ingenhoven

Stuttgart Main Station

Location
Stuttgart, Germany

Built
Expected completion 2026

Railway Station and Mobility Project for the 21st Century

The Stuttgart-Ulm railway expansion is one of the largest infrastructure projects in Europe. The future central station designed by ingenhoven associates forms the core of the Stuttgart 21 transport and urban development project.
As a light-flooded, low-lying, 8-track through station, it will replace the previous 16-track terminus station when it opens. The above-ground rail facilities in the city centre will be dismantled, creating space for new urban development perspectives. The districts of Stuttgart East and Stuttgart North, which were previously separated by the tracks, will be reconnected after more than 150 years. Travel times will be significantly reduced.

In 1997, ingenhoven associates won the international competition for the renovation and new construction of Stuttgart's central train station. A 32-member jury unanimously selected the winner from 126 participants. Following the conclusion of the financing agreement in April 2009, construction work on Stuttgart 21 began on 2 February 2010. Half-time was celebrated on 27 February 2021, when the 14th of the 28 chalice supports was cast in concrete. The new Stuttgart Central Station will go into operation with the timetable change on 14 December 2025.

A new centre for Stuttgart and the metropolitan region

The plans by ingenhoven associates for the central station include the construction of a new underground station concourse, conversion of the historic station building, design of the open spaces around and above the new station, and the relocation of the Staatsgalerie light rail station, plus the construction of a new technical building and a supply and disposal building. The striking station building, designed by Paul Bonatz and Friedrich Eugen Scholer after winning the architectural competition in 1910, is a historic monument and will be retained as the main entrance building. The Schlossgarten (Palace Garden) – the green heart of Stuttgart's most important public green space – will be significantly expanded and more strongly integrated into the city by relocating the tracks.

The development possibilities for Stuttgart's city centre – already restricted by its location in a valley basin – have until now been further hampered by the above-ground tracks. Thanks to the underground high-speed line, the city will gain additional space. A central element of the design by ingenhoven associates is the accessible station roof – featuring a new green square connecting both sides of Stuttgart's Talkessel valley basin. The skylights provide direct views from the plaza into the underground station concourse. Four convex lattice shells made of steel and glass create openings on all four sides of the building. In place of the above-ground tracks, two new districts with a contiguous area of around 100 hectares will soon occupy a central location. In the new Rosenstein district, 50 hectares are planned for housing and work, ten hectares for green spaces and public squares, and 20 hectares for the extension of the Schlossgarten. The new Europaviertel is 20 hectares in size.

The high-performance through station with eight instead of five incoming and outgoing tracks will significantly reduce travel times for regional and long-distance traffic. The Stuttgart rail hub will be fully equipped with digital control and safety technology as part of a Germany-wide pilot project. Unique roof construction 28 chalice-shaped supports made of white exposed concrete form the shell roof of the new, light-flooded underground station concourse. With their free-flowing, dynamic forms, they shape the spatial and sensual qualities of the station. The chalice supports are open at the top to form a circular skylight covered by a steel and glass structure. These so-called light eyes fill the hall with natural daylight and provide natural ventilation.

A shell roof has never been built like this before. It sets new standards in the combination of engineering technology and aesthetics. Measuring 450 metres long by 80 metres wide, the shell roof is a complex structure of anticlastic curved surfaces – mathematically speaking, a free form since there are no mathematical regularities to describe it. The shapes are not arbitrary but efficiently follow the exact course of the forces. This is a very material-saving design – in the middle between the chalice-shaped supports, the concrete shell is only 40 centimetres thick, with a span of about 35 metres. The chalice supports are composed of three main concrete sections: the downward tapering base, the chalice cup, and an upraised “scoop” at the top. The 28 chalice supports under the shell roof span about 32 metres each. Slight variations in the inclination of the chalice cups and the length of their stem adapt to the slope of the terrain between Heilbronner Strasse and the Schlossgarten and to the inclination of the track (8 to 12 metres clear height of the station concourse, approx. 6.5 metres difference in height between the south and north ends of the platforms). One special chalice posed a particular structural challenge. As one of the entrances and exits to the future main station, it is rotated 180 degrees relative to the other 27 chalice supports; an elevator, two staircases, and two escalators pass through it. At the same time, the S-Bahn (urban-suburban rail) tunnel, which was also refurbished, runs in this area just ten centimetres below the platform of the underground station. To bridge this structure without load, an approx. 30-metre-long underground prestressed concrete bridge was erected and holds both the special chalice and a standard chalice.

Each chalice support is reinforced with 22,000 rebars. All the reinforcement steel for the underground station is bent at a bending facility built for this project (8,700 to 11,000 different bending shapes per chalice). The formwork consists of about 550 three-dimensional elements, most of which are used several times. More than 80 large-format formwork elements are needed for a single chalice. They are CNC-milled from softwood blocks (cross-laminated timber) and then coated with a bespoke mixture of resins in a dedicated painting line to achieve SB4 exposed concrete quality. A single chalice support requires up to 350 tonnes of steel and 685 cubic metres of concrete. The concrete can withstand temperatures of up to 1,200 degrees Celsius for 180 minutes in fire tests, due in part to the polypropylene fibres it contains. The new underground station concourse will maintain a comfortable climate without the need for additional air conditioning, which minimizes energy consumption for cooling, heating, and ventilation. The relatively few glass openings, tunnel airflow – which stays around 15 degrees Celsius all year round – and surrounding soil will keep the hall from becoming too hot in summer and too cold in winter. Incident daylight will reduce the need for energy-consuming artificial lighting. Photovoltaic modules installed on the roof of the historic Bonatz building will generate energy for the facility's lighting.

Awards, Nominations

2016
Iconic Awards, Architecture – Public, Winner

2007
International Architecture Award 2007, Chicago Athenaeum Museum of Architecture and Design

2006
Global Holcim Award Gold for Sustainable Construction 2006

2005
MIPIM Architectural Review Future Project Award 2005, Best of Show and Big Urban Projects
Regional Holcim Award Silver for Sustainable Construction 2005

2004
BE Bentley Empowered Award 2004, nominated

Team

Client
Deutsche Bahn AG, Berlin represented by DB ProjektBau GmbH, Stuttgart

Master planner
ingenhoven associates, Düsseldorf

Architect
ingenhoven associates, Düsseldorf

Team ingenhoven associates
Christoph Ingenhoven, Klaus Frankenheim, Hinrich Schumacher, Michael Rathgeb, Bjørn Polzin, Peter Pistorius, Prof. Dieter Henze, Martin Gehrmann, Elvan Urungu, Huub Donkers, Peter Georg Vahlhaus, Barbara Bruder, Peter Jan van Ouwerkerk, Michael Reiß, Pavlos Antoniou, Arghavan Afshar, Marc Böhnke, Jörg Bredenbröcker, Matthias Bockstruck, Lutz Büsing, Ralf Dorsch-Rüter, Ben Dieckmann, Matej Ferenc, Vanessa García Carnicero, David Großefeld, Roland Grube, Stefan Höher, Torsten Horn, Marco Huberts, Anemone Ingenhoven-Feld, Christian Kawe, Heike Kerbs, Ursula Köcker, Arkadij Kublin, Yi Li, Bastian Müller, Viktor Oldiges, Laura Polaczek, Alexander Prang, Frank Reineke, Ulrike Schmälter, Takeshi Semba, Maximo Victoria, Johannes Patrick Vogel, Sira Warneke, Thomas Weber, Tom Wendlinger, Harald Wennemar, Philip H. Wilck, Julian Blönnigen, Mathias Mahncke, Laura Pinckvos, Jascha Klusen, Begona Camarero Gomez, Victor Braun, Michael Hassler, Yesun Lee, Sandro Brigato, Gueorgui Gueorguiev Siarov, Denis Schild, Hannah Palmen, Hannah Novotny

Scientific support for form-finding, shape, construction, and structure
Frei Otto, Leonberg

Project management
DB Projekt Stuttgart Ulm GmbH, Stuttgart

Structural design
Werner Sobek, Stuttgart / Engineering consortium Tragwerksplanung S21 Hauptbahnhof GbR, Leonhardt, Andrä and Partners, Stuttgart with Happold Engineering, Berlin

Facade design
Werner Sobek, Stuttgart

Services installations
DS-Plan, Stuttgart / NEK Ingenieure, Frankfurt a.M. / HL-Technik AG Beratende Ingenieure, Frankfurt a.M.

Building physics
DS-Plan, Stuttgart

Fire protection
BPK Brandschutz Planung Klingsch, Düsseldorf

Landscape design
ingenhoven associates, Düsseldorf / WKM Weber Klein Maas landscape architects, Meerbusch

Transport engineering
Durth Roos Consulting, Darmstadt

Lighting design, natural and artificial light
Tropp Lighting Design, Weilheim

Air flow analysis
IFI Institute for Industrial Aerodynamics, Aachen

Construction supervision
DB Projekt Stuttgart Ulm GmbH, Stuttgart