and soil moisture, enabling real-time correlation between vegetative performance and indoor comfort thresholds.



### RESULTS & DISCUSSION

#### Preliminary Results

The intervention demonstrates the capacity of the implemented systems to operate as effective passive environmental regulators.

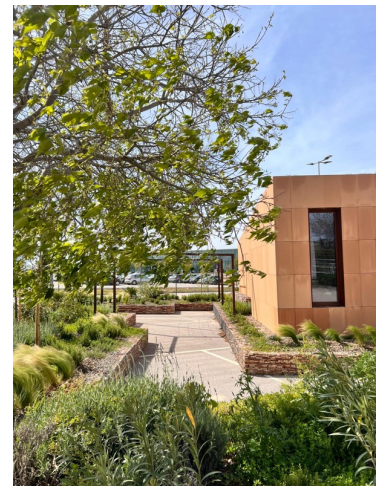
Observed benefits include:

- (1) Reduction of direct solar exposure
- (2) Improved airflow circulation
- (3) Increased evaporative cooling capacity
- (4) Enhanced thermal perception in outdoor spaces
- (5) Generation of shaded microclimatic areas

#### Discussion

The results highlight the potential of the selected flora when combined with contemporary bioclimatic design approaches.

Preliminary findings indicate that plant selection based on ecological adaptation and spatial strategy contributes to reductions in peak indoor temperatures, improved hygrothermal stability, and measurable gains in the Thermal Comfort Index during extreme summer conditions.



### CONCLUSION

Casa Patio Todobarro proposes a contemporary reinterpretation of Mediterranean patio architecture through the combination of ceramic Nature Based Solutions and vegetation.

The results support the hypothesis that botanical criteria when integrated into architectural design as an active environmental system can function as a quantifiable bioclimatic control mechanism in Mediterranean residential architecture.

The project represents a replicable model for sustainable urban cooling strategies in heat vulnerable Mediterranean cities.

### FUTURE WORK / REFERENCES

#### Future Works

1. Continuous thermal monitoring
2. CFD airflow simulations
3. Hygrothermal performance analysis
4. Vegetation growth assessment
5. Comparative comfort measurements
6. Scalability for urban public spaces

#### References

- Olgay, V. (2015). Design with Climate.  
Givoni, B. (1998). Climate Considerations in Building and Urban Design.  
Santamouris, M. (2020). Cooling the Cities. Solar Decathlon Europe (2012) Official Report. IPCC Sixth Assessment Report (2023).