



Green Infrastructure and Solar Energy Integration: Driving Transformation in Sustainable Public Space Design

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FEATURES

Urban Regeneration; Renewable Energy;
Green Infrastructure; Solar Energy;
Photovoltaic Pergola; Climate-Responsive
Design; Sustainable Material; Inclusive
Urban Space; Community Interaction

PRACTICE REFLECTIONS

- The main focus is transforming car-dominated spaces into inclusive, sustainable, and pedestrian-friendly public environments
- Future research can explore bioclimatic

design, renewable energy integration, and community-centered urban regeneration

- Infrastructure can actively enhance public space, combining sustainability, accessibility, and social interaction for better urban living

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1. The photovoltaic pergola enhances social connectivity, strengthens ecological links, and creates productive spaces.

1 Introduction

Les Rondes are a system of ring roads that encircle Barcelona of Spain, designed to improve mobility by connecting different parts of the city and its metropolitan area. Originally conceived in the 1960s, these emblematic roads faced political, technical, and economic disputes that delayed their completion for 30 years. The 1992 Summer Olympics provided the necessary push, leading to an unprecedented urban transformation. Today, the focus has shifted from car dominance to human-



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centered public spaces, exemplified by the redevelopment of the area in front of the Vall d'Hebron Market, where social life had nearly disappeared.

The project elaborated in this article reclaims infrastructure as an active component of public space, prioritizing pedestrian movement, community interaction, and environmental sustainability. A key intervention is the integration of a large photovoltaic pergola, one of the city's largest, demonstrating Barcelona's commitment and the project team's conviction toward renewable energy and energy self-sufficiency for public spaces. Beyond providing shade, it improves the microclimate, allowing increased vegetation and creating a bioclimatic environment.

Special attention was given to inclusive urban design, ensuring safety and accessibility. By eliminating hidden and

dead spaces, the site fosters a sense of security for everyone. A linear garden of native species contributes to re-naturalizing the formerly car-dominated space, while strategically placed stone seating offers quiet retreats from urban noise.

2 Material Selection and Solar Energy Utilization

The project integrates vegetation, sustainable materials, and solar energy to create a climate-responsive public space. A

2. The design facilitates connections between the infrastructure and surrounding neighborhoods.
3. The project incorporates green coverage into the urban fabric.
4. The use of native vegetation species boosts biodiversity and mitigates urban heat island effects.



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5. Pedestrian-centric design improves safety and social interaction.
6. Stone seating utilizes locally sourced materials for sustainable urban amenities.
7. Site section.
8. The folded wooden structure maximizes solar exposure.
9. Details of the photovoltaic panels.

large productive pergola, together with two additional structures along the promenade, promotes plant growth, providing shade that mitigates urban heat and enhances comfort.

To ensure sustainability, locally sourced materials with minimal CO₂ consumption were used. Sandstone from Les Borges Blanques and calcareous stone from Ulldecona minimized processing energy, creating social spaces while preserving natural textures. The pergolas are made of wood, a renewable material, with design features that prevent water damage and extend durability, reinforced by stainless steel joints.

Photovoltaic panels on the largest pergola can generate 43 kW of solar energy, supplying a nearby facility. Covering 580 m² with 218 transparent modules, the panels

maintain an open sky view while casting dynamic shadows on the square. The folded wooden structure optimizes solar exposure while enhancing energy efficiency.

3 Challenges and Reflections

The project faces the challenge of transforming a space dominated by cars into a welcoming, inclusive public area. Balancing infrastructure functionality with social and environmental goals requires careful design and community sensitivity. Political, technical, and economic barriers delayed progress, but perseverance led to innovative solutions like the photovoltaic pergola. This experience highlights the importance of integrating sustainability, accessibility, and public engagement in urban design. It also reflects how

infrastructure can evolve beyond transit, becoming a catalyst for social connection, environmental responsibility, and improved urban life.

Competing interests | The authors declare that they have no competing interests.

Project Name: Green Coverage of the Ronda de Dalt in Barcelona

Location: Barcelona, Spain

Size (area): 7,630 m²

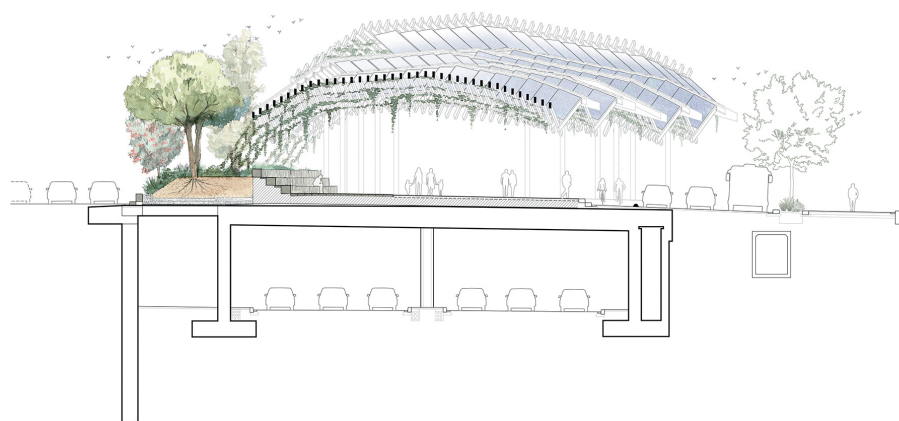
Client: BIMSA – Barcelona d'Infraestructures Municipals

Design Team: Marina Santos Loshuertos, Mercè Lorente i Gras, Diana Calicó Soler, Elisabeth Torregrosa Avilés, Dolors Feu, Yago Cavaller Galí

Design Time: Ongoing since 2018

Collaborators: BIS Structures (structural engineering)

Construction Team: VIAS, Voracys



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