174/2019

WORLD OF PORR

Gathering knowledge. Sharing expertise.

powered by PORR 150

Preface

PORR projects

Building construction

Civil engineering/infrastructure

CONTENT

KARL-HEINZ STRAUSS, CEO

Karl-Heinz Strauss, CEO. Source: PORR AG

Dear Readers,

esteemed Business Partners,

Our World of PORR magazine is distinguished – in the truest sense of the word. Since February 2019, readers have been able to explore our world online at worldofporr.com. It has now received recognition after notable experts presented our specialist magazine with a Silver award in the Website category at the Annual Multimedia Award 2020. This prize for digital excellence is among the most coveted in Germany, Austria and Switzerland. It serves as further proof of our pioneering spirit and shows that, as a construction company, we are also at the forefront of digital brand communication.

Our World of PORR contains numerous fascinating projects for readers to discover. Take a trip with us to Berlin, for instance, and find out all about one of Europe's most modern CHP stations. Currently under construction in Marzahn, it is set to supply over 150,000 households with district heating and electricity, thus reducing CO2 emissions. Passing over 32 connecting structures and through 30km of tunnels on the Stuttgart-Ulm rail project, our journey continues to Vogelweh Elementary School in Kaiserslautern. During the work to build the school for US forces, PORR subsidiary BBGS was required to meet tougher security and sustainability requirements.

A Swiss bridge renovated with ultra-high performance concrete takes us across to Austria, where we also renovated the Plabutsch Tunnel in Styria. At around 10km, it is the second-longest twin-tube motorway tunnel in Europe after Italy's Gran Sasso Tunnel. We have also demonstrated our expertise as a full-service provider at the Berresgasse education campus in Vienna.

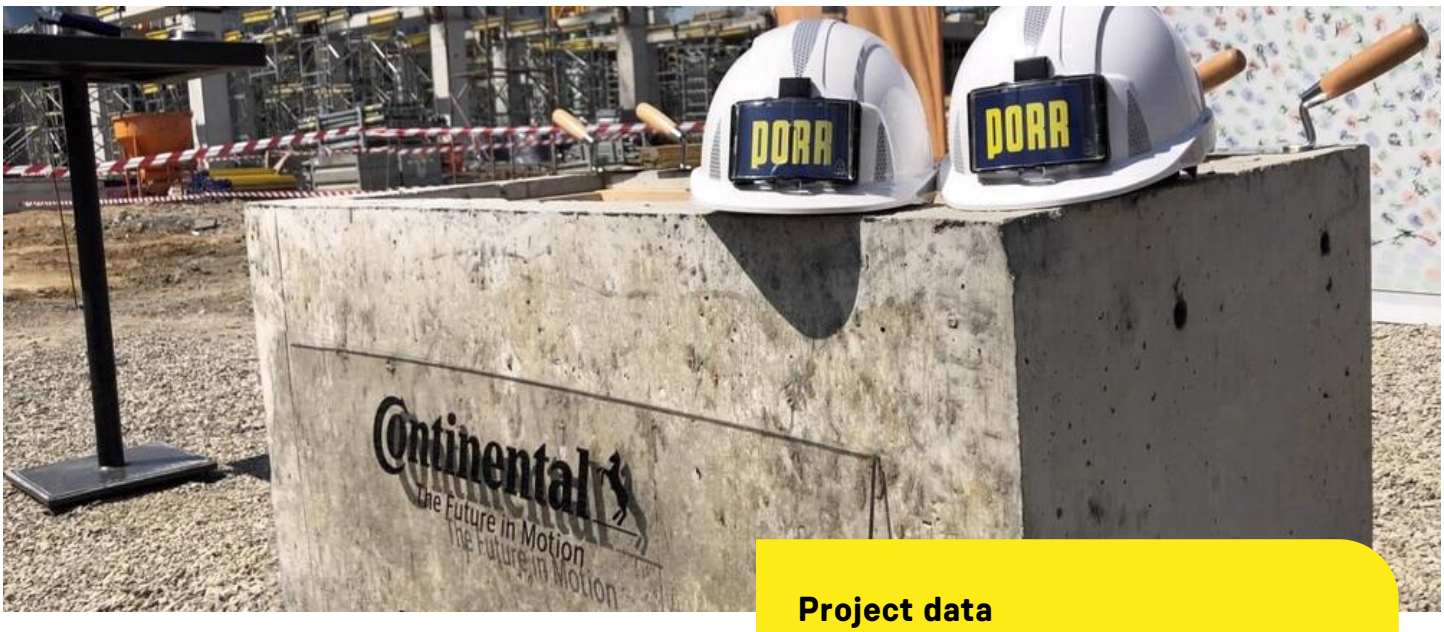
Our journey then takes us on to Poland, where one of the continent's largest university hospitals is taking shape in Krakow. We've also completed a showcase project for sustainable technologies in Koszalin – an office building with photovoltaic modules, wind turbines and vertical gardens.

In 2019 PORR celebrated its 150th birthday. From our festivities and projects to the opening of PORR Campus we have experienced a lot. 2019 was a year of consolidation, as the figures for the third quarter show. The basis for this is an order backlog of EUR 7,358m, that is significantly higher than the previous year. Production output of EUR 4,080m experienced moderate growth. Earnings before taxes (EBT) of 14.4 million euros fell short of expectations due to the challenging environment, particularly in Poland and Norway. Given the high order backlog and the focus on PORR's strengths and our home markets, I am certain that we will emerge from this phase even stronger than before.

Enjoy your journey of discovery as we guide you through the World of PORR. Visit us at worldofporr.com and read the latest articles published by our pool of experts.

Kind regards,

Karl-Heinz Strauss



IN PROGRESS
ROMANIA

ONE OF THE FIRST OF ITS KIND

Extension to Continental building in Iasi

Author: Andrei Docan

At the Continental research centre in Iasi, Romania, PORR is building a seven-storey extension and annexes onto the tyre manufacturer's existing R&D building.

The seven-storey precast concrete structure is one of the first of its kind for Romania. Two major challenges were faced in the first phase of the project: tricky soil and weather conditions, and coordinating the subcontractors.

Project data

Employer	Continental Automotive Romania
Contractor	PORR Construct
Architect	Arcadia Engineering
Order type	Main contractor
Project type	Building construction
Project scope	Planning and building a seven-storey office building including annexes, linked to an existing building
Order volume	24.7 million euros
Construction start	01/2019
Construction end	03/2020

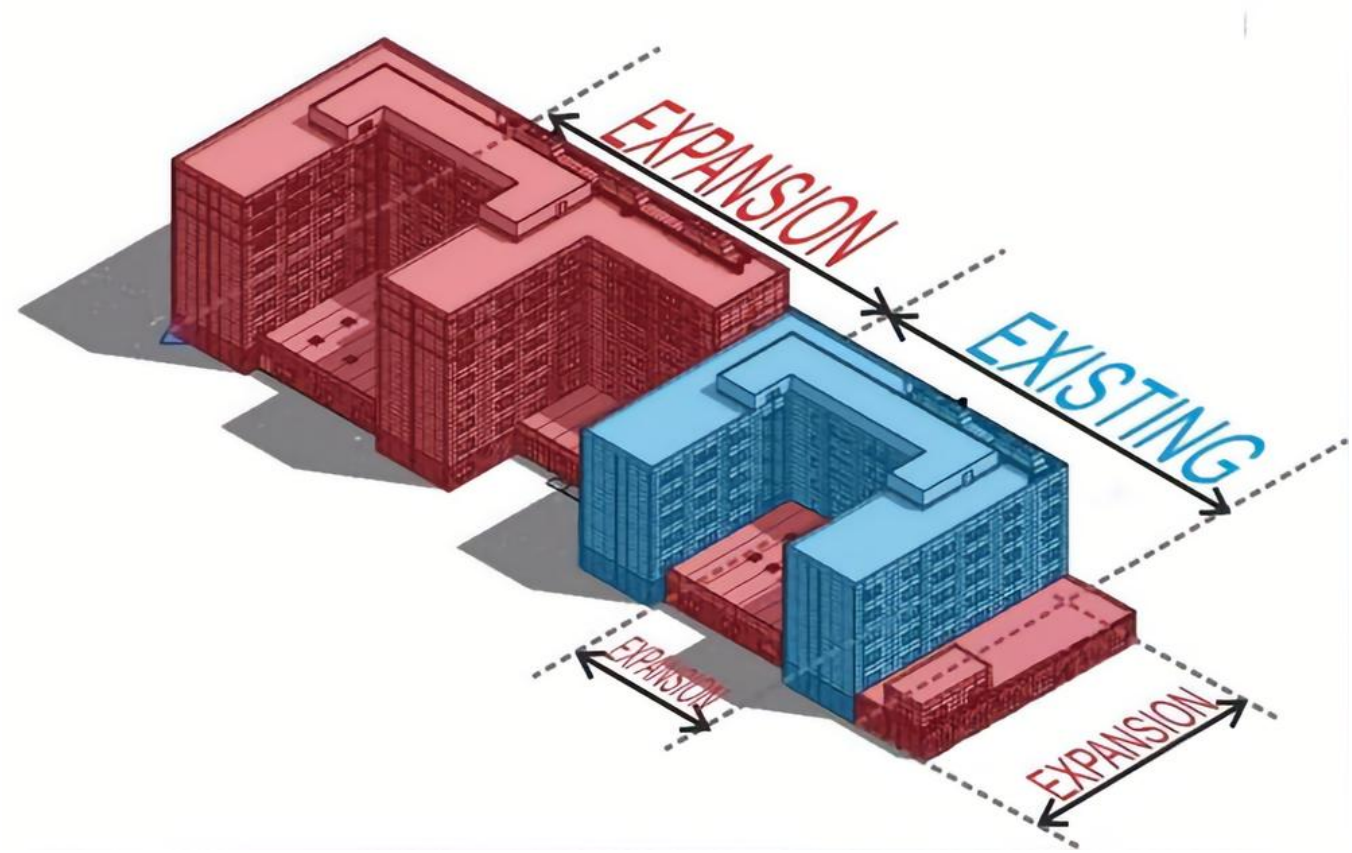
Overview

Tyre manufacturer Continental is planning to use the extension to its research centre in Iasi to centralise its local R&D activities. Employees currently scattered across numerous small offices in the city will relocate to the new centre in March 2020. The contract for the 24.7 million euro project was awarded to PORR Construct. Construction is being carried out almost exclusively by local workers and subcontractors.

Project details

The current research centre in Iasi consists of a five-storey office block and a small single-storey annex used as a test garage, waste area and substation. The extensions are being built on the west and east sides of this existing building and the inner courtyards of the two multi-storey buildings.

After the excavation, 400 concrete piles were drilled and the building foundation was concreted. Even at this early project stage, the PORR experts ran into significant challenges: Repeated heavy rains held up the displacement and sealing process and the 85 tonne drilling rig had to be supported by a work platform as the site turned into a bog. The building foundation was divided into two sections to minimise effects on the schedule. Work on the first half of the base plate to be concreted could then continue despite the difficult conditions.



The extensions are being built on the east and west sides of the existing building and in the inner courtyards. Source: Arcadia Engineering

New construction technique

A particular highlight of the project is the use of precast concrete structures, a technique that has not yet found a foothold in Romania. A system comprising a stiff-jointed frame with precast reinforced concrete girders and columns minimised the effects of the construction work on the existing building and ensured faster installation.

The main component of the structure is a cross girder with precast columns that have corrugated pipe inserts. With this system, the reinforcement can be inserted from the lower level into the upper level. Grout sleeves connect the cross girders with the longitudinal supports. These are installed ex-works in the prefabricated columns and injected in-situ with a mortar.

To avoid problems, the prefabricated columns were not installed until the positioning of the starter bars had been carefully checked. The rebars protruding from the base plate had to be placed with a maximum deviation of 5mm, in order that the grout sleeves in the prefabricated columns could be assembled precisely on the rebar ends.

The rebars had to be placed with a maximum deviation of 5mm, in order that the grout sleeves could be assembled precisely on the prefabricated columns. Source: PORR Construct

A MAJOR CHALLENGE IN THE FIRST STAGE OF THE PROJECT WAS COORDINATING THE SUBCONTRACTORS CARRYING OUT PRECAST CONCRETE PRODUCTION AND ASSEMBLY WITH THE SUBCONTRACTORS FOR THE POURED IN-SITU CONCRETE.

Andrei Docan
Project manager, PORR CONSTRUCT S.R.L.

Summary

The biggest challenge in the first stage of the project was coordinating the subcontractors carrying out precast concrete production and assembly with the subcontractors for the poured in-situ concrete.
The result of the cooperation is a sort of jigsaw of precast elements connected together with small in-situ concrete elements.

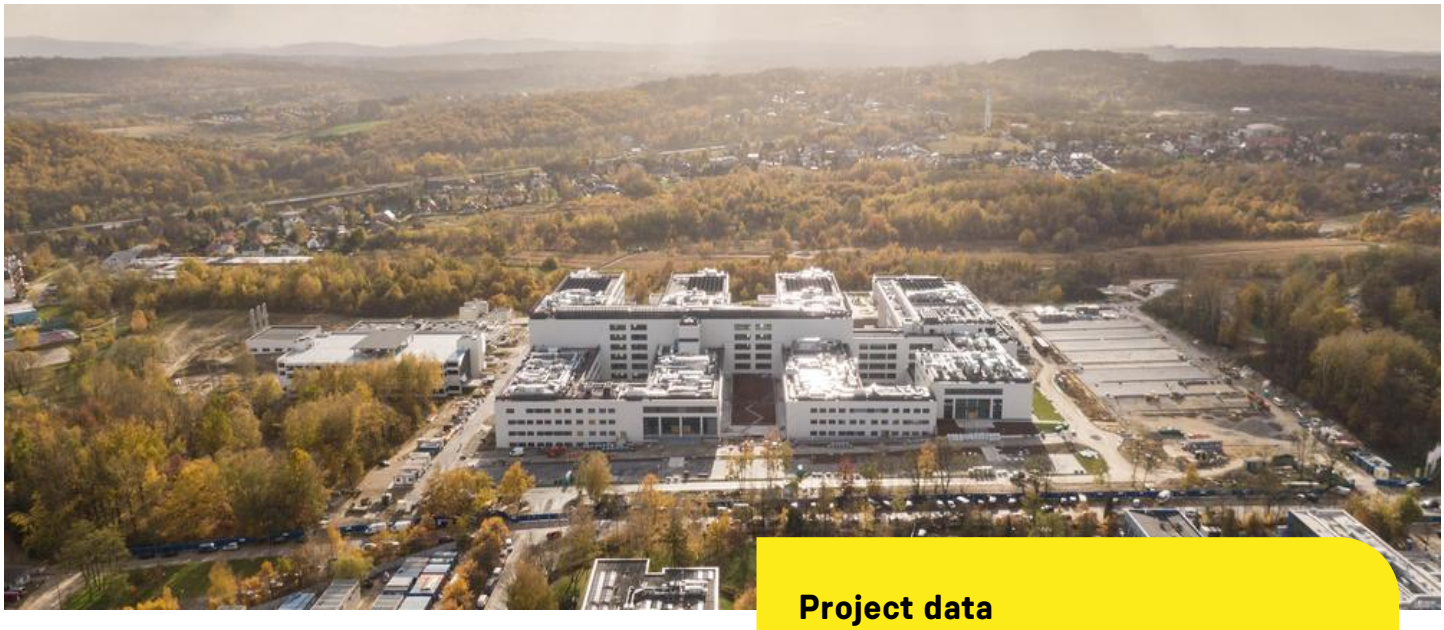
Thanks to excellent cooperation between the individual teams, the way has been paved for completion on time in March 2020.

Technical Data

20,000m³
Excavation volume

400
Drill piles

Gross floor area	2,200m²
Site area	25,000m²
Excavation depth	3.5m
Parking spaces	150
Steel incorporated	50t
Concrete incorporated	9,000m³
Reinforced concrete incorporated	1,200t



PROGRESS: 100% - COMPLETED
POLAND

A NEW HOME FOR CLINICAL RESEARCH

Krakow-Prokocim University Hospital

Author: Łukasz Gombarczyk

In Krakow, PORR – in a consortium with VAMED and WARBUD – built one of Europe's largest university hospitals in only 50 months.

The hospital offers space for 925 beds, 24 operating theatres, 27 specialist clinics, and 69 departments and laboratories. It will also feature an auditorium for 250 people, two lecture halls for 50 people, and numerous seminar rooms. The hospital already complies with the Polish energy efficiency requirements of 2021.

Project data

Employer	Jagiellonian University – Collegium Medicum
Contractor	Consortium of WARBUD S.A., PORR S.A., and VAMED Standortentwicklung und Engineering GmbH & Co KG
Architect	INDUSTRIA PROJECT Sp. z. o.o., WARBUD S.A.
Project type	Building construction . health care facility
Project scope	Planning and construction of the university hospital, including the associated infrastructure and the technical items
Order volume	846.7 million PLN (198.9 million euros)
Construction start	01/2015
Construction end	05/2019

Overview

Plans to build a university hospital in Krakow date back to the 1950s. At that time, the management of the Jagiellonian University decided to build a new campus in Prokocim. However, it was only in 2013 that university senate finally gave the go-ahead for the construction of the new hospital. The call for tenders took place in July 2013, and the contract was awarded to a consortium consisting of PORR, VAMED, and WARBUD. While PORR and WARBUD were responsible for the construction of the hospital, VAMED was responsible for the delivery and installation of the medical equipment.

Medical mega-complex

After a comprehensive planning and preparation phase, the construction work started in June 2015. The multi-story parking garage area was first completed followed by the main building of the hospital. The main building consists of nine interconnected segments that provide space for 925 beds, 24 operating theatres, 27 specialist clinics, 69 departments and laboratories, an auditorium for 250 people, two lecture theatres, and numerous seminar rooms. The hospital complex is supplemented by several auxiliary buildings and infrastructure facilities such as a power supply station, a helicopter landing pad, a sewage treatment plant, a medical gas decompression plant, a kitchen, and a laundry shop.

Erste Pläne für ein Universitätskrankenhaus in Krakau wurden schon in den 1950er-Jahren geschmiedet, aber erst 2013 gab der Uni-Senat grünes Licht für den Projektstart. Quelle: PORR

IN ORDER TO COMPLY WITH THE ENERGY EFFICIENCY GUIDELINES THAT WILL BE APPLICABLE IN POLAND FROM 2021, THE EXTERIOR WALLS WERE INSULATED MORE THAN IS CURRENTLY THE CASE IN POLAND.

Łukasz Gombarczyk
Project head, PORR S.A.

In order to comply with the energy efficiency guidelines that will be applicable in Poland from 2021, the exterior walls were insulated more than is currently the case in Poland. In addition, windows and facades with a higher degree of thermal insulation were installed. A solar system for direct hot water supply was also installed on the roof.

After completion of the infrastructure, deliveries of medical equipment started in July 2018. After the installation was completed in December 2018, the acceptance of the building could begin. In May 2019, the final acceptance protocol was signed, and the building was handed over to the end user.

Um die Energieeffizienz des Gebäudes zu erhöhen, wurde am Dach eine Solaranlage für die Warmwasseraufbereitung errichtet. Quelle: PORR

A PNEUMATIC POSTAL SYSTEM WITH 56 STATIONS ALLOWS THE RAPID TRANSPORT OF BLOOD SAMPLES, MEDICATIONS, OR DOCUMENTS THROUGHOUT THE HOSPITAL.

Łukasz Gombarczyk
Project head, PORR S.A.

Multi-functional facility

The new University Hospital in Krakow-Prokocim was designed and built to fulfil several strategic functions. The hospital serves the training of medical specialists and clinical research but also offers the best diagnostic and treatment options.

In order for the hospital to fulfil its intended functions, it was equipped with state-of-the-art facilities and systems. These include a central control panel in the operating theatres, which gives employees access to key control and information elements – from lighting, ventilation, and temperature to access to the patient database. An audio-visual system also enables the transmission of images and sound from the operating theatres to every room in the hospital, especially the auditorium, the lecture theatres, and the seminar rooms.

Thanks to a pneumatic postal system with 56 stations, blood samples, medications, or documents can be quickly transported throughout the entire hospital. A real-time localisation system (RTLS) is used to identify and monitor the whereabouts of patients. The wireless RTLS tags are attached to the wrists of patients. Their location can then be determined via RTLS wireless access points. In the event of an emergency, the patient can also immediately contact the medical staff via the tag.

Conclusion

The planning and construction of the Krakow-Prokocim University Hospital was an exciting challenge for PORR. Thanks to the excellent cooperation among the consortium partners, the high requirements of the client were fulfilled, and the project – including all medical equipment – was handed over in May 2019.

Modernste medizinische Ausrüstung ermöglicht die bestmögliche Patientenversorgung. Quelle: PORR

Technical data

230,000m³
Excavation

43
Lifts

Gross floor area	108,395m²
Site area	152.800m²
Parking spaces	1,259
Asphalt	22,542m² (roads), 5.990m² (walkways)
Steel used	8,200t
Facade area	44,000m2

PROGRESS: 100% - COMPLETED
POLAND

NEW CONSUMER MECCA IN OPOLE

Solaris shopping centre

Author: Ewa Kożuch / Tomasz Rzewuski

In Opole, PORR realised one of the few public-private partnership projects in Poland with the conversion and expansion of the Solaris shopping centre.

The order included not only the turnkey extension of the shopping centre but also the construction of an underground car park, the redesign of the foodcourt, and the adaptation of the adjacent transport infrastructure. All construction and installations works were preceded by implementation of execution designs by PORR.

Project data

Employer	IGI EXCLUSIVE Sp. z o.o.
Contractor	PORR S.A.
Architect	JSK ARCHITEKCI Sp. z o.o.
Order type	Main contractor
Project type	Building construction . Shopping centre
Project scope	Expansion and conversion of the Solaris shopping and leisure centre with preparation of execution designs
Order volume	88.5 million PLN (20.8 million EUR)
Construction start	09/2017
Construction end	05/2019

Overview

The Solaris shopping and leisure centre, which opened in 2009, is located at the site of the Pringsheim brewery (which was demolished in the 1970s) on Nikolaus-Kopernikus-Platz in the centre of Opole. In 2017 – not quite 10 years after the opening – a large-scale conversion and extension of the centre began. This also included a complete redesign of the square. Trees were planted, a fountain was built, and part of the parking space was moved to a two-story underground car park.

As general contractor, PORR was commissioned with the modernization and expansion of the shopping centre, the construction of the underground car park, and the expansion of the transport infrastructure at Nikolaus-Kopernikus-Platz. The project was implemented as one of the few public-private partnership models in Poland.

THE HEAVY TRAFFIC AROUND THE CONSTRUCTION SITE AND THE ROCKY SUBSOIL MADE THE EXCAVATION WORK A REAL CHALLENGE.

Tomasz Rzewuski
Operations director, PORR S.A.

Elaborate preparatory work

The project was a real challenge. Not only did the shopping centre remain partially open during the conversion work but there were also several tasks to be completed before the actual construction work began. For example, an inventory of

the entire underground infrastructure in the city centre had to be drawn up. This led to the installation of a transformer station for medium and low voltage in the construction site area.

The excavation work was also quite demanding. In addition to the heavy traffic around the construction site, the PORR experts also had to work their way down to a depth of 9 m through a rocky subsoil. Because of the inner-city location, it was crucial to remove the excavated material and protect the construction pit. Taking into account the respective soil and water conditions, the temporary construction pit system was designed as berliner walls and as a palisade of bored piles. The PORR subsidiary Stump was brought on board to carry out the demanding foundation work.

305 new parking spaces were created in the new underground car park. Source: PORR

IN ORDER TO ENSURE THE HIGH QUALITY OF THE INTERIOR FITTINGS REQUIRED BY THE INVESTOR, ALL MATERIALS USED WERE SUBJECTED TO RIGOROUS TESTING IN ADVANCE.

Tomasz Rzewuski
Operations director, PORR S.A.

New construction and connection to the existing building

The new part of the project was a monolithic reinforced concrete construction. Additional reinforcements in the form of steel girders or integrated carbon reinforcements were installed at the connection points to the existing building. An important aspect in the construction of the new building was the gradual dismantling of the existing façade at the border between the old and new buildings.

Before each dismantling of the façade, a series of measures had to be taken in order to ensure smooth operation in the open part of the shopping and leisure centre.

The east and west façades directly adjoining the existing building were designed as brick façades, the south façade as an impressive glass-aluminium façade.

The interior and installation work started in parallel to the work on the building shell. In order to ensure the high quality of the interior fittings required by the investor, all materials used were subjected to rigorous testing in advance.

The technical installations of the energy supply as well as the heating and cooling systems required a sophisticated coordination of the individual crews. These systems and the fire protection system are controlled via an integrated building management system, which also includes the existing part of the shopping centre.

For the turnkey handover, the building was equipped with furniture and all movable elements up to the signage.

After a construction period of 20 months, the turnkey extension was handed over in May 2019. Source: PORR

New transport infrastructure

While the interior work was completed, the existing transport infrastructure was rebuilt, and the area above the underground car park was extended. Nearly all the streets around the shopping and leisure centre had to be adapted for this purpose. The road surfaces were replaced and two new roundabouts were created.

As part of the development of the square above the multi-story underground car park, large granite slabs were laid, a fountain erected, and spacious green areas created.

In the immediate vicinity of the Solaris Center, streets were adapted and two new roundabouts were built. Source: PORR

Conclusion

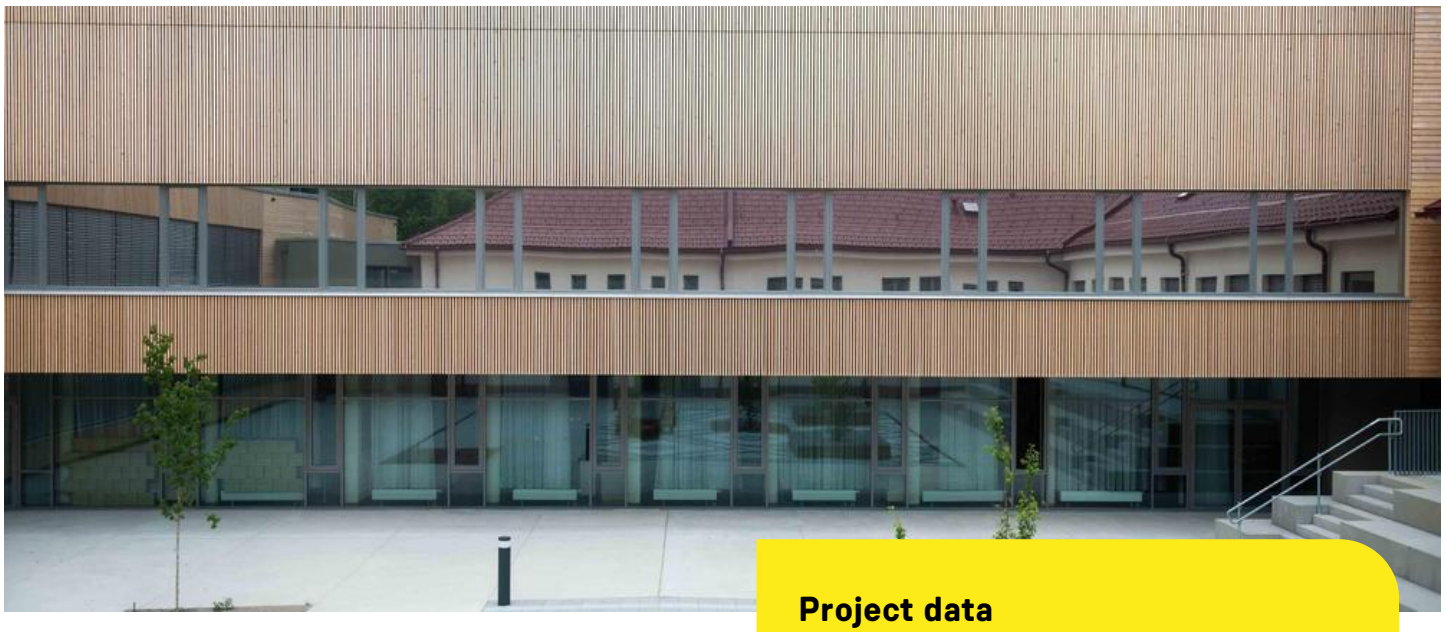
Despite difficult conditions and an ambitious schedule, all work was completed within 20 months thanks to the full commitment of all participants. The official opening of the annex and the completely redesigned square took place on 21 June 2019.

Technical data

26,215 m²
Total floor space

305
Parking spaces

Gross floor area	30,815 m²
Rentable area	10,924 m²
Building cubature	123,613 m³
Parking space	9,247 m²



PROGRESS: 100% - COMPLETED
AUSTRIA

LEARNING IN ENVIRONMENTALLY-FRIENDLY SURROUNDINGS

Volksschule Christian Bucher Gasse 14, Vienna

Author: David Glößl

PORR revitalised the 1950s-built school in a series of construction phases, adding a modern timber extension.

Revitalising the school complex included building additional classrooms, a sports hall and an events hall. The work was carried out in four construction phases each lasting six months, while the school remained open.

Project data

Employer	City of Vienna Municipal Department 56 - Wiener Schulen (Vienna Association of Schools)
Contractor	PORR Bau GmbH
Architect	Dietrich | Untertrifaller Architekten ZT GmbH
Order type	Main contractor
Project type	Building construction . Revitalisation
Project scope	Conversion and extension of a school using solid timber construction, carried out during school operations under cramped conditions
Order volume	12 million euros
Construction start	09/2016
Construction end	06/2019

Overview

In 2016, the City of Vienna tendered a project to revitalise the school in Christian Bucher Gasse in Vienna's 21st district, Floridsdorf. The contract was awarded to PORR in September 2016 and included renovating the main school block during ongoing school operations, plus building additional classrooms, a sports hall and an events hall. Extensive outdoor areas including a sports field were also to be developed.

The City of Vienna placed great importance on using environmentally-friendly materials and sustainable construction techniques. To meet this requirement, cross-laminated timber (CLT) was used for the structural work and the façades.

The environmentally-friendly structure is complemented by extensive green areas on the flat roofs, which reduce heat radiation. Solar panels have also been installed, which supply the building with sustainable energy.

By optimising the specialist foundation work and using prefabricated components, PORR was able to continue work throughout the winter months, thereby keeping the construction period to a minimum. The work was completed over four construction phases of six months each.

In total, 4,300m² of solid CLT ceilings and 3,100m² of solid CLT walls were installed. Source: Gerfried Tamerler/PORR

Demolition and construction

The first construction phase involved building one section of the new classroom block. This was handed over on schedule for occupation, and once the pupils had moved out of the temporary classrooms erected in the 1980s, the second construction phase could begin. In this second stage, the northwest section of the existing school building was demolished and a new classroom block was built. On completion of this phase, the school was able to make use of 15 new classrooms, a media room, a library and various rooms for large and small groups.

THE TWO-STOREY SPORTS HALL, WHICH PROTRUDES 6M OVER THE FORECOURT TO CREATE A COVERED ENTRANCE, PRESENTED A PARTICULAR CHALLENGE.

David Glößl
Site manager, PORR Bau GmbH

Overhanging challenge

The third construction phase saw the erection of the administrative wing and sports hall on the first floor. The two-storey sports hall, which protrudes 6m over the forecourt to create a covered entrance, presented a particular challenge. The overhanging section of the hall was built with 26cm thick CLT walls. The enormous tensile forces generated by the overhang could only be absorbed by creating dovetails in the solid timber walls.

Dovetailing in the solid timber walls absorbs the enormous tensile forces. Source: Gerfried Tamerler/PORR

Once the new sports hall had been completed, work began on conversion of the old sports hall, transforming it into a dining room and events hall – which is used not just by the

school, but by the whole district.

By the end of phase 3, PORR had installed a total of 4,300m² of solid CLT ceilings and 3,100m² of solid CLT walls.

The former sports hall has become a dining room and events hall that is used by the whole district. Source: Gerfried Tamerler/PORR

Accessible design

During the final construction phase, PORR built new media rooms, workshops and recreation rooms, and the caretaker's accommodation.

The opportunity was taken during the renovation work to make the school complex fully accessible and create a sheltered courtyard. The outdoor areas were also developed, with facilities including a sports field, a motor skills area and a garden laboratory, as well as extensive green spaces.

Summary

PORR handed the project over to the City of Vienna on schedule in June 2019. In retrospect, dividing the work into four construction phases worked exceptionally well. The experience gained during the first phase played an important part in PORR's ability to master the complex tasks and overcome the specific technical challenges that arose during later phases.

Technical data

4,400m³
Excavation volume

1,900m²
Timber-framed walls

Gross floor area	8,400m²
Car parking spaces	9
Drill piles	262
Steel incorporated	30t
Concrete incorporated	1,600m³
Reinforced concrete incorporated	141t
CLT solid timber ceilings 10-26cm	4,300m²
CLT solid timber walls 10-26cm	3,100m²
Suspended timber façade	2,070m²

PROGRESS: 100% - COMPLETED
POLAND

PIONEERING SUSTAINABILITY

WFOŚiGW Koszalin branch offices

Author: Piotr Kołek

PORR has built a model low-energy building in Koszalin for the Polish Regional Fund for Environmental Protection and Water Management.

The new building boasts state of the art technologies and techniques to keep energy consumption to a minimum: from solar panels, wind turbines, a double façade and vertical gardens right through to an efficient building management system.

Project data

Employer	Regional Fund for Environmental Protection and Water Management (WFOŚiGW)
Contractor	PORR S.A.
Architect	PiG ARCHITEKCI Sp. z o o.
Order type	Building construction. Office building
Project scope	To design and build a branch office building for the Regional Fund for Environmental Protection and Water Management (WFOŚiGW)
Order volume	4.5 million euros (PLN 19 million)
Construction start	12/2017
Construction end	02/2019

Overview

Koszalin is one of the biggest cities in the Polish province of Western Pomerania, second only to Szczecin. Here in Koszalin, at the end of 2017, PORR was awarded the contract to design and build the new branch office for the Regional Fund for Environmental Protection and Water Management (WFOŚiGW). In addition to building the new office block, PORR's contract included all planning services and demolishing an existing building.

The WFOŚiGW were particularly keen to emphasise sustainability. Their ambitious goal was to use the new branch as a model low-energy building by incorporating renewable energy sources and environmentally friendly materials. The external evidence of this pioneering accomplishment is the sought-after BREEAM certification at either the "Very good" or "Excellent" level. The certification process is in progress.

Challenging circumstances

Construction work began in December 2017 and continued for 15 months. In this time, PORR built a four-storey block plus a basement level. The building has a cubic volume of 12,515m³ and gross floor area of 3,103m². Major challenges resulted from the position of the construction site in central Koszalin: nearby schools and offices generated a lot of foot and vehicle traffic, which made conditions tricky for site traffic.

Despite these difficult circumstances, the work was carried out on schedule. PORR handed the property over to the client in February 2019, confident that the building, with its state of the art technologies, renewable energy sources and environmentally friendly building materials, is a showcase for sustainability far beyond the borders of the province.

The new WFOŚiGW branch offers the first publicly accessible filling stations for electric cars in Koszalin. Source: PORR

Sustainable to the core

Solar panels and a wind turbine have been installed on the roof of the new branch office to provide the building's energy supply. Any excess energy is used for the direct hot water supply. For heating and cooling, a heat pump has been installed; this not only considerably reduces the need for conventional fuels but also yields significant cost savings. It works through 13 deep drillings, extending as far down as 100m.

Several photovoltaic modules and a wind turbine on the roof provide clean electricity. Source: PORR

A BUILDING MANAGEMENT SYSTEM CONTINUOUSLY MONITORS THE ENVIRONMENTAL CONDITIONS AND ENSURES THAT THE BUILDING TECHNOLOGY SYSTEMS ARE MANAGED AS EFFECTIVELY AS POSSIBLE.

Piotr Kołek
Construction manager, PORR S.A.

Technical data

3,103m²
Gross floor area

17.1m
Building height

Site area	1,530m²
Office volume	12,515m³
Parking spaces	24 + 8

A building management system continuously monitors environmental conditions and ensures that the building technology systems are managed as effectively as possible – for example, CO2 concentration and air humidity are measured in the indoor areas to calculate air quality, and the ventilation and air-conditioning systems are adjusted accordingly.

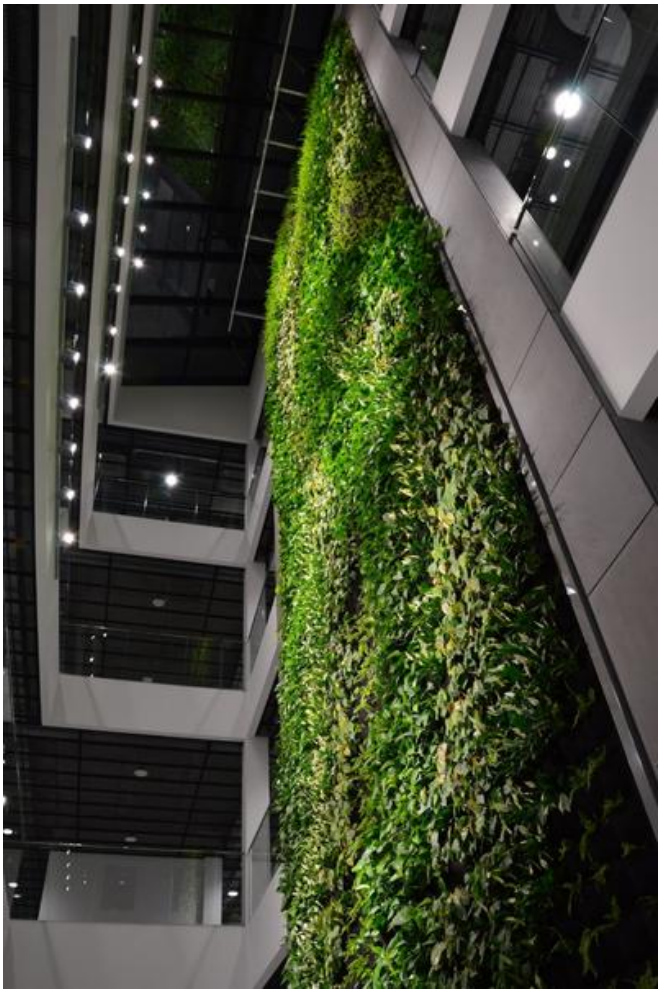
The façade has been built as a double-skin façade, with two surfaces 60cm apart. In winter, the gap acts as a heat buffer and keeps warm air in, while in summer it becomes a vent and directs warm air away from the interior spaces. A cross-ventilation system is also operated through this double-skin façade, reducing temperatures in the office spaces and facilitating air exchange. In addition to these temperature-balancing effects, the façade also provides sound insulation.

The reinforced concrete structure includes thermal component activation: a heating and cooling system in which pipes have been laid in the ceilings and warm or cold water flows through them as needed. This exploits the heat storage mass of the solid building elements to help regulate the temperature.

A vertical garden has been installed in the main atrium: a 15m high green wall with 2,100 different plants. This acts as an effective air filter, temperature regulator and sound insulator.

The basement houses a smart waste management system, which uses sensors to display real-time information about how full the containers are and when they need emptying.

Finally, the new WFOŚiGW branch office also boasts the first publically accessible electric vehicle charging station in Koszalin.



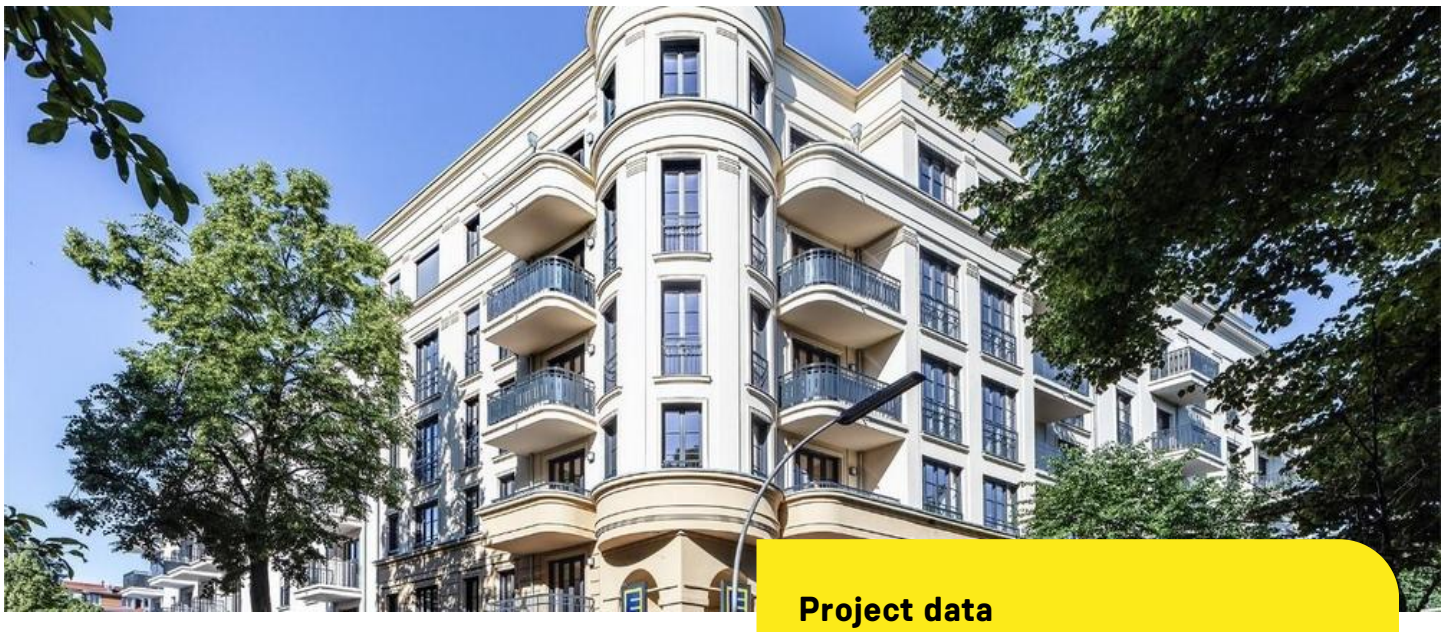
A 15m high vertical garden provides a perfect indoor climate.
Source: PORR

THE VERTICAL GARDEN IN THE MAIN ATRIUM IS AN EFFECTIVE AIR FILTER, TEMPERATURE REGULATOR AND SOUND INSULATOR.

Piotr Kołek
Construction manager, PORR S.A.

Summary

The PORR-built office block has been in use since May 2019 by the Polish Regional Fund for Environmental Protection and Water Management. The technologies used make it much more than just a headquarters for the Fund – it is a visible expression of the Fund's mission: environmental protection.



PROGRESS: 100% - COMPLETED
GERMANY

LANDWEHR CANAL LIVING

Maybachufer 36 residential project, Berlin Neukölln

Author: Melanie Splichal

PORR Deutschland GmbH has completed a turnkey construction with 71 residential and two commercial units in the trendy Neukölln district of Berlin.

The construction of the new complex of four buildings next to Berlin's Landwehr Canal was marked by difficult foundation conditions and a complex façade design, which varied from building to building.

Project data

Employer	Cross Jeanswear GmbH
Contractor	PORR Deutschland GmbH . ZNL Berlin
Architect	Patzschke und Partner Architekten
Order type	Main contractor
Project type	Building construction . Residential building
Project scope	Planning and construction of a six-storey apartment building with grocery store and day care centre
Order volume	16 million euros
Construction start	04/2017
Construction end	03/2019

Overview

The Maybachufer 36 project is a building complex comprising four buildings, situated right next to Berlin's Landwehr Canal, with a gross floor area of around 11,000 m², accommodating a supermarket, a day care centre and 71 residential units in different sizes and configurations.

The client is Turkish jeans manufacturer Cross Jeanswear, which expanded its business to the rest of the European market in the early 1990s. Berlin was selected as a central location in this expansion strategy and an old glassworks was purchased for use as warehouse and office space and as a factory outlet.

As the space available no longer meets its requirements, Cross Jeanswear relocated its warehouse and offices and decided to construct a residential complex with a supermarket and day care centre on the site of the old glassworks.

The renowned architectural firm Patzschke und Partner did the planning; it had previously received international acclaim for the renovation of the Berlin Grand Hotel Adlon. PORR was brought on board as the main contractor. PORR completed the project in March 2019, after less than two years of construction work.

THE REAL CHALLENGE WAS THE INTRICATE FAÇADE DESIGN WITH DIFFERENT STRUCTURES IN THE DIFFERENT BUILDINGS.

Melanie Splichal
Project manager, PORR Bau GmbH

The elaborate façade design has differentiated structures depending on the equipment level. Source: PORR/Markus Löffelhardt

In harmony with the urban landscape

The residential complex comprises four buildings. The supermarket extends through all four buildings; buildings 1 and 2 are also home to the day care centre as well as premium rental apartments. In addition to the supermarket space, building 3 contains mid-scale rental apartments, while building 4 has simple micro apartments.

The complex has a classical style on the outside, tastefully complemented by modern elements. The inclusion of features of the historical architecture of the immediate surroundings ensures that the new building blends into the cityscape. The real challenge was the intricate façade design with different structures, depending on the configuration of the building in question and combined with the copper roof dome.

The Maybachufer 36 residential complex uses classical elements inspired by late 19th to early 20th century architecture with a modern twist. Source: PORR/Markus Löffelhardt

THE GROUNDWATER CONDITIONS ON THE SITE MADE DEWATERING NECESSARY. GROUNDWATER REDUCTION MEASURES WERE PLANNED AND EXECUTED WITH A SOLDIER PILE WALL FOR SHORING.

Melanie Splichal
Project manager, PORR Bau GmbH

Difficult foundation conditions

The building complex includes a basement level with a garage, technical and storage rooms, a ground floor and five or six higher storeys depending on the building.

The high groundwater conditions on the site made dewatering necessary. Groundwater reduction measures were planned and executed using a soldier pile wall for shoring. A trench embankment on neighbouring land was possible on one site boundary. The entire basement level was constructed in waterproof reinforced concrete. The ceilings over the ground floor in the areas not built on and the passageways were also planned and implemented with waterproof concrete.

The load-bearing vertical components were designed in reinforced concrete and brickwork; the ceilings are also made of reinforced concrete. The roofs were constructed as warm roofs with bituminous sealing. The roofs of the internal courtyard and all other roofs outside of the roof terraces have a green roof.

PORR handed over the day care centre to the client as an extended shell for the work to be completed by the operator. All other areas were handed over by PORR on a turnkey basis.

Modern elements complement the classic façade style. Source: PORR/Markus Löffelhardt

Conclusion

The confined inner-city location of the construction area with a directly adjacent building and a car park required a high level of care, consideration and precision from the experts at PORR. For example, during the excavation work, the soldier pile wall was installed directly on the car park boundary. The team had to ensure that use of the rest of the car park was not obstructed during the work.

Thanks to a strong project team that worked passionately to implement our PORR principles in collaboration with the subcontractors and all involved in the planning process, the project was handed over to a happy client in March 2019.

Technical data

2,222 m²
Plot area

7,200 m³
Amount of excavated material

Gross floor area	10,961 m²
Excavation pit depth	3.50 m
Car parking spaces	33
Steel incorporated	682 t
Concrete incorporated	3,600 m³

The copper roof dome makes the residential project a special eye-catcher. Source: PORR/Markus Löffelhardt

PROGRESS: 100% - COMPLETED
GERMANY

AMERICAN-STYLE LEARNING

Vogelweh Elementary School Kaiserslautern

Author: Elke Kleres / Hubert Ackermann

The school was built by PORR subsidiary BBGS, at a cost of EUR 28.5 million, as part of a school-building Programme by the American Armed Forces in Europe.

When building the Elementary School, both US and EU standards had to be taken into account. Flexibility and accessibility were also required, along with high security and sustainability requirements.

Overview

Vogelweh Elementary School was built by a consortium under the technical lead of PORR subsidiary BBGS. The 52,000m² site is located within the US-owned 'Vogelweh Housing' estate in the south-west of Kaiserslautern. The school is accessible throughout and will be attended by 655 students aged 2-12, of whom 25% are special needs students. The flexible building concept allows for different learning styles and varied class sizes.

Preparations

BBGS began work in September 2016 with the earthworks. The terrain modelling involved shifting more than 200,000 tonnes of soil. Some 124,000 tonnes of partially contaminated earth were removed and disposed of; the remaining 76,000 tonnes were used for landscaping the new site.

Project data

Employer	Landesbetrieb Liegenschafts- und Baubetreuung Rheinland-Pfalz LBB, Trier branch
Contractor	Neubau VOES consortium: BBGS GmbH, Mickan General-Baugesellschaft mbH & Co. KG and Steffensky & Ringle Bau GmbH
Order type	Main contractor
Project type	Building construction . Public buildings
Project scope	Construction of a two-storey school complex with additional safety and sustainability requirements
Order volume	28.5 million euros
Construction start	09/2016
Construction end	08/2019

SINCE THE CUSTOMER PLACES A GREAT DEAL OF VALUE ON SUSTAINABILITY, WE WORKED WITH REGIONALLY-SOURCED BUILDING MATERIALS WITH A HIGH PROPORTION OF RECYCLED MATERIAL. THE REINFORCED CONCRETE USED CONTAINED OVER 97% WASTE MATERIAL.

Hubert Ackermann
Site manager, BBGS

Safety and sustainability

To keep damage to a minimum in the event of an attack, the US military has high security requirements for its buildings. For this reason, the buildings are mostly monolithic reinforced concrete structures. Glass facades and windows are reinforced with steel structures and have a special triple-layer safety glazing. All ceiling suspensions are double-secured.

In order to meet the high security requirements, the school was built almost entirely using a monolithic construction technique. Source: BBGS GmbH

In addition to security, the US military also places considerable emphasis on sustainability – this applies to construction of the building as well as during operation. The school was built from primarily regionally-sourced building materials with a high proportion of recycled material. For example, the reinforced concrete contained over 97% waste material. Light coloured materials were used for the outdoor areas and roof covering, in order to reflect as much sunlight as possible.

Surface water is collected in sunken buffer storage systems, specifically, swales, which slow down rainwater runoff to avoid flooding neighbouring land. Rainwater from the roof is stored in four 5m³ tanks and used to water the gardens. Green roofs also contribute to water management and improve the microclimate. The project aims to achieve a Silver LEED certification.

A wind turbine with solar panels supplies clean energy and provides the students with an example of regenerative energy. Source: BBGS GmbH

The building concept

The core of the school building is the “Commons”, a large communal area at the centre of the school complex which serves as a kind of hub connected to all the main areas of the building. The main entrance is located on the north-east side of the building and access checks will be carried out here.

It is flanked by the administrative area and information centre. The glass-fronted north-west facade of the commons hall opens into the school’s outdoor courtyard, with access to an outdoor “green classroom” in the style of an amphitheatre.

A vestibule in the façade, located next to the break hall, can be used as a direct entrance to the commons area for external events.

The “Commons” at the heart of the complex is the building’s connecting hub. Source: BBGS GmbH

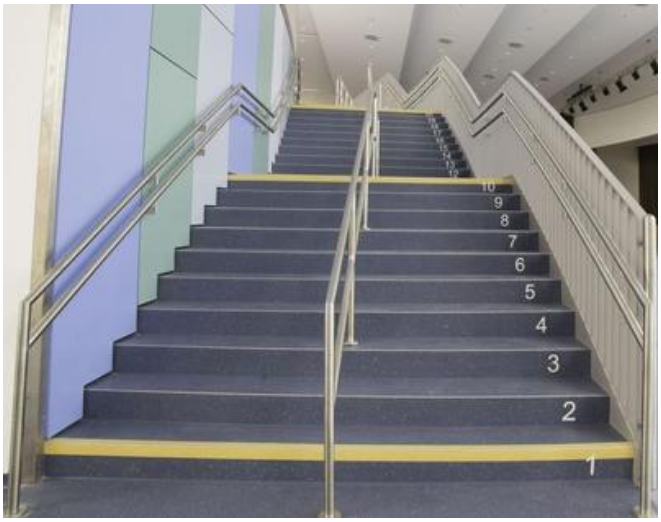
THE FORMWORK FOR THE CURVED STAGE TOWER IN THE COMMUNAL AREA REQUIRED CONSIDERABLE MANUAL SKILL.

Hubert Ackermann
Site manager, BBGS

The auxiliary campus buildings, called “Neighborhoods”, follow a similar construction to the main building. Individual study studios are grouped around a communal connecting area that serves as a multifunctional space. An open, flexible construction method with mobile separating walls means that the study studios can be arbitrarily extended into the hub.

There are also group areas and individual rooms. Art and music each have their own blocks linked to the outdoor area. A large gym is available for physical education, with pitch markings for a variety of sports. A large kitchen built to US hygiene standards ensures that students will not go hungry.

Learning tools have been integrated into the furnishings: the flooring in the hub includes maps of the continents, and a world map is integrated into the commons area. Stairs are labelled with numbers and the notes of the US national anthem are recessed into the music room. Another learning tool is a number of ceiling panels made of acrylic glass, through which students can observe the inner life of the ceiling cavity.



Learning tools have been incorporated throughout the building, from country maps laid into the floor to numbered stairs for the smallest scholars. Source: BBGS GmbH

Construction challenge

A highlight from a construction point of view is the stage tower integrated into the communal area. The formwork for the curved tower has an inclined upper edge that required particular manual skill. The interior and external facades were clad with clay tiles. This rounded arrangement is unique in Germany and required a special building permit.

The stage tower has a curved reinforced concrete wall that was a significant challenge to build. Source: BBGS GmbH

Summary

PORR subsidiary BBGS acted as technical lead for a consortium that has built a school complex with a gross floor area of 15,500m², during a construction period of three years. More than 160 tonnes of steel, almost 10,000m³ of concrete and around 1,300 tonnes of reinforced concrete went into the building.

Technical data

52,000m²
Plot area

Soil moved	75,000t
Soil removed	124,000t
Parking spots	161
Asphalt road	2,580m²
Concrete road	3,200m²
Concrete paving	4,300m²
Playing field	540m²
School garden	150m²
Gross floor area	15,500m²
Steel incorporated in superstructure	165.5t
Concrete incorporated (building)	9,846m³
Reinforced concrete incorporated (building)	1,285t

PROGRESS: 100% - COMPLETED
AUSTRIA

APARTMENT COMPLEX WITH WAVE DESIGN

WHA Gregorygasse 10 + 10A, Vienna

Author: Reinhard Rieser / Lukas Shamoun

In just 20 months, PORR has constructed an apartment complex containing 220 apartments and a two-storey underground parking garage in the 23rd city district.

The construction period was kept short through a combination of forward-thinking execution and the use of partially and fully prefabricated elements. Fully adhered facade profiles featuring a striking wave design lend the complex a distinctive visual appearance.

Project data

Employer	Arwag Bauträger GmbH, Arwag Objektvermietungsgesellschaft
Contractor	ARGE Gregorygasse PORR – SWIETELSKY
Architect	SMAC Smart Architectural Concepts KG
Order type	Main contractor
Project type	Building construction . Residential building
Project scope	New construction of an apartment complex with underground garage
Order volume	22 million euros
Construction start	04/2017
Construction end	12/2018

Overview

In the middle of a park-like complex near the Liesingbach, PORR operated under contract to Arwag to construct an apartment complex comprising a total of 220 apartments in four buildings. The buildings are connected by a subterranean parking garage and contain a broad range of apartment types and floor plans. A five-storey building element along Gregorygasse contains the very compact “smart apartments” with reduced internal infrastructure, as well as space-optimised subsidised rental apartments. The remaining three seven-storey buildings, in contrast, contain spacious, independently financed rental and freehold apartments.

The height variation in the individual building sections enables the complex to blend into the surrounding area of predominantly single-family houses. A recessed top floor on the building along Gregorygasse further emphasizes this variation. When establishing ground floor access from the street, PORR made use of the natural lie of the land, which slopes considerably from east to west.

The three seven-storey building elements contain spacious, independently financed rental and freehold apartments, while space-optimised subsidised apartments have been constructed in the longer building along Gregorygasse. Source: PORR

THE INCREASED USE OF PARTIALLY AND FULLY PREFABRICATED COMPONENTS KEPT THE SHELL CONSTRUCTION TIME TO A MINIMUM AND ENSURED THE PROJECT REMAINED WITHIN THE TIGHT TIMETABLE REQUIRED.

Reinhard Rieser
Construction manager, PORR Bau GmbH

Short shell construction stage

Owing to the poor load bearing capacity of the soil, the entire complex was constructed on a foundation of 290 bored piles. Both basement floors were constructed from waterproof concrete, rendering additional sealing works on the exterior cellar walls unnecessary.

The structural engineering was conceived as a continuous design across all floors. The buildings have load-bearing external walls and a supporting staircase core. Supporting walls and plates subdividing the individual accommodation units also contribute to the building structure, resulting in smaller spans and optimal slab thicknesses.

The load-bearing building elements, the entire cellar and the ground floor were constructed from in-situ concrete. The remaining floors chiefly consist of partially prefabricated elements together with cavity walls and prefabricated ceilings. The balcony slabs, lift shafts and staircases were made from fully prefabricated elements. This construction method made it possible to complete the shell construction within a short time frame, and work was able to begin on the interior after only eight months.

OWING TO THE POOR LOAD-BEARING CAPACITY OF THE SOIL, THE ENTIRE COMPLEX WAS CONSTRUCTED ON A FOUNDATION OF 290 BORED PILES.

Reinhard Rieser
Construction manager, PORR Bau GmbH

Building shell with design elements

The shell of the building comprises load-bearing reinforced concrete walling and a thermal insulation system. The most striking feature of the whole project is the special wave design of the fully adhered facade profiles. All the building elements share a vertically structured facade design. The openings consist of French windows with large glass surfaces. The smooth, white main facade represents a geometric interplay with the generous window areas and the individual wave-patterned sections, enhanced by broad balconies. The sleek, uninterrupted white surface of the upper storeys provides a smooth finish to the facade. This subtle contrast between the outer surface structures is particularly evident in sunny daylight conditions.

High-quality fittings

Each apartment includes an outdoor area in the form of a terrace, balcony or private garden on the ground floor. There are slight differences in the interior fittings between the subsidised and independently financed apartments. For instance, the subsidised apartments feature wooden windows with aluminium cover caps. The living areas and wet rooms are finished with laminate and small tiles. By contrast, the independently financed apartments are equipped with plastic windows with aluminium cover caps, and parquet flooring and larger tiles feature in their execution. Each window is fitted with external, electrically controlled solar shading.

All bathrooms include electric underfloor heating. Source: Arwag

Spacious outdoor areas

The outdoor concept of the complex is characterised by efficient pathway design, ensuring the

various levels of the site are fully accessible and connected via the shortest possible distances. Owing to the differences in level, access to the complex is via a broad external staircase, complemented by a convenient, accessible ramp construction. A broad range of spacious outdoor areas, including an infants' playground and children's playground, will satisfy all the tenants' requirements, and spaces for meetings and communication were also included in the plans.

Conclusion

PORR has operated in consortium with Swietelsky to build a home where all residents will feel comfortable - the Gregorygasse 10 + 10A apartment complex. The effective and forward-thinking collaboration of the entire project team made it possible to complete the construction scheme with optimum results. Work remained constantly one step ahead of schedule, so unexpected developments could be addressed in good time and there was never any danger of exceeding the planned construction period.

Technical data

11,050m²
Plot area

14,500m³
Excavation volume

Gross floor area	21,650m²
Usable living area	16,800m²
Built area	3,550m²
Car parking spaces	176
Sheet piling (wall)	80rm
Bored piles	290
Steel incorporated	1,630t
Concrete incorporated	15,500m³

The wave-patterned facade profiles raise the look of the apartment complex to another level in comparison to other, similar projects. Source: Austrotherm

PROGRESS: 100% - COMPLETED
AUSTRIA

URBAN LIVING BY THE WATER

BVH Erdberg Site 26 – NORD2 Laendyard

Author: Michael Teggan

As part of a revitalisation project at the former Siemens factory site, PORR has built a residential complex on the Danube Canal in Vienna.

The Laendyard project consists of four buildings and a great deal of architectural diversity. The main challenges included the protruding balconies for the upper storeys, a cramped construction site and difficult soil conditions. The project team were supported by various PORR subsidiaries.

Project data

Employer	Joint venture JP Immobilien and CA Immobilien Anlage AG
Contractor	Porr Bau GmbH
Architect	Malek Herbst ZT GmbH BEHF Ebner Hasenauer Ferenczy ZT GmbH
Order type	Main contractor
Project type	Building construction. Residential building
Project scope	Construction of a residential complex including commercial areas, consisting of two 11-storey blocks and two 7-storey blocks
Order volume	approx. 30 million euros
Construction start	08/2016
Construction end	05/2018

Overview

Towards the end of summer 2016, joint venture partners JP Immobilien and CA Immobilien Anlage AG awarded PORR the contract for the prestigious Laendyard construction scheme on the former Siemens land, part of the Erdberg site in Vienna's third city district. The Laendyard project encompasses construction of 270 homes and 1,500m² of commercial space in four buildings. The complex has guaranteed unobstructed views, thanks to its location right next to the Danube Canal. In addition to the attractive outlook and its high quality of living, the location boasts superb connections to the public transport network, cycle network, and major and minor road networks.

PORR had already been awarded a contract to build 220 flats on this site six months before acquiring the Laendyard project. The project managers were therefore able to fully exploit the synergies and bring a net order volume of 30 million euros into the country through the new project. The two residential projects are both referred to as "Laendyard" and are part of the city development area "Site 3". This site is a revitalisation of the former Siemens factory location for mixed use, with residential, office, restaurant and retail spaces.

At the ground-breaking ceremony on 6 Sepember 2019: Karl-Heinz Strauss (PORR CEO), Marion Weinberger-Fritz (Manager of Raiffeisen Vorsorge Wohnung GmbH (RVW)), Elisabeth Binder (Manager of Raiffeisen Vorsorge Wohnung GmbH (RVW)), Erich Hohenberger (Head of Vienna's Landstrasse district), Daniel Jelitzka (JP Immobilien) and Florian Nowotny (Board member at CA Immobilien Anlagen AG).

The ground-breaking ceremony. Source: CA Immo AG/APA-Fotoservice/Schedl

IN ORDER TO BUILD ON THE 6,600M² BASE PLATE AS EFFICIENTLY AS POSSIBLE AND KEEP TO THE TIGHT SCHEDULE, FOUR LARGE CRANES WORKED AT FULL LOAD DURING PEAK PERIODS.

Michael Teggan
Construction manager, PORR Bau GmbH

Complex temporary construction pit system and foundations

As soon as the construction site containers were in place, the excavators rolled in to start on the earthworks and underground demolition work. The soil conditions meant that the soil had to be completely replaced in some areas. PORR specialist civil engineering provided in-house support for these activities.

The temporary construction pit system was then created on the Erdberg site using sheet-pile walls. The neighbouring site had to be underpinned and the remaining construction area was secured with a slope. For the basement that runs below almost the entire site, a foundation was laid over the entire site using base plates reinforced with haunches: a haunch is a triangular angled piece placed over the transition area between the column and the support. Once the 6,600m² base plate was complete, the 1-2 storey basement, which will be largely used for underground parking, was then built onto it. In order to work as efficiently as possible on the considerable area and keep to the tight schedule, four large cranes were used at peak periods, working at full load to move the numerous heavy precast and semi-finished parts to their final installation positions.

Up to four large cranes were in use on the construction site at peak periods. Source: PORR

Overhanging challenges

During the work on the carcass, the team faced a major challenge in constructing the balconies for storeys 9 to 11 on the Erdberg site, as they protrude 2.4m from the structure along a length of 36m. Due to the height of the falsework, the balcony plates could not be supported with the conventional technique of setting up a heavy-duty scaffold from the ground. Structural engineers were brought in to develop a special solution: welded I-beams that were 3–4 times the length of the overhang were installed on the reinforced concrete plates on the eighth storey, where they protruded over the external edge of the building to the full width of the balconies. Underpinning for the balcony plates could then be built on these I-beams. In this way, the effective load-bearing forces were transferred from the underpinning through the I-beams and floor plate into the building. Once the blacktop work had been completed by PORR subsidiary IAT GmbH, it was time for the topping-out ceremony.

The overhanging balconies in the three top storeys presented a major challenge during the carcass construction. Source: PORR

TO ERECT THE OVERHANGING BALCONIES FOR THE TOP THREE STORIES, WE WORKED WITH THE STRUCTURAL ENGINEERS TO DEVELOP A SPECIAL SOLUTION USING WELDED I-BEAMS.

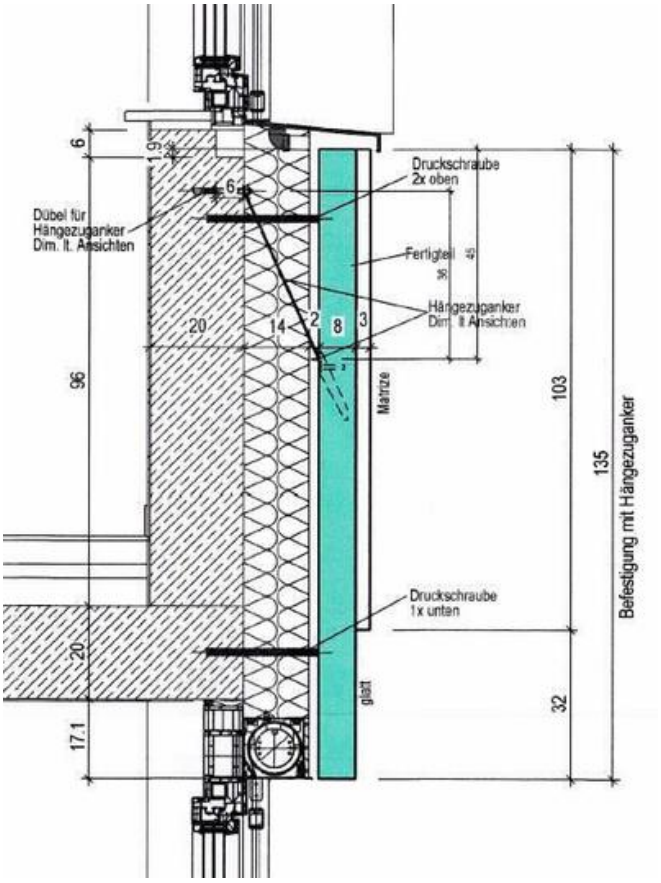
Michael Teggan
Construction manager, PORR Bau GmbH

Diversity outside...

The Laendyard project is characterised by diversity and variety. This design approach is particularly evident on the building facade. The length of the building along the Erdberg site has an eye-catching glazed post-and-beam facade for the ground floor commercial areas. The facade structure extends over two storeys and is particularly striking due to its narrow supports, which were developed by converting the reinforced concrete solid construction to a reinforced concrete skeleton for this area.

Construction blocks 1 and 4 also boast a showy facade that can be seen from a distance: shimmering pearly gold Alucobond with a fully-insulated dark-green abraded surface. Alucobond facades are usually constructed as part of mounted rear-ventilated facades. For the Laendyard project, however, the Alucobond facade is a purely decorative element with a continuous impermeable coat beneath it.

The facade on construction block 3 was equally resource intensive: it consists of mounted precast concrete slabs produced using a patterned vertical stripe template to create the visual element. The supporting structure consists of compression screws and panel anchors.



The mounted rear-ventilated facade on construction block 3 is composed of precast concrete slabs. Source: BEHF Ebner Hasenauer Ferenczy ZT GmbH

... and inside

The diversity in the project is not limited to the externalities; it is also carried over to the interior of the building. Each building has an individual own colour scheme and the foyers have a different design at each stairwell. The flats in the different storeys of each construction block are also fitted out differently. This includes the heating system – underfloor heating or radiators –, the wallpaper and floor coverings, plastic window frames vs. wooden with aluminium shells, diverse HVAC options, and even different door sizes and decking materials for the balcony and terrace areas. The higher-quality flats have larch wood decking from PORR subsidiary Wibeba on their balconies and terraces.

M&E and external areas

All four Laendyard buildings are fitted with fire alarm systems and smoke and heat extraction systems, including electronically controlled dome lights and windows in the stairwells. The stairwells also have pressure ventilation systems with door closers. A CO warning system with automatic exhaust valve has been installed in the garage.

The buildings are set off by a generous outdoor area with a time-switched fountain in the “village square” and a children’s play area. PORR civil engineering subsidiary Allbau was involved in the paving and asphalting work in and around the complex.

Summary

The completion of the Laendyard project represents a milestone in the Site 3 revitalisation scheme. Laendyard stands for high quality furnishings and diversity inside and out. A particular highlight: from the roof terraces on the four buildings, renters can enjoy a panoramic view extending from Prater to St. Stephen’s cathedral.

Technical data

approx. 16,200m²
Living areas

approx. 5,200m²
Garage area

Gross floor area	approx. 33,500m²
Plot area	approx. 7,000m²
Commercial areas	approx. 1,500m²
Terraces and roof terraces	approx. 600m²
Garage parking places	157 cars and 12 motorbikes
Other areas	approx. 3,500m²
Building pit depth	approx. 11m at the deepest point
Construction pit system	Sheet-pile walls
Steel incorporated	approx. 2,200t
Concrete incorporated	approx. 21,000m³

The Laendyard residential complex is part of the “Laendyard” project development area on the Danube Canal in Vienna. Source: Laende3

IN PROGRESS
GERMANY

WORKING TOGETHER FOR CLIMATE PROTECTION

Marzahn CHP

Author: Fabian Hemauer

Under contract to Siemens AG, PORR is constructing a foundation for one of the most modern combined heat and power stations in Europe.

The Marzahn CHP will provide district heating and electricity for 150,000 households, resulting in a significant reduction in CO2 emissions. PORR's contribution to the project consists of main construction works plus the turnkey completion of four buildings.

Project data

Employer	Siemens Aktiengesellschaft Power & Gas
Contractor	PORR GmbH & Co. KGaA
Order type	Main contractor
Project type	Civil engineering . Power station construction/Building construction/Civil engineering . Road construction
Project scope	Planning and complete turnkey construction of four buildings and execution of main construction works for the power station
Order volume	Approx. 30 million euros
Construction start	09/2017
Construction end	03/2020

Overview

The Berlin-Lichtenberg combined heat and power station, originally built in the 70s, was decommissioned in 2010. The project was opened for tender by Vattenfall Wärme Berlin AG in 2014, and Siemens AG was successful in securing the contract for the construction of one of the most modern combined heat and power stations in Europe. Most of the necessary plant components were sourced from the region around the German capital city.

The SGT5-2000E gas turbine was manufactured in the Siemens factory in Berlin-Moabit, while the SST-800 steam turbine came from Görlitz, around 200km away. Transformers, generators and switchgear were sourced from Dresden, Leipzig and Erfurt.

The role of main construction works for the power station and the complete turnkey construction of four supply buildings was assigned to PORR's Infrastructure and Civil Engineering branch in Munich. Main construction works for the project include earthworks, numerous supply lines, foundations for the "power block", two 45m-high stairwells, two turbine platforms, a switching station building, several auxiliary buildings and the necessary road construction.

The total value of these works amounts to around 23 million euros. The role also includes planning and turnkey execution of a block control room building, an administrative building, a social, storage and workshop building and a garage to the value of 7 million euros.

IN DEFERENCE TO THE TIGHT SCHEDULE, VERY RAPID-SETTING CONCRETE WAS USED. THE STAIRWELLS WERE ALSO HEATED AND COATED IN FROST PROTECTION MATS OVER THE WEEKEND.

Fabian Hemauer
Project manager, PORR Bau GmbH

Logistical feat

The central element of the entire plant is the power block. This structure contains the two powerhouses for the turbines (UMA and UMB), two transformer buildings (UBC and UBF), the boiler house (UHA), the feed water pump room (ULA) and the switching station building (UBA). The project represented a major logistical challenge right from the start owing to the ambitious timetable, need for concurrent planning and the numerous subcontractors at work simultaneously.

The limited space of the site has had to accommodate a great deal of activity with the construction of a foundation plate for the structural steelwork, the turbine foundation, a vibration-damped turbine platform on columns, two staircases up to 45m high and the geometrically demanding switching station building. Constant coordination of the various lifting devices in use by the individual work teams, often operating in close proximity, was necessary to ensure safe working conditions. In spite of time pressure, workplace safety was a key issue on the construction site. Collaborative effort ensured that PORR's construction site team put into practice the "seven golden rules" of PORR's VISION ZERO for the reduction of workplace accidents and managed to satisfy the high safety requirements specified by end client Vattenfall for a power plant project.

CONSTANT COORDINATION OF THE VARIOUS LIFTING DEVICES IN USE BY THE INDIVIDUAL WORK TEAMS, OFTEN OPERATING IN CLOSE PROXIMITY, WAS NECESSARY TO ENSURE SAFE WORKING CONDITIONS.

Fabian Hemauer
Project manager, PORR Bau GmbH

Complex turbine platform and staircases

On top of the site logistics, the turbine platform for the steam turbine was another significant challenge to be addressed. The supporting structure for the turbine and corresponding generator rests on six vibration dampers at a height of 15m. Falsework for the concreting was erected between the column-and-beam construction. This auxiliary structure formed the basis for a total of 45t of reinforcing steel, 170 built-in elements and 280m³ of concrete. The high reinforcement requirements and 10mm installation tolerances for formwork and built-in elements necessitated a high degree of concentration when positioning reinforcement. A unique concrete formula was developed to meet the high compression strength requirements, and this formula was initially checked in test rows and then monitored with temperature sensors throughout the concreting and subsequent hydration processes.

The completed turbine platform. Source: PORR/Fabian Hemauer

The two stairwells of the power block, which were completed with the aid of climbing formwork, also presented a genuine challenge. PORR's team of experts outdid themselves in completing the climbing formwork, scaffolding the walls with their numerous niches and openings, and positioning the necessary reinforcement and earth. In deference to the tight schedule, very rapid-setting concrete was used. The stairwells were also heated and coated in frost protection mats over the weekends. Each Monday, the firmness of the concrete was assessed using test cubes before the next section of formwork was erected.

In an effort to meet weekly deadlines, the stairwells had to be heated and coated in frost protection mats over the weekends. Source: PORR/Fabian Hemauer

The entire power station will be monitored and controlled from the block control room building. Source: PORR/Fabian Hemauer

Turnkey construction

Along with works on the power station, PORR was also responsible for turnkey construction of the control room building, administration building, social, storage and workshop building and garage.

In future operation, the entire power station will be monitored and controlled from the UCA block control room building. Accordingly, the workplaces are arranged in an oval formation and connected to the adjacent server room via a double floor system.

The administrative building (UYA) contains office and training rooms, two server rooms, a first-aid room, a commercial kitchen and a cafeteria.

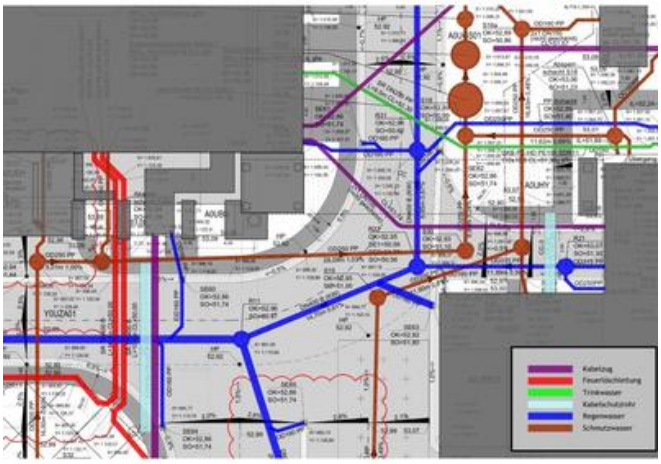
Replacement parts will be managed, plant components maintained and hazardous materials stored in the social, storage and workshop building (UST). A crane has been installed in the machinery room to facilitate these functions. The fourth building will serve as a garage for company vehicles (UYQ).

To offset the high demands in terms of formwork and reinforcement for the power station building, the auxiliary buildings were primarily constructed using double-shell walls and precast panels. In view of the span involved, the roof was made from prestressed concrete elements.

The high standards required of the technical building equipment for the building stipulated redundant systems for ventilation, climate control and lighting in all important operational areas. A battery installation in every building will ensure uninterrupted power supply in an emergency, and the batteries are designed to last until emergency generators begin operating. All the buildings also feature additional fire protection equipment. A large number of fire sections, automatic extinguishing systems, additional smoke extraction systems and fire alarms will assist employees on site as needed.

Subterranean network

Switching systems for the power block, block control room, auxiliary buildings and administration building are connected via a network of cable ducts and cable drum lines to ensure constant monitoring of all plant components of the power station. Cable drum lines form an additional element of the complex subterranean operation, alongside the gas pipeline, fire-extinguisher pipes, drinking water network, rainwater piping including rainwater retention basin and wastewater network. Cable ducts are buried at depths of up to 5.30m beneath all the buildings and peripheral plant components.



Beneath the power station lies a complex subterranean network of cable drum lines and ducts. Source: Siemens AG

Concreting the outdoor storage area floor slab for the Marzahn combined heat and power station. Source: PORR/Fabian Hemauer

Key Figures

Since construction began in September 2017, PORR has done far more than just lay the foundations for the power station, employing around 20,000m³ of concrete, 2,000t of reinforcement steel and 15,000m of conduit in the area of the power block and auxiliary buildings. The basic shell construction was successfully completed and handed over to the employer in February 2018. The PORR team is also responsible for outdoor facilities, finishing works, fire protection equipment and road construction. The four turnkey buildings are being constructed in cooperation with H+E Haustechnik und Elektro GmbH and will be handed over at the end of 2019, with overall completion to follow in March 2020.

Technical data

15,000m
Conduit

Excavation volume	24,000m³
Concrete poured	19,000m³
Reinforcing steel used	2,000t
Earthing cable	20,000m

PROGRESS: 100% - COMPLETED
GERMANY

NEW JEWEL IN OLD TOWN ON THE BALTIC COAST

Schlossquartier Kiel

Author: Daniel Wriesnik

PORR was the main contractor for LEED certified residential complex comprising 213 flats in six sections, in the heart of Kiel's old town.

The project's city centre location made the construction site logistics particularly challenging. Vibrations had to be essentially avoided and noisy construction activities were subject to restrictions.

Project data

Employer	NGEG Objekt Schlossquartier GmbH & Co. KG
Contractor	PORR Deutschland GmbH
Architect	Schnittger Architekten + Partner und bbp : architekten bda
Order type	Main contractor
Project type	Building construction . Residential building
Project scope	Construction of a residential complex including underground parking and execution planning to project phase 5
Order volume	40 million euros
Construction start	01/2016
Construction end	02/2019

Overview

On 18 December 2015, NGEG Objekt Schlossquartier GmbH & Co KG named PORR Deutschland GmbH as the main contractor for the construction of the "Schlossquartier Kiel". The project comprises a residential complex numbering 130 owner-occupied flats, 83 rental flats, seven commercial spaces on the ground floor and an underground car park for 184 vehicles.

Various PORR AG departments were involved in the project: PORR Design & Engineering was responsible for planning and cost estimation, while the Hamburg branch of PORR Deutschland GmbH worked with Vienna's Major Projects Building Construction department on the construction.

Three derelict buildings were demolished to make room for the new Schlossquartier Kiel. Source: PORR/Arne Biederbeck

Harmonious architecture

The exclusive location in the heart of Kiel's old town led to demanding architectural standards for the project. Architects Schnittger Architekten + Partner and bbp : architekten bda rose to the challenge splendidly, designing a timeless residential ensemble that blends perfectly into its historic town setting. The Schlossquartier's facade is clad with clinker masonry bricks, using different brick and joint colours for each construction section. The clinker bricks were assembled entirely by hand and are highly resistant to winds and driving rain. The building entrances, balconies and bay windows have a partial sheet-metal facade, which sets the Kiel Schlossquartier apart from the buildings around it.

The Schlossquartier Kiel with its clinker brick facade blends harmoniously into the historic town setting. Source: PORR/Arne Biederbeck

THE DAILY TV BROADCASTS AT THE NDR BRANCH NEXT DOOR RULED OUT NOISY CONSTRUCTION ACTIVITIES AT CERTAIN TIMES.

Daniel Wriesnik
Project manager, PORR Bau GmbH

Challenging logistics

In addition to the architecture, the construction site logistics were also confronted with some challenges due to the inner-city location. PORR's experts, sandwiched between the glorious old St. Nikolai church, the Schleswig-Holstein headquarters for North German Radio (Norddeutschen Rundfunk, NDR) and the "Schloss", or castle, that gives the Schlossquartier its name, found themselves facing various conundrums: the church, almost 800 years old, could not be subjected to any vibrations, the daily TV broadcasts at NDR ruled out noisy construction activities at certain times, and regular events in the castle also had to be taken into account

The exclusive central location presented various challenges, particularly for construction site logistics. Source: PORR/Arne Biederbeck

BEFORE THE 'LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN' CERTIFICATION CAN BE AWARDED, EACH INDIVIDUAL BUILDING IS SUBJECTED TO ITS OWN INSPECTION CYCLE.

Daniel Wriesnik
Project manager, PORR Bau GmbH

Superb living conditions

The apartments in Schlossquartier Kiel have an air extraction system and external air inlets in the facade. Exhaust air is extracted by central extraction fans on the roofs of the various buildings and vented over the rooftops. The external air inlets noiselessly supply fresh air to the apartments. This type of home ventilation guarantees a pleasant indoor climate at all times, without having to open any windows. All the apartments also have balconies, loggias or terraces, a further boost to the excellent living conditions.

The Schlossquartier is one of the very few residential buildings in Germany to boast a Gold LEED certificate. Before the "Leadership in Energy and Environmental Design" certification can be awarded, each individual building is subjected to its own inspection cycle. It's not just about the building envelope criteria: the finishes and installations in the flats are also inspected.

A special catalogue of fittings was prepared in advance, which the future flat owners could use to plan their homes individually.

Summary

PORR has created a real jewel in Kiel's old town. The Schlossquartier blends harmoniously into the historic town centre while at the same time adding a modern touch. The sought-after LEED certification guarantees that the complex has a high ecological quality, while a modern ventilation system ensures a pleasant internal climate and optimum living conditions.

An inner courtyard boasts small play area, several raised beds and seating areas. Source: PORR/Arne Biederbeck

Technical Data

213
Residences

44 – 133m²
Flat size

Gross floor area	31,358m²
Plot area	6,600m²
Underground car park	6,408m²
Car parking spaces	184
Public spaces	4,850m²
Type of foundation	Ground slab
Electric car charging points	6
Certification	LEED Gold status, Dekra
Facade	Clinker brick facade

IN PROGRESS
SWITZERLAND

NEW “ARENA” AT ZURICH CENTRAL RAILWAY STATION.

HB Nord - Gleisarena

Author: Christian Koehly

In the heart of Zurich, right next to the central railway station, planning and construction are underway for the new Gleisarena office block.

With a cramped construction site, difficult foundation conditions, ongoing rail operations, and a specially developed double-curved glass brick facade, the Gleisarena project presented PORR with significant challenges to overcome.

Project data

Employer	Schweizerische Bundesbahnen SBB [Swiss Federal Railways]
Contractor	PORR SUISSE AG
Architect	Made in Sàrl, Geneva
Order type	General contractor
Project type	Building construction . Office
Project scope	Planning and construction of a seven-storey head end structure and a six-storey longitudinal building
Order volume	40 million francs (35.9 million euros)
Construction start	05/2017
Construction end	02/2020

Overview

Swiss Federal Railways (SBB) contracted PORR to build the Gleisarena office and commercial building in Zurich’s Zollstrasse. Work began on the project in May 2017: a seven-storey head end structure connected to a six-storey longitudinal building via a shared basement. In total, the project comprises 9,000m² of office space on the upper floors and 850m² of restaurant and retail areas on the ground floor. Both buildings meet the Swiss Minergie-P-Eco energy standard and qualify for Gold certification by the German Sustainable Building Council (DGNB).
The project also involves adding a civil protection shelter to an existing pedestrian and utility tunnel, as well as linking the underground level of the Gleisarena to the Gleistribune complex – another PORR project – and to Zurich central railway station’s underground passage.

View across the tracks to the Gleisarena and protective tunnel.
Source: PORR

Tight squeeze for the construction pit

In light of the extremely cramped conditions, PORR decided on a reinforced sheet-pile wall to seal the construction pit. Building on experiences from other construction sites in the Europaallee opposite, PORR successfully used vibratory hammers to drive the sheet-piles, using gravel from the nearby Sihl. The sheet-pile walls were strengthened with horizontal steel girders to maintain their alignment and reinforce them against the diaphragm wall of the existing tunnel. This structure eliminated the need for additional earth anchors and thus saved the considerable costs of installing and subsequently removing such anchors. The construction pit was fully dismantled after completion of the underground level.

A PEDESTRIAN/UTILITY TUNNEL RUNS BENEATH A LARGE PART OF THE GLEISARENA SITE, WHICH MEANS THE BUILDING PHYSICS HAS TO ENSURE THAT THE STRUCTURE DISPERSES LOADS APPROPRIATELY IN THESE TUNNEL REGIONS AS WELL AS INTO THE SOIL.

Christian Koehly
Team leader, PORR SUISSE AG

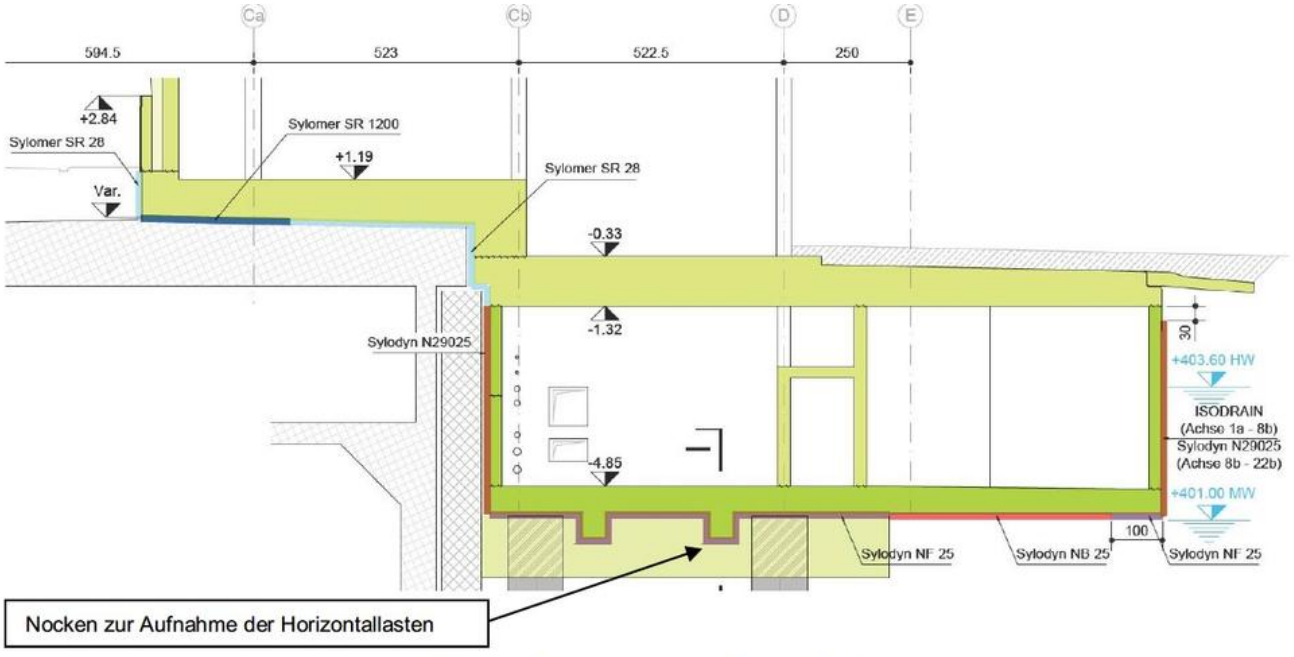
Complex foundations by existing tunnel

A pedestrian/utility tunnel runs beneath a large part of the Gleisarena site, which means the building physics has to ensure that the structure disperses loads appropriately in the tunnel regions as well as into the soil. PORR implemented various measures to avoid uneven settling behaviour resulting from different foundation conditions. A total of 49 bored piles, with diameters between 100 and 120cm, were installed beneath the building components that transfer loads into the ground. To ensure even load dispersal and to absorb horizontal loads such as wind or earthquakes, pile caps were bolted together in groups.

The 50 to 80cm thick floor slab for the underground level has a shallow foundation along the outer wall. Over the rest of the building plot, it is set on bored piles due to the high load concentrations. This considerably reduces the degree of settlement and differences in settlement resulting from the tunnel construction. The dimensions of the pile bolts were chosen such that sufficient bearing surface is available to take up the building loads by means of an elastic bedding.

Horizontal load distribution

The thickness of the ground floor slab varies from 70 to 100cm. It serves for load distribution and to take up horizontal loads across the tunnel roof. The supports in the above-ground storeys are set at an angle, which allows the horizontal loads to be transmitted through the walls in the core area and front facades and then directed into the floor slab. The horizontal loads are passed through tappets to the bored piles and then into the soil.



Elastische Lagerung - Querschnitt

By using elastic polymers in the building foundations, PORR was able to suppress vibrations and noise from the neighbouring railway operations. Source: Lurati Muttoni Partner SA

THE LOCATION RIGHT NEXT TO THE MAIN TRAIN STATION AND THE LONG, NARROW CONSTRUCTION SITE MADE FOR EXTREMELY TIGHT CONDITIONS. THE EXISTING TUNNEL, THE ELECTRICITY SUPPLY THAT CROSSED THE SITE, AND THE DEMANDING REQUIREMENTS FOR THE FOUNDATIONS ADDED TO THE CHALLENGES.

Christian Koehly
Team leader, PORR SUISSE AG

Elastic building foundation

The Gleisarena is located right next to Zurich's main railway station, which has a large number of tracks on several different levels, and is therefore a significant source of vibrations and noise. To compensate for this, the floor slab of the Gleisarena is separated from the foundation structure by an elastomer (elastic polymer) layer.

To ensure the decoupling of both noise and vibration by these elastomers, flat supports are essential. This was achieved by joining the bedding to the pile caps with foundation walers. The walers have a sufficiently large top surface to meet the permitted compressive stress for the specified elastomer.

The elastomer bedding is installed above the roof of the tunnel construction and over the pile bolts. Its purpose is to take up the vertical loads from the upper floors: the compressive stress under permanent load when the building is in use can be up to 1500kN/m². In the areas with lower load profiles, a shallow foundation supported on soft elastomer bedding was employed.

The horizontal loads from wind and earthquakes are dispersed into the subsoil via the pile bolts. The floor slab for the underground level has been fitted with tappets in the area where the pile bolts had been installed: the tappets are inset into the pile bolts and serve to disperse the loads. An elastomer has also been installed on the contact surfaces of these horizontal layers.

Redundant conduit block rerouting

The building plan necessitated rerouting a conduit block containing electrical cables for Zurich's main station and a number of optical fibre cables for various telecommunications providers. Since this included the main power supply for Zurich main station, and rail operations were continuing during the work, a redundant rerouting plan had to be implemented: First, the power supply was switched from the Zollstrasse substation to two other existing substations. The Zollstrasse substation could then be taken out of service and the existing conduit block decommissioned. Once this had been done, the new conduit block was reintegrated back into the grid. On completion of the work, the station was once again supplied with electricity from the Zollstrasse substation.

The spectacular curved glass brick facade of the Gleisarena was developed in-house by PORR. Source: PORR

Summary

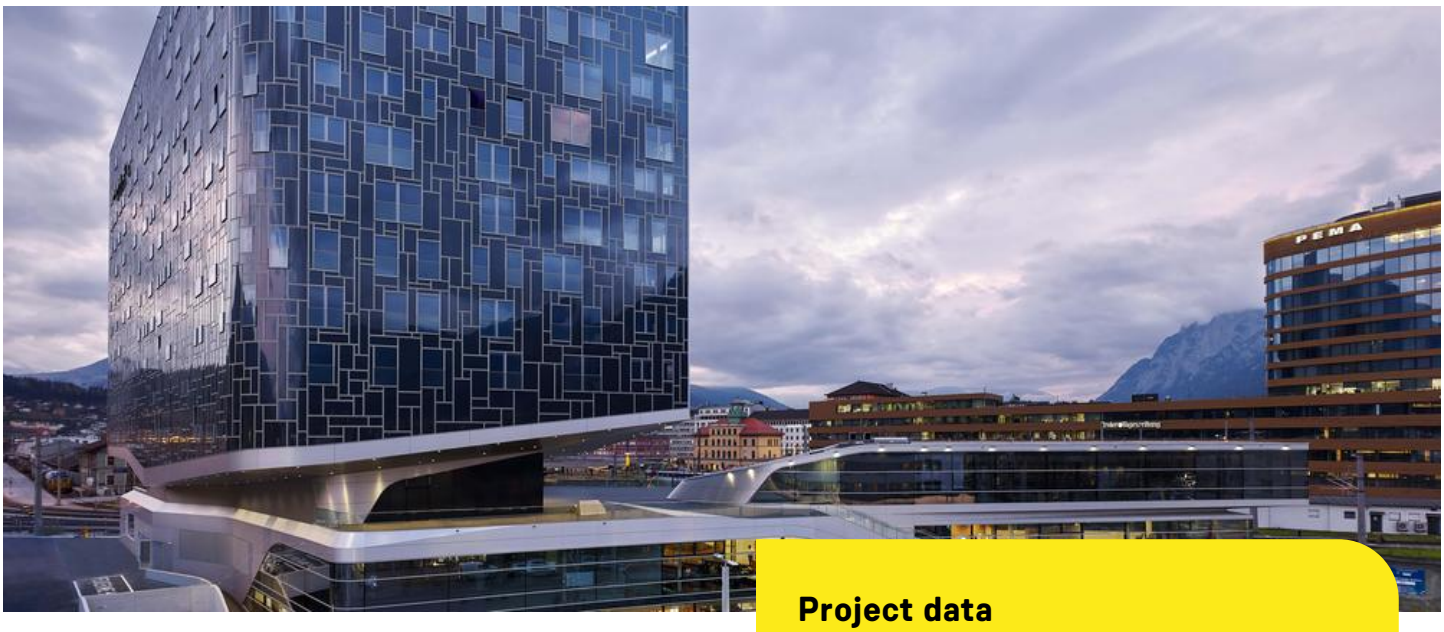
The Gleisarena project presented PORR with several challenges, all of which PORR rose to beautifully. The location right next to the main train station and the long, narrow construction site made for extremely tight conditions. The existing tunnel, the electricity supply crossing the site, and the demanding requirements for the foundations added to the challenges. Finally, the building was given a spectacular facade facing the main station tracks and curved in two dimensions. This complex one-of-a-kind structure of glass bricks set in a metal framework was developed in-house by PORR.

Technical data

52,000m³
Building volume

10,200m³
Concrete incorporated

Gross surface area	14,000m²
Building volume	9,900m²
Excavated volume	13,000m³
Drilled piles	49
Reinforced steel	1,500t
Curved facade	1,500m²
Post-bolt facade	215m²



PROGRESS: 100% - COMPLETED
AUSTRIA

AN URBAN HYBRID FOR INNSBRUCK

PEMA 2

Author: Wolfgang Feichtner

In Innsbruck, PORR has constructed a mixed-use, architecturally sophisticated high-rise building on a particularly constricted construction site.

The site's location immediately adjacent to train lines and their overhead wires presented additional challenges during the construction phase. For instance, tracks had to be taken out of service, while the confined space available meant that creative solutions had to be found for site facilities.

Project data

Employer	Pema Group
Contractor	PORR-Ortner-Elin Consortium
Architect	LAAC Architekten – PORR Design & Engineering GmbH
Order type	General contractor
Project type	Building construction/Residential building
Project scope	Erection of a mixed-use building with residential and commercial space, comprising 173 accommodation units, deep basement with three basement floors
Order volume	approx. EUR 30 m
Construction start	06/2016
Construction end	09/2018

General information

The project parameters were extremely challenging: the plot acquired by the Pema Group measures just 3,000m² and is directly adjacent to the tracks leading into Innsbruck Hauptbahnhof, the city's main train station. The site also borders a busy arterial road with bus and tram traffic and a complex road-crossing system.

Yet, on this cramped site, the Pema Group drew up plans to construct a 50-metre-high mixed-use residential building. Following a call for proposals, the project put forward by the architectural firm LAAC won out over the competition. Named "Urban Hybrid", the winning project impressed the judges with building geometry that would prove challenging in the execution phase and a complex, elaborately designed glass façade.

PORR Design & Engineering GmbH was commissioned with execution planning for the building, with LAAC remaining responsible for design supervision.

Preliminary works and contract extension

Originally, PORR was awarded a contract exclusively for excavation of the construction pit. The complex temporary construction pit system consisted of a combination of bored piles, jetcrete and anchors. In close collaboration with PORR Design & Engineering GmbH, numerous optimisations were planned so that, although the building's height remained unchanged, it would include another floor of residential space.

As this significantly increased the returns from the project for the client, PORR was awarded a contract to serve as main contractor in a consortium with Ortner and Elin.

The tracks closest to the construction site were taken out of service for two months. During this time, PORR constructed the storeys from ground level up to third floor. Source: PORR Bau GmbH

THE RISER ZONES IN THE APARTMENTS WERE REALISED WITH PREFABRICATED INSTABLOCK ELEMENTS. THIS EASED THEIR INSTALLATION AND REDUCED THE CONSTRUCTION PERIOD.

Wolfgang Feichtner
Team leader, PORR Bau GmbH

Complex logistics

The building, classed as a high rise, was planned as a reinforced concrete structure. For economic reasons, the extremely strong base plate was created using a combination of 75 continuous-flight auger piles to a depth of up to 19 metres and a reduced base plate. Given the lack of storage space available outside of the construction pit, in light of the spatial conditions, the decision was taken to divide the building into the “tower section”, which was erected first, and the “plinth section”, which was constructed later. Single-sided formwork was installed with a separating layer on the external walls of the basement car park and then secured to the jetcrete reinforcements.
As the distance to the railway lines’ overhead wires fell significantly below the permitted safety clearances for the upper floors, a safety concept was drawn up in advance in close collaboration with the Austrian Federal Railways (ÖBB). In this document, it was agreed that the track situated only around 5m from the building would be taken out of service for two months. For its part, PORR committed to erect the ground floor and up to the third floor of the building in this time.
In collaboration with Doka, an overhanging protective platform was created that projected from the ceiling above the second floor to protect the track below against falling objects once it had been put back into service.
The exterior of the plant room was another highlight of the project. Its inclined ceiling slab, which connects the third floor with the fourth, forms the protruding base of the tower above it. The entire jetty of the tower area projecting from the ceiling above the second floor was created using a staxo load-bearing structure up to 12m high.
The riser zones in the apartments were realised with prefabricated instablock elements. This meant that all required connections, such as for showers and toilets, could be factory-installed, which significantly eased their installation and reduced the construction period.

A bird’s-eye view of the shell construction for the sixth floor. Source: PORR Bau GmbH

THE EXTERIOR OF THE PLANT ROOM ALSO PRESENTED A PARTICULAR CHALLENGE: ITS INCLINED CEILING SLAB, WHICH CONNECTS THE THIRD FLOOR WITH THE FOURTH, FORMS THE PROTRUDING BASE OF THE TOWER ABOVE IT.

Wolfgang Feichtner
Team leader, PORR Bau GmbH

Confined surroundings

PORR also had to find a suitable solution for the locations of cabins for site management, sanitary equipment, the foremen and the site team. As there were also no spaces available for the cabins on neighbouring sites during the shell construction phase, PORR decided to place the cabins on a staxo support structure. This elevated the cabins to the level of the third to fifth floors, which significantly reduced the distances employees had to travel.
The client awarded the contract for the building's entire glass façade to an external contractor for reasons of economy. However, PORR was again commissioned with construction management and implementation duties.
Work to fit out the apartments from the 3rd to 13th floor began in July 2017. The kitchens directly ordered by the client were installed from March 2018.

The projecting architecture makes PEMA 2 truly eye-catching.
Source: PORR Bau GmbH

Library to meet the highest standards

The fitout of Innsbruck's new city library, which is on the ground floor and first floor of the plinth section and has a total surface area of approx. 4,000m², became particularly challenging. The architectural firm LAAC was again responsible for the architectonic design of the library. The original design, which was relatively simple, gradually evolved to incorporate sophisticated equipment that required execution work of the highest order. At the same time, all changes in the execution phase had to be reported promptly to the client.
In late September 2018, PORR received the order to fit out an additional office space on the first floor that is now used by the Mozarteum. This space was completed in mid-December 2018.

Summary

In PEMA 2, PORR successfully realised a project that was the subject of considerable public attention – starting with the exposed location at the centre of a traffic hub, continuing with the spectacular construction pit and finishing with the building's unusual size for Innsbruck and its special geometry. The best possible use was made of the wide range of resources available to the PORR Group during the project.

Technical data

29,280m²
Gross floor area

2,200 t
Reinforced concrete

Plot area	approx. 3,000 m²
Construction pit depth	10.00 m to 14.00 m
Car parking spaces	189
Volume of material excavated	30,000 m³
Bored piles	75x CFA piles
Concrete	20,000 m³
Enclosed space	approx. 100,000 m³

PROGRESS: 100% - COMPLETED
AUSTRIA

PORR IMPLEMENTS PPP MODEL IN VIENNA

Educational campus on Berresgasse

Author: Stefan Schreiner / Michael Sagmeister

PORR finances, plans, builds, and maintains an educational campus in Vienna-Hirschstetten. The project has a duration of 25 years.

Several PORR departments were involved in the Berresgasse educational campus project. PORR Design & Engineering was responsible for planning, PORR Bau GmbH built the complex, and PORREAL Facility Management is responsible for supervision and maintenance.

Project data

Employer	CamBerr22 GmbH
Contractor	Porr Bau GmbH
Architect	PSLA ARCHITEKTEN ZT GmbH / Porr Design & Engineering
Order type	Main contractor, including execution planning
Project type	Building construction
Project scope	Construction of an educational campus as a PPP project
Order volume	EUR 42.5 m
Construction start	10/2017
Construction end	05/2019

General

The educational campus on Berresgasse in Vienna's Hirschstetten district was planned and implemented by the City of Vienna as a public-private partnership model. PORR was responsible for the financing, planning, and construction of the project together with PORR Design & Engineering. PORR Bau and will operate the campus with PORREAL for 25 years before it becomes the property of the City of Vienna.

The campus offers children up to the age of fourteen a holistic, integrative educational institution. This includes infant groups, kindergartens, and schools. A triple gymnasium, a band rehearsal room, and outdoor play and sports facilities also offer numerous possibilities for active leisure activities.

PORR secured the contract in a multi-stage award procedure based on the best bidder principle. In addition to the price (which had a weighting of 30%), qualitative criteria were also taken into account.

Planning and rapid implementation

Based on the draft and submission planning of the architectural office PSLA ARCHITEKTEN ZT GmbH, PORR Design & Engineering developed the planning, including structural design and building physics. In order to coordinate the planning process and to better integrate the companies for the building services, PORR relied on the principles of lean management.

This meant that the plans were quickly forwarded to the construction department. Following the operational start of construction in October 2017, the topping out took place in

May 2018. A particular challenge proved to be the production of large areas of exposed concrete in winter weather.

ALL PRODUCTS USED HAD TO BE DURABLE, EASY TO CLEAN, AND HARD-WEARING. IN THE COURSE OF SAMPLING APPOINTMENTS, ALL LEAD PRODUCTS WERE SCRUTINISED TOGETHER WITH THE CLIENT, TESTED FOR THEIR SUITABILITY AND, IF NECESSARY, REPLACED BY ALTERNATIVE PRODUCTS.

Michael Sagmeister
Construction manager, PORR Bau GmbH

Inside a classroom. Source: Outline Pictures · Jakob Gsöllpointner

Sustainable materials

Parallel to the erection of the shell, the first sampling appointments also took place. Together with the City of Vienna and its consultants, the design of the campus was coordinated. The technical properties of the lead products were scrutinised and their suitability was tested. If necessary, they were replaced by alternative products.

All products used have to be durable, easy to clean, and hard-wearing. This high requirement profile can be seen, for example, in the wooden façade that surrounds the building from the 1st floor onwards. This was already agreed in the design phase with Holzforschung Austria and several fire protection experts in order to ensure the best possible drying of the cladding after precipitation and the protection of the 20 cm thick insulation.

During the erection of the support battens, care was taken to prevent fire flashovers. Because of the change from vertical to horizontal planking specified by the architects, this was no small feat. The cladding weathers and greys differently depending on the installation position. The desired appearance will therefore develop over time.

For all materials, great importance was attached to longevity, easy care, and durability. Image source: Outline Pictures · Jakob Gsöllpointner

Open alignment through multifunctional areas

Meeting and communication should be at the centre of the individual education areas. Therefore, all educational spaces are connected by multifunctional areas. This open character can also be seen in the atriums on the second floor, which allow direct visual contact with the floor below. These ceiling openings are secured with room-high, colourful coated stainless steel nets, the substructure of which was elaborately integrated into the ceiling and floor. The mesh size of the nets was designed for the best possible visibility. However, if there is a need for a privacy screen, curtains can be used inside the atriums.

All spaces are connected by multifunctional areas, which are intended to promote meeting and communication. Source: PORR AG

STONEWARE TILES WERE CUT USING A WATER JET AND ASSEMBLED INTO VARIOUS PATTERNS. A SPECIAL LAYING PATTERN WAS DEVISED FOR THE REMAINING PIECES. THIS WAS USED IN VARIOUS SANITARY AREAS.

Michael Sagmeister
Construction manager, PORR Bau GmbH

Precise tiling

All sanitary facilities on campus were adapted to the needs of the respective age group. Special attention was paid to the tiling of the development areas. Using a water jet, triangular and trapezoidal parts were cut from stoneware tiles in 30/60 format and assembled into various patterns. A special laying pattern was devised for the remaining pieces. This was used in various sanitary areas. Cutting the tiles using a water jet ensures a cutting accuracy in the range of one tenth of a degree. Appropriate care was then also required when laying the tiles because even the smallest inaccuracies in the surface would be visible immediately.

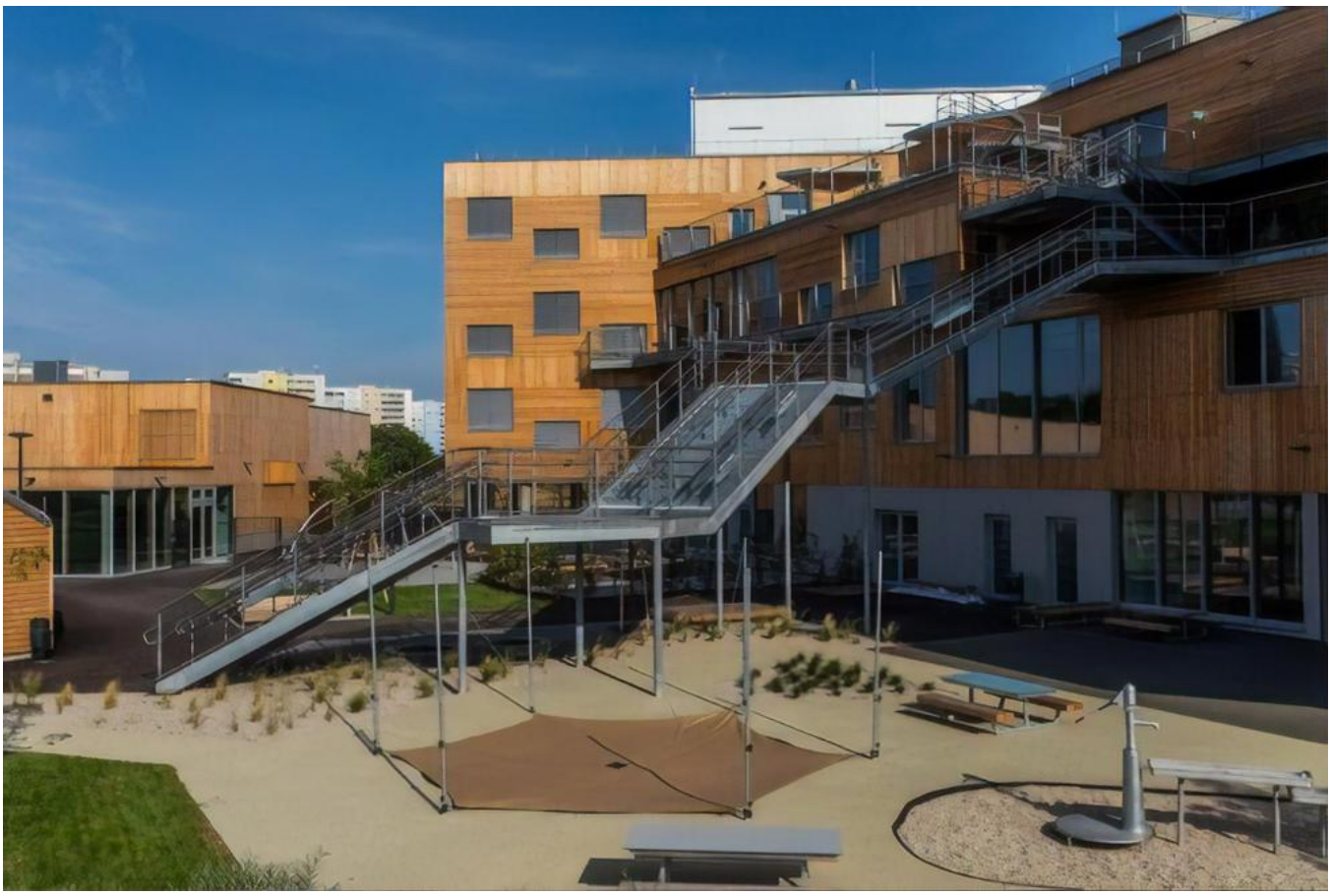
Spacious common areas in front of the classrooms promote a communicative atmosphere. Source: Outline Pictures · Jakob Gsöllpointner

Gymnasium with a lot of exposed concrete

The triple gymnasium extends as a solitary structure over the basement and ground floors and is connected underground to the main building. The gymnasium can be divided into three individual areas using separating curtains. The exterior walls are made of exposed concrete approx. 10.5 m high and up to 50 cm thick; these are clad with a larch wood façade. For the roof construction, four 28 m long glued laminated timber girders were lifted in. Together with the cross beams installed between them, they form the supports for the ceiling made of cross-layer laminated wood. A warm roof with extensive greening was constructed on this. An originally planned photovoltaic system was dispensed with for structural reasons.

Complex logistics

The outdoor facilities, some of which are open to the public, offer play and sports facilities for all ages. The ground plan of the outdoor facility made the construction possible only via the future running track, which was the last to be built. The almost simultaneous production of ethylene-propylene-diene rubber coverings, synthetic resin-bonded high-grade chippings, water-bonded pavements, asphalt surfaces, and green areas therefore had to be precisely coordinated.



The Berresgasse school campus in Vienna/Hirschstetten. Source: Outline Pictures · Jakob Gsöllpointner

Technical data

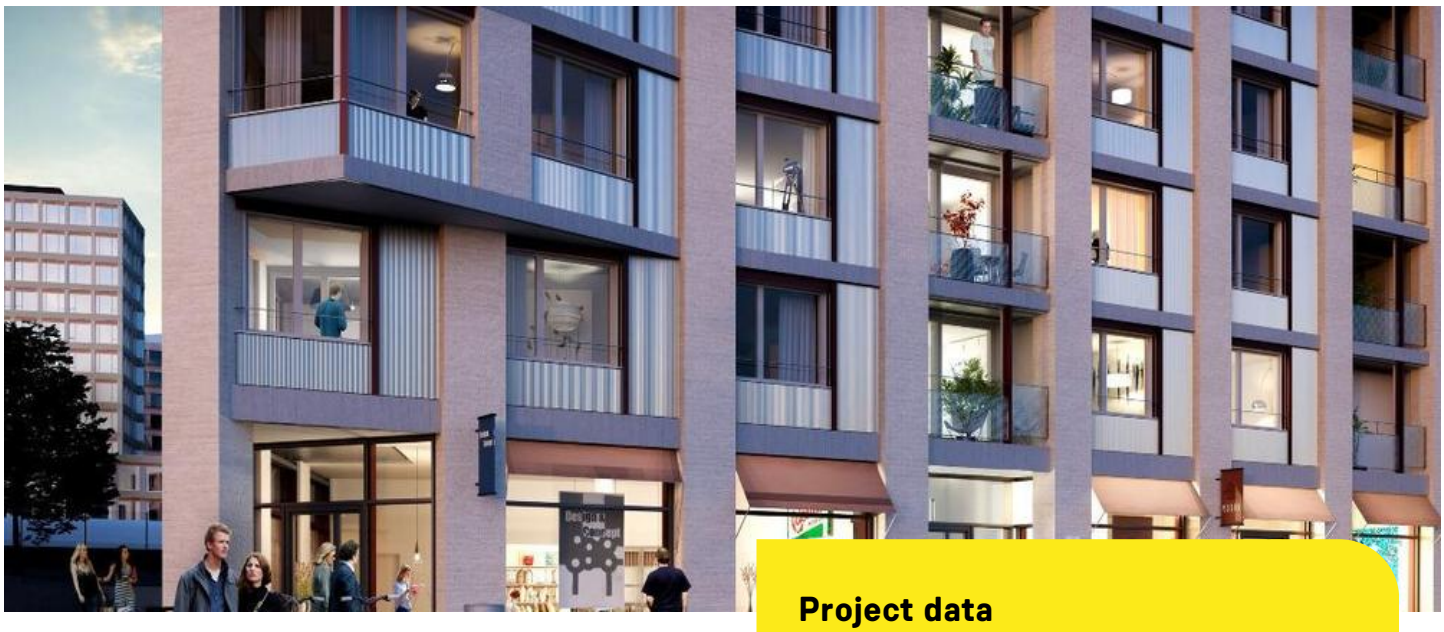
approx. 19,070m²
Property area

approx. 40,000m³
Excavation volume

Gross floor area	approx. 19,280m²
Excavation depth	up to 7.2m
Car parking spaces	10
Asphalt	approx. 2,800m²
Steel used	approx. 47t
Concrete used	approx. 14,000m³
Reinforcing steel used	approx. 1,285t

Conclusion

In the Berresgasse PPP project, PORR was able to offer all central tasks – from financing to planning to construction – from a single source. Once the construction work has been completed, the building will be handed over to PORREAL at the end of 2019. The campus will be gradually put into operation by the start of the new school year in September 2019.



PROGRESS: 100% - COMPLETED
SWITZERLAND/SWITZERLAND

LIVING WITH A VIEW OVER THE TRACKS

HB Nord – Gleistribüne

Author: Christian Koehly

In the heart of Zurich, PORR is building a premium-quality residential complex boasting spectacular views.

As our cities become increasingly built up, construction companies face ever-growing logistical challenges. The Gleistribüne project required PORR to work in extremely tight conditions, while rail operations continued as normal.

Project data

Employer	Schweizerische Bundesbahnen SBB
Contractor	PORR SUISSE AG
Architect	Esch Sintzel Architekten GmbH, Zürich
Order type	General contractor
Project type	Building construction . Residential building
Project scope	Planning and construction of three residential buildings with five to seven storeys
Order volume	CHF 60 m (EUR 53.9 m)
Construction start	04/2017
Construction end	08/2019

Overview

Swiss Federal Railways (SBB) has been working with the City of Zurich and Swiss Post since 2003 to give a new lease of life to one of the last large building plots in central Zurich. As part of this collaboration, SBB has been keen to emphasise the importance of making good use of inactive city centre sites previously used for rail operations – many other towns have also seen similar projects to transform industrial sites into attractive plots and develop them for retail, services and residential use.
PORR had previously worked on three construction plots in the “Europaallee” site opposite the Gleistribüne.

In 2017, these projects were followed by the contract to construct 139 rental flats in three apartment buildings with five to seven floors. The ground floor plans include retail spaces and commercial areas, as well as a restaurant with a bar and terrace. The contract also included the construction of a drinking water fountain, thereby continuing a centuries-old tradition: Zurich currently has 1200 fountains, one of the highest tallies for any city in the world.
The Gleistribüne is the capstone of the urban development projects rejuvenating the rail site around Zurich main station. The plans were drawn up by Zurich architects Esch Sintzel Architekten GmbH, based on the concept “Living next to Zurich’s central railway station with views of the tracks”. Construction was completed in August 2019.

High-quality materials are used throughout the flats in the Gleistribüne. Source: PORR

Shoring the construction pit, securing the tracks

Given the restricted space conditions along the Zollstrasse, the designs called for a sheet-pile wall to seal the construction pit. By contrast with the neighbouring Gleisarena project, it was not possible to reinforce this construction pit, meaning PORR had to work instead with anchoring in the soil beneath the Zollstrasse. An S-Bahn tunnel running alongside the construction area and exposed on one side during the construction pit excavation was secured in position with diagonal HEB-profile props. Building on experiences from other construction sites in the Europaallee opposite, PORR successfully used vibratory hammers to drive the sheet-piles, using gravel from the nearby Sihl. The construction pit was fully dismantled after completion of the basement level.

For the safety of the overhead lines and passing trains, protective scaffolding was erected on bored piles installed specially for this purpose. This protective scaffolding met SBB's strict requirements and was regularly serviced and checked for functionality.

THE FOUNDATION IS ELASTICALLY SUPPORTED OVER ITS ENTIRE SURFACE TO KEEP THE TRANSMISSION OF VIBRATIONS AND STRUCTURE-BORNE NOISE FROM THE NEARBY RAILWAY TRACKS TO A MINIMUM.

Christian Koehly
Team leader, PORR SUISSE AG

Foundations, basement level

Key areas of the building were built on shallow foundations with a continuous floor slab. In areas with high load concentrations, the shallow foundations were supplemented with strip foundations, individual foundations, and localised deeper foundations. The foundation is elastically supported over its entire surface to keep the transmission of vibrations and structure-borne noise from the nearby railway tracks to a minimum.
The floor slab and external walls of the underground level were constructed from waterproof tanking with class 2 impermeability. The basement level also supports the existing SBB tunnel and holds it in place.

The Gleistribüne complex shortly before completion. Source: PORR

THE COMPLEX LOAD TRANSMISSION SYSTEM AND VARIETY OF MATERIALS PRESENTED SIGNIFICANT CHALLENGES FOR THE FACADE CONSTRUCTION.

Christian Koehly
Team leader, PORR SUISSE AG

Superstructure, facade

The building has a traditional skeleton superstructure. Its ceilings are constructed from in-situ reinforced concrete slabs. Vertical loads are transferred through reinforced concrete walling and columns. The columns are prefabricated components manufactured especially for this project. The building is reinforced against horizontal loads through cores in the vertical structures – stairwells, lifts, installation shafts, etc.
The building envelope itself has no structural support function. The transparent parts of the facade in front of the flats and the businesses on the ground floor are constructed from a metal post-and-beam framework, with opening elements such as windows and doors installed by means of extrusion profiles.

These elements, as well as thermally decoupled horizontal concrete elements in the roof and front area, are attached directly to the superstructure. The only elements that transfer loads directly to the foundation are the precast concrete clinker supports visible from the outside. These are connected to the carcass in the ceiling area of each storey. The precast elements were insulated on the inside, covered with clinker bricks on the outside, and delivered prefabricated to the construction site.
The complex load transmission system and variety of materials presented significant challenges for the construction of the facade. In addition, the scaffolding had to be rebuilt several times to allow prefabricated clinker facade elements to be lifted into place by crane.

Energy supply, plumbing

The Gleistribüne has 420m² of solar panels with a nominal capacity of 34kWp (kilowatt peak). This is expected to yield an average of around 35MWh of energy per year, which will be fed into the City of Zurich electricity grid. The primary energy source for heat generation is a groundwater source with four collectors installed beneath the building. Each collector pumps groundwater to a central heat pump, where the water is heated or cooled.

This heating/cooling system will supply the two office blocks in the Gleisarena complex in addition to the three Gleistribüne buildings. The direct hot water supply is also implemented via the heat pump. The hot water is stored in stainless steel containers and serves as the basis of the hot water supply. Drinking water is protected against legionella by a special control system which briefly heats the water above 60 degrees Celsius, and the building automation system ensures the heating periods are followed.

Technical data

71,750m³
Building volume

29,000m³
Excavated volume

Gross surface area	21,421m²
Concrete incorporated	12,000m³
Reinforced concrete installed	1,100t

Summary

The Gleistribüne occupies one of the last brownfield sites in Zurich's city centre. The five to seven storey residential buildings are an architectural highlight for the area surrounding the railway station and boast a spectacular view over the Swiss Federal Railway tracks.

The Gleistribüne complex shortly before completion. Source: PORR

PROGRESS: 100% - COMPLETED
CZECH REPUBLIC/2017-18

THEATRE REVITALISATION – WITH A FEW SURPRISES

Divadlo Jiřího Myrona

Author: Lukáš Cibulka

In Ostrava, in the Czech Republic, PORR has revitalised a theatre complex consisting of three buildings – all during ongoing theatre operations.

More than 155 amendments were necessary for the proper execution of the contract. Numerous constructions that were supposed to be preserved were in such poor technical condition that they had to be demolished and replaced.More than 155 amendments were necessary for the proper execution of the contract. Numerous constructions that were supposed to be preserved were in such poor technical condition that they had to be demolished and replaced.

Project data

Employer	Národní divadlo Moravskoslezské (National Moravian-Silesian Theatre)
Contractor	PORR a.s.
Architect	Dipl.-Ing. arch. Jiří Stejskalík
Order type	Main contractor services
Project type	Building construction . Revitalisation
Project scope	Extensive redesign of the National Moravian-Silesian Theatre building complex
Order volume	CZK 161 million (6.15 million euros)
Construction start	10/2017
Construction end	11/2018

Overview

The redesign of the National Moravian-Silesian Theatre in Ostrava comprised the theatre building itself, the Malá Scéna or small theatre, and an administration building. All three buildings had listed façades that needed renovating. The foyer of the “Divadlo Jiřího Myrona” theatre was also redesigned and all the floor structures, including the marble flooring, were replaced. The staircase was demolished and a new one built. This meant that theatre buffets and new sanitary facilities could be constructed on each floor. The theatre café and the ceremonial hall were also completely redesigned, creating additional spaces for ticket sales and a shopping arcade with direct access to the theatre café.

The Malá Scéna building, which until recently had housed an insurance company, was redesigned to feature a small stage with an auditorium seating around 60 people, a bar, and sanitary facilities. The offices on the upper floor were also converted.

Finally, the offices in the administration building were comprehensively renovated and several new rooms added. These include a ballet studio and an orchestra rehearsal room in the previously unused attic.

The newly designed Malá Scéna, for which PORR also supplied the stage technology and all the audiovisual equipment, can accommodate up to 60 audience members. Source: PORR

The original order volume was CZK 137 million. However, during the course of the work it quickly became apparent that it would not be possible to meet either the budget and the original deadline. A total of 155 amendments was necessary for proper completion, and as a result, the price rose to CZK 161 million and the handover had to be postponed until the end of November 2018.

THE ENTIRE REVITALISATION PROCESS WAS VERY DEMANDING IN TERMS OF STRUCTURAL ENGINEERING. WE WERE CONSTANTLY FACED WITH SURPRISES AND CHANGES OF PLAN.

Lukáš Cibulka
Project manager, PORR a.s.

Lots of challenges

The fact that PORR had a tough nut to crack with this project was evident from the very beginning, when the contract was awarded. The revitalisation was carried out while the theatre was still in operation. This meant that the construction stages and execution had to be planned in minute detail. The areas in which the work was carried out were kept completely separate from the theatre. New steel supporting structures were erected in the small theatre, the ballet studio and the orchestra rehearsal room, necessitating major interventions in the load-bearing structures. Only then could the existing brickwork and in-situ concrete structures such as walls, ceilings and joists be demolished. The works were all carried out under the constant supervision of a structural engineer. Regular adjustments and new plans were also necessary due to the condition of the old building fabric.

Sophisticated construction logistics

The entire logistics, transporting materials to and from the construction site, and the assembly procedures also posed challenges for the PORR construction site team. The steel joist for the ballet studio was 9.5m long and could not be divided. The steel support structures weighed 50 metric tonnes, and the demolition material came to 2,000 tonnes. A micro-pile platform had to be dismantled and rebuilt in the basement because it wouldn't fit through a 1m wide doorway. A particular challenge was the demolition of an entire floor and the construction of a new portal in the Malá Scéna at a height of 6m. This necessitated a steel construction consisting of four steel girders, each of them 10m long. It was anchored in the block foundations outside the building.

The future Malá Scéna, or small theatre, before... Source: PORR

...and during the conversion work Source: PORR

Building fabric in poor condition

A new ticket office, a shopping arcade and a café were added to the main building. A ceremonial hall was built directly above the café, replacing the former ballet studio. The existing structures posed a number of problems. They were actually supposed to be preserved, but in many cases, their poor structural condition made this impossible.

Sections frequently had to be demolished and replaced by new, functional constructions. A mural from the 1920s was discovered behind a suspended ceiling in the theatre café. Again, it was impossible to restore these frescos due to their

poor condition, so they were preserved in their current state. The team also erected a new steel construction for the suspended ceiling.

Technical data

8.000m²
Gross floor area

2.500m²
Facade area

Plot area	2.500m²
Bored piles	Micro-pile foundations
Steel incorporated	50t
Concrete incorporated	30m³
In-situ concrete/reinforced concrete incorporated	35m³

More than just construction works

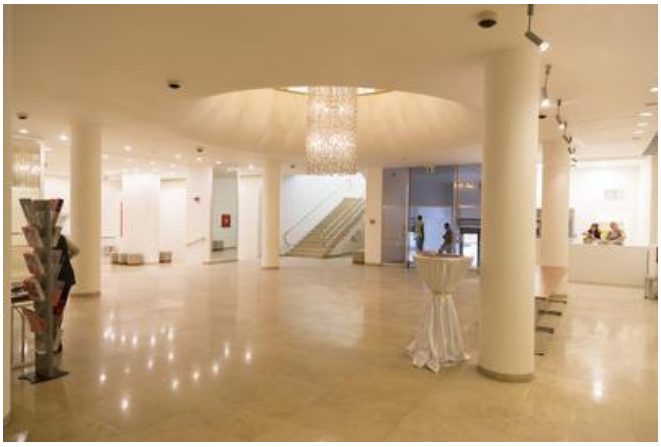
The construction of the new ballet studio and orchestra rehearsal room in the administration building meant that the existing and demolished constructions had to be comprehensively secured, and a number of fire safety measures became necessary. PORR installed special sound insulation cladding on the walls and ceilings to meet the acoustic requirements. In addition, some of the wooden ceiling's load-bearing beams had to be refurbished or replaced to ensure stability for the new dry floor structures. Technical building services included installing new pipelines for the sanitary facilities, ventilation and heating, and high and low-voltage power lines, including terminals, distributors and units.

In the Malá Scéna, PORR was not only responsible for the structural measures but also for the audiovisual equipment, the stage technology and the entire lighting system. One special feature is the bar that replaced the old ticket office. An ingenious device hoists the tables up to the ceiling at the touch of a button so the area can be used as a dance floor.

Space for dancing: the tables are raised to the ceiling at the touch of a button. Source: PORR

Conclusion

On 1 September, PORR handed over the revitalised theatre building, the new Malá Scéna and the theatre bar to the client for immediate use. The other rooms were handed over at the end of November. Despite the new problems and challenges constantly cropping up during the course of the project, due to the poor state of the building fabric, that resulted in numerous changes of plan, PORR's elaborate revitalisation of the theatre complex delights not only the client, but also hundreds of theatre-goers.



In the main building, the foyer was redesigned and all the floor structures were replaced, including the marble flooring shown here. Source: PORR

PROGRESS: 100% - COMPLETED
ROMANIA

GROUNDWORK FOR A NEW AIRPORT

Brasov International Airport

Author: Cosmina Elena Hermeziu / René Fischer

PORR is building a runway, an apron and a comprehensive drainage network for Transylvania's new airport in Brasov.

Brasov airport is PORR's fourth airport project in Romania. A short construction period, further reduced by a long winter break, tested the PORR teams to the utmost.

Project data

Employer	Brasov administrative district
Contractor	PORR Construct S.R.L.
Architect	Search Corporation S.R.L.
Project type	Infrastructure
Project scope	Construction of a taxiway, apron and rainwater drainage system
Order volume	3.6 million euros
Construction start	08/2018
Construction end	04/2019

Overview

Brasov is one of the largest cities in Romania, with over 250,000 residents. The initial plans for building an airport in the Transylvanian city date back to 2012. A runway was tendered and by 2014 it had been built. However, the project then ground to a halt. It remained on hold until 2017, when the city administration launched a call for tenders to construct a taxiway, an apron and a drainage network.

After a careful analysis of the quotes and a suitability test, PORR won the contract for the 3.6 million euro order in July 2018. Work began in August, immediately after the contract was signed.

IN ORDER TO ENSURE NO FURTHER EDGE PROTECTION IS REQUIRED, THE ASPHALT LAYERS HAVE A LATERAL GRADIENT OF 45 DEGREES.

René Fischer
Project manager, PORR CONSTRUCT S.R.L.

Apron and taxiway

The apron is 146m long and 135m wide, with has room for at least three category C aircraft. The rigid structure consists of poured concrete screed with a thickness of 41cm and links in both longitudinal and lateral directions. The apron and runway are connected by a taxiway 170m long and 23m wide, with two 7.5m shoulders. The taxiway likewise has a rigid structure, consisting of 41m thick BCR 5 special

concrete with tensile strength raised to 5.5N/mm².

In order to ensure that no further edge protection is required, the asphalt layers have a lateral gradient of 45 degrees.

Suitable soil

The actual work began by removing the topsoil and excavating the ground to a minimum depth of 60cm, ready to create the apron, taxiway and shoulder strips. The foundation layer was stabilised with a hydraulic binder. Work began on the drainage channels at the same time.

A 25cm thick stabilised ballast layer was laid on top of the lower ballast layer for the taxiway and apron. Source: PORR Construct

The next stage of the structural work for the apron and taxiway was to create a 40cm thick ballast base course. A further 25cm thick course of stabilised ballast was then laid on top of this. Cable ducts were incorporated into the stabilised ballast, so that the power supply cables for the taxiway lights could be laid in the ground. The shoulder was constructed from a base course consisting of 35cm thick ballast beneath a 25cm course of stabilised ballast.

Solid steel girders were used as formwork for the concrete layer. The project was particularly challenging due to the short construction period, which meant that work had to be done around the clock, including weekends.

Once the platform had been completed, asphalting began on the shoulders. The 10cm thick base course was installed on the stabilised ballast, followed by a 5cm binding layer and finally a 5cm surface layer.

Solid steel girders were used as formwork for the concrete layer.

Source: PORR Construct

The rainwater drainage system

In just two months, 12km of GRP pipes (DN 500–DN 2000) were manufactured in Turkey and delivered to Romania for the rainwater drainage channels. They were transported to Constanta by two ships and then transferred onto a total of 223 lorries. The first transport had to include every type of pipe, so that work could begin immediately. This was made possible by the collaboration with the excellent delivery contractor APS, who was also responsible for delivering the GRP shafts and concrete shafts.

Work on the drainage channels began downstream, to ensure that any precipitation during construction could flow away. A platform was built with a 1% incline in both lateral and longitudinal directions so that water would run off. A precast concrete drainage channel was built into the centre of the platform, through which water from the apron could flow directly into the new channels. The rainwater channels on the taxiway were installed in the shoulder strips.

The pipes for the rainwater drainage channels were delivered from Turkey on two ships. Source: PORR Construct

INSTALLING THE OIL SEPARATORS WAS A SIGNIFICANT CHALLENGE DUE TO THE HIGH GROUNDWATER LEVEL: WE HIT WATER AFTER JUST A METRE OF EXCAVATION AND HAD TO CONTINUOUSLY PUMP IT AWAY.

René Fischer
Project manager, PORR CONSTRUCT S.R.L.

Challenge: the oil separators

The water collected in the drainage network is transported through the GRP pipes to two oil separators that remove impurities from the water. Each separator has a capacity of 440l/sec and there is also a bypass with a capacity of 1,200l/sec.

Installing the oil separators was a significant challenge due to the high groundwater level: we hit water after just one metre of excavation and had to pump it away continuously. A 15cm ballast layer was installed after the required depth was reached. A concrete course, also 15cm thick, followed. Once the separators were in place, 20cm thick concrete layers reaching to the top sections of the separators were installed.

Water is cleaned in the two-stage oil separator system. Source: PORR Construct

Legacy system rehabilitated

The runway constructed between 2012 and 2014 included water channels and connecting pipes in the shoulder strips. These were covered with a concrete plate with an asphalt course over the top. In order to link them to the new drainage network, the asphalt had to be broken up and the old concrete plates removed. The new plates had to be reinforced and the concrete poured in-situ in two stages.

The two arms of the drainage network run in parallel for a few metres after the end of the runway. The water is directed through DN 2000 GRP pipes and the direction of flow is controlled through special redirection ducts. These ducts are made of concrete and were constructed in-situ.

A discharge chamber is located at the very end of the drainage system. The water is collected here and directed into the River Barsa. To ensure the water can flow into the river, a 27m long concrete surface has been built, followed by a 30m long shaft. The river had to be diverted for the concrete to be poured.

Electrics

The final part of the work was to install the lighting system: three 28m light masts. Each mast has four LEDs, a control panel and a lightning conductor. The foundation is 2.4m high and includes all necessary cables and ducts. It is made of class C30/37 reinforced concrete.

PORR built a high-mast lighting system at the edge of the platform. Source: PORR Construct

Summary

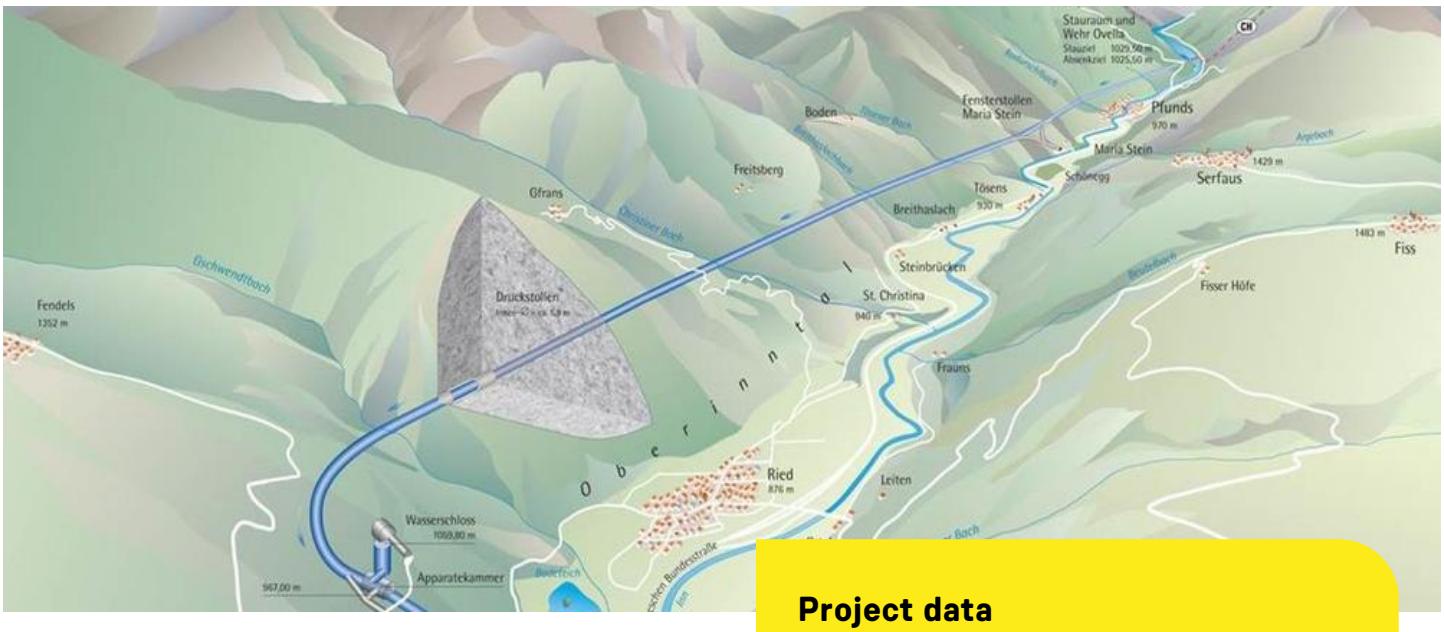
Despite a lengthy winter pause from 21 November 2018 to 15 March 2019, the work at Brasov airport was completed in just nine months. The client is extremely satisfied with the work and PORR has already been awarded follow-up contracts for the Otopeni and Baneasa airports in Bucharest. These involve constructing and renovating runways and extensive maintenance work.

Technical data

9,956.0 m³
Upper soil

1,572.92t
Asphalt

Length of drainage channel 11,780.10m
Excavation for platform and taxiway 22,476.00m³
BCR5 concrete with special characteristics ... 10,073.70m³
Stabilised ballast 7,028.00m³
Ballast 12,278.00m³
Soil stabilisation 9,223.00m³



IN PROGRESS
AUSTRIA

HEADRACE TUNNEL FOR THE RIVER INN JOINT POWER PLANT

River Inn joint power plant

Author: Robert Wachter

After conflicts with the original contractor, a consortium took over the construction of the headrace tunnel from "Maria Stein" for the River Inn power plant.

The construction site equipment was taken over from the previous contractor. The site and logistics were optimised so that the remaining project work could be completed as effectively as possible.

Project data

Employer	GKI GmbH
Contractor	ARGE GKI Triebwasserweg Maria Stein – Strabag/Jäger/Hinteregger
Architect	Master building work
Project type	Tunnel construction
Project scope	Construction of a headrace tunnel using two dual-shield tunnel boring machines
Construction start	02/2017
Construction end	12/2020

Overview

The earliest plans to exploit water power from the Upper River Inn date back to the nineteen-twenties. However, despite a number of feasibility studies being drawn up, the project was never pursued. In 2003, when planning finally began again, the project was optimised and brought up to date with the current state of the art and environmental standards.

In 2014, after a cross-border approval procedure, work began on the joint power plant on the River Inn, which will generate around 414 GWh per year. The diversion power plant covers an area of land belonging to eight different communities: seven in Austria and one in Switzerland.

Salzburg-based G. Hinteregger & Söhne Baugesellschaft m.b.H. is a member of the consortium building the 22km long headrace tunnel in the GKI Maria Stein construction section. Since the initial work on the construction section was done by a different contractor, the consortium that won the new tender had to take over the construction site set up by their predecessor – the first successful execution in Austria of an alliance contract model in infrastructure construction. Consequently, the project does not just involve driving the tunnels, but also modifying the tunnelling equipment and optimising the existing infrastructure.

THIS WAS THE FIRST SUCCESSFUL EXECUTION IN AUSTRIA OF AN ALLIANCE CONTRACT MODEL IN INFRASTRUCTURE CONSTRUCTION.

Robert Wachter
Project leader, Hinteregger Bau GmbH

The power station

A weir system is being built in a gorge on the Swiss/Austrian border. The head is around 15m and the retention area behind it stretches back 2.6km with a storage volume of approximately 900,000m³. A discharge power station, a fish pass and the inlet structure for the headrace are located by the weir.

Once complete, up to 75m³/s will be diverted out of the steep-sided gorge and channelled to the powerhouse via a 22km headrace that is being built from an intermediate heading in Maria Stein (Pfunds municipality). The water is then directed via an armoured inclined shaft (connected to a shaft surge tank on the high-water site) to two Francis turbines, which together generate power of up to 86.9MW.

The diversion of the torrents by the power station will bring important additional benefits in the form of improvements to the ecological situation in the River Inn. Additional compensatory and recultivation activities will further improve environmental conditions in the project zone.

Geology

The project area falls entirely within the Lower Engadine window in the Upper Inn Valley. The Lower Engadine window is part of a tectonic unit that extends longitudinally from the Austrian village of Prutz in the north-east to the Swiss village of Ardez in the south-west. In this tectonic window, the higher Austroalpine tectonic units have eroded to expose the Penninic units below. The stone exposed here is surrounded by crystalline units from the Silvretta Crystalline in the west and the Eastern Crystalline in the east.

All the areas where the TBMs are working consist of grey Bündner schist. This is primarily chalky calcareous shale with banks of marble (Ga 2.1, approx. 2.5km), pure calcareous shale or calcareous shale with pitch and graphite layers (Ga 2.2 and Ga 2.3, approx. 19km). Asbestos fibres were found in a significant part of the tunnelling sections.

The two tunnel boring machines had to bore through almost 20km of grey Bündner schist. Source: GKI Maria Stein consortium

THE HEADRACE TUNNEL IS BEING CONSTRUCTED BY TWO IDENTICAL DUAL-SHIELD TUNNEL BORING MACHINES WITH EXCAVATION DIAMETERS OF 6.50M WORKING IN PARALLEL TOWARDS THE NORTH AND SOUTH.

Robert Wachter
Project leader, Hinteregger Bau GmbH

Advancing

Work on the headrace tunnel began at Maria Stein and is advancing to both the north (7,775m still to be driven) and south (10,175m still to be driven). Two identical dual-shield tunnel boring machines with excavation diameters of 6.50m are working in parallel. All site facilities have been taken over from the previous contractor and made available to the GKI Maria Stein headrace consortium, including tunnel boring machines belonging to the client, GKI GmbH. Before the consortium could begin work, the existing infrastructure had to be optimised for the remaining construction activities. The optimisation was carried out between February and April 2017, with the bulk of the work focussing on the following areas:

- TBM and trailing supports
- California switch
- Track system
- A complete restructure in the dump area (Figure 2) where the disposal carriages are emptied

Considerable attention was given to overhauling the entire track system, since the existing system was to be used for removing the spoil by rail.

The GKI Maria Stein consortium took over the existing construction site from the previous contractor. Various restructures were necessary to improve efficiency – for example, the system for unloading spoil from the service carriages was completely reorganised. Source: GKI Maria Stein consortium

After the handover phase, the advance in the southern part of the headrace began in April 2017, when the first tunnel boring machine was started back up. The second tunnel boring machine was fired up in May 2017, beginning the advance through the northern part of the headrace. After some initial difficulties, the average advance for months when nothing unexpected occurred was around 12-19m/d.

The tunnelling work in 2017 and 2018 was held up by five long interruptions, mainly due to the shield skin getting trapped, so that the TBM had to be freed by raising the tunnel roof (Figure 4) or using special techniques such as pipe arches and injections. Following the team's experiences in this geology, a decision was made to enlarge the overcut for both TBMs and thus reduce the risk of the skin getting trapped.

On several occasions, the trapped shield skin had to be released by raising the tunnel roof. Source: GKI Maria Stein consortium

Tunnel cladding

The tunnel is being clad with reinforced concrete segments. Two different types of ring are used in an open-jointed system consisting of normal rings and high-performance rings installed in parallel. Once installed, the segments will be blasted with pea gravel. The ring joints and longitudinal joints will be sealed with indented mortar joints sufficiently to prevent the cement suspension from leaking out. The mortar will be installed from the region of the TBM's trailing supports.

The annular space will be filled with cement suspension in the area that has been bored, separately from the boring equipment. Multi-stage injections will then be carried out along the entire headrace.

The segment cladding is produced and stored in an on-site casting facility using a carousel system. Source: GKI Maria Stein consortium

Injections

The injections, intended to increase the stability and impermeability of the open-jointed tunnel segments, are a vital part of the tunnel cladding system. The goal is to create cladding that will remain stable in the specific situation with the rock and mountain water conditions on one side and the internal pressures generated by the power station operation on the other side. Headrace water is not completely separated from mountain water in this system, as would be the case with a fully impermeable lining.

The injections are carried out in multiple stages:

1. Annular gap grouting – grouting the pea gravel void volume
2. Contact injection – to improve segment lining bedding
3. Consolidation injection – to repair areas of loose rock around the hollow space if necessary
4. Sealing injection – in areas where the mountain water level falls below the internal pressure level

Monitoring bores are used to check that the injections have been successful. Due to the long length of tunnel to be

driven and the agreed construction schedule, the annular gap grouting injections had to be carried out in parallel with the tunnel advance, using a single injection unit composed of four injection pumps. A self-driving portal construction was developed in order to ensure that the train removing the excavated material could travel safely through the injection area.

Material logistics

The tunnel boring and excavation works for the weir system and powerhouse will produce around a million cubic metres of spoil. The aggregate material is collected with a dredger and processed on site into concrete aggregate and pea gravel. The resulting quarry lake will be filled with uncontaminated spoil from the tunnelling work. The remaining spoil will be permanently stored in a nearby landfill. A conveyor belt transports the material to the landfill from the dump site where it is deposited by the tunnel service train.

Aggregate material is collected from a side entrance and processed on site. Source: GKI Maria Stein consortium

Summary

The tunnel advance began in April 2017. Exactly two years later, in April 2019, we broke through on the northern section. The southern section broke through in July 2019. The injections and remaining concrete works in the dismantling caverns and intermediate heading are expected to continue until late summer 2020. Handover to the client is scheduled for autumn 2020.

The northern section of the headrace tunnel was the first to be broken through, in April 2019. Source: GKI Maria Stein consortium

Technical data

6.53m
Diameter excavated

82,076m³
Segment concrete

Total tunnel length	21,500m
Excavated volume	610,000m³
Segment production	9,246 rings @ 1.66m
Dry injection products	14,200t
Pea gravel blasted	36,800m³

PROGRESS: 100% - COMPLETED
AUSTRIA

GENERAL REHABILITATION OF AUSTRIA'S MOST HEAVILY FREQUENTED ROAD

A23 Inzersdorf elevated highway

Author: Franz Hrebik

As part of a consortium with Strabag and Habau, PORR was awarded the contract for the general rehabilitation of a major section of Vienna's main arterial road.

In addition to demolishing and rebuilding several bridges, the contract also included the construction of noise protection walls and two water protection facilities, as well as retrofitting the entire lighting system with energy-saving LED lights.

Project data

Employer	ASFINAG Autobahnen- und Schnellstraßen-Finanzierungs AG
Contractor	Consortium PORR / STRABAG / HABAU
Architect	ZT Lorenz / IBBS ZT GmbH
Order type	General contractor
Project type	Traffic route engineering
Project scope	Demolition and construction of semi-integral bridges, a noise protection wall, a pedestrian passageway and a drainage system
Order volume	78.5 million euros
Construction start	03/2015
Construction end	08/2018

Background

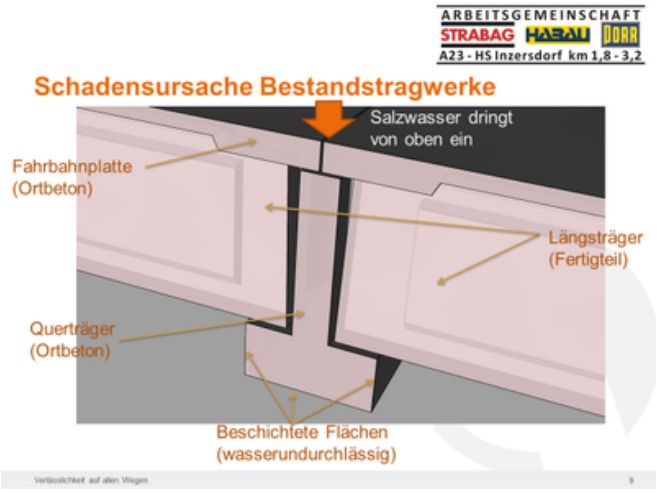
In December 1970, the first section of the Vienna south-east ring road between the Inzersdorf intersection and the Favoriten junction was opened. Even then, PORR was responsible for building the superstructures of the "Inzersdorf elevated road", which was produced as a single-span chain using lean, fast and material-efficient methods.

Originally designed to handle approximately 45,000 vehicles per day, this section of Austria's busiest road currently has more than 100,000 vehicles roaring across it every day.

The steep rise in lorry traffic and decades of road salting were the main culprits in inflicting so much damage to the bridge structures that a standard refurbishment would no longer have been economically viable.

The old elevated highway was therefore completely demolished and rebuilt, and almost 700 metres of the road section were comprehensively rehabilitated. Today, one third of the new Inzersdorf elevated highway runs along an embankment and two thirds along solid, durable bridges.

The steep increase in lorry traffic and prolonged use of road salt have resulted in irreparable damage. Source: PORR



Depiction of the cause of Damage. Source: PORR

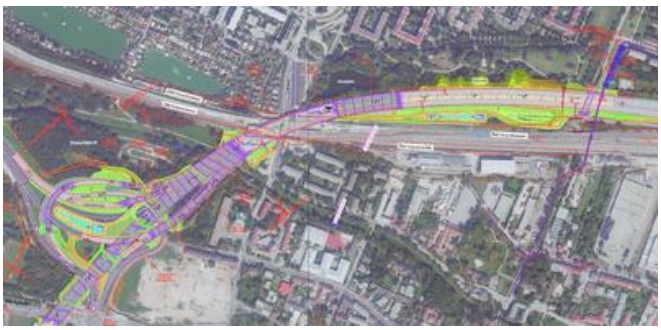
Challenging conditions

Since the Inzersdorf elevated highway plays a major role for the urban traffic of Vienna, planning and implementing the traffic management system was a real challenge. The high volume of traffic meant that individual lanes could only be closed at night and on weekends. To cope with the daily traffic volume during the construction period and to create sufficient space for the construction site facilities, the existing lane on the south side was provisionally widened by up to 9.5m. After the load-bearing surfaces had thus been cleared and demolished, the northern parts of the embankments and superstructures were erected. The traffic was then diverted and the south side was demolished and rebuilt.

By shifting the support axes, it was possible to construct a large part of the new substructure under the existing superstructures without obstructing traffic on the A23. It was also possible to prefill the embankments underneath the existing structure using the same technique.

The entire construction section, including all the ramps at the Inzersdorf intersection, was around 3.7km long. When completed, the main carriageway of the A23 will have 3 lanes and one hard shoulder in either direction.

There was also a strong focus on minimising the impact on local residents. The employer Asfinag spent a total of 1.1 million euros on this. All the construction site roadways were paved and regularly swept and sprayed with water in an effort to reduce the amount of dust generated. The site setup area was scaled down, which meant that fewer trees had to be felled than originally authorised. Temporary noise protection walls were used while the existing noise protection walls were being dismantled, and speeds on the construction site were reduced to 60km/h and monitored by Section Control. Finally, working hours were cut to 6:00 a.m. to 8:00 p.m. from Mondays to Saturdays, although non-stop operations on the construction would have been legally permissible.



The Inzersdorf elevated highway on the south-east Vienna ring road is one of the busiest traffic intersections in Austria. Source: PORR

The building process: Construction phase 1

Before demolition of the bridge structures could begin, the existing lane had to be widened. With the aid of a composite steel bridge 2m to 7m wide, a temporary supporting structure was erected which was designed for a service life of two years.

The two water protection facilities also had to be constructed during this construction phase, as the runoff was contaminated with road salt and had to be purified before being discharged. The Neilreichgasse underpass and the Pfarrgasse overpass were also built during this phase.

To create space for the construction site facilities and maintain ongoing traffic, the lanes were temporarily widened with the aid of composite steel bridges. Source: PORR

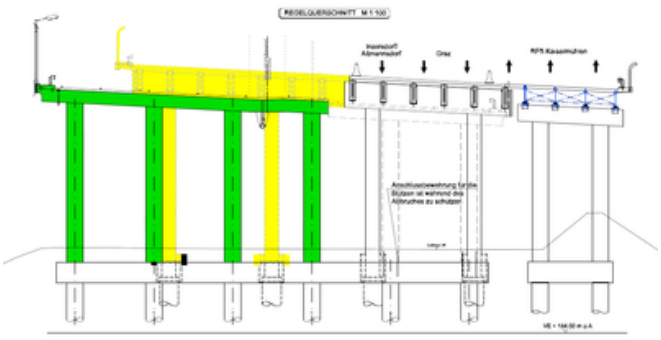
Construction phase 2

After demolition of the northern lanes, several bridges were partially or completely rebuilt and a new overpass was erected. Once the structures just above it had been demolished and the new lanes constructed, an existing railway tunnel was backfilled with a mixture of conventional filling material and foam glass ballast to save weight.

Several bridges were completely or partially rebuilt and an existing tunnel was backfilled. Source: PORR

Construction phases 3 to 5

Phases 3 to 5 focused on the Altmannsdorf/Inzersdorf exit intersection. Since all the relations of the individual constructions had to be preserved, the structures had to be built in sections. Due to the limited space available and the small working area, this required a high degree of coordination. For example, the location of the crane had to be carefully selected to ensure that the crane boom would not swing out across the carriageways. At the same time, it was also possible to build two additional bridges during these phases.



Overview of the phased construction. Source: PORR

Construction phases 6 to 8

After a construction period of less than two years, all the new load-bearing structures were ready for use on the southbound carriageway. This meant that the superstructures for the carriageway going in the opposite direction were now ready for demolition and rebuilding. Finally, the central reservation including guardrails, lighting and wiring was produced during the final construction phase.

THE EXCELLENT COOPERATION AMONG ALL THE PROJECT PARTICIPANTS MEANT THAT THE CONSTRUCTION PERIOD WAS THREE MONTHS SHORTER THAN PLANNED AND A BONUS WAS PAID BY THE CLIENT.

Frank Hrebik
Project manager, PORR Bau Gmbh

Conclusion

Construction work along heavily frequented roads always poses a major challenge. This is of course even more the case if the road in question is the busiest in the country. Despite the large number of different traffic phases, the limited lane closure periods and the extensive work involved, the excellent cooperation between all participants made it possible to reduce the contractually agreed construction period by three months and thus earn a bonus.

Technical data

Approx. 14,600 rm
Bored piles

Approx. 10,000m²
Recultivation

526
Newly planted trees

Bridge deck area	Approx. 42,000m²
Excavation	Approx. 157,000m³
Fill	Approx. 130,000m³
Noise protection wall	Approx. 12,000m²
Water protection facilities	2
Asphalt	Approx. 95,000m²
Traffic phases	15, 8 of them peak traffic phases
Concrete incorporated	Approx. 55,000m³
Rebar incorporated	Approx. 10.000t

PROGRESS: 100% - COMPLETED
SWITZERLAND

BRIDGE RENOVATION IN RECORD TIME WITH UHPC

Renovation on the A4 between Küssnacht and Brunnen

Author: Marco Schöpf

The comprehensive overhaul of a 5km stretch of national road was one of the first projects to involve the large-scale use of UHPC in Switzerland.

The use of ultra-high performance concrete (UHPC) replaces sealing and waterproofing processes across the entire surface of a bridge. In doing so, it makes it possible to significantly shorten the construction period by dispensing with weather-dependent work stages such as applying the epoxy resin seal and laying polymer-bitumen membranes (PBMs).

Project data

Employer	Federal Roads Office (FEDRO)
Contractor	ARGE N4 EP KüBru (PORR SUISSE AG, Implenia Schweiz AG, Cellere Bau AG)
Architect	INGE A4SZ (Jauslin Stebler AG, B+S AG, Locher Ingenieure AG)
Project type	Civil engineering
Project scope	Overhaul of a 5km stretch of national road and sections of road with several large bridge structures, renovation of two tunnels and expansion of two tunnel control centres
Order volume	53.9 million francs (49.1 million euros)
Construction start	03/2017
Construction end	07/2019

General information

In early 2017, the ARGE N4 EP KüBru consortium – composed of Implenia Schweiz AG, PORR SUISSE AG and Cellere Bau AG – accepted a contract from the Swiss Federal Roads Office (FEDRO) to overhaul section 2 of the EP KüBru maintenance project on the A4 between Arth and Goldau. PORR was responsible for commercial management of the project.

As this was a pilot project trialling the large-scale use of UHPC without an additional sealing layer, at the start of construction work, all installations and test specimens were produced using a machine-based UHPC installation. The first year of construction focused on renovating the longitudinal beams with UHPC and replacing bearings on the three main bridges at Boli, Mettlen and Linden. The second and third years of construction involved comprehensive renovation work, creation of new bridge parapets, large-scale use of UHFB for reinforcement and sealing purposes and renovation of the safety barrier systems and cable conduit blocks.

Requirements

The 4.8km stretch of the national road that was to be renovated, located between Arth and Goldau and referred to as section 2, included five bridges and two tunnels. The

practicability of the route was significantly restricted during the project due to the altered height and position of the carriageways. As it was not possible for works to continue during the winter months, the construction schedule was divided into three sections over three years with numerous construction stages.

The three bridges at Boli, Mettlen and Linden, which are between 120m and 540m long, were in poor condition with structural deficits and serious corrosion damage to the parapets, cantilever plates and the exterior faces of the lateral longitudinal beams. The required total renovation included removing and reinstalling approx. 4,000m of parapets with in-situ concrete, partially replacing the expansion joints, replacing the bridge bearings and overhauling the longitudinal beams and pier heads. In addition, CFRP fins and shear reinforcement elements were installed in the first span. The cross-beam reinforcements were also exposed and re-installed, UHPC was used on a large scale and two layers of poured asphalt were applied as a binding and covering layer.

The two smaller bridges, Harmettlen and Rigiaa, were renovated with smaller-scale concrete restoration works; the parapets were also replaced and the carriageway was surfaced with a new noise-minimising top layer. As the Harmettlen Bridge crosses the two-track Arth-Goldau railway line, the line had to be closed overnight on numerous occasions to install and remove the protective scaffolding and work platforms.

Due to damage in the portal areas, the Engiberg and Schönegg tunnels required extensive renovation. The existing control centres in both tunnels also had to be expanded.

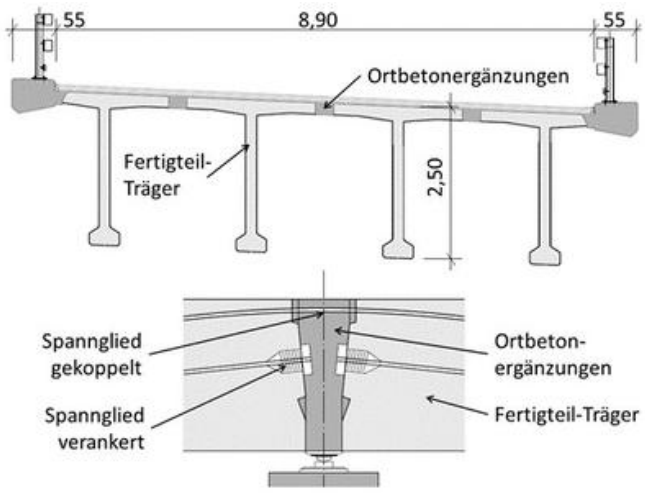
The two overpasses for the Rigi train line and Gotthardstrasse only required small-scale renovation, including localised repairs to the supports and a range of repair work on the undersides of the bridges.

Two column piers were also installed to reinforce the column heads of the Gotthardstrasse overpass.

New cable blocks were installed in certain sections of the route, while drainage ducts were renovated with support sleeves and inliners. This involved a special procedure to repair old, damaged tubing without having to excavate the surrounding area. In addition, the binding course and top surface of the carriageways were renewed and all restraint systems replaced.

UHPC – Pilot project

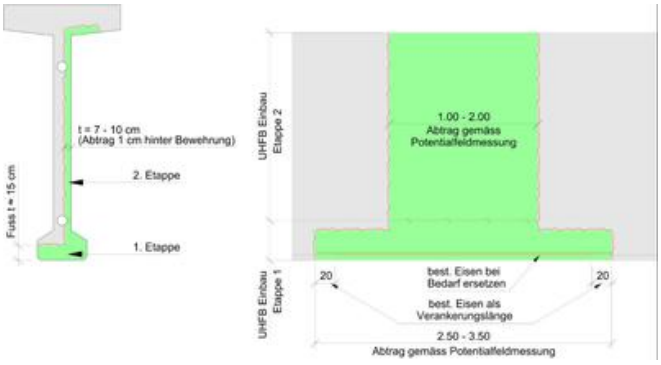
The three large bridges at Boli, Mettlen and Linden have almost identical designs with separate carriageways. They consist of different numbers of spans of different widths. Their construction is based on four pre-stressed longitudinal girders, roughly 2.5 metres in height, which were pre-cast on site. The four joined longitudinal beams were connected with in-situ concrete between the connecting elements, or “flanges”, and transversely between the supporting and longitudinal beams. The parapets were attached on the sides to the outer flanges of the ready-mixed concrete beams as in-situ concrete elements. In the longitudinal direction, the joins create a continuous beam system using pre-stressed cables coupled above the columns and an in-situ concrete cross-beam. The surface of the supporting concrete cross-section corresponds to the surface of the longitudinal beams upon which the seal and surface were installed.



A cross-section and longitudinal section of the three large bridges at Boli, Mettlen and Linden. Source: INGE A4SZ

Renovation of bridge supports

The bridge supports in the poorest condition were renovated with the help of self-compacting UHPC. In addition, the foot section and the mend points in the platform’s concrete were stripped back to approx. 1-2cm behind the reinforcements using high-pressure water jets. The UHPC was introduced directly into the formwork through a bored hole in the carriageway slab. Cathodic protection (CP) was installed to halt the progress of damage in longitudinal beams that had been less badly affected.

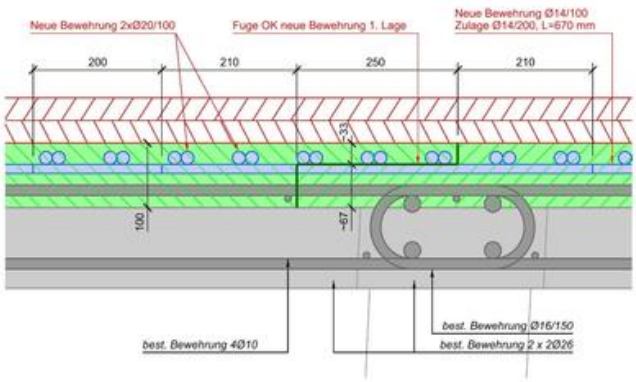


High-pressure water jets were used to strip back the existing concrete to approx. 1-2cm behind the reinforcement. Source: INGE A4SZ

Renovation of the bridge slab

The new bridge construction is composed of a field section and a support section. In the support section of the cross-beams, the existing surface concrete was stripped back by approx. 5cm with a high-pressure water jet and a new 10cm-thick layer of UHPC applied over a length of 10m across the entire section. In this section, strong reinforcements were installed in the longitudinal direction (2 x D=20mm at 10cm intervals).

In the field section, the existing concrete surface was roughened with water jets and secondary reinforcement put in place. In the field area, a 4.5cm layer of reinforcing UHPC was applied extensively.



In the support section of the new bridge slabs, the reinforcement was significantly increased. Source: INGE A4SZ

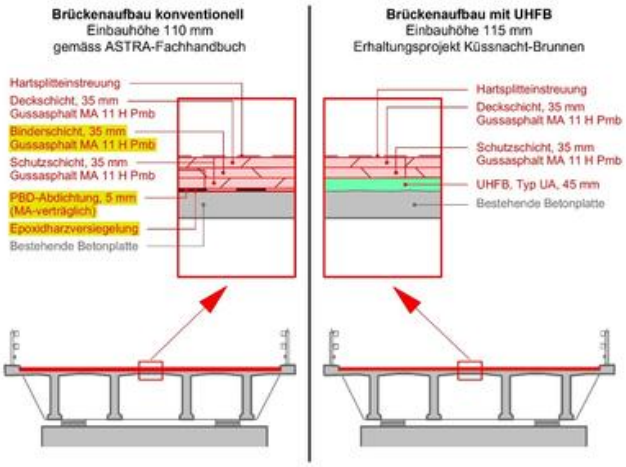
THE USE OF UHPC IN BRIDGE RENOVATION HAS PROVEN EFFECTIVE AND IS A GENUINE WIN-WIN.

Marco Schöpf
Construction Manager, PORR SUISSE AG

The advantages of UHPC

The combination of UHPC to increase the cross-section in the form of the thinnest possible concrete overlay while simultaneously avoiding additional sealing and waterproofing has proven completely effective and represents a genuine win-win. Investigations in the preliminary stages showed that the UHPC inhibits vapour diffusion and is comparable to a polymer-bitumen membrane (PBM). This means that the UHPC can be used to achieve practically the same results as a PBM seal. Dispensing with an epoxy resin seal and PBM waterproofing results in enormous time and cost savings. Less weather-dependent work stages reduce the risk in the execution stage, and expensive protective canopies are not required.

In this specific case, the use of UHPC resulted in additional thickness of 5mm, an increase of just 4.5%, compared to classic, conventional bridge construction methods.



Left: Conventional composition with sealing layer. Right: Composition with UHPC. Source: INGE A4SZ

The Linden Bridge with scaffolding below the sides and new parapets. Source: PORR AG

THE UHPC WAS PRODUCED ON THE CONSTRUCTION SITE ITSELF IN A SPECIFICALLY DEVELOPED MOBILE MIXING FACILITY.

Marco Schöpf
Construction Manager, PORR SUISSE AG

Production, logistics and installation with slipform paver

Ultra-high performance concrete (UHPC) is composed of cement, microsilica, fine sand, additives, steel fibres and water; it was produced on the construction site itself in a specifically developed mobile mixing facility. As the production of UHPC involves long mixing periods, the system was placed on the central reservation between the two carriageways. This ensured that transport distances for the concrete were minimised.

The product was transported on the building site using a hydraulic/pneumatic excavator, which was able to precisely deliver the UHPC ready for application. Daily progress involved covering 550m² to 900m² with 40m³ to 60m³ of UHPC. Applying the UHPC along one side of the tunnel meant that access was always ensured via the logistics lane. The formwork alongside was erected with a special T-square that had to be precisely placed at exactly the correct height.

When temperatures during the day were high, work had to begin at 4am so that application could be completed by around 11am, before temperatures reached their peak. In normal conditions, work began at 6am. A second unit then cured the UHPC by applying a covering of PE film.

When temperatures during the day were high, work to apply the ultra-high performance concrete (UHPC) had to begin as early as 4am. Source: PORR AG

Summary

This pilot project allowed both the companies executing the project and the employer to gather valuable knowledge. Results showed that the large-scale use of UHPC to repair and reinforce structures while simultaneously providing bridge sealing is more than just an alternative to conventional methods.

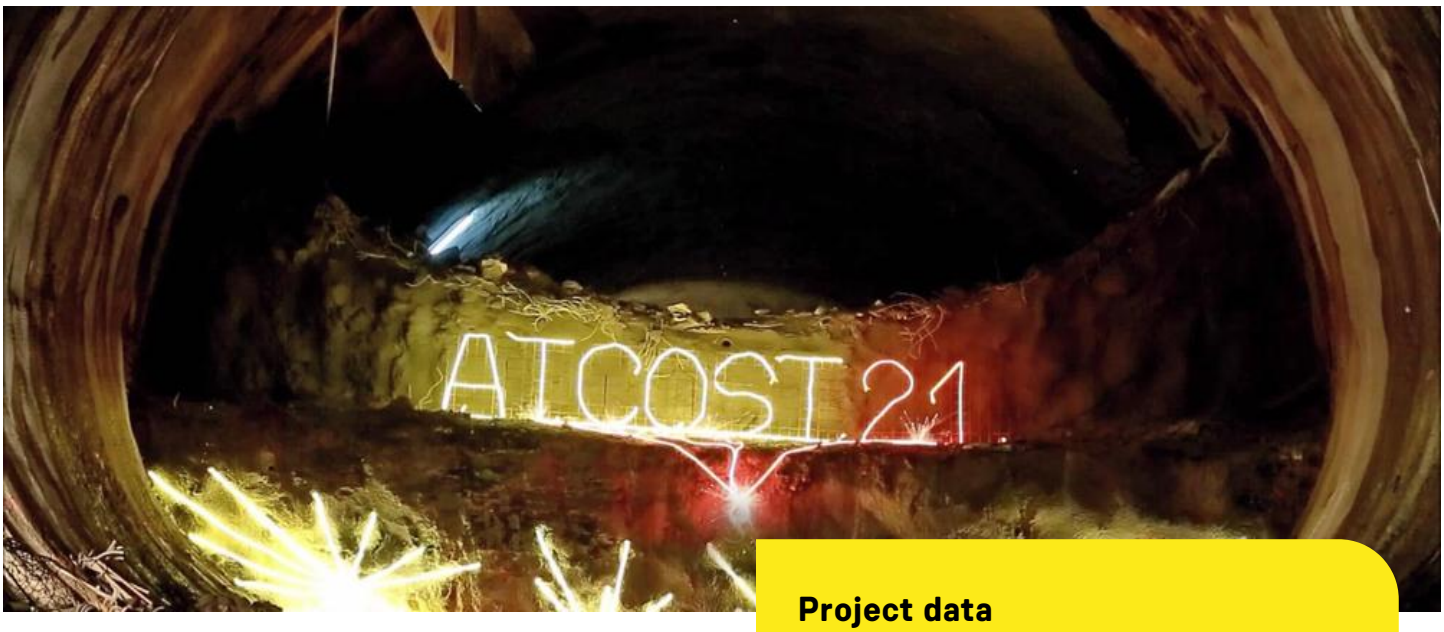
The UHPC was successfully produced on site in the required quality and was applied without any problems. Thanks to the unconventional and innovative method and the positive cooperation between all parties involved in the project, targets were actually exceeded and the construction period reduced by almost four months. As all milestones were adhered to or exceeded, the agreed system of financial incentives was awarded in full.

Technical data

1,200t
Reinforcement steel used

approx. 1,350m³
UHPC used

Section length	4.8km
Total bridge length	approx. 1,200m of carriageway
Asphalt	approx. 17,000t
Repair mortar used	approx. 480t
Concrete used	approx. 2,200m³



IN PROGRESS
GERMANY

A RAILWAY PROJECT OF EPIC PROPORTIONS

ATCOST21 – Austrian Tunnel Consortium Stuttgart 21

Author: Andreas Rath

PORR is constructing more than 30km of tunnels and 32 connecting structures for the Stuttgart–Ulm railway project.

Over 530 individuals are working on the project; these include 80 executives at four office locations and more than 450 labourers on site. The demanding conditions sometimes required creative and innovative solutions, some of which have been the subject of patient applications.

Project data

Employer	DB Netz AG
Contractor	ARGE ATCOST21 PORR Bau GmbH, PORR GmbH & Co. KGaA, G. Hinteregger & Söhne Bauges.m.b.H, Östu-Stettin Hoch- u. Tiefbau GmbH, Swietelsky Tunnelbau GmbH & Co KG
Project type	Tunnel construction and civil engineering
Project scope	Construction of a 9.4km and 6km twin-tube railway tunnel
Order volume	720 million euros
Construction start	08/2011
Construction end	12/2022

Overview

The Stuttgart-Ulm railway project is currently the largest infrastructure construction site in Germany. The heart of the project is the reorganisation of the Stuttgart railway junction with an underground through station and several access tunnels.

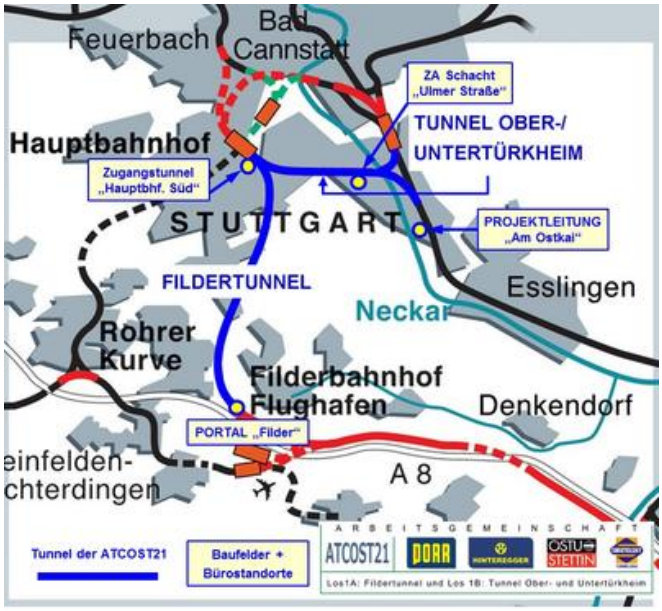
The railway and urban development project known as “Stuttgart 21” dates back to an idea of a Stuttgart based professor of traffic engineering from 1988. The implementation of this idea began in 2011. The contract was awarded to the “Austrian Tunnel Consortium Stuttgart 21” (ATCOST21) under the leadership of PORR. However, the road to placing the order was a rocky one. After successful pre-qualification in spring 2010, three main and 29 secondary offers were worked out within only 11 weeks on the basis of 11 forwarded messages and almost 600 bidder questions and answers. The offer was followed by an eleven-month negotiation process.

On 31 July, Deutsche Bahn awarded ATCOST21 the contract for the first two construction lots of the major project, the 9.4km long twin-tube Filder Tunnel and the nearly 6km long tunnels to Ober- and Untertürkheim. The more than 30km of tunnels and 32 connecting structures have an order volume of more than 720 million euros.

Complex logistics and tunnelling works

In addition to the structural details, a look at the personnel involved reveals the enormous dimensions of the project. In construction and project management alone, around 80 people are working at four office locations. There are also more than 450 labourers, including subcontractors, spread over the project length of more than 30km. For the effective coordination of personnel and for the short information and communication paths required especially in tunnel construction, PORR uses modern communication equipment with Wi-Fi and internal radio links.

In addition to logistics and communication, the actual tunnelling work for the more than 30km of tunnels, half of which are constructed by a tunnelling machine and half by conventional excavator and blast tunnelling, is also challenging. Originally seven starting points were planned. However, an intermediate starting point for the Filder tunnel as well as three access possibilities for the tunnel work were omitted because of delays in the neighbouring construction lots. All work is thus carried out from the remaining three construction sites at the “Filder portal”, the “Emergency access Hauptbahnhof Süd” and the shaft of the “Ulmer Straße intermediate starting point”. This resulted in numerous changes in the construction processes.



Map showing the three different construction sites. Source: DB-PSU / ATCOST21

WE DEVELOPED AN INNOVATIVE CONCEPT FOR THE ANNULAR GAP MORTAR FOR THE LOWER FILDER TUNNEL. WE HAVE APPLIED FOR A EUROPEAN PATENT FOR THIS NEW DEVELOPMENT.

Andreas Rath
Project manager, PORR Bau GmbH

The rotation of the shield section through the turning cavern was particularly spectacular. Source: ATCOST21

Filder portal partial construction site

The "Filder portal" is located directly next to the motorway BAB 8 in the immediate vicinity of Stuttgart airport and is the main starting point for the Filder tunnel. From here, two tunnel tubes with a length of over 17km will be constructed in six sections between the Filder level and the 155m underground station below.

For the first two sections in the clay and sandstone formations of the “upper Filder tunnel”, tunnelling is carried out with a tunnel boring machine (TBM) with earth pressure and compressed air components for active working face support. The working face is the place in the tunnel where the tunnelling takes place.

For the two sections in the “lower Filder tunnel”, the TBM in the mountain was converted into an open hard stone shield machine. Because of the swelling capacity of the unleached, anhydrite-bearing gipskeuper, no free water may be used in these sections. Special solutions had to be developed to protect humans and machines from dust and to clean devices and system components. On the initiative and under the leadership of PORR, an innovative concept for the annular gap mortar was developed for the “lower Filder tunnel”: The water in this cement-free mortar is chemically activated and saturated in such a way that practically no swelling processes can be triggered in connection with the anhydrite in the gipskeuper. PORR has applied for a European patent for this new development.

The 1.1km long sections of the “middle Filder tunnel” between the TBM sections are located in geological transition zones. For structural reasons, they were excavated by conventional blasting. The double-shell construction with up to 1m thick reinforced inner shells is currently being carried out here. As in the entire project, the waterproofing work with plastic waterproofing membranes is carried out by the PORR subsidiary IAT.

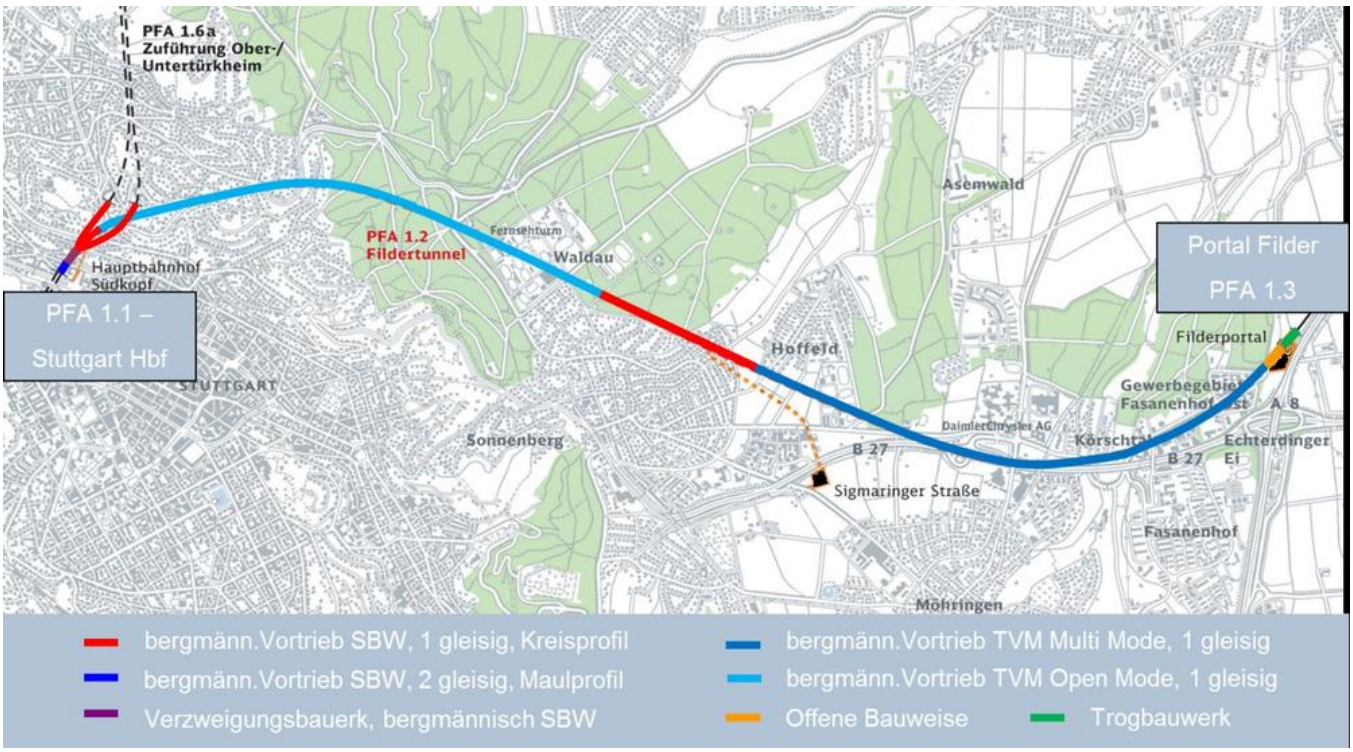
The ramp concept of the Filder tunnel follows a special proposal by the PORR tunnel builders. The TBM was pulled through the 1.1km long “middle Filder tunnel” and turned

underground before the last driving process.

In only three months, the complete tunnelling unit was transferred to the neighbouring tube. The two most spectacular days were those on which the 1,400t, 11m high and wide shield part was rotated through the 12m wide and 13m high turning cavern. These novel shifting and turning processes for a TBM including trailer and logistics were among the project highlights for all participants.

FOR THE MIDDLE FILDER TUNNEL, THE TBM WAS PULLED 1.1KM THROUGH THE TUNNEL AND TURNED BEFORE THE LAST DRIVING PROCESS. THIS MEANT THAT THE ENTIRE TUNNELLING UNIT COULD BE TRANSFERRED TO THE NEIGHBOURING TUBE IN JUST THREE MONTHS.

Andreas Rath
Project manager, PORR Bau GmbH



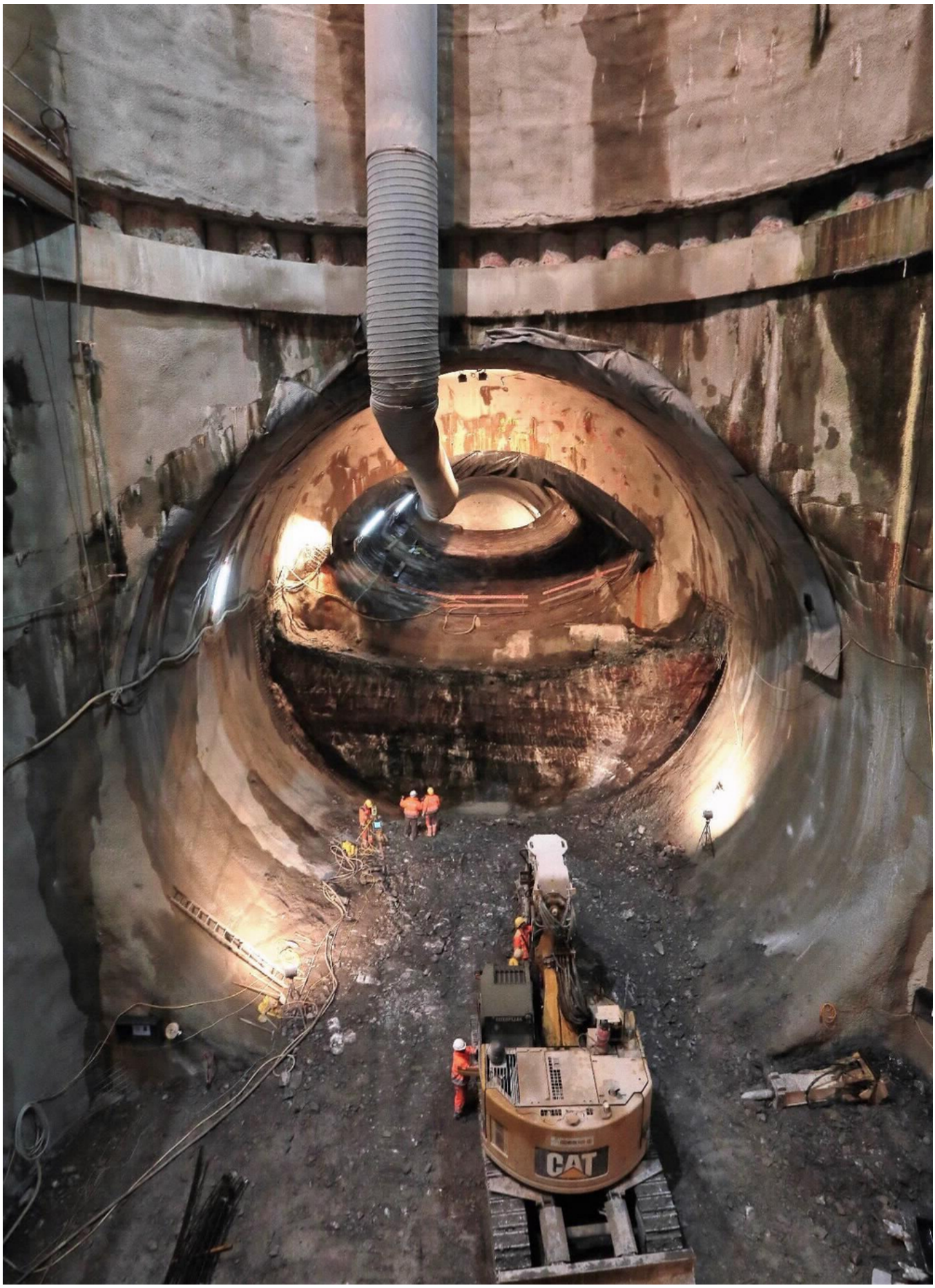
The tunnelling work for the two tunnel tubes will be carried out in six stages. Source: DB-PSU

Hauptbahnhof Süd emergency access

The PORR experts found themselves confronted with completely different challenges during the “Hauptbahnhof Süd” emergency access. There, a 240m long access tunnel leads directly into a complex branching structure in which four tunnel tubes lead into two double-track large tunnels directly in front of the underground station. This section, with overlaps of between 20m and 55m, lies directly beneath a densely built-up area and was constructed with leading pier entries. Because of the narrow position of the tubes, the rock between the four tunnels was replaced by 10m high and up to 6m wide reinforced concrete piers.

The last tunnel metres to the future underground station are currently being constructed here. Because of the low tunnel coverage – in some cases, the tunnel is only 8m below the foundations of the surface development – the PORR subsidiary Stump-Franki Spezialtiefbau will use two shafts to carry out preliminary uplift injections on more than 12,000m². A dense grid of injection boreholes between the tunnel and the surface is used to compensate for settlements in the low two-digit millimetre range caused by tunnel excavation.

Excavation cross-sections of up to 200 m². Source: ATCOST21



The only tunnel access for the twin-tube tunnel to the new underground station is via a 37m deep shaft and a 110m long access tunnel.
Source: ATCOST21 / imagocura

Ulmer Straße intermediate starting point

The underground station in Ober- and Untertürkheim will be connected to the current railway line in the Neckar valley with a new 6km long twin-tube tunnel. The only access to the tunnel is via the Ulmer Straße intermediate starting point A 37m deep shaft with a diameter of 22m and a 110m long access tunnel is the starting point for the six tunnel sections of the two tubes.

The feed rails to Ober- and Untertürkheim are the first four mining crossings of the River Neckar ever. The distances to the river bed in these 200m long sections were only between 8.5m and 18m; the distance between the 10m diameter individual tubes was only 1m in the minimum case. Separate emergency alarm and evacuation plans were therefore in place until the watertight inner shells were installed.

The tunnelling work in Lot 1B was mainly carried out by blasting using a newly developed ignition system, which was able to reduce the blasting vibrations on the surface by up to 35% compared with conventional methods. At present, tunnelling work is still being carried out over a few hundred metres each to the breakthrough points in Ober- and Untertürkheim. In the remaining sections of the tunnel, the construction of the inner shells has begun after extensive waterproofing injections to preserve the groundwater conditions.

Technical Data

ca. 3,000,000m³
Outbreak volume (fixed)

1,195,000m³
Concrete

Cross-cuts	32 pc. and 3 technical rooms
Reinforcement	ca. 80,000t
Segment rings	7,378 pcs.
Segment length	2m

Conclusion

The Stuttgart-Ulm rail project is also a project of epic proportions for PORR. Around 3 million m³ of rock will be excavated and more than 1.2 million m³ of concrete will be used for the more than 30km of tunnel sections. November 2019 marks the 100th month of construction. Currently, 65% of the total project has been completed.

TURNING WASTE INTO ENERGY

The new district heating pipeline supplies 12,500 households in Villach with a total of 100 million kilowatt hours of heat per year from the waste incineration plant in Arnoldstein. Source: PORR

PROGRESS: 100% - COMPLETED
AUSTRIA/2017-18

The Arnoldstein-Villach district heating pipeline

Author: Josef Wildhaber

PORR has made an important contribution to climate protection with the construction of the district heating transport pipeline from Arnoldstein to Villach.

Thanks to seamless cooperation between the various companies and subsections, the new district heating pipeline running from the waste incineration plant in Arnoldstein to Villach was laid in just 16 months.

Project data

Employer	KELAG Energie & Wärme GmbH
Contractor	PORR Bau GmbH, Carinthia/East Tyrol branch
Order type	Construction services
Project type	Civil Engineering/Infrastructure . Utility line construction
Project scope	Construction of a district heating transport pipeline
Order volume	5.7 million euros
Construction start	04/2017
Construction end	08/2018

Background

Over the last ten years, the district heating system of the city of Villach has grown to encompass around 100km of pipeline. Another 17.5 km have now been added: the new pipeline transports around 100 million kilowatt hours of waste heat per year from the waste incineration plant in Arnoldstein to serve the city of Villach. KELAG Energie & Wärme GmbH commissioned PORR Bau GmbH to implement this project which, as well as doubling the fuel efficiency of the Arnoldstein waste incineration plant, will also replace the natural gas used for district heating in Villach and improve the overall emissions balance. In just under 16 months, PORR laid two steel pipes – one for flow and one for return – each with an internal diameter of 300mm and an external diameter of 500mm, including insulation. The water is transported along this pipeline from Arnoldstein to Villach at a temperature of up to 130 degrees Celsius and a pressure of up to 25 bar.

The order volume for the excavation and corrective maintenance work was around 5.7 million euros. The contract also comprised the construction of a ring connection from Villach/Warmbad to Villach/Auen, making the heat supply to the city on the River Drau even greener, more modern and more efficient.

44,000M³ OF EXCAVATED MATERIAL CORRESPONDS TO AROUND 6,000 3-AXLE-LORRY LOADS, WHICH WOULD BE 50KM LONG IF YOU LINED THEM ALL UP.

Josef Wildhaber
Site manager, PORR Bau GmbH

Maintaining the flow of traffic

The pipeline runs from the heat transfer station in Villach/Warmbad along Warmbader Straße and the B83, Kärntner Straße, via Fürnitz, Hart, Neuhaus and Pöckau to Arnoldstein. Great care had to be taken to minimise the impact on traffic throughout the construction period. Traffic along Warmbader Straße in Villach was regulated by a traffic light. The area around the main road, where the flow of traffic had to be maintained while the works were being carried out, was particularly tricky. Red, weather-resistant ground markings were applied to the carriageway for the duration of the construction work and removed again afterwards. The measures set out in the permit granted by the traffic authorities had to be strictly adhered to and were continuously monitored by the authorities.

The district heating transport pipeline in Pöckau. Source: PORR

Hand in hand

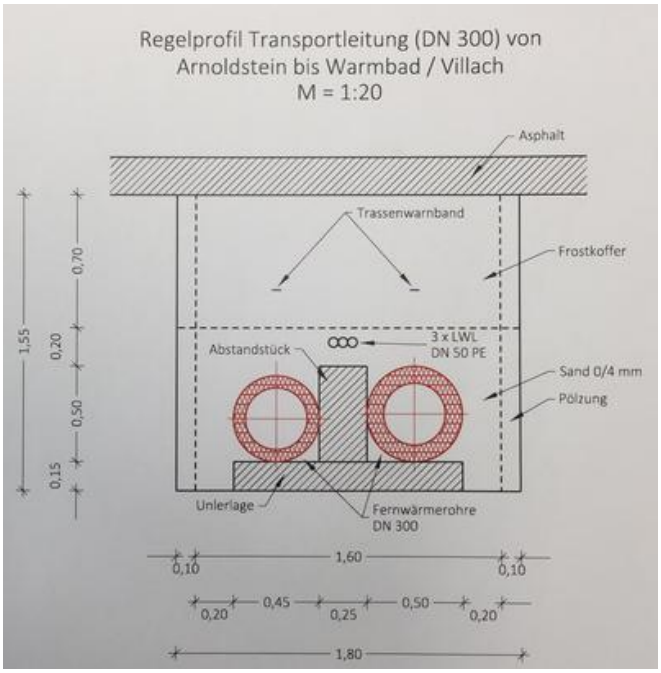
On 17 April, PORR started on the construction work in Villach heading towards Arnoldstein. The work was carried out in sections, sometimes simultaneously, with five driving crews. Each crew was made up of two construction workers, two excavators and two lorries. A total of 3,000m of temporary fencing and shoring materials had to be kept available to secure and support the trench. Timber sheeting elements measuring 400/180/5cm were manufactured, fitted with 5/16cm or 8/16cm wales and 10/10cm struts, certified in terms of structural performance, and used to shore the trench.

One of the employer's requirements was that the individual subsections not hinder each other in their work. Thanks to the excellent cooperation between the foremen, the various companies and subsections were able to work hand in hand. First to start work on the project was PORR with the excavation works. Once an approximately 200-300m trench had been excavated, the pipe-laying company immediately began inserting the pipes. PORR then moved the struts to allow the pipe to be lowered into the trench.

All the excavated material was transported to an interim storage location and stored separately according to whether it was to be used as backfill material or loose technical filler. The waste material was separated into inert materials, construction rubble and residual materials, and duly recycled.

Laying and compacting the bedding

Bedding material with a grain size of 0/4mm was used for the district heating pipes, the ductwork and the cables. To avoid any risk of damage to the pipes and cables by tilting the lorry sideways, the material was poured into the trench from an excavator bucket. The bedding was laid and tamped, and the sides and tops of the pipes were covered with backfill exactly as specified by the employer and the pipe supplier.



The regulation sheet for the district heating pipe bedding. Source: PORR

Lots of material excavated, but not much rock removed

Nearly a third of the 17,500m long pipeline was laid in undeveloped areas; the remainder was laid under municipal and national roads. Roughly 44,000m³ of material was excavated, which corresponds to about 6,000 3-axle lorry loads. If you lined all these lorries up, they would stretch for nearly 50km. Only a small amount of rock, 2% of the excavated spoil, had to be removed. PORR built ten inspection shafts with prefabricated flat concrete covers along the entire length of the pipeline and concreted abutments for five pipe bridges at the water crossings.

Technical data

17.700m
Route length

30.500m² / 11.500t
Asphalt

Trench width	1.80m
Trench depth	1.70m to 3.20m
Amount of excavated material	44.000m³
Bedding sand	16.500m³
External pipe diameter	500mm
Internal pipe diameter	300mm

Handover according to schedule

Construction site supervision was carried out by KELAG's local site supervisor and an external construction site coordinator. Special attention was paid to the construction of boundaries and lighting systems, the cleanliness of the construction site, and high occupational safety standards.

After a construction period of 16 months, the district heating pipeline went into operation on schedule in August 2018. Since then, thanks in part to PORR's contribution, half of Villach's heat requirements have been covered by waste heat from the Arnoldstein waste incineration plant. Natural gas is only used as a failure reserve and to cover peak demand.

One third of the pipeline was laid in undeveloped areas; the remainder was laid under municipal and national roads. Source: PORR

PROGRESS: 100% - COMPLETED
AUSTRIA/2018-19

IMPROVING SAFETY BENEATH THE PLABUTSCH MOUNTAIN RANGE

Rehabilitation of the Plabutsch tunnel

Author: Thomas Exel

The consortium for the underground rehabilitation of the Plabutsch tunnel (ASPUT) was commissioned by Asfinag to construct 20 underground cross passages.

With a length of approximately 10km, the Plabutsch tunnel is the second longest road tunnel in Austria. In an effort to keep traffic disruption to a minimum, most of the works were carried out at night under challenging logistical conditions.

Project data

Employer	ASFINAG
Contractor	Consortium PORR/STRABAG/PKE
Project type	Tunnelling
Project scope	Construction of 20 underground cross passages
Construction start	01/2018
Construction end	04/2019

Background

With a length of approximately 10km, the Plabutsch tunnel is the second longest twin-tube tunnel in Europe after the Gran Sasso tunnel in Italy and the second longest road tunnel in all of Austria after the Arlberg tunnel. To handle the daily traffic volume of around 30,000 vehicles, a twin-tube route has been in operation since 2004. The Plabutsch tunnel had to be comprehensively rehabilitated by 30.04.2019 due to a tightening of the Austrian Road Tunnel Safety Act (Straßentunnelsicherheitsgesetz or STSG). In accordance with the new STSG, escape route lengths must not exceed 500m and cross passages that may be used by emergency vehicles are required every 1,500m. The consortium for the underground rehabilitation of the Plabutsch tunnel (Arge Sanierung Plabutschtunnel Untertage or ASPUT) was commissioned as a subcontractor of umbrella consortium PORR, STRABAG and PKE to construct the cross passages, five of which are accessible by vehicle, 15 on foot. The construction period was 15 months. The total tunnelling length comprised 951m.

Two construction phases

The project was executed in two separate construction phases. The first construction phase, which took approximately eight months, involved excavating all the passages from the east tunnel to the inner lining of the west tunnel and fitting the inner linings, including those of the eastern terminal blocks.

During the second construction phase, from January to April 2019, the inner linings of the west tunnel were removed and the western terminal blocks were lined.

A total of 20 cross passages were constructed, five accessible by vehicle, 15 on foot. Source: Thomas Exel

AS A FULL ROAD CLOSURE WAS NOT AN OPTION, WE WERE ONLY ABLE TO WORK DURING THE NIGHT AND ON SELECTED WEEKENDS.

Thomas Exel
Site manager, PORR Bau GmbH

The ultimate challenge: "Construction in existing contexts"

The challenges of rehabilitating an existing tunnel are entirely different from those involved in building a new one, especially if, as with the Plabutsch tunnel, the existing tunnel is part of a key arterial road and full road closure was not an option. It was not possible to close each tube for work other than during the night shifts, from 8 p.m. to 5 a.m., and occasionally during the day on selected weekends. After deducting the time required for setting up, cleaning and clearing the site, this resulted in a net working period of only six hours.

The night closure periods from 8 p.m. to 5 a.m. resulted in a net working period of only six hours. An entire round had to be completed within this time window. Source: Thomas Exel

To ensure that work ran smoothly, it was necessary to complete at least one entire "round of advance" within this very short period of time. In tunnelling, this refers to the entire process: from drilling and loading the boreholes, blasting and removing the rock, to securing the tunnel with jetcrete, reinforcements and anchor bolts. Each of these individual steps required its own equipment, which had to be parked underground in the tunnel in the breakdown bays and the cross passages currently under construction.

The two existing tunnel tubes and associated facilities such as emergency telephone recesses, cables and fire-fighting water supply lines had to be optimally protected during ongoing work. This entailed using vibration measuring devices for all the blasting operations, for example.

The passages were excavated from the east tunnel towards the west tunnel, which was still open to traffic. To avoid endangering road users, blasting operations were performed at a round length of only one metre once work had advanced to six metres before the west tunnel. Traffic was stopped during blasting. Work was carried out mechanically, using only an excavator, three metres before reaching the west tunnel.

All the blasting operations were monitored with vibration measuring devices. Source: Thomas Exel

WHILE WORK IN CONVENTIONAL TUNNELLING PROJECTS IS CARRIED OUT SEQUENTIALLY ON ONE SUBSECTION AFTER THE OTHER, THE WORK BELOW THE PLABUTSCH MOUNTAIN RANGE WAS CARRIED OUT IN PARALLEL. THIS NECESSITATES GOOD COMMUNICATIONS AND LOGISTICS.

Thomas Exel
Site manager, PORR Bau GmbH

Challenging logistics

Coordination between individual trades constituted another major difference to conventional tunnel construction projects. While the work on conventional sites is carried out sequentially on one subsection after the other, the work below the Plabutsch mountain range was carried out in parallel, requiring good communications and logistics. The length of the construction site, approximately 10km, also called for good logistical planning in advance. The long transport routes meant that each employee had to be equipped with the appropriate tools and assigned work tasks at the beginning of every shift to avoid the risk of further delays in an already very tight time window.

Work was carried out, using only an excavator, for the last few metres before reaching the west tunnel. Source: Thomas Exel

Conclusion

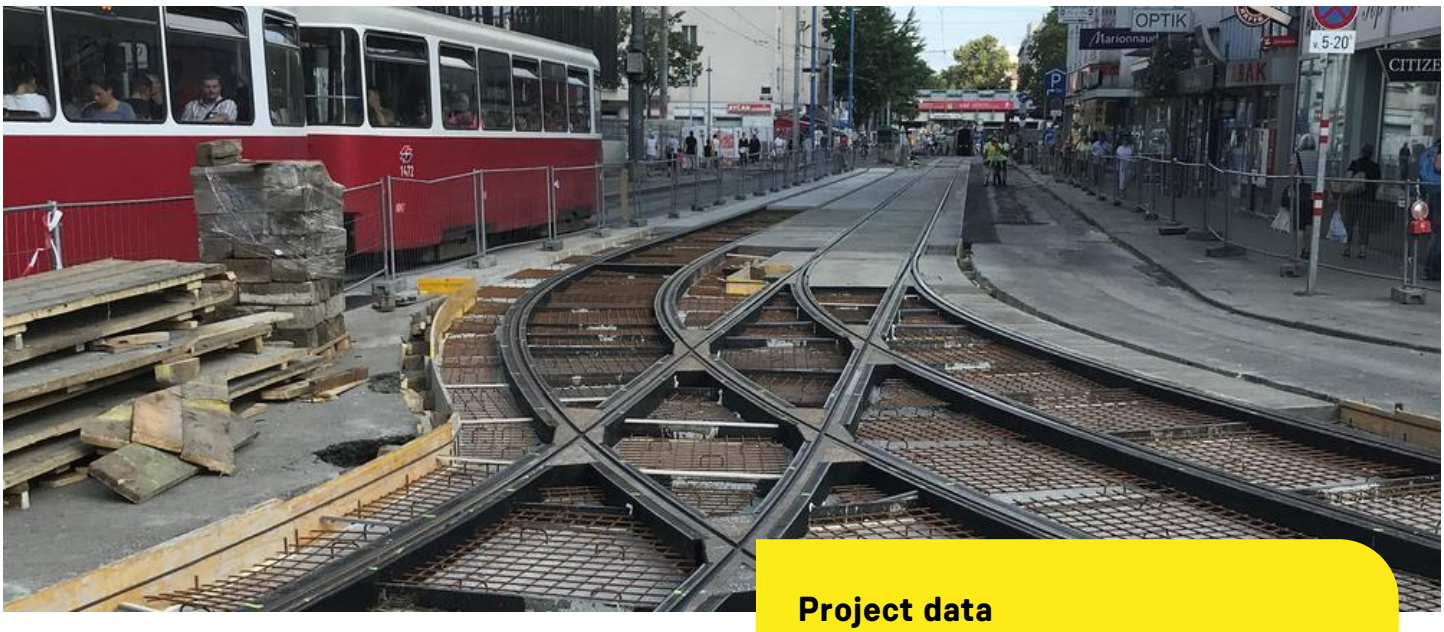
During the main phase, up to 50 workers per shift were working on concreting four tunnels and several cross passages. Three foremen and one shift supervisor were deployed per shift to coordinate the work.

Despite these challenging and unusual tunnelling conditions, the ASPUT consortium was able to complete the work on time and thus put Austria's second longest road tunnel on track for an even safer future.

Technical Data

951m total in 20 cross passages
Tunnel length

Driving technique ..... Blasting, mechanical tunnelling
Number of cross passages ... 15 GQ (on foot), 5 EQ (by vehicle)
Excavation cross section ..... 17m² - 61m²



PROGRESS: 100% - COMPLETED
AUSTRIA/VIENNA

RETREADED TRAM INTERSECTION IN FLORIDSDORF

Track and master builder work “Am Spitz”

Author: Christoph Nowak

During a three-month construction period, PORR renovated the tram tracks around the “Am Spitz/Brünner Strasse/Prager Strasse/Schlosshofer Strasse” intersection.

The works were carried out in restricted spatial conditions as the trams continued to operate. In order to keep traffic disruption to a minimum during the construction period, the work was divided into four short construction stages.

Project data

Employer	Wiener Linien GmbH & Co KG
Contractor	PORR Bau GmbH, Railway construction
Order type	Track and master builder work
Project type	Civil engineering/Infrastructure
Project scope	Renovation of the track slabs and rails, including building surfaces
Order volume	1,4 million euros
Construction start	07/2018
Construction end	09/2018

Background

Over the last few years, PORR has completed numerous tram-related projects for Wiener Linien. PORR was entrusted with a new project at the end of May 2018 with an order volume of 1.4 million euros. The contract included renovating the tracks and switches, the concrete track slabs, the surface covering and two tram stops at the “Am Spitz” intersection, where three busy streets meet: Brünner Strasse, Prager Strasse and Floridsdorf’s main street “Haupstrasse”. Due to the high traffic volumes, the project was divided into four construction stages, each lasting between two and four weeks.

The project was carried out by the Railway construction department, Track construction OST. Minor surface work was done by PORR Civil engineering, Vienna branch.

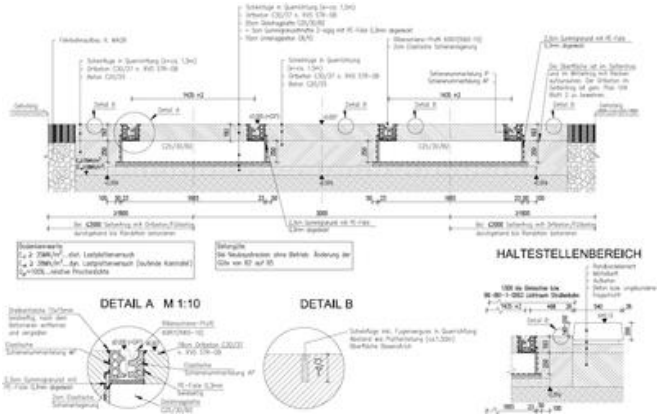
DUE TO THE PROJECT LOCATION, WE HAD TO INSTALL BOTH A SOUND-INSULATED SUPERSTRUCTURE AND A SOUNDPROOF SUPERSTRUCTURE.

Christoph Nowak
Construction manager, PORR Bau GmbH

Complex logistics and varied construction shapes

The intersection is located next to taxi ranks as well as bus stops for Wiener Linien, ÖBB and regional transport. As it furthermore represents the sole delivery route for many businesses, it was essential to ensure access to and from the intersection area throughout the construction work. To achieve this, PORR divided the project into several construction stages. The beginning of each construction stage entailed road closures and setting up diversions – work which was done during the low-traffic night hours.

Due to the densely populated area around the project, at the planning stage the client specified two superstructures for sound insulation and soundproofing. The sound-insulating superstructure was created by laying the jacketed rails on an unreinforced track slab. The soundproof superstructure consisted of a lightweight mass-spring system with 25cm forces. The track slab was strengthened with a reinforcement cage and elastic rubber mats were used to create a separation from the filling concrete either side and from the granular subbase below; this reduces vibrations from the tramway.



PORR installed sound-insulating and soundproof superstructures to protect the local residents. Source: Wiener Linien GmbH & Co KG

Construction stage 1, the first three weeks

The first stage involved the northern part of Schlosshofer Strasse and the track curve into Brünner Strasse. The project area was closed to all traffic other than the trams. Right from this first stage, PORR was working with both the superstructures. The straight section in Schlosshofer Strasse was sound-insulated and the soundproof structure was installed for the curve into Brünner Strasse.

During the first part of the work, the existing surface, consisting of pre-fabricated concrete slabs between the rails, was removed.

The existing track slab in the straight sections was removed with a concrete milling machine in the course of track replacement, and the new rails temporarily laid on wooden sleeper blocks. Supporting the track in this way meant that the tram could continue to operate during construction work.

In the curve, the concrete track slab was demolished by an excavator with a hydraulic hammer – as it was reinforced, this was a very time-consuming process.

The pre-fabricated concrete slabs and the gravel bed were professionally dismantled. Source: PORR AG

THE RAILS WERE REACHING THE END OF THEIR SERVICE LIVES. SPECIAL CARE WAS REQUIRED WHEN CHISELLING IN ORDER TO AVOID ANY BREAKAGES.

Christoph Nowak
Construction manager, PORR Bau GmbH

After the dismantling work, PORR began work in the curve on building the soundproof superstructure. Rubber mats were laid on the granular subbase and the wooden sleeper blocks were replaced with fixed “concrete pedestals”. The reinforcement work was completed and then the track was aligned for position and height, taken off, and concreted overnight.

Once the track slab had been manufactured, work began on creating the surface. The track recesses were sealed with filler blocks. These are 1.5m-long blocks that surround the rails on three sides and minimise vibrations from the tramway. A reinforcement mesh was installed in the intermediate space and then filled with road surface concrete. Due to the restricted space, around 85% of the concrete volume (650m³) was installed at night between 11pm and 5am.

The grooved swivel plates for the intersection were pre-installed. Source: PORR AG

Construction stage 2, the challenge

Once the surface concrete had hardened and the asphalt levelling course next to the track was in place, the second construction phase could begin. The southern part of Schlosshofer Strasse and the eastern half of the Brünner Strasse plateau were closed for this stage, which turned out to be the biggest challenge in the whole project. Altogether, 180 running metres of track, an intersection and a switch had to be renovated. A lot of time was saved by using a concrete milling machine for demolition in Schlosshofer Strasse. The excavator had to be brought in for the switches and intersection area.As the rails in the intersection were reaching the end of their service life, chiselling was carried out with great care, in order to avoid breaking any rails and thereby hindering the tram operation. The new switches and intersection were assembled ahead of installation on the construction site.

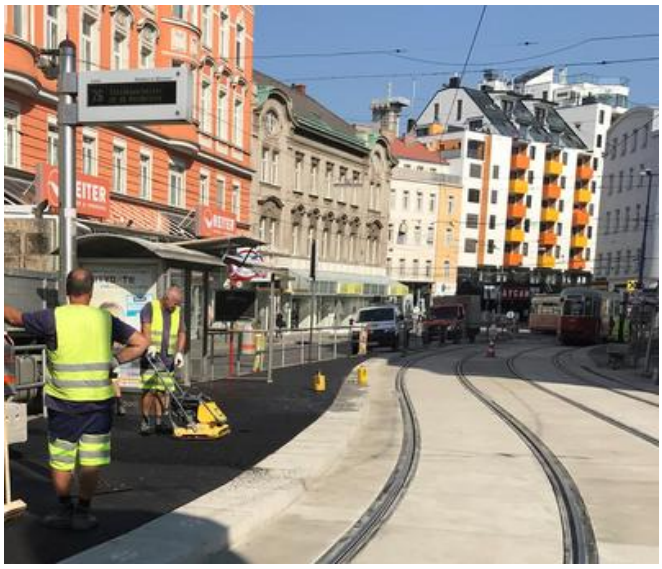
Replacing the switch and intersection, including a 9m track section, was a particularly delicate task, which had to be carried out during the night within a mere 3.5 hours. A large vehicle-mounted crane was used to remove the old, worn rails so that the two to six tonne new rail sections waiting at the side could be lifted into place. The rails were connected with iron plates until welded.

A reinforced soundproof superstructure was constructed for the switch and intersection, on 140m² of sound insulation mats. The intersecting rails and the track rods used to maintain the distance between the rails made installing the reinforcement a real challenge. During the morning and afternoon rush hours, a tram crossed the intersection every two to three minutes, making it impossible to keep up continuous work. Despite the high frequency of trams in this area, the section was completed before the intermediate deadline, avoiding a contractual penalty.

The road was usable very soon after the road surface concrete had been installed. Source: PORR AG

Construction stages 3&4, completion

The greater distance to the neighbouring buildings in the last two construction stages meant that the simpler sound-insulating superstructure could be used. While replacing the track, the existing track slabs were milled, aligned, and then concreted. For the very tight curve from Prager Strasse towards “Am Spitz”, a lubrication system was built at the start of the curve from each direction: the lubricating film minimises the squealing from the rails. This area also included two tram stops that needed to be renovated; they were closed for two weeks by Wiener Linien. Once the new guide wall elements had been laid, the asphalt surface was installed by PORR Civil engineering, Vienna branch.



The final stage was to install asphalt between the guide wall element and the road at the tram stops. Source: PORR AG

Conclusion

Despite the very hot summer presenting challenging conditions for both workers and machinery, all work was completed on schedule and to the complete satisfaction of the client.

The complete intersection was opened to traffic on the agreed date. Source: PORR AG

Technical data

660m
Track removed and newly laid

25t
Reinforced concrete

1.300lfm
Rail base profile

Concrete demolition	290m³
Concrete milled	190m³
Switches replaced	1
Intersections replaced	1
Concrete incorporated	770m³
of which road surface concrete as per RVS	290m³
Filler block elements for grooved rail	2.600lfm
Bituminous joint sealant	3.600lfm

Imprint

Distributor and publisher
PORR AG
Absberggasse 47, 1100 Vienna
T +43 50 626-0
office@porr-group.com
porr-group.com

Managing editor
Bernadette M. Hoeritzauer
T +43 50 626-3338
comms@porr-group.com

Editor-in-chief
Armin Rainer
wop@porr-group.com

Technical editors
Uwe Gattermayr
Hans Wenkenbach
Rainer Rengshausen
Bernd Schockemöhle
Manfred Bauer
and all editors

Concept & layout
pixelart GmbH, Salzburg/Bergheim

Print
Druckwerkstatt Handels GmbH, Vienna

Cover photo
Krakow-Prokocim University Hospital
© PORR AG

porr-group.com | worldofporr.com

The enclosed magazine is an automatically generated print version of the original electronic publication: worldofporr.com

Information on data protection can be found at
https://porr-group.com/en/data-protection-policy

powered by PORR 150

worldofporr.com