



# Civil Engineering | NEWS

**A**FTER THE MARKETPLACE on the Plaza de la Encarnación, in Sevilla (Seville), Spain, was demolished, the public square fell into disrepair and became an eyesore amid the area's cafés, ice-cream parlors, churches, and residences. The demolition occurred in the 1970s, and the plaza remained derelict for nearly 30 years before city officials decided that something needed to be done to rejuvenate the space. They planned to construct a shopping center on the square, but those plans were halted when Roman ruins were discovered at the site. In 2004 city officials organized an international design competition to obtain proposals for a structure that would preserve the ruins and transform the square into an inviting destination even during the city's scorching summer months. The result, Metropol Parasol, is a contemporary timber structure that provides a striking contrast to the city's traditional architecture.

Designed by the Berlin-based architect Jürgen Mayer H. in partnership with the Berlin and Madrid offices of the engineering firm Arup, Metropol Parasol comprises four levels. The bottommost is 5 m below-ground. With a length of 100 m and a width of 70 m, this level is a composite of steel and concrete and serves as an archaeology museum from

## STRUCTURES

### *Mushbrooming Timber Structure Stands Out amid Spanish City's Traditional Architecture*

**Visitors take in views of the city from walkways positioned atop Metropol Parasol's timber canopy.**

which visitors can view the recently discovered ruins. Atop this structure, at ground level, is a 2,155 m<sup>2</sup> marketplace that can accommodate several stalls. The roof of the 5 m tall market supports an elevated plaza that offers space for cultural and public events, and these benefit from the shadow of Metropol Parasol's signature elements, the six immense timber parasols that blossom from massive trunks into a 150 by 75 m canopy that reaches a height of 28 m. Two of these parasol structures surround a café; five of them support walkways above that form the structure's fourth

level and afford extensive views of the city. The parasols allude to the surrounding trees and undulating rooftops, their canopy providing shade to much of the square, said Jürgen Mayer H. in response to written questions from *Civil Engineering*.

Although Metropol Parasol is unlike any other structure in Sevilla, its design was influenced to a great extent by its location. For instance, the ruins at the site limited the number of pile foundations that could be bored into the ground. There are just six pile caps, each covering 9 to 16 piles. Challenged

to develop a lightweight structure that wouldn't require additional piles, the design team selected timber as the primary building material for the parasols themselves. But this material made some city officials uneasy because wood

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typically does not hold up well in such places as Sevilla, where temperatures can soar well above 100°F several days a year. The design team addressed this concern by covering each of the laminated wood members with a 3 mm thick coating of polyurethane. "That way, the timber is actually completely protected from the elements," says Jan-Peter Koppitz, an associate and structural engineer in Arup's Madrid office.

Metropol Parasol is one of the largest timber structures in the world, its canopy comprising more than 3,400 wooden elements arranged in an orthogonal grid involving more than 3,000 connections in which the rows are spaced 1.5 m apart. While connections in timber structures often present problems, this project encountered additional hurdles because of Sevilla's blistering climate. The design team developed the moment connections using a proven method of gluing steel rods into the timber elements and then screwing metal plates onto these rods so as to transfer the forces through the connection. The only problem was that the epoxy resin traditionally used to hold the steel rods in place does not perform well at high temperatures. The team overcame this challenge by developing a special process that



**Metropol Parasol stands in striking contrast to the traditional architecture found throughout Sevilla, Spain, above. The structure features a museum belowground, a marketplace at ground level, and a plaza elevated 5 m aboveground. All of these levels are located beneath the structure's most distinctive feature, the six timber parasols that blossom into an immense canopy.**

involved gluing the rods in place and then putting the assemblies into a kiln and heating them to 158°F. "[We deployed] a known technology, and then we adapted it," Koppitz says. "That postcuring makes the epoxy connection [strong enough to] withstand the temperatures in Sevilla."

The canopy is supported by six timber trunks, each resting on a pile cap. The piles descend roughly 30 to 40 m



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## Civil Engineering **NEWS**

below the surface. The parasols share these piles with the museum building, which features 40 m long Vierendeel trusses within its framework to make up for the limited foundation structures. Two of the parasols' trunks are lined with concrete to support the café, which is a composite structure of steel and concrete. Those trunks also house

elevators and stairways, which lead to the café and the walkways above. The four other trunks enclose emergency stairways, and all six are faced with concrete to a height of 5 m for fire protection.

Construction of Metropol Parasol began in 2004, and at the time many people in Sevilla disliked the idea, regarding the edifice as too modern. However, since its completion, in March of this year, Metropol Parasol has been embraced by the city and has

even served as the setting for political demonstrations and other gatherings. "Currently in Spain you find demonstrations by the people for more democracy and social justice," Jürgen Mayer H. said. "One of the hot spots for this movement became Metropol Parasol, in Sevilla, where social media dynamics and public spaces collapse into a packed place [of] overnight camps, concerts, speeches, and workshops—a real urban, democratic, open cathedral." —JENNY JONES